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Algal diversity and their ecology in Pariyapurath Chali, a wetland in Ramanattukara Municipality, Kozhikode, Kerala, India

Diversidad y ecología de algas en Pariyapurath Chali, un humedal del municipio de Ramanattukara, Kozhikode, Kerala, India

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ABSTRACT

Wetlands are one of the important ecosystems which contribute much to primary productivity and atmospheric oxygen. Algal diversity and their ecological role in Pariyapurath Chali were studied. Standard methods for collection, identification and preservation were followed, and their importance in the ecosystem were noted. A total of 52 samples were collected, of which 65 taxa were identified. These taxa belonged to 4 classes; Chlorophyceae, Bacillariophyceae, Euglenophyceae and Cyanophyceae. The occurrence of cyanobacteria was high in the study site, the non-hetrocystous cyanobacteria were more frequent in all the sampling sites especially in the soil with high nitrogen and organic content. This contribution increases the taxonomic knowledge of Indian wetland algae.

Keywords — Cyanophyceae; green algae; paddy field; Pariyapurath Chali; wetland.

RESUMEN

Los humedales constituyen uno de los ecosistemas más importantes que contribuyen en gran medida a la productividad primaria y aportan oxígeno atmosférico. Se estudió la diversidad algal y su papel ecológico en Pariyapurath Chali. Se siguieron

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métodos estándar de recolección, identificación y preservación, y se relevó su importancia en el ecosistema. Se recolectaron un total de 52 muestras, de las cuales se identificaron 65 taxones. Los que pertenecían a 4 clases: Chlorophyceae, Bacillariophyceae, Euglenophyceae y Cyanophyceae. La ocurrencia de cianobacterias fue alta en el sitio de estudio, las cianobacterias sin heterocistos fueron más frecuentes en todos los sitios de muestreo, especialmente en el suelo con alto contenido de nitrógeno orgánico. En esta contribución se incrementa el conocimiento taxonómico de las algas de los humedales de la India.

Palabras clave — Algas verdes; campos de arroz; cianofíceas; humedal; Pariyapurath Chali.

INTRODUCTION

The aquatic environment contains over 80% of the world's plant and animal species and 34 of the 36 phyla of life are represented in the aquatic ecosystem. Algae is a vital component of the aquatic environment it has a significant role in maintaining an equilibrium of abiotic and biotic components. Algal flora constitutes about 1.6% of the total biodiversity. They are the simplest members of the Plant kingdom and are the first photosynthetic organisms to release elemental oxygen to the environment. Around 90% of the photosynthetic activities contribute to approximately half of the total global primary production (Graham & Wilcox, 2000).

Microalgae are potential organisms that have a plenty of applications as pharmaceuticals, health foods, bioremediation of industrial effluent. Algae play an important role in maintaining aquatic ecosystems and form the base of food chain or food web and the productivity of algae depends on the water quality (Meshram & Dhande, 2000; Santhanam & Peruma, 2003). Algae are used as biological indicators of water pollution in many countries. Algae can be used for the sustainable management of soil fertility.

Algae are found in almost all possible environments, such as extreme acidic to alkaline environments. In highly polluted waters, they grow abundantly forming algal blooms. Some of the common members that are seen in polluted areas are: *Oscillatoria* sp., *Chlorella* sp., among others. In addition to their ecological roles as oxygen producers and as the food base for almost all aquatic life, algae are economically important as a source of crude oil and as sources of food and a number of pharmaceutical and industrial products for humans. In recent years, algae flourished in water polluted with organic wastes and played an important part in "self-purification of water bodies".

Over the past decade there has been a surge of interest in understanding the potentiality of algae in various aspects especially in the food, cosmetic and energy industry. Kerala being a land blessed with many water bodies both freshwater and marine. The potential for algal research is very high. Even though these are the situations the algae are one among the least explored and exploited communities. The objective of this study was to collect, document and to identify the ecology of the algae in our neighborhood.

