Original Research Article

Composition And Diversity Of Algal Flora In Jahanara Imam- Pritilota Hall Sorobar (JP) Lake of Jahangirnagar University Campus,Savar, Dhaka, Bangladesh

ABSTRACT

The study aimed to evaluate the composition and diversity of algae in the JP lake of Jahangirnagar University campus. The research was carried out between the period of December 2021 to November 2022. 72 water samples were taken into consideration to conduct the research. Shannon and Simpson diversity indexes were used to determine the level of diversity. A total of 234 phytoplankton species under 98 genera were found belonging to 8 classes (Cyanophyceae, Chlorophyceae, Bacillariophyceae, Synurophyceae, Euglenophyceae, Cryptophyceae, Dinophyceae, and Xanthophyceae). According to the generic percentage composition, Chlorophyceae comprised 46%, followed by Bacillariophycea (20%) and Cyanophyceae (18%). At the species level, Euglenophyceae were found to dominate (34%) the studied sites that were followed by Chlorophyceae (31%) and Cyanophyceae (18%). The highest phytoplankton density was found in April, and the lowest one was in November. Cell dispersion was below average in May for Cyanophyceae, Bacillariophyceae, Cryptophyceae, and Synurophyceae. The total density of dominant phytoplankton was 567.52×10^5/L. *Oscillatoria, Carteria,* and *Trachlelomonas* dominated the surveyed region. The Shannon Diversity Index (H) showed a value of 1.51, while Simpson's Diversity Index (D) showed a value of 0.28. The overall variation (80.73%) among the classes was represented by PCA cells. According to the Shannon and Simpson Diversity Indexes, phytoplankton diversity was low.

Keywords: Algal diversity, phytoplankton density, dominant phytoplankton, Principal Component Analysis (PCA)

1. INTRODUCTION

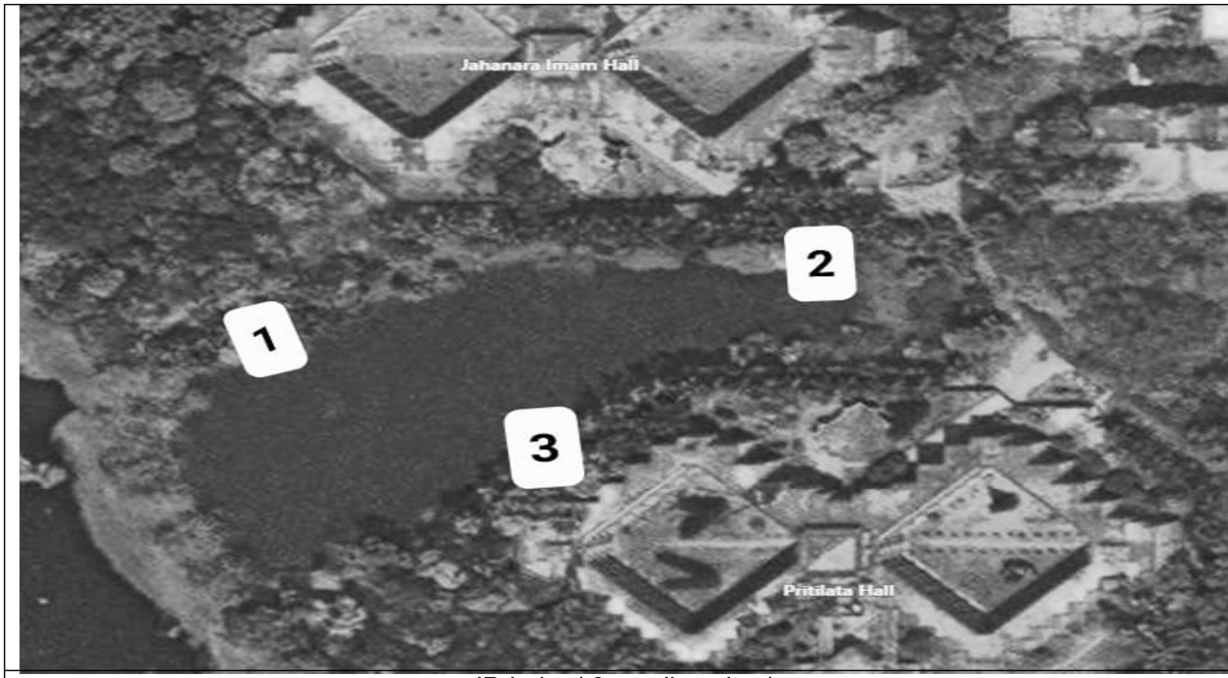
The most crucial element in forming the landscape and controlling the climate is water. It is regarded as one of the most important compounds that affect life. There are very few instances of natural lakes or genuine lakes in Bangladesh [1]. The species variety of phytoplankton reacts very quickly to shifts in the aquatic environment, particularly in connection to the availability of nutrients [2]. There are many different taxonomic classes of unicellular and colonial species that make up the complex group known as phytoplankton. These organisms have a wide range of morphological and color variations and usually float with the movement of water. The quality of the water, as well as the number and variety of phytoplankton and zooplankton, are directly impacted by human activity, urbanization, and industrialization. Aquatic ecosystems are exceptional examples of ecological communities since their surrounding environments are in a state of constant flux [3]. The phytoplankton is challenged by the possibility of light deprivation, which results in diatom predominance. In contrast, during the rainy season, the shallow mixed layer has a lower Zm: Zeu ratio, which favors high-light-adapted phytoplankton such as green algae and cyanobacteria. [4]. Because algae respond rapidly to changes in water conditions, both in terms of the species makeup of their populations and the densities of those populations, algae are valuable indicators of the state of the ecosystem [5].

In order to assess the condition of an aquatic ecosystem, it is necessary to consider the correlation between the species diversity indices and the levels of pollution in the water bodies. The overall ecological picture of the research region can be expressed by comparing the amount and quality of phytoplankton across sites and seasons [6]. The soil of the campus of Jahangirnagar University is reddish-brown color, and the majority of the water bodies in this region are highly turbid due to the presence of silt, sand, and clay, which appears to result in poorer primary production [7]. The purpose of this research was to identify monthly and seasonal variations in the phytoplankton composition of Jahanara Imam Pritilota hall sorobar lake on the Jahangirnagar University campus, Savar, Dhaka, Bangladesh.

