Research Article

Diversity of Fresh Water Algal Community from Cheruchakkichola, Mangad, Kerala

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ABSTRACT

By methodical censoring of biological, physical and chemical characteristics of water bodies and phytoplanktons, have been extensively used as water quality indicators. This study also aims to find out the relationship between phytoplankton population along with some Physico-chemical variables. Sampling was performed in 5 sampling sites. Studies on the phytoplankton assemblages in Cheruchakkichola results 53 species belongs to six classes namely Chlorophyceae, Bacillariophyceae, Dinophyceae, Cyanophyceae and Euglenophyceae. Chlorophyceae shows progressive wealth and abundance on the study area. Cyanophyceae and Euglenophyceae were observed to least dominance. According to Nygaard and Palmer index, low supremacy of Cyanophyceae and Euglenophyceae shows that the studied ecosystem should be least organically polluted and suitable for human consumption purposes. This study indicates that biomonitoring methods can give relevant and stable results of water quality and purification assessment that can be employed to monitor the regional water quality.

Key words: Phytoplanktons, Cheruchakkichola, Species composition, Physico- chemical parameters, Pollution index

1. INTRODUCTION

Pollution of freshwater ecosystems has become one of the serious threats towards humankind as it is known. Continuous monitoring of these aquatic ecosystems by using biological organisms are the important for the scientific field. It can be achieved by the scrutinising the algal community along with its abiotic factors. Microalgae, the primary producers of stream ecosystem in an especially important biodiversity hotspots needs special attention because it forms the initial feed for many endemic aquatic organisms and also fix the water quality perturbations in this fragile

ecosystem (Nair, 2002). Algae are being the topic of global interest nowadays and forms alternative source of energy. Algae are widely using in the field of agriculture, medical science, industries and as laboratory tools in genomics, proteomics and another research (Khan, 1991). Studies on algae for over a century were on understanding their structure and reproduction and several treatises (Fritsch, 1945a&b; Prescott, 1951) and monographs were published for several groups of algae with details on the occurrence and distribution with reference to diverse habitats (Desikachary, 1989; Randhawa, 1959; Pal *et al.*, 1982; and Philipose, 1958). Majority of the algae are cosmopolitan in distribution (Sudeep *et al*., 2007) and the ecology of them in any specific environment will be interesting to algologist world over. Microalgae play an important role in maintaining the equilibrium between living organisms and abiotic factors (Sreevastava,2003&2010). In short, except for the chemosynthetic bacteria, all organisms are directly or indirectly benefited from algae (Krishnamurthy, 1974).

Kerala is rich in algal diversity. A perusal of the existing literature reveals that very few investigations related to the algal biodiversity had been done on Cheruchakkichola, Mangad in Thrissur district, Kerala. This place is not that commercialized like other waterfalls and cannot consider it as a big waterfall as such. Bharathapuzha is the main contributor to the waterfall. Practically no work has been done on the taxonomy, distribution, species diversity and contribution of freshwater algae from Cheruchakkichola and hence the present work was undertaken. The species composition, distribution and comparison of algal flora would give information regarding the species richness of kerala. The data obtained from the proposed study expected to be beneficial to future studies in this field.

2. MATERIALS & METHODS

Study area

Cheruchakkichola is a degrading evergreen forest situated in Chittanda panchayath in Mangad, Thrissur at an altitude of 200 meters 10° 42’ 30”N,76° 11’ 43”E. Different kinds of trees and plants which are unique to an evergreen forest make the forest a greener one and soil very spongy. The chola and the surrounding area is made up of laterite rocks. So, it is one of the lateritic hillocks of the central Kerala.