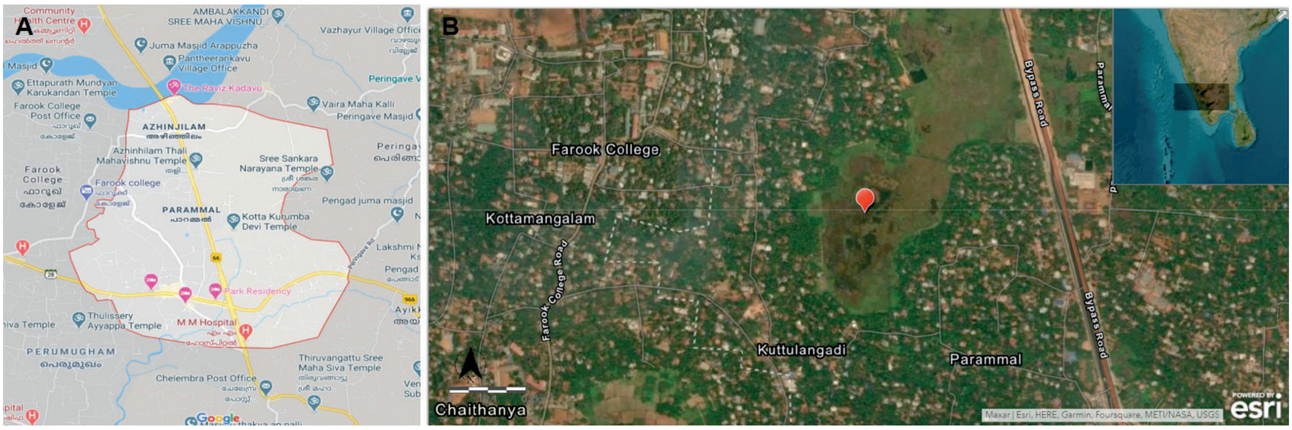

Fig. 1. A) Map showing the Study Area. B) Satellite photography of the study area.

Fig. 1. A) Mapa que muestra el área de estudio. B) Fotografa Satelital del área de estudio.

MATERIALS AND METHODS

Study Area

The area of study is located in the Ramanattukara Municipality of Kozhikode district, Kerala State (Fig. 1). This wetland area is the largest under the Ramanatturkara municipality where paddy cultivation is done successfully, even though majority of the regions remain as uncultivated waterlogged area. The area got its name from the name of the old land lords of the area, 'Pariyapurath' and Chali means a stream.

The area comprises more than 30 acres, of which only around 10-15 acres are wetland, rest of which are converted to housing plots. The area has been badly affected by floods in the last two years resulting in massive crop loss in addition to the loss of biodiversity.

Collection of Samples

Algal samples for the systematic analysis were collected from Pariyapurath Chali, Ramanattukara from sampling stations marked in figure 1. Specimens were collected at monthly intervals from these stations of the study area for 3 months from October to December.

Materials were collected in tightly capped plastic bottles and labeled for algal taxonomic studies. The samples were brought to the laboratory at the Department of Botany, Farook College (Autonomous) Kozhikode, Kerala and preserved in 4% formalin solution till the microscopic observations were done.

Morphological Identifications

The temporary slides were prepared from the samples and observed under Microscope using 10X, and 40X objectives. In addition, digital photomicrographs were taken for the identification of algal taxa in their original morphology. Care was taken that the identification is done within 2 days of collection in order to get the original morphology. The digital microphotographs were taken in the Olympus microscope attached with the camera.

Identification

The taxa were identified with the help of authentic scientific literatures like John & Francis (2013), Desikachary (1959) and algaebase (Guiry & Guiry, 2023) were also used.

RESULTS

Enumeration of the taxa

The study area mainly included the paddy fields. From the collection trips a total of 51 samples were collected. From the total collections we could enumerate 25 taxa belonging to green algae, 5 taxa of diatom and 35 taxa belonging to cyanobacteria (Fig. 2).

These taxa belonged to 4 classes viz., Chlorophyceae, Bacillariophyceae, Euglenophyceae and Cyanophyceae. The Chlorophyceae showed maximum diversity followed by Cyanophyceae. The diversity of Bacillariophycea and Euglenophyceae members were minimal (Fig. 3).

The macro algae along with the diatom constituted 30 taxa belonging to 13 genera and 3 Classes. There were 8 Green algae (Chlorophyceae), 3 Diatoms (Bacillariophyceae) and 2 unicellular motile Euglenophyceae members. Among these macro algae the most dominant Class was Chlorophyceae with 8 genera and the most dominant genus was Spirogyra with frequency of 12.