2. MATERIAL AND METHODS

The experiment was conducted at Jahangirnagar University's JP lake (Jahanara Imam-Pritilota Hall Sorobor) from December 2021 to November 2022. The lake was selected due to its biodiversity (Fig. 1). A Schindler's Sampler with a 5 L capacity was used to gather water samples from 50 cm depth in the lake's coastal zone. The sampler was submerged in water gradually before being retrieved. The water was then transferred to a 5-litre black plastic carboy for analysis. Each water sample was treated with Lugol's iodine solution and left to settle for 48 hours to assess the phytoplankton's number and quality. Phytoplankton cells were counted using a Hawksley microplankton counting chamber with a modified Neubauer Ruling (Hawksley Ltd., Lancing, UK) and a 400 Nikon compound microscope (Japan). Phytoplankton dispersion patterns were reported during the studied period.

The following seasons[8] were considered: summer (March to May), monsoon (June to early October), autumn (late October to November) and winter (December to February). The Shannon index was calculated with the following equation: H=. Where, : The Shannon Diversity Index; : The total number of unique species; = The proportion of the entire community made up of species . The greater the value of *H*, the greater the species diversity in a given community. The lower the value of H, the less diverse the population. A value of $H = 0$ represents a community with a single species. The Shannon Equitability Index is a method for measuring the diversity of a community's species. The term "evenness" refers to the degree to which the abundances of different species in a community are comparable [9]. This index, denoted E_H, is calculated as follows: . The Simpson's Diversity index was calculated with the following equation: . Where, : The number of organisms that belong to species i; : The total number of organisms. Simpson's Diversity Index has a range between 0 and 1. The greater the value, the less diverse the population. As this interpretation is somewhat counterintuitive, Simpson's Index of Diversity (sometimes referred to as a Dominance Index) is calculated as. The greater the value of this indicator, the greater the species variety. Calculation of the reciprocal index of Simpson, which is . This index has a minimum value of 1 and a maximum value equal to the number of species [10]. Across the research period, the average cell density of the phytoplankton classes was represented. At JP lake, a heatmap of phytoplankton classes was utilized to report data for the chosen month. From December 2021 to November 2022, monthly observations of phytoplankton cell densities were made in the surface waters of JP Lake using principal component analysis (PCA). Phytoplankton classes found during the four seasons were also presented. Finally, Excel and R programming languages (4.2.2) were used to calculate and represent the dominant phytoplankton species in different months.



JP-Lake (3 smpling sites)

Fig. 1. Photograph of the studied lake.

3. RESULTS AND DISCUSSION

3.1 Composition Of Phytoplankton

234 phytoplankton species belonging to 98 genera and eight classes were found at the selected site in this investigation. These included Chlorophyceae (genus-45, species-72), Bacillariophyceae (genus-19, species-23), Cyanophyceae (genus-18, species-43), Euglenophyceae (genus-6, species-80), Cryptophyceae (genus-5, species-10), Dinophyceae (genus-1, species-2), Synurophyceae (genus-1, species-1), Xanthophyceae (genus-3, species-3) (Fig. 3, Fig. 4 and Fig. 5). Nearly similar types of genus and species were found by Khondkar *et al*., 2012 from the limnological studies on Ramsagar, Dinajpur, Bangladesh[11]; in some estuaries from Ratnagiri district of Maharashtra (India) by Nivrutti Dhumal & Baburao Sabale, 2014; in Turag River of Bangladesh [12]; in lake Bogakain, Bandarban, Bangladesh [13]; Xanthophyte, Eustigmatophyte, and Raphidophyte Algae [14]and in an ice-free high Arctic fjord (Adventfjorden, West Spitsbergen) [15].

The class with the highest mean is Euglenophyceae (9.108), followed by Cyanophyceae (6.175) and Dinophyceae (3.048). The class with the lowest mean is Synurophyceae (1.0400), followed by Xanthophyceae (1.419) and Cryptophyceae (2.525). Overall, each class has a wide range of values, with some classes having a more extensive range (e.g., Euglenophyceae) than others (e.g., Synurophyceae) (Table 1).

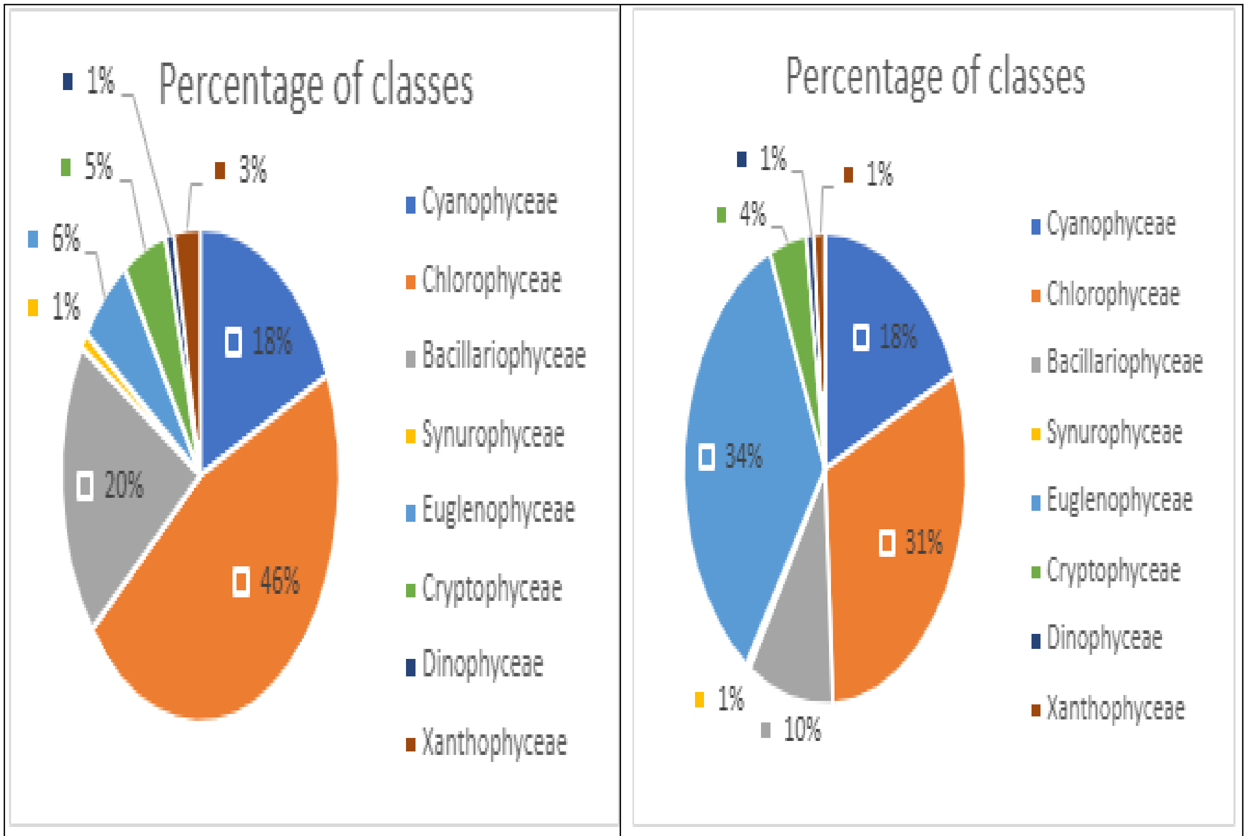
The highest phytoplankton density was found in April (43.84×10^5 ind/l), and the lowest was in November (20.48×10^5 ind/l). In the present research the total phytoplankton density was found 387.34×10^5 ind/l. The total phytoplankton density was 163.53×10^4 ind/l, according to limnological notes on Ramsagar, Dinajpur, Bangladesh [11]. On the other hand, in several studied areas, the maximum phytoplankton densities were observed in the months of May and June, while the lowest densities were observed in the months of November and September in the water bodies around Dhaka export processing zone (DEPZ), Savar, Dhaka, Bangladesh[16] Moreover, identical taxa were discovered in limnological studies of lake Ashura, on the Ramsagar, Dinajpur, and in a lake on the Jahangirnagar University campus, both of which are located in Bangladesh [1], [2].

