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Ecological observation on the seasonal diversity and succession of algal bloom in a lentic water body in Assam, India

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Abstract
Phytoplanktons are a highly diverse group of organisms that inhibit the upper sunlit layer of almost all freshwater ecosystems and form an important part of the lentic system biota. The present study was conducted to investigate the seasonal species diversity and succession of phytoplanktons in algal bloom in Garjan *beel*, Assam. The study was performed during 2020-2021 and samples were collected seasonally. The results indicate that there are changes in phytoplankton groups in the study site which are influenced by temporal variations observed during these two seasons and the possible anthropogenic activities around the area. These seasonal changes indicate the importance of short-term and long term observations of the beel for understanding the variation in phytoplankton groups in a lentic ecosystem. The cyanophyceae were dominant both during winter and pre-monsoon season. Chlorophyceae occured in pre-monsoon season.

Keywords: phytoplankton, composition, lentic, succession

Introduction

Algae sometimes referred to as the phytoplanktons inhibit the upper sunlit layer of almost all freshwater ecosystems and form part of the lentic system biota. They are the principal photosynthesisers and primary producers of the aquatic food web. Most algae are annuals and survive the non-growing seasons as dormant spores or other cells capable of survival. Changes in algal population have been reported seasonally, but the dominant species may differ from year to year (Transeau, 1916) [11].

Nowadays the term algae is applied to a broad assemblage of organisms that can be defined both in terms of morphology and general physiology (Bellinger & Sigee, 2015) [1]. They are widely present in almost all freshwater environments, such as lakes and rivers, where they are typically present as microorganisms – visible only with the aid of a light microscope. Although they are relatively inconspicuous, but play a major role in the freshwater environment.

Phytoplanktons show great diversity and form an important part of aquatic ecosystem. They form an important ecological component in the survival of life in the aquatic environment. It is important to note how economically important the beel is to the people residing in an around the area as well as environmental monitoring in general. No previous studies have been done on the diversity and seasonal successsional changes in phytoplankton dynamics in Garjan beel. The study is aimed at assessing the phytoplankton community composition and changes during transition from winter to pre-monsoon season at Garjan beel, Assam.

The intimate association of algae with aquatic habitats makes them an interesting tool for such studies. Algal blooms can represent very large numbers of algal cells. Some algal blooms have been recorded in excess of 800,000 cells per millilitre (ml) of water (Water Facts, Water Rivers Commission, 1998) [19]. An excessive growth of microscopic algae is defined as a bloom when it reaches high densities of cells/ml in a water sample.

Cyanobacteria play an important role in bloom formation. Bloom alage belonging to the genera *Microcystis*, *Anabaena*, *Euglena*, etc. are a common sight in the tropics during late winters and summers. However, in tropical regions growth are found to be nearly continuous when sufficient nutrients are available (Pal and Choudhury, 2014) [13].

The principal source of organic production in aquatic ecosystems are the phytoplanktons that form the base of food webs (Chao *et al*., 2016) [2]. The biomass, composition and community structure of phytoplankton can serve as indices to monitor aquatic environments (Paerl *et al*., 2003) [12]. Meanwhile, the distribution and succession of phytoplankton are the consequences of adaptation to different environmental conditions (Margalef, 1978) [7]. They are the important primary producers of aquatic ecological system and also form the foundation of the water ecological system. Phytoplankton are sensitive aquatic organisms and their community structure could reflect the eutrophic situation in a short time (Jing *et al*., 2014) [6].

Phytoplankton communities undergo changes within individual years. These changes have been termed 'seasonal succession' by plankton ecologists. Investigations on the successional development of a water body can be well studied by taking pond as a model system. Lentic ecosysytems such as ponds, beels, lakes undergo successional progression faster than other larger aquatic ecosystems. Wu *et al*. (2020) [20] states that temperature and nutrients were important driving force for phytoplankton seasonal succession.

The ecology and succession of phytoplankton in ponds were studied by many Indian limnologists. Seenayya (1971) [17], Rao (1975) [15] and Munawar (1974) [9] made detailed studies on the species turnover and periodicity of phytoplankton community in freshwater ponds of

Hyderabad. These studies unravelled the pattern of species succession and dominance with respect to season and hydrology of ponds. The processes involved in species turn-over of plankton communities in tropical reservoirs were studied by Santos *et al*. (2016) [16].