Methodology

The surface water samples for the systematic analysis of algae have been collected from Cheruchakkichola and check dam. Water samples were collected from four stations of the study area for a period of different seasons in one year. Samples taken from three seasons, Premonsoon, Monsoon and Postmonsoon during the months of January, august and November 2018 between 9 to 10 a.m. From all the 4 stations, two litre water samples were collected in well labelled and tightly capped plastic bottles for both phyco-chemical and algal taxonomic studies. All bottles are washed thoroughly and rinsed with sample water before collecting it. The collected one litre sample from each site kept for physico-chemical parameter analysis. Temperature, altitude, pH, TDS, EC and dissolved oxygen were measured on the spot at the time of collection. Determination of Nitrate, Phosphate and Silicate by Colourimetric methods using visible spectrophotometer. Remaining one litre were preserved immediately in 4% formalin solution and brought to the laboratory. Algae associated with natural surfaces can be collected effectively with the help of some devices such as toothbrush. Periphytic microalgae were sampled by scraping the surface of pebbles and rocks, collected and preserved in dilute formalin. The temporary slides were prepared from the water samples and were observed under compound microscope. A drop of water including the algae is placed on a microscopic slide and carefully put coverslip on to it and observed from power 10x to 40x and photographs were taken by using digital camera. The samples were identified

by using standard keys and descriptions given by standard publications (Scott and Prescott, 1961; Jose john and Francis, 2012).

3. RESULTS AND DISCUSSION

During the present study, 53 species of algae were observed from various stations of Cheruchakkichola. Microalgae belongs to six classes namely Chlorophyceae, Bacillariophyceae, Dinophyceae, Cyanophyceae and Euglenophyceae were recorded during the present study. Chlorophycean members are found to be most dominant class, which is represented by 39 species within 19 genera. Least dominant classes are Dinophyceae and Euglenophyceae which represent by only one species. Abundance of the species and quality of water have strong interrelationship. Least dominance of Dinophyceae and Euglenophyceae denotes the pollution status of that area since it shows maximum abundance in organically polluted water resource. It has been considered as indicative of enriched waters and also gives an evidence of pollution status of water. Several works were undertaken this relationship as their objectives.

Physico-chemical Characteristics

Physico- chemical parameters of the study area have a great influence on the diversity of algae. The density of Bacillariophyceae population was found to be strongly associated with pH. It is observed that the acidic waters do not support an abundance of Bacillariophyceae. In the present study all the parameters are within permissible limit and it denotes the quality of water and the pollution status. Variation in these parameters exceeding the permissible limit can be considered as an indication of organic pollution and also we can observe the abundance of pollution tolerant varities.

Table 1: Physico-chemical parameters

No.	Parameter	Range	Permissible limit (BIS)
1	Total Dissolved Substances (TDS)	38ppm	500
2	Electrical conductivity (EC)	83ms	250
3	pH	7.5	6.5-8.5
4	Temperature	27.8°c	-
5	Dissolved Oxygen (DO)	8.2	-
6	Silicate	0.89 µg/ml	-
7	Nitrate	0.009 µg/ml	45
8	Phosphate	0.029 µg/ml	5

Biological characteristics

During the present investigation, phytoplankton population composed of 5 major groups viz., Chlorophyceae, Bacillariophyceae, Euglenophyceae, Dinophyceae and Cyanophyceae.

Table 2: Phytoplankton diversity in Cheruchakkichola

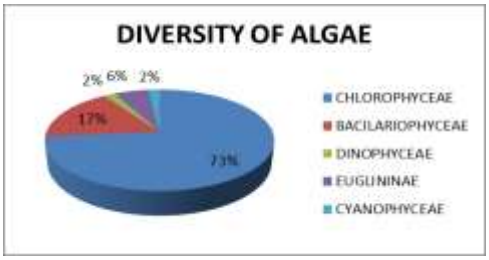
Sl. No.	Algal class	No. of genera	No. of species	%
1	Chlorophyceae	19	39	73
2	Bacillariophyceae	4	9	17
3	Dinophyceae	1	1	2
4	Euglenophyceae	3	3	6
5	Cyanophyceae	1	1	2