Table 1. Comparison of phytoplankton densities among the classes.

Class	Min	1st Qu.	Median	Mean	3rd Qu.	Max
Cyanophyceae	1.900	3.550	6.465	6.175	7.082	13.500
Chlorophyceae	2.370	4.860	5.570	5.641	6.803	8.930
Bacillariophyceae	1.620	2.585	3.310	3.322	4.090	4.990
Euglenophyceae	3.390	4.237	6.340	9.108	11.060	24.710
Cryptophyceae	0.940	1.905	2.600	2.525	3.152	4.120
Dinophyceae	1.120	1.475	2.365	3.048	3.920	8.670
Synurophyceae	0.1000	0.9675	1.1650	1.0400	1.2725	1.8500
Xanthophyceae	0.210	1.022	1.120	1.419	1.433	4.800

During the present research period, Chlorophyceae was found to dominate the studied sites and occupied 46% of the total area according to the generic percentage composition, followed by Bacillariophyceae (20%), Cyanophyceae (18%), Euglenophyceae (6%), Cryptophyceae (5%), Xanthophyceae (3%), Synurophyceae (1%), and Dinophyceae (1%) (Fig. 2). However, similar results were observed in the water bodies in the Dhaka Export Processing Zone (DEPZ), Savar, Dhaka, Bangladesh. The composition of these water bodies revealed that Chlorophyceae dominated the study locations, occupying 49% and 35.68%, respectively [16]. Comparatively, in several freshwater wetlands and seasonal changes of phytoplankton flora of freshwater wetlands in the larger Dhaka district, the number of genera for the Chlorophyceae family was the largest [17]. In the present study, Xanthophyceae, Synurophyceae, and Dinophyceae made up a relatively small portion of the total algal group, despite having been observed in a similar pattern in previous research on Lake Ashura's Limnology [1].

In the present study, Euglenophyceae inhabited 34% at the species level, followed by Chlorophyceae (31%), Cyanophyceae (18%), Bacillariophyceae (10%), Cryptophyceae (4%), Xanthophyceae (1%), Synurophyceae (1%), and Dinophyceae (1%), among others (Fig. 3). This finding shows similarity to the study of lake Ashura, the Euglenophyceae (42.86%) dominated the phytoplankton community in terms of species diversity [1] In contrast, Chlorophyceae (43%) dominated at the species level in the water bodies surrounding Dhaka Export Processing Zone (DEPZ), Savar, Dhaka, Bangladesh [16]. In Lake Bogakain, Bandarban, Bangladesh, both the number of species and the percentage of Euglenophyceae were the highest [13]. Additionally, two members of the Dinophyceae were found in Lake Ashura, Bogakain, and in angiospermic record for Bangladesh [1], [13], [18] (Fig. 2).



At the generic level	At the species level

Fig. 2. Percentages of different classes.