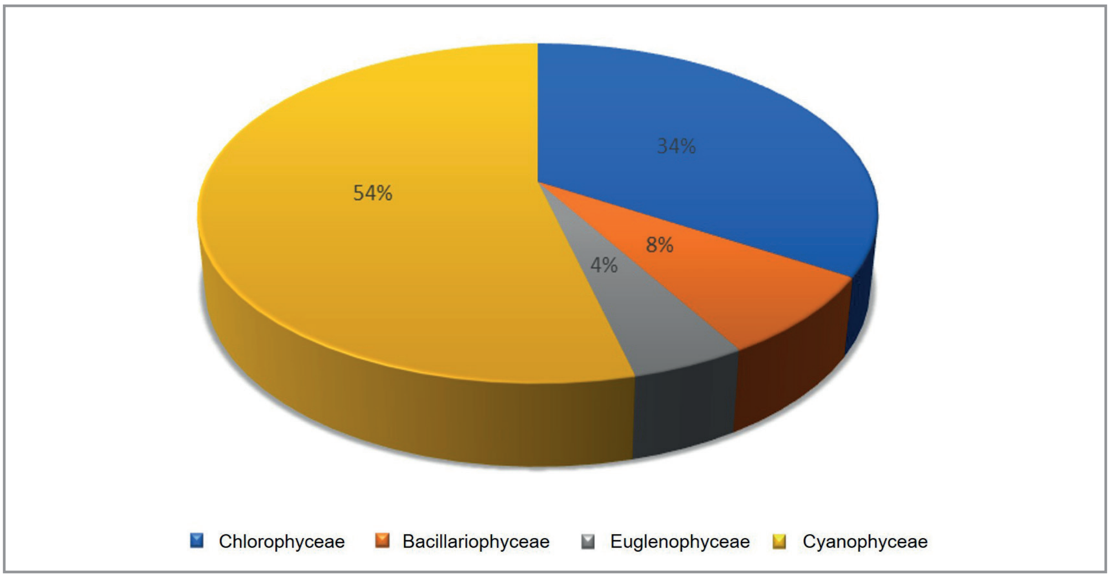

Fig. 2. Graph showing the percentage of different algal class in the study area

Fig. 2. Gráfico que muestra el porcentaje de diferentes clases de algas en el área de estudio.

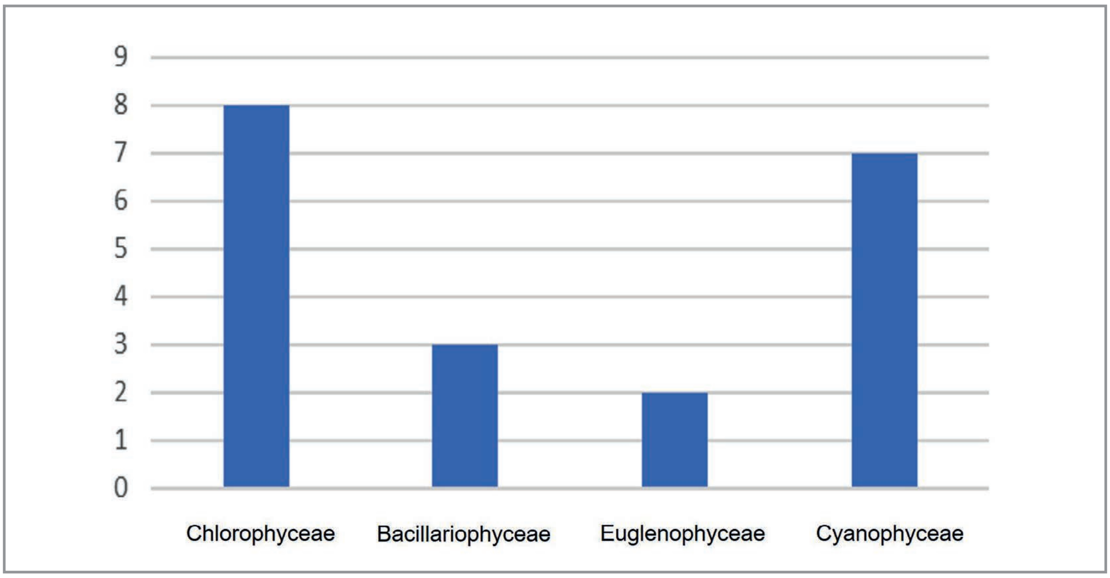

Fig. 3. Graph showing the frequency of different class of algae in the study area
Fig. 3. Gráfico que muestra la frecuencia de diferentes clases de algas en el área de estudio.