The role of phytoplanktons is important in any lentic ecosystem as it is sensitive and extremely responsive to changes in the environment and thus indicating environmental changes and fluctuations that may occur (Moss, 2018) [8]. Seasonal succession of phytoplanktons have been studied in a river of Western Ghat, India (Rao and Madhyaytha, 1990) [14] which shows temporal variations of the algal taxa.

So, the aim of this study was to analyse the seasonal succession and the composition of the bloom phytoplankton which will help in providing baseline data on the knowledge of the phytoplankton assemblages in the lentic ecosystem.

Materials and Methods

Study Area

The present study has been conducted in Garjan beel. The beel lies in 26°13'5"N latitude and 91°30'41"E longitude. The beel is situated in Hajo, Kamrup district of Assam. The study site, Garjan beel is situated on the northern part of Brahmaputra basin.

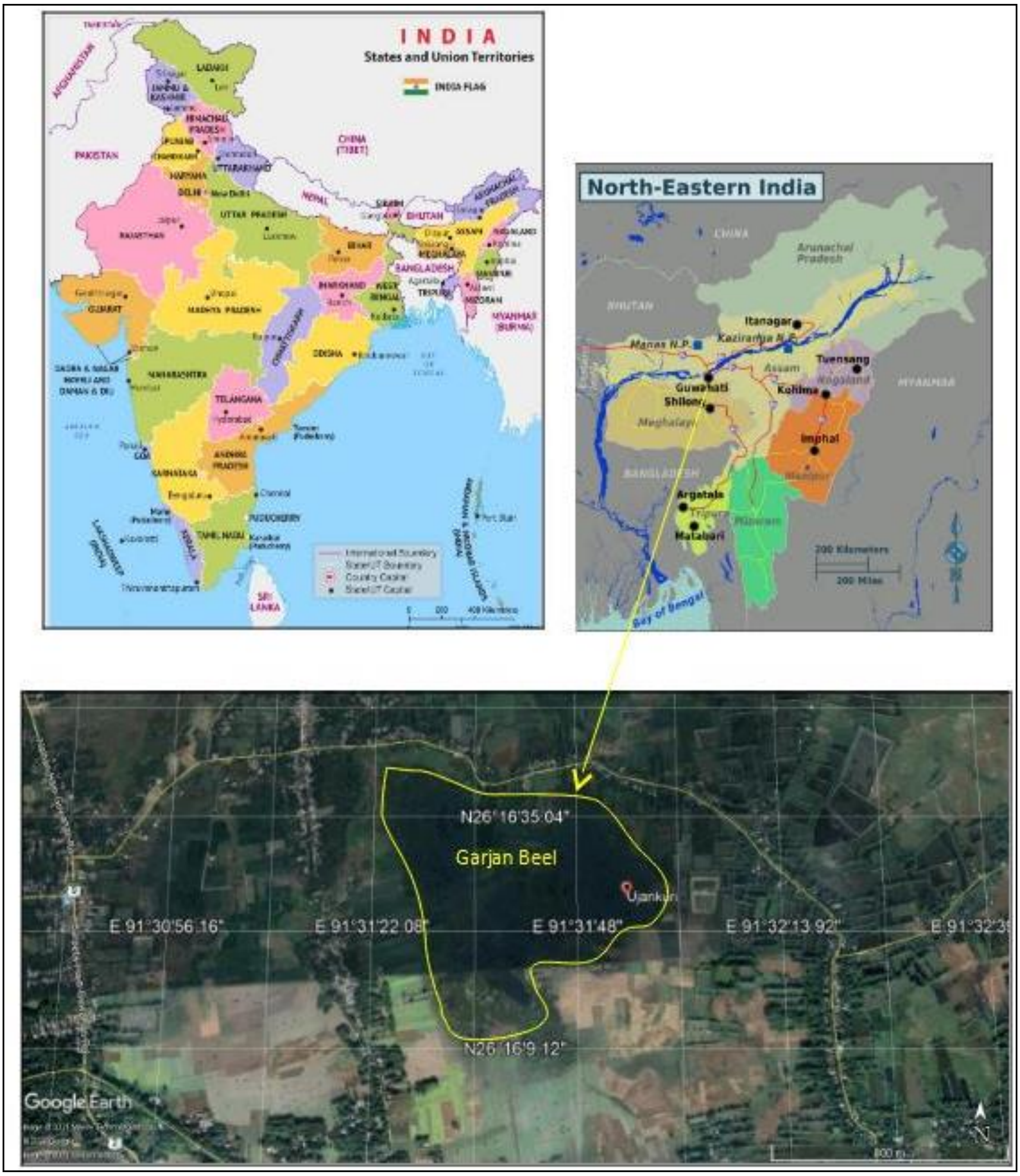

Fig 1: Location map of the study area

Collection of bloom algae

Algae samples from the seasonal bloom were collected from five sampling points that were at a distance apart from each other. The sampling points were mainly based on the anthropogenic activities such as fishing, bathing, washing, defecating, waste disposal and household sewage that are discharged directly into the water body. The sampling points were assigned as I, II, III, IV and V. The sampling was done at approximately the same time of day each time, preferably in the morning. This is because the algae move up in the water towards the surface in the morning and tend to sink to lower regions in the afternoon. Replicate samples were collected and the data was averaged.

Bloom algae sampling

Bloom algae samplings were done from the water surface wherever a visible appearance of the bloom was observed. Sampling of the bloom was done by moving the sample bottle through the surface of the scum. They were then put in an ice box for transfer to the laboratory for further study.

Phytoplankton study and identification