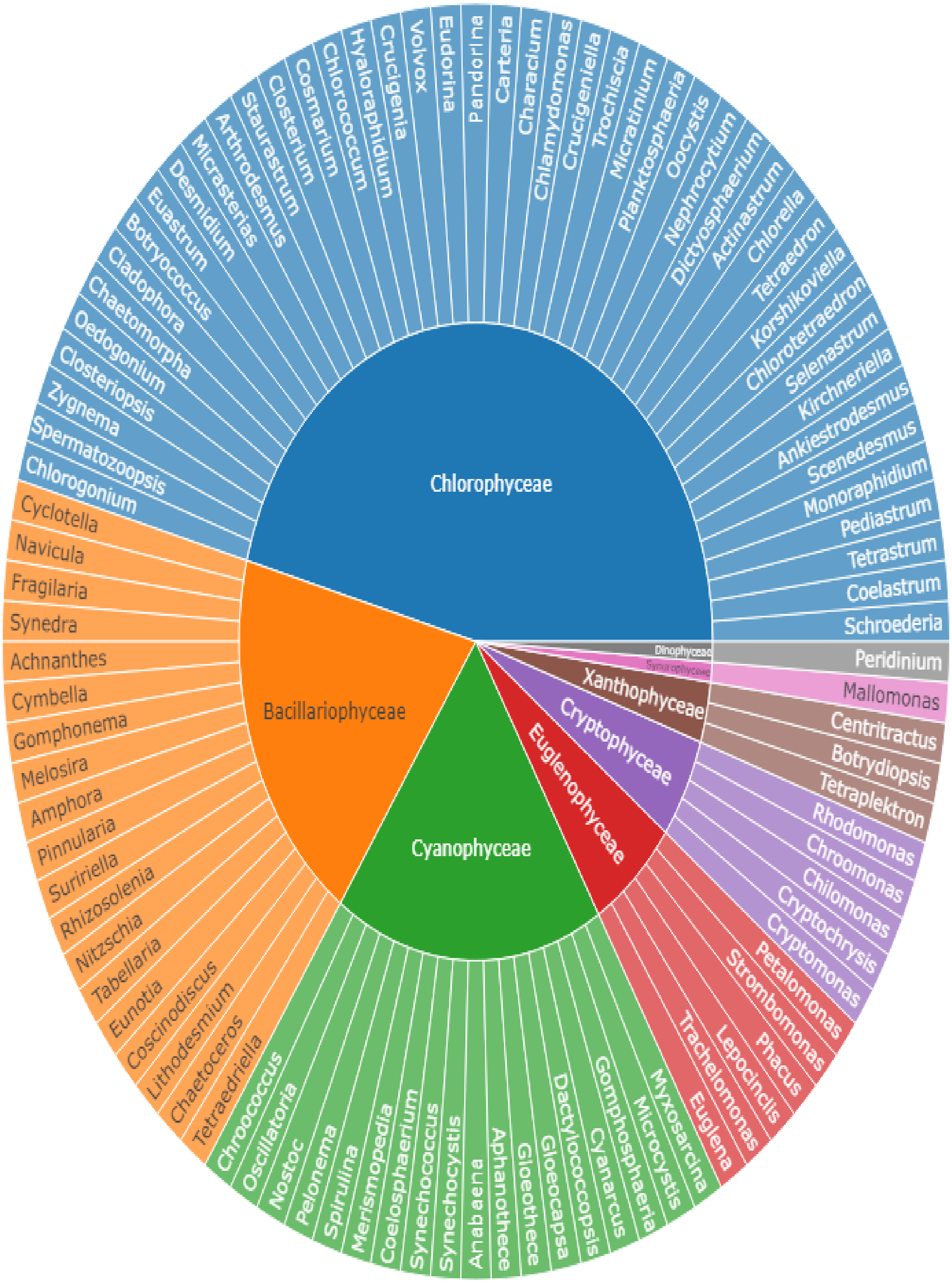


Fig. 3. Total phytoplankton genera (98) found in the studied lake.

Fig. 4. Total phytoplankton species found in the studied lake (cont.).

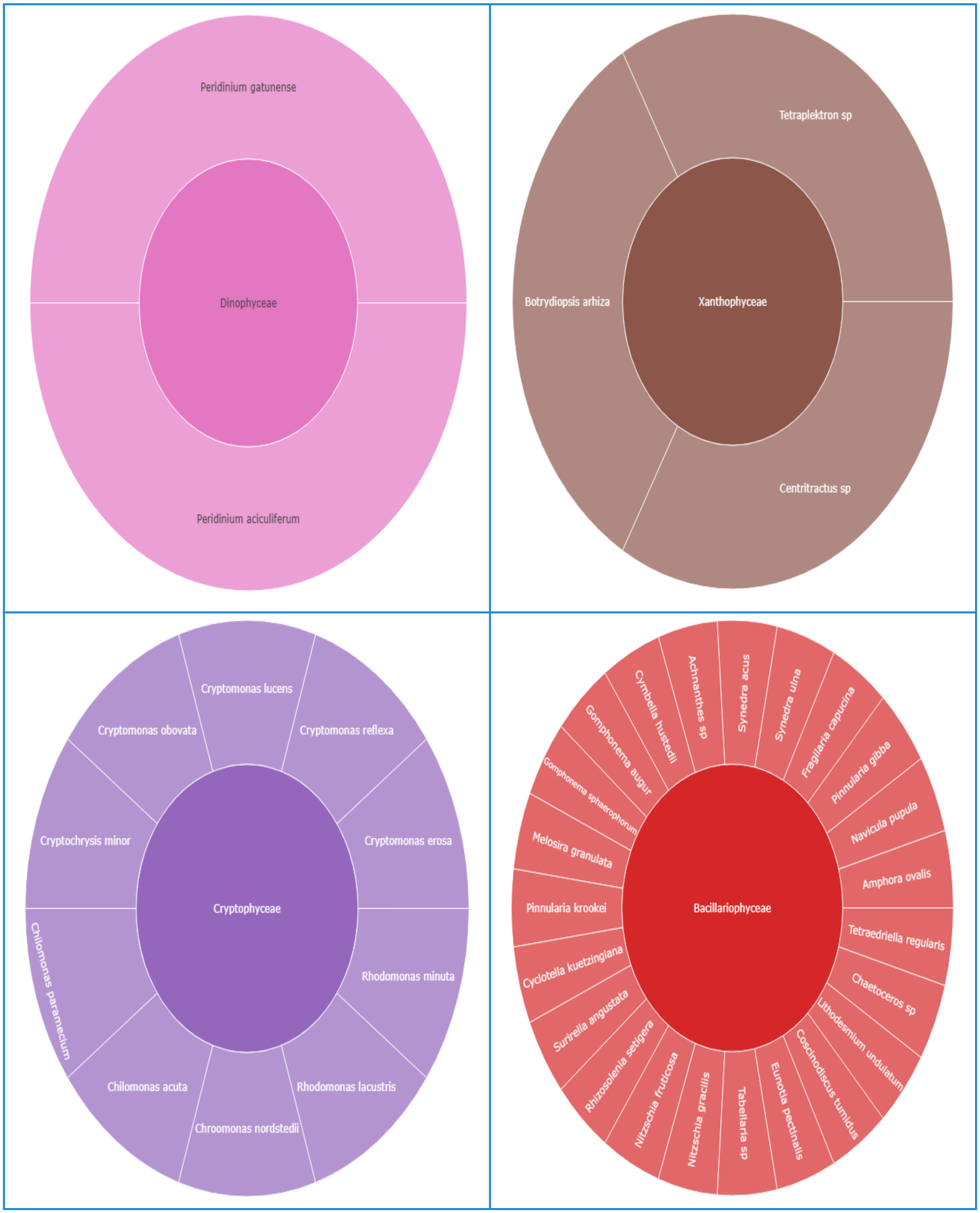


Fig. 5. Total phytoplankton species found in the studied lake.

3.2 Dispersion of cell densities

The graph (Fig. 6) illustrates the distribution of cell densities by depicting densities below and above the mean using a distinct color range. The red hue indicates a below-average cell distribution, whereas the green color indicates a cell distribution that is above standard. For JP lake, the chart (Fig. 7) consists of a heatmap in the middle of the plot and dendrograms clustering the chart's cells on the top and left of the heatmap (Fig. 7). According to the levels of expression; the colors are subdivided and grouped. The Euglenophyceae, Bacillariophyceae, Synurophyceae, Chlorophyceae, Cyanophyceae, Dinophyceae, Cryptophyceae, and Xanthophyceae groups were all prominent at various times throughout the period. Cluster analysis allows for comparing two or more samples based on their underlying functional differences, while the heatmap is useful for visualizing changes in the abundance of individual taxa [19], [20].

The highest value for above-average cell density was observed for Cyanophyceae in August, whereas the class Cyanophyceae appeared to be more prevalent in July (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Chlorophyceae in March, whereas the class Chlorophyceae appeared to be more prevalent in March (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Bacillariophyceae in June, whereas the class Bacillariophyceae appeared to be more prevalent in June (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Euglenophyceae in May, whereas the class Euglenophyceae appeared to be more prevalent in April (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Cryptophyceae in December, whereas the class Cryptophyceae appeared to be more prevalent in December (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Dinophyceae in January, whereas the class Dinophyceae appeared to be more prevalent in February (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Synurophyceae in February, whereas the class Synurophyceae appeared to be more prevalent in February (Fig. 6 and Fig. 7). The highest value for above-average cell density was observed for Xanthophyceae in March, whereas the class Xanthophyceae appeared to be more prevalent in August (Fig. 6 and Fig. 7).

