Eco. Env. & Cons. 29 (August Suppl. Issue) : 2023; pp. (S186-S190)

ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i04s.030

Seasonal variation in diversity of Phytoplankton of Komen lake in Meghalaya, India

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(Received 17 February, 2023; Accepted 27 April, 2023)

ABSTRACT

The present investigation was undertaken to study the phytoplankton diversity and physico-chemical analysis of Komen lake during March 2019 to February 2020. Seasonal changes in diversity were observed. Total 124 species belonging to 7 classes were recorded. Diversity was maximum in spring with 1.49 and low in monsoon with 0.85. Chlorophyceae was dominant group among the 7 classes. Seasonal changes were also observed in distributional pattern of phytoplankton. Chlorophyceae and Zgynematophyceae were high during spring season and their numbers of species were low in monsoon. It shows seasonal fluctuation in temperature, turbidity, biochemical oxygen demand, nitrate and phosphate and these nutrients concentration were maximum in monsoon due to runoff of water from the agricultural, forest and residential area and negatively impact the distributional pattern of phytoplankton of the lake.

Key words: *Phytoplankton, Diversity, Physico-chemical analysis and Komen lake*

Introduction

Algae commonly known as Phytoplankton is the basic component in the aquatic ecosystems which trap almost all the energy and is one of the most important contributor of primary productivity, playing a key role in supporting the entire life forms in any aquatic ecosystem (Mooij *et al*., 2005; Noges *et al*., 2010; Kumar *et al*., 2018). Free floating phytoplankton on the surface of water thus maintain the equilibrium between abiotic and biotic components of any an aquatic system and help to regulate atmospheric temperature via photosynethesis (Murulidhar and Murthy, 2015). Phytoplanktons follow a fairly recognizable annual cycle of growth, but sometimes the synchrony in their normal annual cycle is disrupted by explosive growth of some species (Vaulot, 2001). Composition of an algal species in freshwater body depends on many environmental and chemical factors like water velocity, depth, transparency, water temperature, pH, nutrients content, dissolved oxygen and grazing by higher organism (Srinivas *et al*., 2017; Halder *et al*., 2019).

Algae are very sensitive to pollution and are used as indicators of water quality (Phillips *et al*., 2012). It is very necessary to assess the fresh water bodies because they receive different type of wastes from different sources which remain unchecked. Many researchers worked on species diversity which combine species richness as qualitative and abundance of species as quantitative measure of different groups of algae to determine the trophic status of many water bodies (Gopinath and Kumar, 2015; Belokda *et al*., 2019). A high diversity count

suggests a healthy ecosystem, the reverse indicate a degraded ecosystem. The komen lake is one of the tourist spot in that region and it is surrounded by agriculture fields, hence the present work was carried out to determined the seasonal changes in phytoplankton diversity in relation to water quality of the lake.

Materials and Methods

Study site

Meghalaya is one of the states in North East India, it has 11 districts; the study was conducted in one of the districts. Komen lake is located at Jholgaon, South West Garo Hills, Ampati with the geographical coordinates at latitude 25°49′72" N and longitude 89°89′69" E. The lake is one of the well known tourist spot in that region and surrounded by agriculture field, forest and residential area.

Sample collection and analysis

Water and algal samples were collected from March 2019 to February 2020 from Komen lake. Water temperature, pH and turbidity were measured on the spot using mercury thermometer, digital pH meter, and turbidity meter respectively. Collected water samples were brought to the laboratory for immediate estimation of dissolved oxygen, biochemical oxygen demand, phosphate and nitrate following standard procedure (APHA, 2012). Phytoplankton was collected from surface water by using a plankton net having mesh size of 45 mm. Algal samples were observed under trinocular microscope, photopgraphed (using Olympus B41 microcsope). Taxonomic identification up to species level was carried out with the help of standard books and Monographs (Presscott, 1982; Desikachary, 1985; John *et al.,* 2002; Gandhi, 1998) were followed and taxonomy was updated using the online database Algae Base (Guiry and Guiry, 2020).

Data Analysis

1. **Species diversity Index** was calculated by using **Shannon-Wiener diversity index** following the formula:

$$H' = \sum_{i=1}^{s} Pi \ln Pi$$

Where; s = total number of species.