Table 3: checklist of algae observed during sample analysis

Sl.No.	**Name of Algal species**
	Class: CHLOROPHYCEAE
1	*Pediastrum tetras* (Ehrenberg) Ralfs
2	*Pediatrum duplex* Meyen
3	*Ankistrodesmus sigmoides* (Rabenh.) Bruhl et Biswas
4	*Coelastrm sphaericum* Naegali
5	*Scenedesmus armatus* (Chodat) Smith
6	*Scenedesmus quadricauda* (Turpin) Brebisson
7	*Scenedesmus quadricauda* (Turpin) Brebisson
8	*Scenedesmus oahuensis* (Lemmermann) G.M.Smith
9	*Oedogonium sp.*
10	*Mougeotia sp*.
11	*Spirogyra sp*.
12	*Netrium digitus* (Ehrbg.)Itzigs.&Rothe
13	*Arthrodesmus convergens* Ehrenberg
14	*Arthrodesmus curvatus* Turner
15	*Bambusina brebisonii* Kutzing
16	*Closterium parvulum* Naegali
17	*Closterium closteriodes* (Ralfs) Louis et peeters
18	*Cosmarium contractum* Kirchner
19	*Cosmarium margaritatum* (Lund) Roy &Bisset
20	*Cosmarium corda* ex Ralfs
21	*Cosmarium cucurbita* Breb

22	*Cosmarium cuneatum* Josh
23	*Cosmarium Pachydermum* P. Lundell
24	*Cosmarium sp.*
25	*Cosmarium sp.*
26	*Desmidium bengalicum* (Kuetz.) De Bary
27	*Euastrum ansatum* Ehrbg
28	*Micrasterias foliacea* Bailey ex Ralf
29	*Micrasterias mahabuleshwarensis* Hobs
30	*Micrasterias pinnatifida* (Kutz)Ralfs
31	*Micrasterias zeylanica* Fritsch
32	*Onychonema leave* Nordst
33	*Pleurotaenium trabecula* (Ehrbg) Nag
34	*Staurastrum zonatum* Borgs
35	*Staurastrum anatinoides* Scott and Presc
36	*Staurastrum bifidum* ex Ralfs
37	*Staurastrum polytrichum* (Perty) Rabenhorst
38	*Staurastrum setigerum* Cleve
39	*Xanthidium sexmamillatum* West &West
	Class: BACILLARIOPHYCEAE
40	*Actinocyclus sp.*
41	*Fragilaria sp.*
42	*Tabellaria sp.*
43	*Eunotia camelus* Ehr.
44	*Pinnularia brevicostata* Cleve
45	*Pinnularia divergens* W.Smith
46	*Pinnularia sp.*
47	*Nitzschia Closterium* W.Smith
48	*Gyrosigma distatum* W.Smith
	Class: DINOPHYCEAE
49	*Peridinium sp.*
	Class: EUGLENINEAE
50	*Euglena spirogyra* Ehrenberg
51	*Phacus acuminatus* Stockes
52	*Trachelomonas sp.*
	Class: CYANOPHYCEAE
53	*Nostoc sp.*

Composition of algae collected from Cheruchakkichola



Use of algae in classification of water bodies in study area

Algal community can predict the status of pollution because of their quick response to the pollutants and physico-chemical properties. So that can be used to classify water bodies. According to Nygaard (1949), compound quotient values obtained from the study indicate the intensity of pollution.

$$CQ = \frac{\text{Cyanophyceae+Diatom+Chlorococcales+Euglenophyceae}}{\text{Desmids}}$$

If CQ values are

CQ<2 = oligotrophic
2-6=Weak trophic
>6=Eutrophic

In the present study, compound quotient value as

CQ=1+9+13+5/26 = 1.07 - Oligotrophic

According to Nygaard, 1949, Cheruchakkichola clearly defines as Oligotrophic in nature indicating that poor productivity, little nutrient contents and relatively clear for drinking purposes.

In 1965, Patrick suggested an idea to the pollution status of water bodies by evaluating algal community. Desmids, Bacillariophyceae, Cyanophyceae and Euglenophyceae are used to accomplish meaningful evaluation degree of pollution. According to Patrick, lower the index value, higher the degree of pollution.

Pollution index = Bacillariophyceae+Desmids/Euglenophyceae +Cyanophyceae

= 9+28/1+3 =9.25

From the above pollution index, it has observed that high pollution index value due to high diversity of desmids and Bacillariophyceae compared with other groups of phytoplanktons.

In 1969, Palmer carried out a widespread literature survey to access the tolerance of algal species to organic pollution and to compare data into an organic pollution index for rating water quality. According to Palmer's score, values of >20 consistent with high organic pollution and <10 signify lack of nutrient enrichment. According to it, the area is least polluted.