Here in Fig. 8, the phytoplankton density of the Cyanophyceae (8.3×10^5 ind/l), Bacillariophyceae (4.4×10^5 ind/l), and Xanthophyceae (2.01×10^5 ind/l) were highest during the monsoon and lowest throughout the summer (2.98×10^5 ind/l), winter (2.05×10^5 ind/l), and autumn (0.42×10^5 ind/l). The highest phytoplankton density was recorded by the Chlorophyceae (7.63×10^5 ind/l) and Euglenophyceae (17.3×10^5 ind/l) in the summer (2.7×10^5 ind/l) and the lowest in the autumn (3.72×10^5 ind/l). The phytoplankton density was highest for Cryptophyceae (3.84×10^5 ind/l), Dinophyceae (6.06×10^5 ind/l), and Synurophyceae (1.43×10^5 ind/l) in the winter and lowest during the monsoon (1.7×10^5 ind/l), summer (1.3×10^5 ind/l), and autumn (0.19×10^5 ind/l) (Fig. 8).

However, physio-chemical conditions and the plankton population of two fishponds in Khulna showed that Cyanophyceae and Euglenophyceae were abundant in April and May. And for Bacillariophyceae, the highest was September and October [21]. The highest density of Cyanophyceae occurred in July at 52.85×10^6 ind/l in the seasonal variation of Dharma Sagar water quality in Comilla [22]. In the Karkamis Dam lake in Sanliurfa, Turkey, Cyanophyta species were typically observed during the spring and summer but in much smaller numbers during the fall and winter. Similarly, most members of Chlorophyta were detected throughout the summer months.

Species diversity of Bacillariophyta was most significant in spring, followed by summer, and lowest in winter and fall. Similarly, during the summer, Euglenophyta was found in the spatial and temporal distribution of phytoplankton [23].Euglenophyceae were found in both April and May in terms of quantity and variety [21]. Similarly, it has been found that euglenoid algae predominate in the phytoplankton flora of Lake Ashura [1]. This seems to be consistent with the results of this investigation. A variety of taxa, primarily those belonging to the Dinophyceae and Cryptophyceae, composed the winter communities observed during the polar night and the early spring (17 January - 16 April and 15 November - 13 December, respectively) [15]. During the spring, synurophytes frequently predominate the phytoplankton biomass, although other studies have shown that their maximum concentrations occur at temperatures below 12 °C [24]. The analysis of fresh records of *Vaucheria* species (Xanthophyceae) with related *Proales werneckii* (Rotifera) from North America, however, revealed that Xanthophyceae were discovered between September and January [25]. Chlorophyceae, Bacillariophyceae, Euglenophyceae, Cryptophyceae, and Dinophyceae exhibited similar seasonal trends in the water bodies surrounding the Dhaka export processing zone (DEPZ), Savar, Dhaka, Bangladesh, except for Cyanophyceae, whose density was highest in summer. Phytoplankton density was also found to change with the seasons and between different study locations [16]. Carbon sequestration capability in an urban river was highest for the Cyanophyceae and Chlorophyceae communities in October, whereas the Bacillariophyceae class was constant throughout the year. [26].

Fig. 6. **The average cell density of phytoplankton classes during the studied months.**

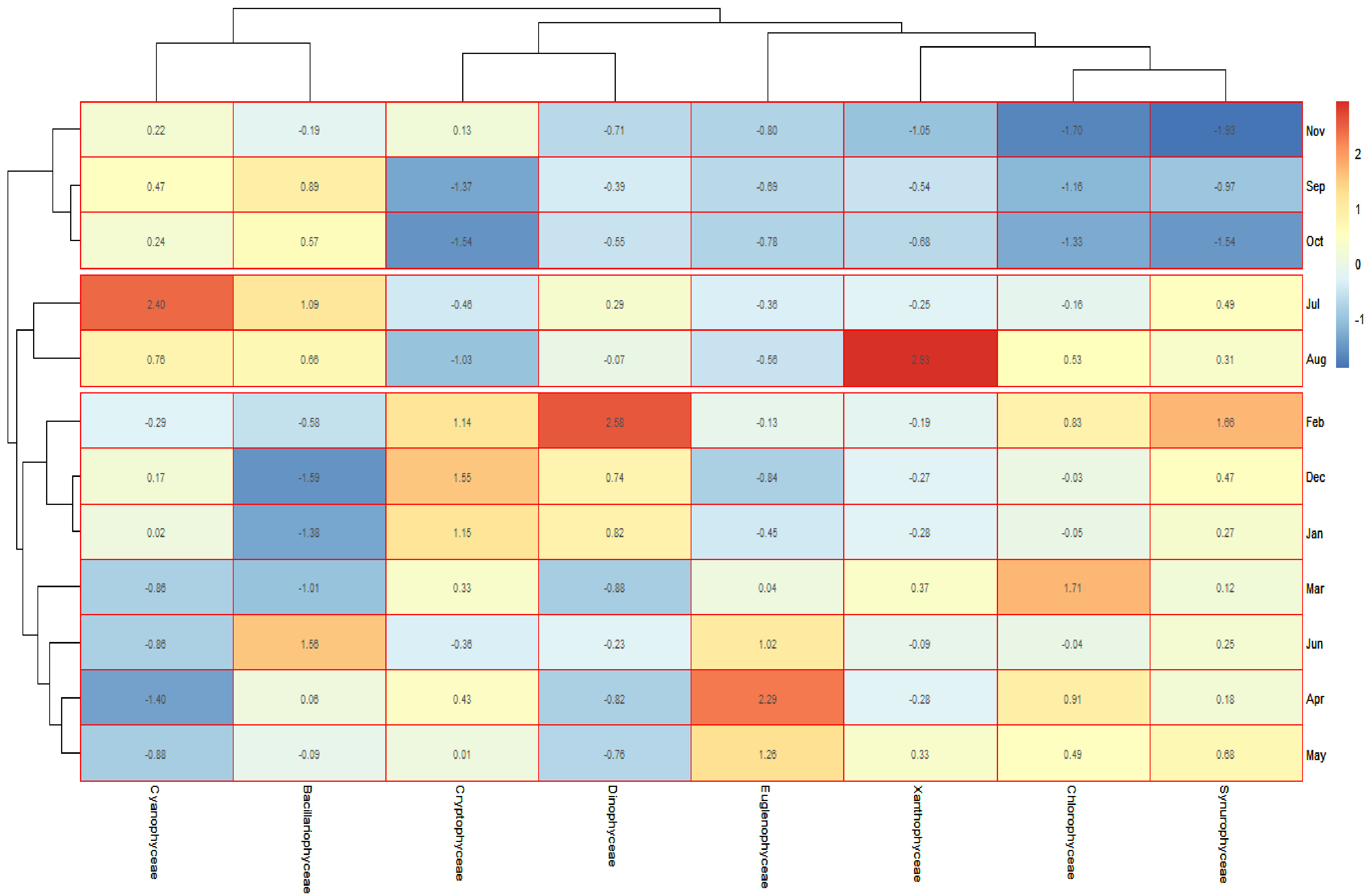


Fig. 7. Heatmap for phytoplankton classes during the studied period.