For the study of the algal samples, they were fixed in Lugol's iodine solution immediately after collection. This is one of the most widely recommended preservative. A larger proportion of Lugol's solution is required for field samples wherein 10 drops of Lugol's solution was added per 200 ml of sample or until the appearence of weak colour of tea. (Lugol's is made by dissolving 100g Potassium Iodide (KI) in 1L of distilled water, then 50 g crystalline iodine (I2) is dissolved in this solution and then 100 ml of glacial acetic acid is added). Identification of phytoplanktons was carried out following the monographs of Tiffany and Britton (1952) [16]; Desikachary (1959) [5]; Smith, G. (1951) [21], Fritsch (1945) [6] and Davis (1955). Classification was done by algaebase.org.

Results and Discussion

Bloom analysis (species composition)

Table 1 shows the composition and diversity of species in the bloom. A total of 13 taxa belonging to 4 different classes were recorded in the Garjan beel. The phytoplankton in the water body is represented by eight major families Chroococcaceae (3), Nostocaceae (1) Oscillatoriaceae (2), Volvocaceae (1), Scenedesmaceae (2), Zygnemataceae (2), Euglenidae (1) and Cryptomonadaceae (1). The percentage compositions (Fig.2) of these eight families were Chroococcaceae (23.1%), Nostocaceae (7.69%), Oscillatoriaceae (15.38%), Volvocaceae (7.69%), Scenedesmaceae (15.38%), Zygnemataceae (15.38%), Euglenidae (7.69%) and Cryptomonadaceae (7.69%).

Table 1: Composition of the bloom

Sl. No	Class	Order/Family	Name of the species
1	Cyanophyceae	Chroococcales/ Chroococcaceae	*Microcystis aeruginosa*
2			*Microcystis pseudofilamentosa*
3			*Microcystis robusta*
4		Nostocales/ Nostocaceae	*Anabaena verrucosa*
5		Nostocales/ Oscillatoriaceae	*Lyngbya truncicola*
6			*Lyngbya confervoides*
7	Chlorophyceae	Chlamydomonadales/Volvocaceae	*Eudorina indica*
8		Sphaeropleales/Scenedesmaceae	*Ankistrodesmus spiralis*
			Scenedesmus serratus
10		Zygnematales/Zygnemataceae	*Zygnema subcylindricum*
11			*Mougeotia scalaris*
12	Euglenophyceae	Euglenida/Euglenidae	*Euglena oxyuris*
13	Cryptophyceae	Cryptomonadales/Cryptomonadaceae	*Cryptomonas* sp.

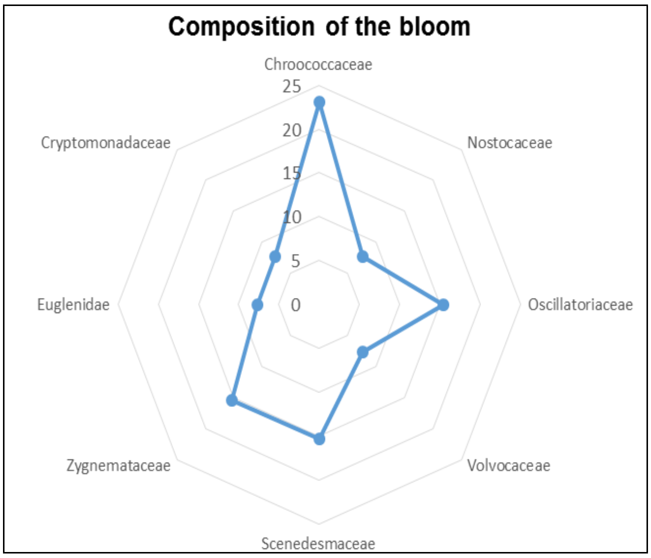

Fig 2: Bloom algae composition shown in percentage for winter and pre-monsoon season