Pi is ni/N, ln Pi is normal log of Pi

ni = Number of individuals belonging to the i^{th} species.

N = total number of individual of all the species.

Results and Discussion

Physico-chemical parameters

The physico-chemical parameters of water play an important role in the composition of algal taxa in any water body. Water temperature is one of the prime factors on seasonal assemblages of algae. The water temperature was found to be maximum during monsoon with 28°C and minimum during winter with 18°C. Seasonal fluctuation of temperature and high temperature in summer and low temperature in winter was reported by many authors (Khan *et al.*, 2017; Manohar, 2018; Rameshkumar *et al.*, 2019; Pokhrel *et al.*, 2021). The pH of the water is slightly alkaline throughout the seasons, maximum alkalinity value was observed during monsoon with 8.2 which could be due to the runoff from the nearby agricultural field during the rainy season. pH is the important factor which helps to determined the pollution level of the water bodies and there is increase in pH level with entry of runoff water (Zhao *et al.*, 2017). Dissolved oxygen was recorded higher in winter with 7.6mg/l and low in Monsoon. High dissolved oxygen in winter could be due to optimum photosynthesis rate of algae in clear water. Similar result is also reported by Ravindra *et al.*, (2003). Biochemical oxygen demand (BOD) indicates the degrees of water pollution by oxidizable organic matter (Mangaiyarkarasi *et al.*, 2017). Higher BOD was recorded during monsoon with 3.5 mg/l than others could be due to maximum turbidity (12.4 NTU) which indicated higher quantity of dissolved solids and microbial population. Similar result was also reported by Solanki *et al.*, (2007). Anthropogenic activities are the prime contributor in increase in nitrate and phosphate concentration in water body. The nitrate and phosphate content was observed maximum during monsoon with 0.12 mg/l and 0.10 mg/l respectively (Table1). Rapid increased nitrate and phosphate concentrations have been reported due to excessive pollution caused by anthropogenic activities (Halder *et al.*,2019, Maansi *et al.*, 2022).

Phytoplankton diversity

There are total 124 numbers of species spreading

over 7 classes have been recorded from the Komen lake. The highest number of species was recorded from Chlorophyceae with 44 species followed by Bacillariophyceae with 32 species, Zygnematophyceae with 30 species, Cyanobacteria with 8 species, Euglenophyceae with 5 species, Xanthophyceae with 3 species and Trebouxiophyceae with 2 species (Figure 1). The dominant species are *Cosmarium* species then followed by *Scenedesmus* species, *Navicula* species, *Pinnularia* species and *Closterium* species.

The diversity of algae in water bodies depend mainly on the physico-chemical parameters of water bodies (Srinivas *et al*., 2017). Maximum number of Chlorophyceae (26 species) in spring could be due to high dissolved oxygen, low turbidity and low nutrient concentration. Low nutrient concentration, low turbidity and high dissolved oxygen favour the distribution of chlorophyceae (Rajagopal *et al*., 2010;). The occurrence of Bacillariophyceae (20 species) was maximum during winter which can be related to optimum pH and low nutrient concentration in winter. Similar results were also reported by Moore, (1974); Round (1991). Srinivas *et al*., (2017) reported high phosphate and organic matter exerted negative influence on the growth of benthic diatom. Zygnematophyceae (19 species) was maximum during spring which could be due to low phosphate and alkaline pH and low BOD. Kiran, (2016) revealed that low phosphate promote the growth of zygnematophyceae. Silva *et al*., (2013) reported the dominance of desmids in one of the reservoirs in Sri Lanka and based on the dominance of desmids, considered the reservoir in oligotrophic to mesotrophic state. Among the four seasons, the occurrence of Cyanobacteria (5 species) and Euglenophyceae (4 species) species were more in monsoon and autumn which could be due to the increase in nutrients concentration mainly nitrate and phosphate. During the monsoon runoff of water from agricultural field led to increase in phosphate and nitrogen concentration (Zhao *et al*., 2017). Trebouxiophyceae (2 species) and Xanthophyceae (2 species) were maximum during spring and autumn respectively. The distribution of these species was less as compared to the other species throughout the seasons (Table 2). There was