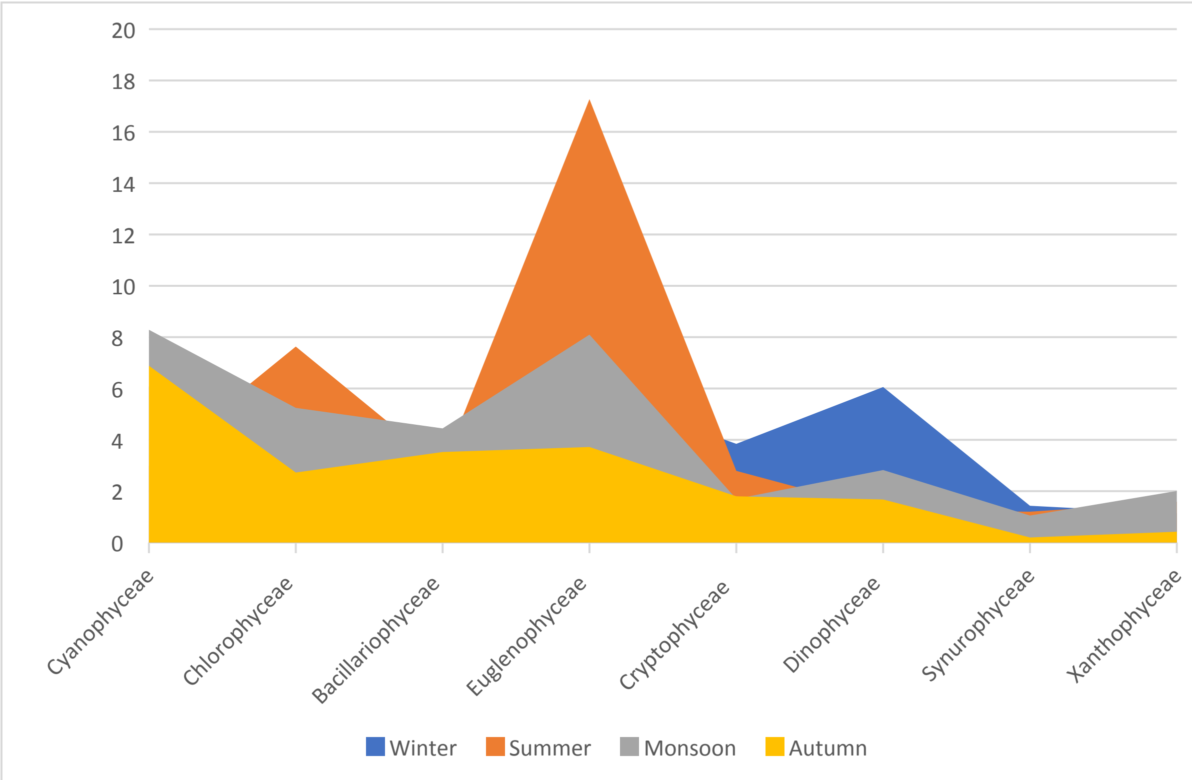


Fig. 8. Distribution of different phytoplankton groups during the studied four seasons.

3.4 Diversity Index

Shannon Diversity Index : 1.51, Shannon Equitability Index : 0.73, Simpson's Diversity Index : 0.28, Dominance Index : 0.72, and Simpson's Reciprocal Index : 3.54 are the values for genus numbers (Fig. 9). And Shannon Diversity Index (H): 1.52, Shannon Equitability Index : 0.73, and Simpson's Diversity Index : 0.25, Dominance Index : 0.75, Simpson's Reciprocal Index : 3.94 are the values for species numbers (Fig. 9). The Shannon diversity value was 1.51 on a scale from 1 to 4. According to the Shannon formula, the diversity level was low. (< 2 = poor diversified; 2-3 = moderately diversified; and >3 = highly diversified). Simpson diversity index was 0.25 when the data were observed and calculated, with a range of 0 to 1. Thus, the diversity were poor and at their lowest during the studied period (0= poor diversified; 0.5= moderately diversified; and 0.8 -0.9 = highly diversified).

The study of certain estuaries in Ratnagiri district, Maharashtra, India, revealed a relative range of (1.279–1.681). The Shannon diversity index was associated with the number of species and their abundance, and diversity is measured by the Shannon index , which combines species richness and evenness [3]. The Burullus Lagoon drainage system on Egypt's southern Mediterranean coast was also studied for phytoplankton abundance and structure as a water quality indicator. The results revealed relevant ranges for phytoplankton diversity indices [5]. Algal flora of the water bodies in Dhaka Export Processing Zone (DEPZ), Savar, Dhaka, Bangladesh, showed similar indices variability ranges [16]. Nearly identical variations in phytoplankton quantity and structure as a measure of water quality were found in the Teera Drain of the Burullus Lagoon on the southern Mediterranean coast of Egypt [5].