Table 4: Pollution index of algal genera from the present study

No	Genera	Palmer index value
1	Closterium	1
2	Euglena	5
3	Phacus	2
4	Scenedesmus	4
	Total	12

Pollution index value below 15, too small in this area. That is only slight evidence for organic pollution. Throughout the globe algal communities are used to study aquatic pollutions and the use of algal communities can be correlated with water pollution studies (Sonneman *et al.,* 2001; Trivedi, 1982; Mahajan *et al.,* 1987). The most important effect of organic pollution in a water bodies is due to enrichment of nutrients and total number of algal species (Winter *et al*., 2000; Prasad *et al*., 2008) emphasized the importance of biological survey in monitoring water quality, which is dependent on qualitative and quantitative composition of aquatic population. Algal communities are generally abundant, diverse and important component in aquatic ecosystem. They collectively show a broad range of tolerance along a gradient of aquatic productivity, individual species have specific water chemical requirements (Patil *et al*., 2011; Biswas, 1949).

4. CONCLUSION

Being the primary producers in the grazing food chain, microalgae hold the key for the productivity of all water bodies. All animals living in water are directly or indirectly linked with

microalgae in their life cycle. Mapping and enlisting all these taxa is the preliminary step to understand their links with other life forms.

Cheruchakkichola which is situated in Kondenchira forest, Mangad, is a moist deciduous forest and freshwater resource is rich in microalgal diversity. In the present study, 53 species of algae were observed from various stations of Cheruchakkichola. Microalgae belong to six classes namely Chlorophyceae, Bacillariophyceae, Dinophyceae, Cyanophyceae and Euglenophyceae were recorded. Among them Class Cyanophyceae are found to be the prominent member represented by about 39 species. Least abundance of Cyanophyceae and Euglenophyceae denotes the pollution status of the study area. These pollution tolerant varieties were only about 2%. Algae have been used as a potent indicator to study changes in water quality of rivers with relation to inorganic nutrient levels through eutrophication. Physico-chemical parameters analyzed also within the permissible limit. The distribution of phytoplankton species depends upon the physico-chemical factors of the environment. The species that showed close association with the physicochemical conditions may be useful tools for ecological water quality index analysis. They bring about changes in chemical composition of water. Palmer (1969) carried out an extensive literature survey to access the tolerance of algal species to organic pollution and to compare data into an organic pollution index for rating water quality. According to it, the present area is least polluted. The data presented in this study will help in creating the framework for further studies. Since the area remain unexplored, there observed an abundance of various algal species within a small area and also have very little human interpretation, so the area is pollution free. So, in essence, through this study we are introducing one more biodiversity spot that we have conserve.