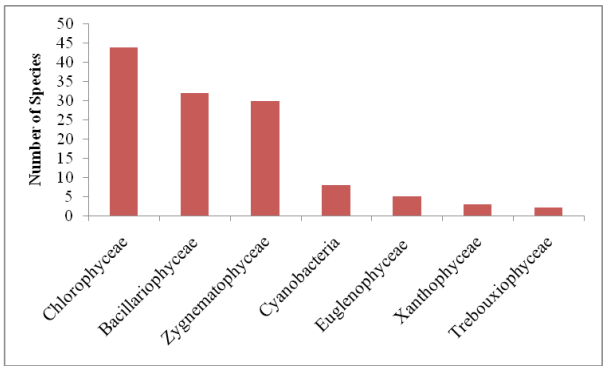

Fig. 1. Overall distribution of different classes of algae in Komen lake

Table 1. Seasonal variation in physico-chemical parameters of Komen lake

Physico-chemical parameters	Spring	Monsoon	Autumn	Winter
Temperature (^{O}C)	24 ± 0.02	28 ±0.12	24 ±0.03	18 ±0.04
pH	7.8 ±0.01	8.2 ±0.02	7.2 ±0.03	7.5 ±0.01
Turbidity (NTU)	8.6 ±0.12	12.4 ±0.4	6.5 ±0.2	4.7 ±0.02
Dissolved oxygen (mg/l)	6.8 ±0.5	4.34 ±0.06	5.24 ±0.05	7.6 ±0.04
Biochemical oxygen demand (mg/l)	1.62 ±0.03	3.5 ±0.02	2.64 ±0.01	1.25 ±0.05
Nitrate (mg/l)	0.05 ±0.002	0.13 ±0.001	0.12 ±0.01	0.07 ±0.001
Phosphate (mg/l)	0.06 ±0.004	0.10 ±0.003	0.04 ±0.001	0.08 ±0.003

Table 2. Seasonal distribution of different classes of algae in Komen lake

Classes	Spring	Monsoon	Autumn	Winter
Chlorophyceae	26	11	18	21
Zygnematophyceae	19	7	11	15
Bacillariophyceae	18	15	11	20
Trebouxiophyceae	2	0	0	1
Xanthophyceae	1	0	2	2
Cyanobacteria	4	5	5	4
Euglenophyceae	2	4	2	1

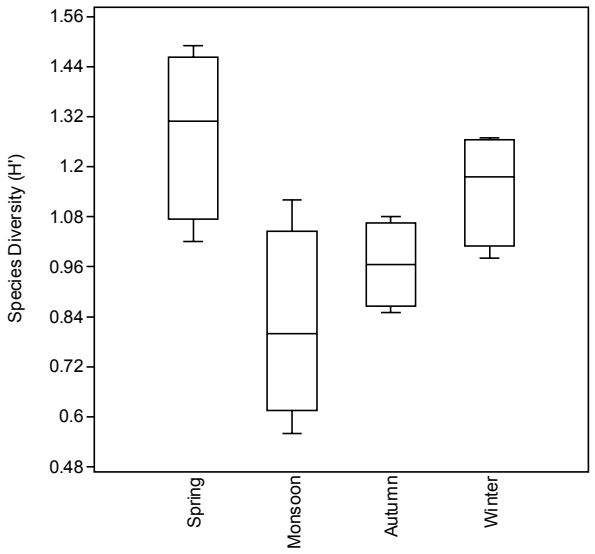

Fig. 2. Box plot showing the Species Diversity of Komen Lake.

seasonal variation in species diversity (Figure 2). The box plot shows species diversity was peaked during spring with 1.49 and low during Monsoon with 0.85. The high species diversity during spring could be due to low level of nutrient concentration and good amount of dissolved oxygen were the factors responsible for high species diversity in Komen lake. Shah *et al*., (2018) reported that high turbidity reduced the light availability in water therefore it reduced the oxygenation which in turn decreased the species diversity in monsoon.

Acknowledgements

Authors would like to thank the Department of Botany, North Eastern Hill University for providing all the laboratory facilities. The first author would like to thank the department of Botany, University of Science and Technology Meghalaya for necessary support.

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