The 35 taxa of cyanobacteria identified belonged to 7 genera, under 4 families. Of the 4 families, only the Nostocaceae members are heterocystous i.e., with the capacity for nitrogen fixation. The most dominant family was the Nostocaceae with 3 genera, followed by Oscillatoriaceae with 2 genera, Rivulariaceae with 1 genus and Chroococcaceae with 1 genus. The heterocystous cyanobacteria showed high diversity with 4 genera vice., *Nostoc*, *Anabaena*, *Cylindrospermum* and *Scytonema* while the non-heterocystous cyanobacteria obtained were *Oscillatoria*, *Phormidium* and *Microcystis*. Of which Microcystis was unicellular.

Ecology of the algae in the study area

The study area consisted of both the cultivated land, especially the paddy fields and marshy areas, and the distribution of different classes of algae were different in the sampling sites (Table 1). Cyanobacteria showed maximum distribution since it was found in all the sampling sites. The most frequent genera were that of *Oscillatoria* and *Phormidium*, they are non-heterocystous cyanobacteria. This may be due to the high nitrogen content in the soil especially in the drainages, imparting a foul smell.

Table 1. Distribution pattern of different algal class in the sampling sites.
Table 1. Patrón de distribución de diferentes clases de algas en los sitios de muestreo.

Algal Class	Paddy Field	Stream	Drainage	Marsh	Waste Land	Plantation
Chlorophyceae	X	X	X	X		X
Bacillariophyceae			X	X		
Euglenophyceae	X		X			X
Cyanophyceae	X		X	X	X	X