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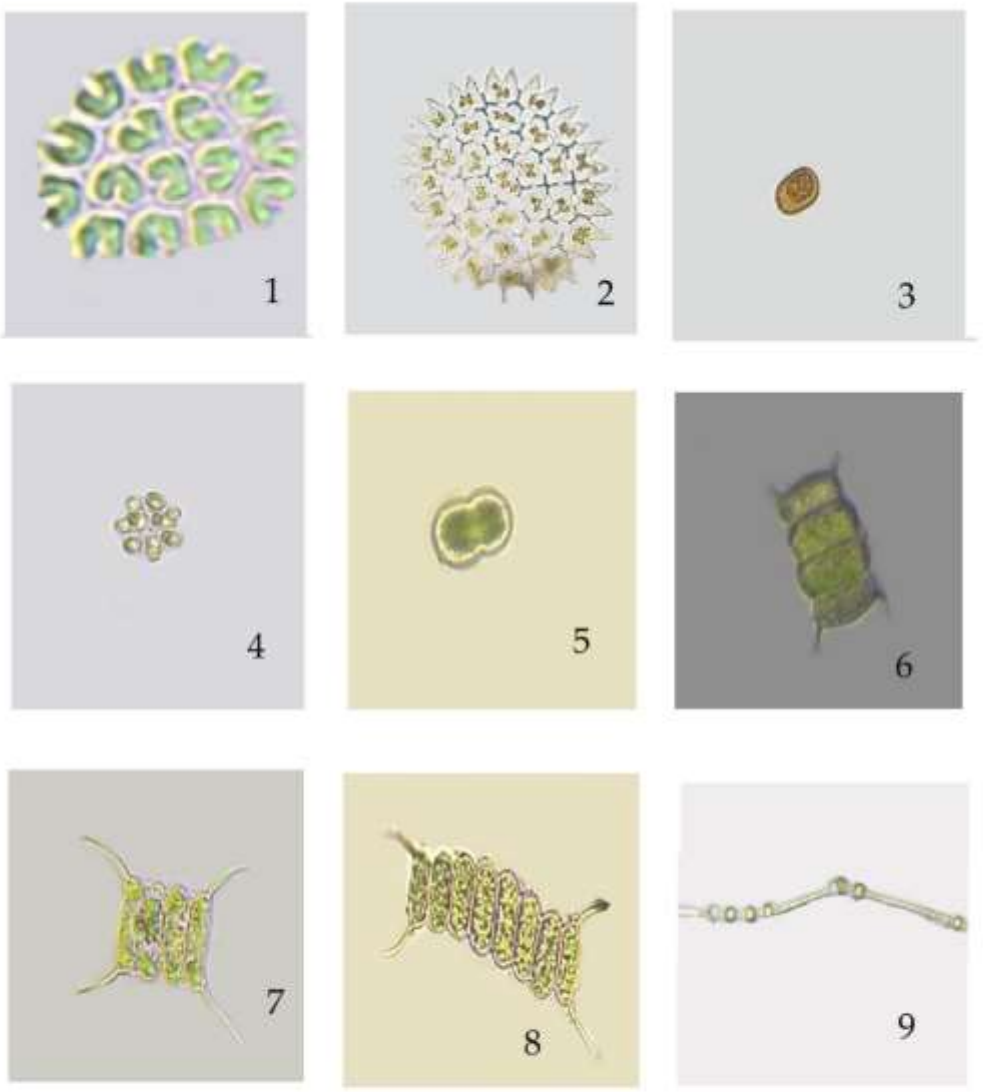

Plate 1: 1.*Pediastrum tetras* (Ehrenberg) Ralfs 2.*Pediatrum duplex* Meyen **3.** *Trachelomonas sp.* 4. Coelastrm sphaericum Naegali 5. *Cosmarium sp.* 6. *Scenedesmus armatus* (Chodat) Smith 7.*Scenedesmus quadricauda* (Turpin) Brebisson 8.*Scenedesmus sp.* 9. *Oedogonium sp.*