Seasonal succession of phytoplanktons

The study indicate a rapid growth in the dominating bloom phytoplanktons during the pre-monsoon season. Members of the family Chroococcaceae have icreased during the pre-monsoon months. Study of changes in phytoplankton abundance is very important in aquatic productivity as it explains much about majority of primary production and mediating biogeochemical cycles in water column. Also it helps to evaluate freshwater aquatic ecosystem functions. The phytoplankton succession observed during the study period (Table 2) indicate that Cyanophyceae has the highest concentration throughout the study period. Chlorophyceae is the second highest group recorded during winter and pre-mnosoon seasons. Euglenophyceae and Cryptophyceae are present in the winter months and absent during pre-monsoon season. Euglenophyceae comes third in the hierarchy and Cryptophyceae occupying the fourth position. The class Cyanophyceae showed a decline in the percentage occurence of 88-83% and Chlorophyceae showed an increase from 5%-17% from winter to pre-monsoon season.

Table 2: Proportion of the seasonal phytoplankton (successional) composition in the bloom

Garjan Beel	
Winter, 2020	**Pre-Monsoon, 2021**
Proportion of individual species	**Proportion of individual species**
Microcystis aeruginosa (60%)	*Microcystis aeruginosa* (72%)
Microcystis robusta (13%)	*Microcystis pseudofilamentosa* (8%)
Lyngbya truncicola (9%)	*Anabaena verrucosa* (3%)
Lyngbya confervoides (6%)	*Zygnema subcylindricum* (6%)
Mougeotia scalaris (5%)	*Ankistrodesmus spiralis* (2%)
Euglena oxyuris (5%)	*Scenedesmus serratus* (5%)
Cryptomonas sp (2%)	*Eudorina indica* (4%)