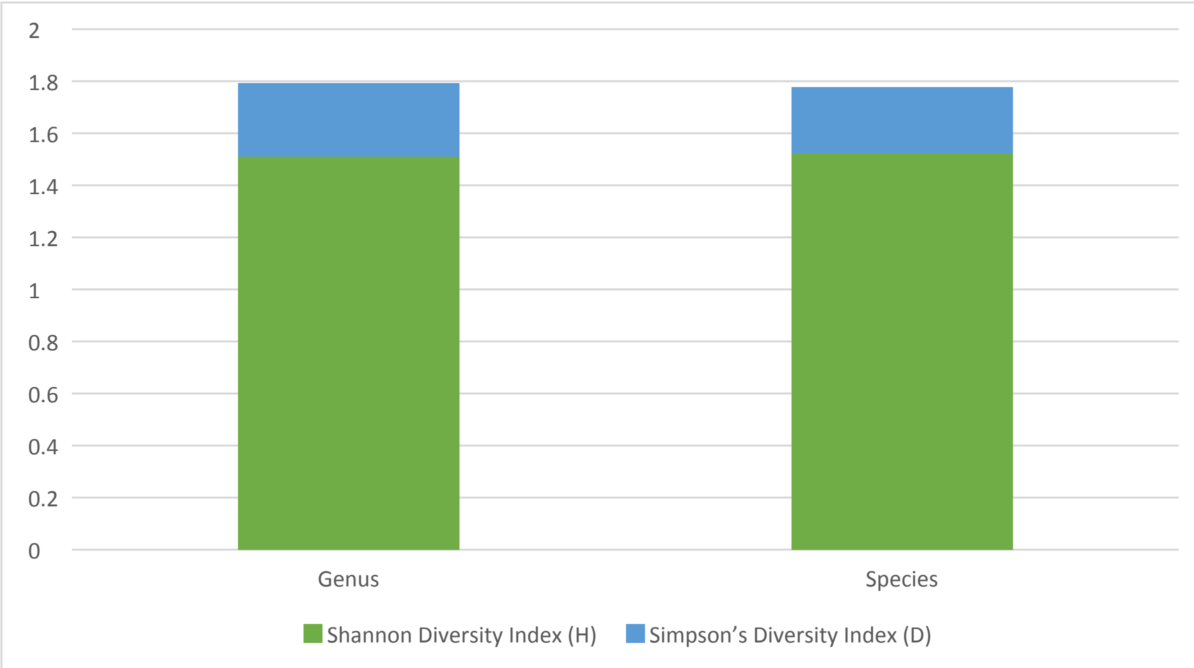


Fig. 9. Shannon diversity and Simpson's Diversity indices for the studied lake.

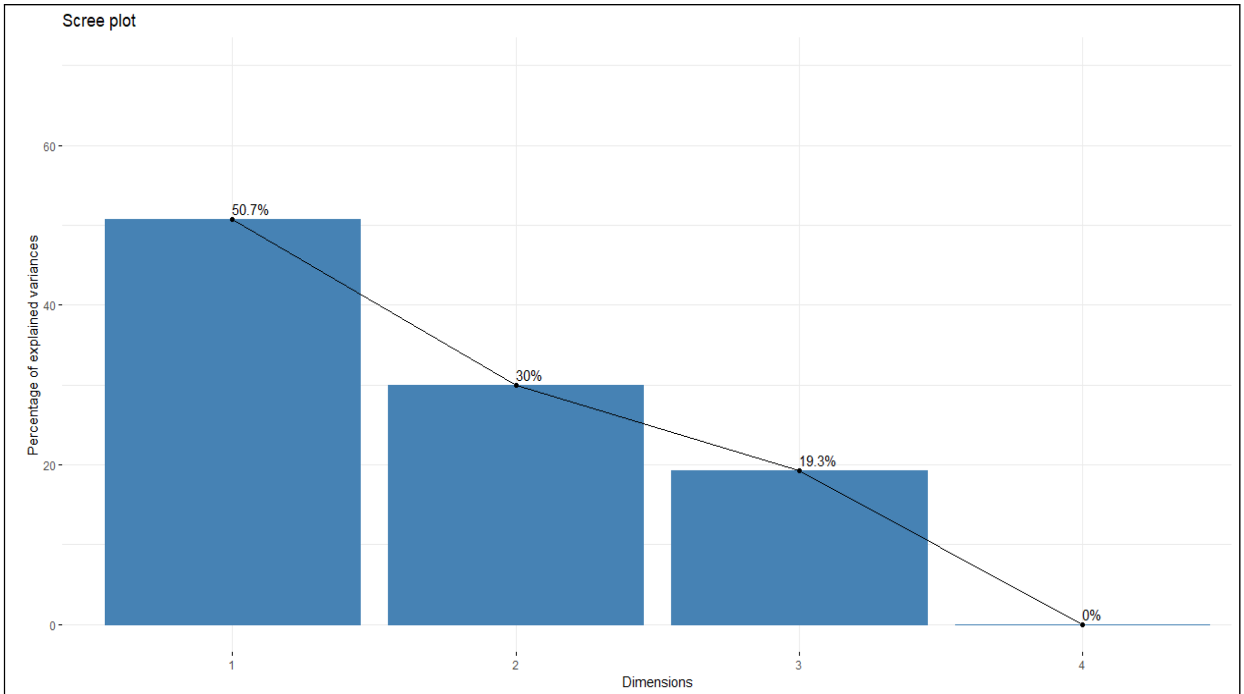
However, the high diversity of the phytoplankton assemblage may be the result of favourable ecological conditions for its growth, according to Simpson's diversity index (0.93) in the research of phytoplankton assemblage concerning water quality in Turag River of Bangladesh [6].

3.5 Correlation between different classes according to PCA cells

There are four dimensions to this scree plot. The eigenvalues for each of the four dimensions were 4.056839e+00, 2.401320e+00, 1.541841e+00, and 2.100430e-31. The four dimensions were 5.071048e+01, 3.001651e+01, 1.927301e+01, and 2.625537e-30 in terms of variance. The cumulative percentages of variance for each dimension were 50.71048, 80.72699, 100.00000, and 100.00000 (Fig. 10; Table 2).

Table 2. Importance of components.

Principle components	Standard deviation	Proportion of Variance	Cumulative Proportion
PC1	2.0142	0.5071	0.5071
PC2	1.5496	0.3002	0.8073
PC3	1.2417	0.1927	1.0000
PC4	4.583e-16	0.000e+00	1.000e+00



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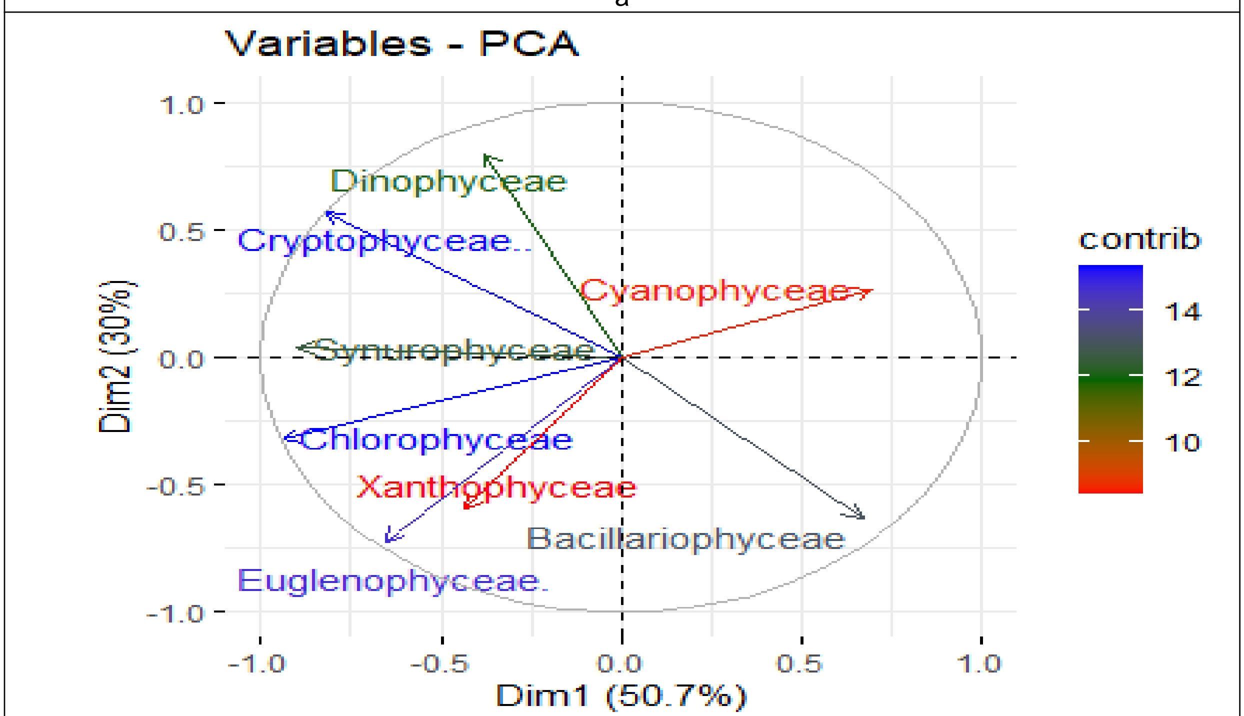