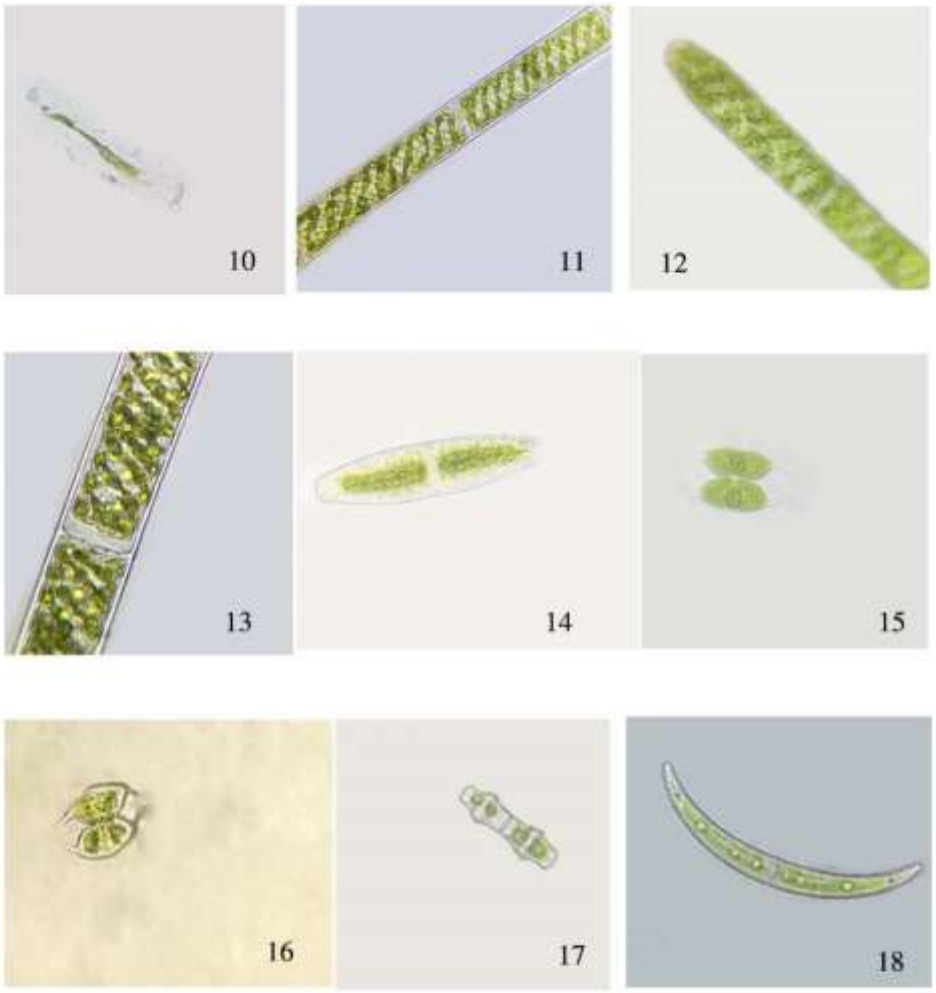

Plate 2: 10 *Mougeotia sp.*, 11-13 *Spirogyra sp.*, 14 *Netrium digitus* (Ehrbg.)Itzigs.&Rothe, 15 *Arthrodesmus convergens* Ehren berg, 16 *Arthrodesmus curvatus* Turner ,17 *Bambusina brebisonii* Kutzing ,18 *Closterium parvulum* Naegali