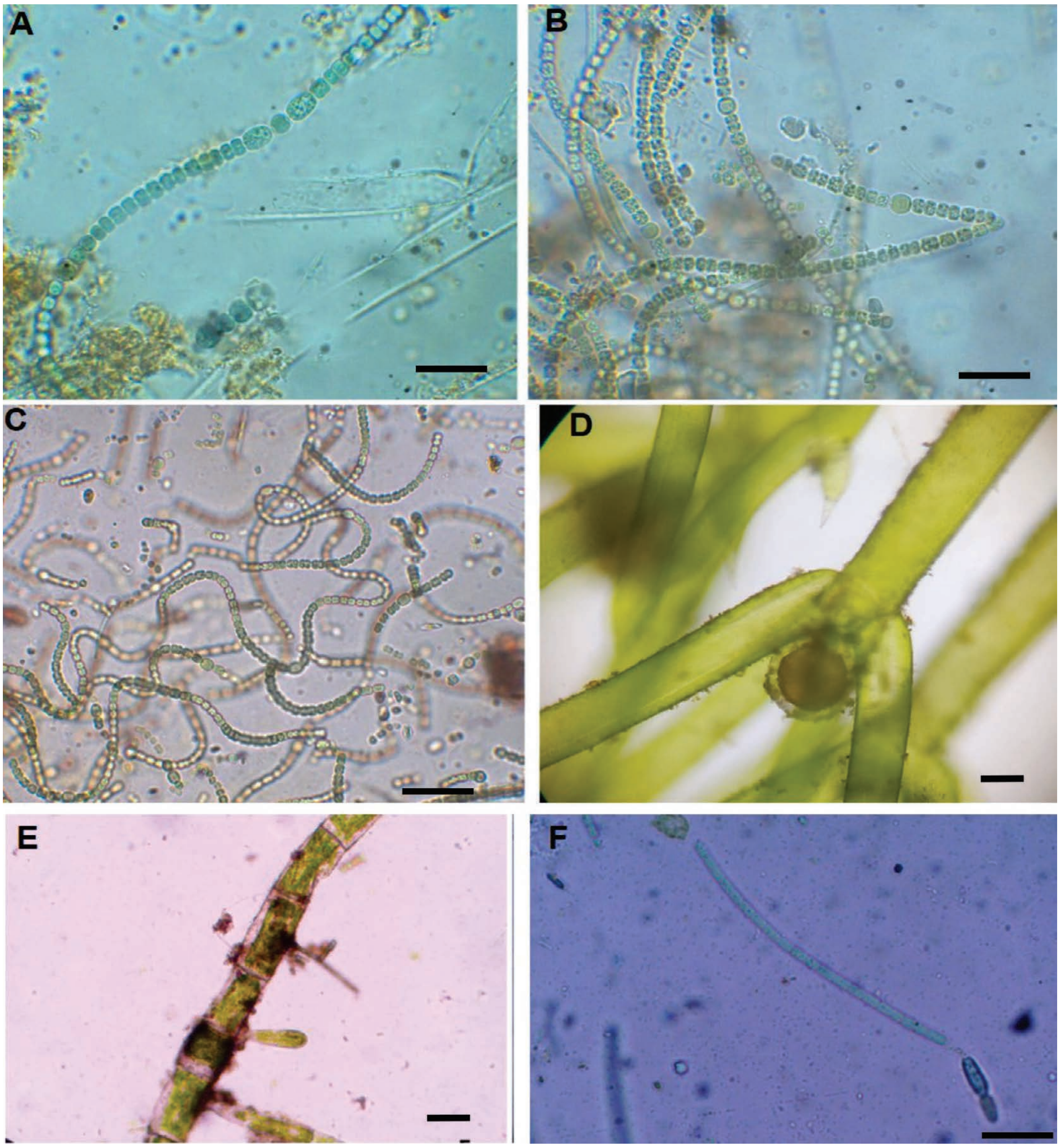

Fig. 4. Microphotographs of some of the mentioned taxa: A) *Anabaena oscillaroides.* B) *Anabaena torulosa*. C) *Nostoc linckia*. D) *Nitella globosum*. E) *Oedogonium desikachary*. F) *Cylindrospermum* sp. Scale: A-C= 10 μm, D= 5 μm, E and F= 10 μm.

Fig. 4. Microfotografías de algunos de los taxones mencionados: A) *Anabaena oscillaroides*. B) *Anabaena torulosa*. C) *Nostoc linckia*. D) *Nitella globosum*. E) *Oedogonium desikachary*. F) *Cylindrospermum* sp. Escala: A-C= 10 μm, D= 5 μm, E y F= 10 μm.

Whereas in the paddy fields and other cultivated lands like banana and tapioca plantation the frequency of heterocystous cyanobacteria were high and their diversity was also high with 4 genera viz., *Nostoc, Anabaena, Cylindrospermum* and *Scytonema*. These heterocystous communities help in the biological nitrogen fixation and hence augment the soil fertility thus they eventually help the farmers.

The Chlorophyceae members were found in all the collection sites except the waste land. These members grow profusely forming the algal bloom. Figures 4 and 5 detail some of the most common algal taxa.