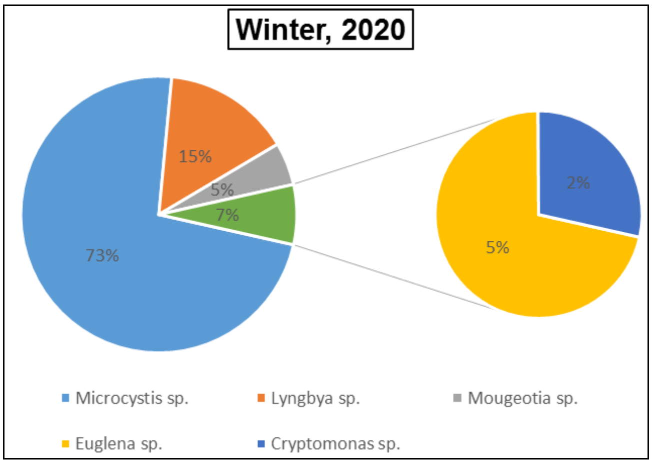

Fig 3: Percentage occurence of bloom algae genus wise in winter season

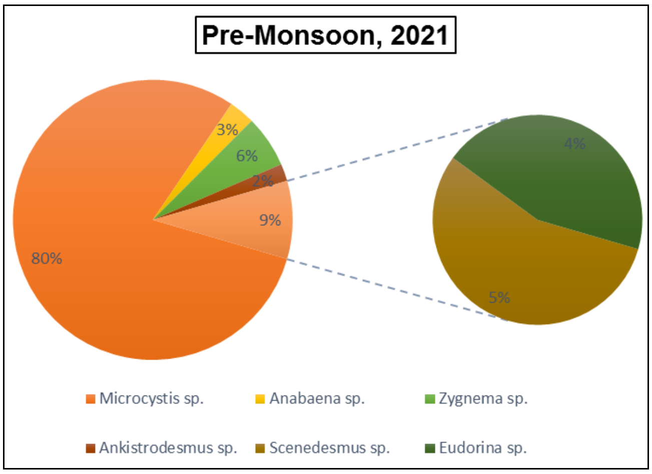

Fig 4: Percentage occurence of bloom algae genus wise in pre-monsoon season

Fig 3 and 4 shows the percentage occurence of bloom algae according to genus in the two seasons. In Garjan Beel, Cyanobacteria were again the dominant category both in winter (88%) and in pre-monsoon (83%) seasons. *Microcystis aeruginosa* was the dominant species in both the seasons. In pre-monsoon its proportion of occurence was 72%. *Microcystis robusta* was replaced by *Microcystis pseudofilamentosa* in pre-monsoon. Percentage occurance of *Lyngbya* and *Anabaena* was 15% and 3% in winter and pre monsoon respectively. Euglenophyceae was represented by *Euglena oxyuris* in the winter season. Chlorophyceae began to increase during pre-monsoon with a percentage occurence of 17%. Members of the Chlorophyceae makes a strong presence during this season.

Conclusions

The present study revealed the diversity in composition and differences in succession seasonally in Garjan beel. The composition of the *beel's* species assemblage shifted, alongwith it overall changes in algal abundance was observed with the exception of higher winter densities of cyanophytes. The composition of the algal bloom also differs from season to season. It can be summarized from the above study that there can be seen seasonal variations in the phytoplankton community of the lentic ecosystem of Garjan beel.

References

1. Bellinger EG, Sigee DC. Freshwater Algae: Identification and Use as Bioindicators. Wiley-Blackwell, 2010, 1–243.
2. Chai Chao, Jiang Tao, Cen Jingyi, Ge Wei, Lu Songhui. Phytoplankton pigments and functional community structure in relation to environmental factors in the Pearl River Estuary. Oceanologia,2016:58(3):201-211.
3. Davis C. Charles. The Marine and fresh water plankton, Michigan state University press, 1955, 1–562.
4. Desikachary TV. Cyanophyta. New Delhi: Indian Council of Agricultural Research, 1959.
5. Fritsch FE. The structure and reproduction of the algae. New York Cambridge University Press, 1945, (2).
6. Jing M, Li JY, Liu MY. Canonical Correspondence Analysis Between Phytoplankton Community and Environmental Factors in Yangcheng Lake. Environmental Science and Management,2014:39(11):145.
7. Margalef R. Life forms of phytoplankton as survival alternatives in an unstable environment. Oceanol. Acta,1978:1(4):493-509.
8. Moss B. Ecology of Freshwaters: Earth's Bloodstream, John Wiley & Sons Ltd, UK, 2018.
9. Munawar M. Limnological studies on freshwater ponds of Hyderabad-India. Hydrobiologia,1974:44(1):13-27.
10. Tiffany LH, Britton ME. The Algae of Illinois. Chicago: Univ. of Chicago Press, 1952.
11. Transeau EN. The periodicity of freshwater algae. American Journal of Botany,1916:3:121-133.
12. Paerl HW, Valdes LM, Pinckney JL, Piehler MF, Dyble J, Moisander PH. Phytoplankton photopigments as indicators of estuarine and coastal eutrophication. BioScience,2003:53(10):953-964.
13. Pal Ruma, Choudhury AK. An Introduction to Phytoplanktons: Diversity and Ecology, Springer India, 2014. ISBN 978-81-322-1837-1.
14. Rao JI, Madhyaytha MN. Seasonal Succession of Phytoplankton in a River of Western Ghat, India; Acta hydrochim. Hydrobiol,1990:18(4):433-442.
15. Rao VS. An ecological study of three freshwater ponds of Hyderabad-India III. The phytoplankton

(Volvocales, Chlorococcales, and Desmids). Hydrobiologia,1975:47(2):319-337.
16. Santos JBO, Silva LHS, Branco CWC, Huszar VLM. The roles of environmental conditions and geographical distances on the species turnover of the whole phytoplankton and zooplankton communities and their subsets in tropical reservoirs. Hydrobiologia,2016:764:171–186.
17. Seenayya G. Ecological studies in the plankton of certain freshwater ponds of hyderabad—India II, phytoplankton—1. Hydrobiologia,1971:37(1):55-88.
18. Smith GM. Manual of Phycology - An introduction to the algae and their biology. New York. NY. Ronald Press, 1951.
19. Water and Rivers Commission: Water facts 10. ISSN 1328-2042, ISBN 0-7309-7295-X, East Perth, Western Australia, 1998, 6004.
20. Wu Mei-Lin, Wang Yu-Tu, Cheng H, Sun Fu-lin, Fei J, Sun Cui-Ci *et al*. Phytoplankton community, structure and succession delineated by partial least square regression in Daya Bay, South China Sea. Ecotoxicology,2020:29:751–761.