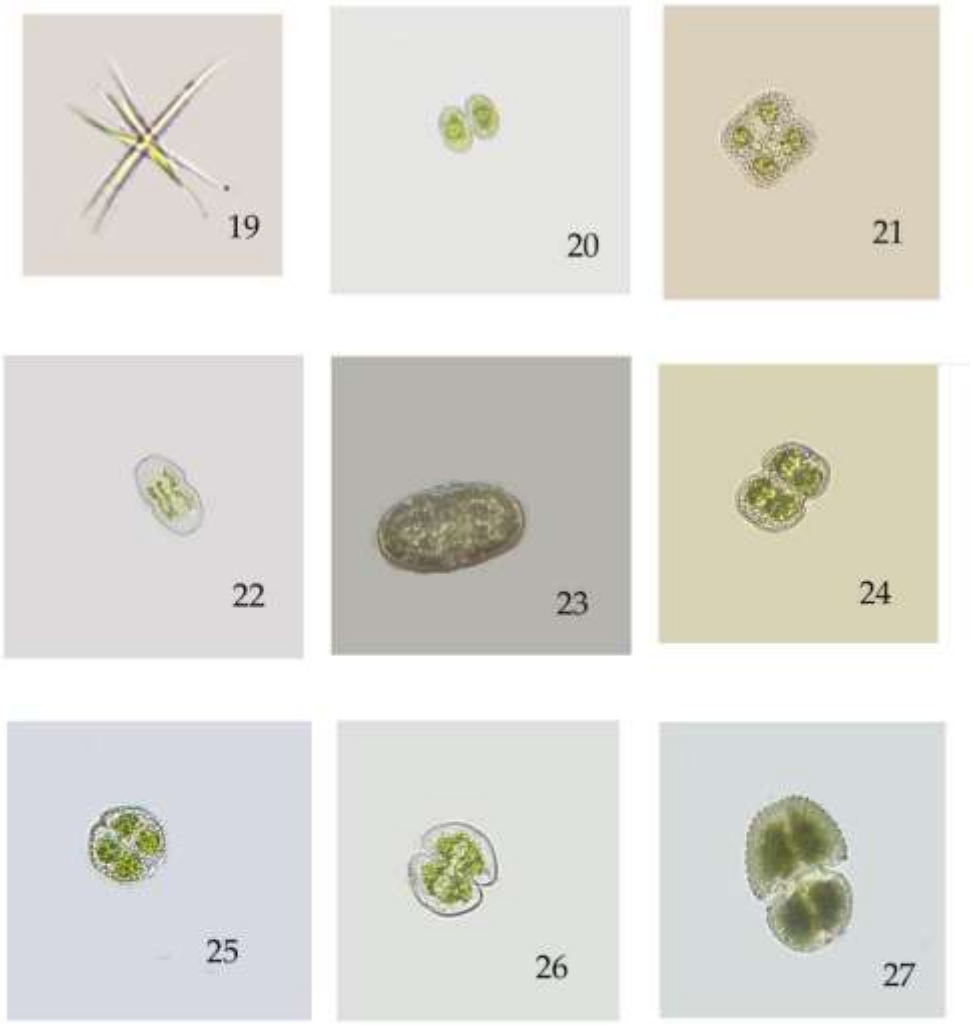

Plate 3: 19. *Ankistrodesmus sigmoides* (Rabenh.) 20. *Cosmarium contractum* Kirchner 21.*Cosmarium margaritatum* (Lund) 22. *Cosmarium corda* ex Ralfs 23. *Cosmarium cucurbita* Breb 24. *Cosmarium cuneatum* Josh 25. *Cosmarium Pachydermum* P. Lundell 26. *Cosmarium sp.* 27. *Cosmarium sp.*