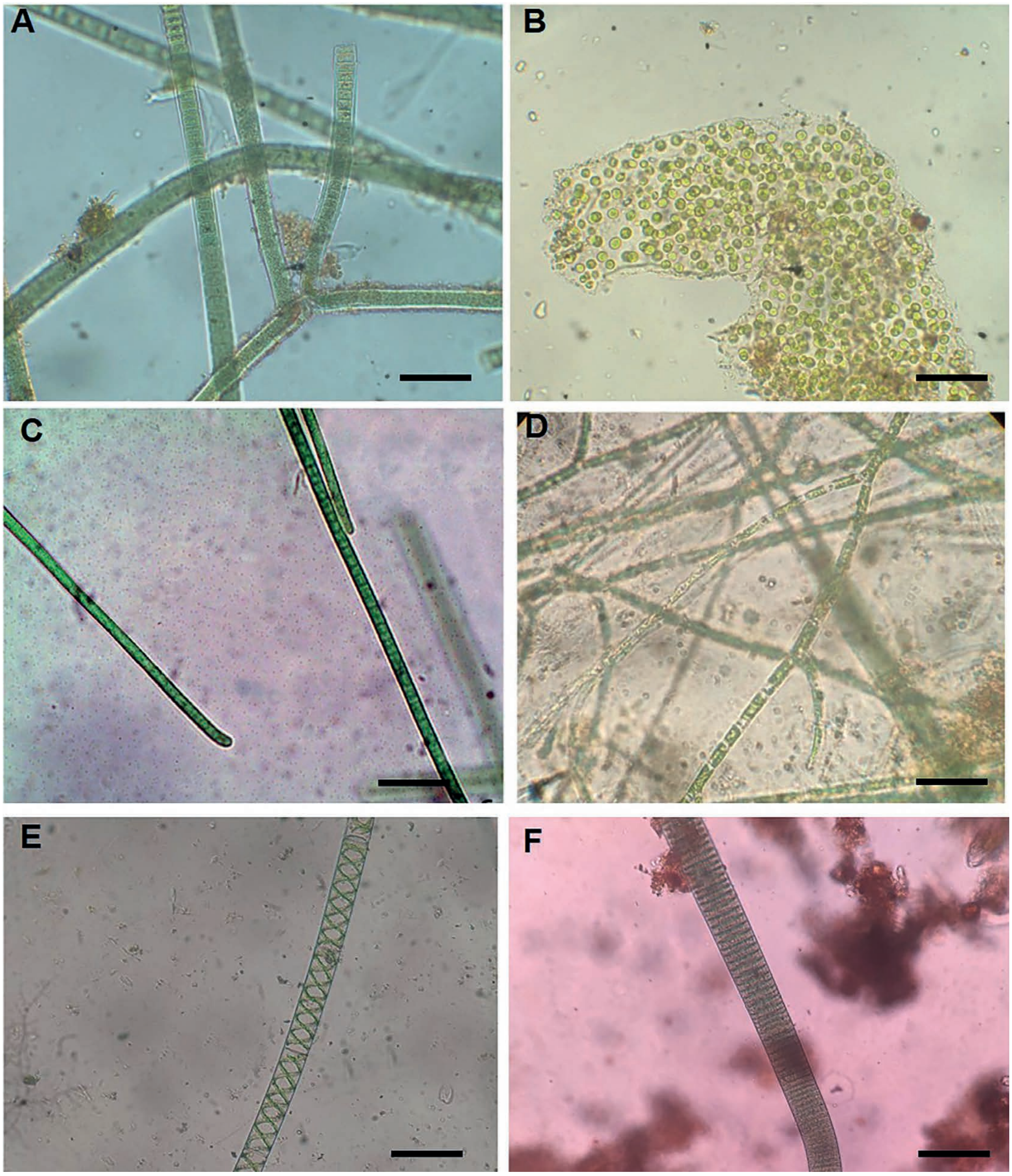

Fig. 5. Microphotographs of some of the mentioned taxa: A) *Scytonema* sp. B) *Microcystis* sp. C) *Phormidium* sp. D) *Cladophora* sp. E) *Spirogyra baileyi*. F) *Oscillatoria princeps*. Scale: A-F= 10 μm.

Fig. 5. Microfotografías de algunos de los taxones mencionados: A) *Scytonema* sp. B) *Microcystis* sp. C) *Phormidium* sp. D) *Cladophora* sp. E) *Spirogyra baileyi*. F) *Oscillatoria princeps*. Escala: A-F= 10 μm.

DISCUSSION

Algae is an important component of the ecosystem, which responds to ecosystem alterations rather rapidly. The research on algae dates back to the 1950s. Algae can be divided into three ecological groups, namely phytoplankton, benthic microalgae, and macroalgae in mangrove ecosystems, which play important roles in organic carbon production and nutrient cycle. Gao & Lin (2018) briefly introduced algal groups and their ecological importance in mangrove ecosystems and they suggested that studies of algae should be part of comprehensive investigations on long term ecosystem dynamics. We attempted to identify the algae and their ecological role in the neighboring freshwater ecosystem.

Srivastava *et al*. (2018) collected 30 samples of freshwater microalgae from central India and found that these belonged to Chlorophyceae, Bacillariophyceae and Cyanophyceae. His results revealed a maximum diversity of Chlorophyceae followed by Cyanophyceae. This result was in accordance with the present study also. High green algal diversity was reported by Vijayan & Rey (2015) also. The dominance of Chlorophyceae was reported by Jose & Xavier (2022) at Chimmony Wildlife Sanctuary, Thrissur also.

Seena (2021) evaluated the river ecosystem in Palakkad district by analysis and interpretation of the data on taxonomy and ecology of freshwater algae.

CONCLUSION

The wetlands are the most species rich or biodiversity rich regions. Kerala is gifted with a large number of water bodies and related wetlands. But wetlands are among the most polluted and exploited areas. Biodiversity documentation of such areas will be helpful in studying the impact of pollution and land exploitations. Algae are the least studied and documented organism, owing to their simple structure and delicate nature. So, an attempt was made to document the algal flora of Pariyapurath Chali, a neighboring wet land to Farook College. The biodiversity documentation of this area was already done, but no data was available about the algal flora.

The present study is only a preliminary study and it will be helpful for the biodiversity documentation and further survey. It is suggested that the macroalgae are the most efficient and reliable indicators of trace metal pollution and also algal bloom is noticed in highly polluted areas.

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