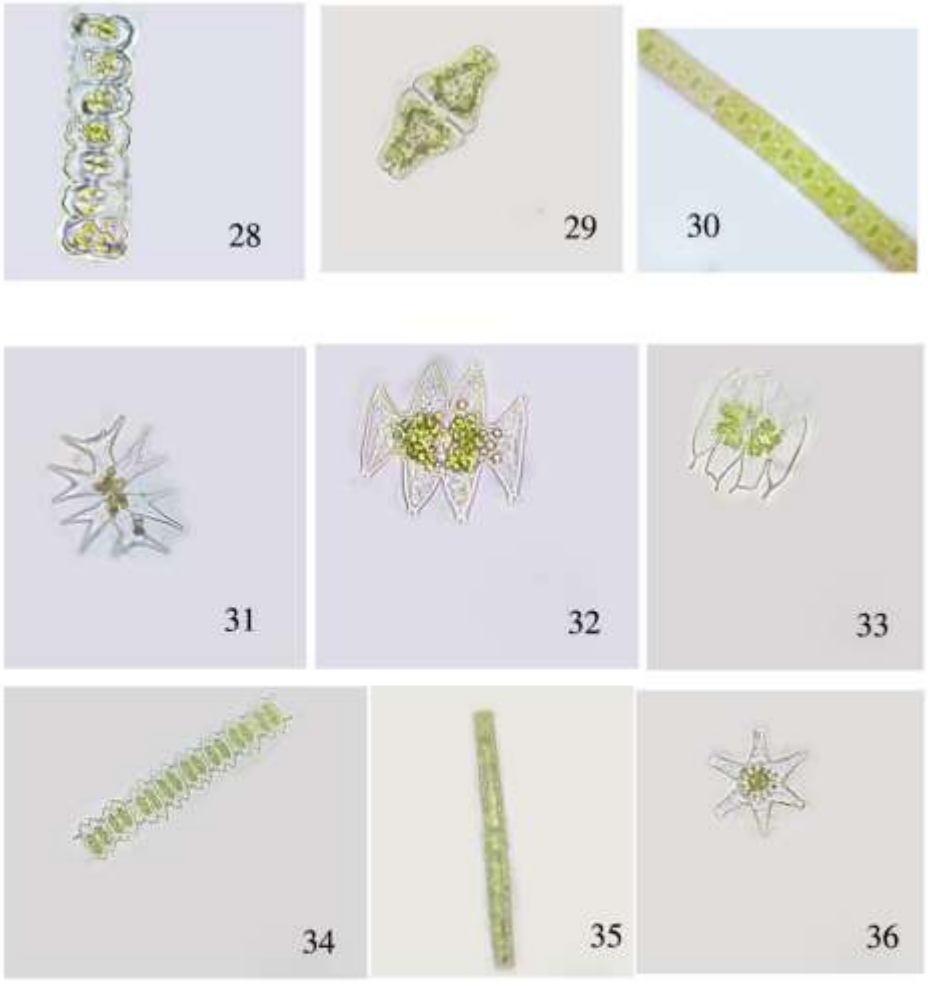

Plate 4: 28-*Desmidium bengalicum* (Kuetz.)De Bary, 29- *Euastr um ansatum* Ehrbg, 30- *Micrasterias foliacea* Bailey ex Ralf, 31- *Micrasterias mahabuleshwarensis* Hobs., 32- *Micraste rias pinnatifida* (Kutz)Ralfs , 33-*Micrasterias zeylanica* Frit sch , 34- *Onychonema leave* Nordst , 35- *Pleurotaenium trabecula* (Ehrbg) Nag , 36- *Staurastrum zonatum* Borgs

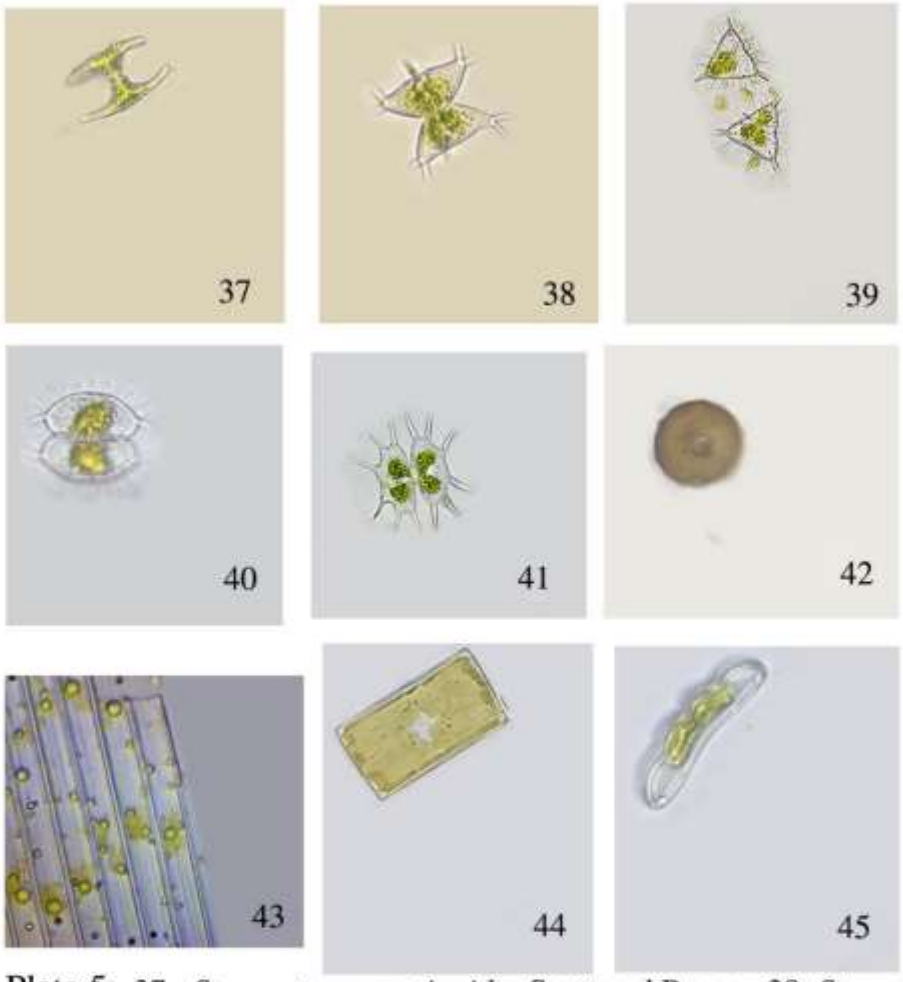

Plate 5: 37 -*Staurastrum anatinoides* Scott and Presc. , 38-*Staurastrum bifidum* ex Ralfs, 39 -*Staurastrum polytrichum* (Perty) Rabenhorst, 40-*Staurastrum setigerum* Cleve, 41 -*Xanthidium sexmamillatum*West &West, 42- *Actinocyclus sp.* , 43-*Fragilaria sp.*, 44 - *Tabellaria sp.* 45- *Eunotia camelus* Ehr.