b

Fig. 10. Principal component analysis (PCA) of phytoplankton cell densities observed monthly in the surface water of the studied lake from December 2021 to November 2022.

The first two pcs of the dataset represent the most variation in standard deviation. Additionally, from cumulative proportion, the first two PCs express 80.73% of the total variation in the sample (Table 2). Similarly, in evaluating a phytoplankton risk matrix in drinking water supplies, the PCA accounted for 84.7% of the variability [27]. The first axis, in contrast, accounts for 30.5% of the total variance in a large tropical lake [4]. Additionally, 73.18%, 77.61% and 65.39% percent of the total variance in the assessment of surface water quality in the Fuji River basin, Japan, were explained by the PCA [28].

Table 3. Calculation of each component's data.

Class	PC1	PC2	PC3	PC4
Cyanophyceae	0.34	0.17	-0.53	0.7
Chlorophyceae	-0.46	-0.21	-0.07	0.32
Bacillariophyceae	0.33	-0.4	-0.32	-0.17
Euglenophyceae	-0.32	-0.46	0.18	0.47
Cryptophyceae	-0.42	0.36	0.07	0.16
Dinophyceae	-0.19	0.51	-0.38	-0.09
Synurophyceae	-0.44	0.02	-0.35	-0.26
Xanthophyceae	-0.21	-0.38	-0.54	-0.23

Chlorophyceae, Euglenophyceae, Cryptophyceae, Dinophyceae Synurophyceae, and Xanthophyceae showed negative contribution to PC1, while Cyanophyceae and Bacillariophyceae showed positive contribution. In contrast to the positive contributions of Dinophyceae and Synurophyceae to PC2, Bacillariophyceae showed negative contributions (Table 3).

According to the graph (Fig. 10), the items are shown as either row names or points. A series of arrows represent the variables. The scores are expressed as data points or sample identifiers. Each variable's score is expressed as a deviation from its average. The variable vectors are shown as arrows (Fig. 10). Separation between phytoplankton phyla is represented on the PCA by elongated vectors that point in the direction and have a certain amplitude [29].

The primary goal of the principal component analysis is to identify groups of study variables that adequately explain the underlying patterns in a given matrix [30]. Linear combinations of the original variables are transformed into new, independent indicators using this statistical technique called principal components [28], [31]. To be statistically significant, an eigenvalue must be greater than 1 [28], [32].

While Cyanophyceae exhibited a positive correlation with Bacillariophyceae and Dinophyceae, it exhibited a slightly negative correlation with other groups. Although it exhibits a negative correlation with certain other groups, Chlorophyceae exhibits a positive correlation with Euglenophyceae, Cryptophyceae, Dinophyceae, Synurophyceae, and Xanthophyceae. Cryptophyceae shows a slightly strong positive relation with Chlorophyceae, Euglenophyceae, Dinophyceae, and Synurophyceae; and showed a negative correlation with Cyanophyceae, Bacillariophyceae, and Xanthophyceae (Fig. 10).

In contrast, the importance of phytoplankton composition in the study of primary production in a large tropical lake revealed an inverse correlation between phytoplankton [4]. The distribution characteristics of the phytoplankton and their link to the bacterioplankton in Dianchi Lake, though, revealed a similar positive correlation between the families Bacillariophyceae and Cyanophyceae as well as Chlorophyceae and Cryptophyceae [19]. Similarities are most noticeable in the most abundant group of phytoplankton, the Cyanophyceae [22], [33], [34]. At Santa Olalla, cyanobacteria were the dominant phytoplankton. Although the dominant cyanobacterial community diversified, the species composition shifted with time. In addition, the proportion of cells from various species to total cyanobacteria varied substantially [35]. Compared to rivers, lakes have a higher biomass of cyanobacteria [36].

3.6 Dominant phytoplankton and their densities in different months

During the month of December, *Oscillatoria* (9.1×10^5 ind/l), *Carteria* (8.1×10^5 ind/l), *Monoraphidium* (6.03×10^5 ind/l), and *Trachlelomonas* (5.5×10^5 ind/l) were the most abundant phytoplankton in this lake. In the month of January, the most common blooms were *Monoraphidium* (8.6×10^5 ind/l), *Carteria* (7.03×10^5

ind/l), *Closterium* (6.3×10^5 ind/l), and *Scenedesmus* (5.81×10^5 ind/l). Species such as *Actinastrum* (66.5×10^5 ind/l), *Scenedesmus* (12.9×10^5 ind/l), *Monoraphidium* (9.54×10^5 ind/l), and *Trachlelomonas* (8.16×10^5 ind/l) dominated the environment in February. March was dominated by *Cosmarium* (8.29×10^5 ind/l), *Carteria* (8.17×10^5 ind/l), *Monoraphidium* (7.83×10^5 ind/l), and *Euglena* (7.45×10^5 ind/l). In April, the most common species were *Trachelomonas* (43.15×10^5 ind/l), *Monoraphidium* (21.5×10^5 ind/l), *Actinastrum* (11.05×10^5 ind/l), and *Scenedesmus* (11×10^5 ind/l). May saw an abundance of *Trachelomonas* (51.27×10^5 ind/l), *Scenedesmus* (14.39×10^5 ind/l), *Actinastrum* (10.2×10^5 ind/l), and *Phacus* (7.13×10^5 ind/l).

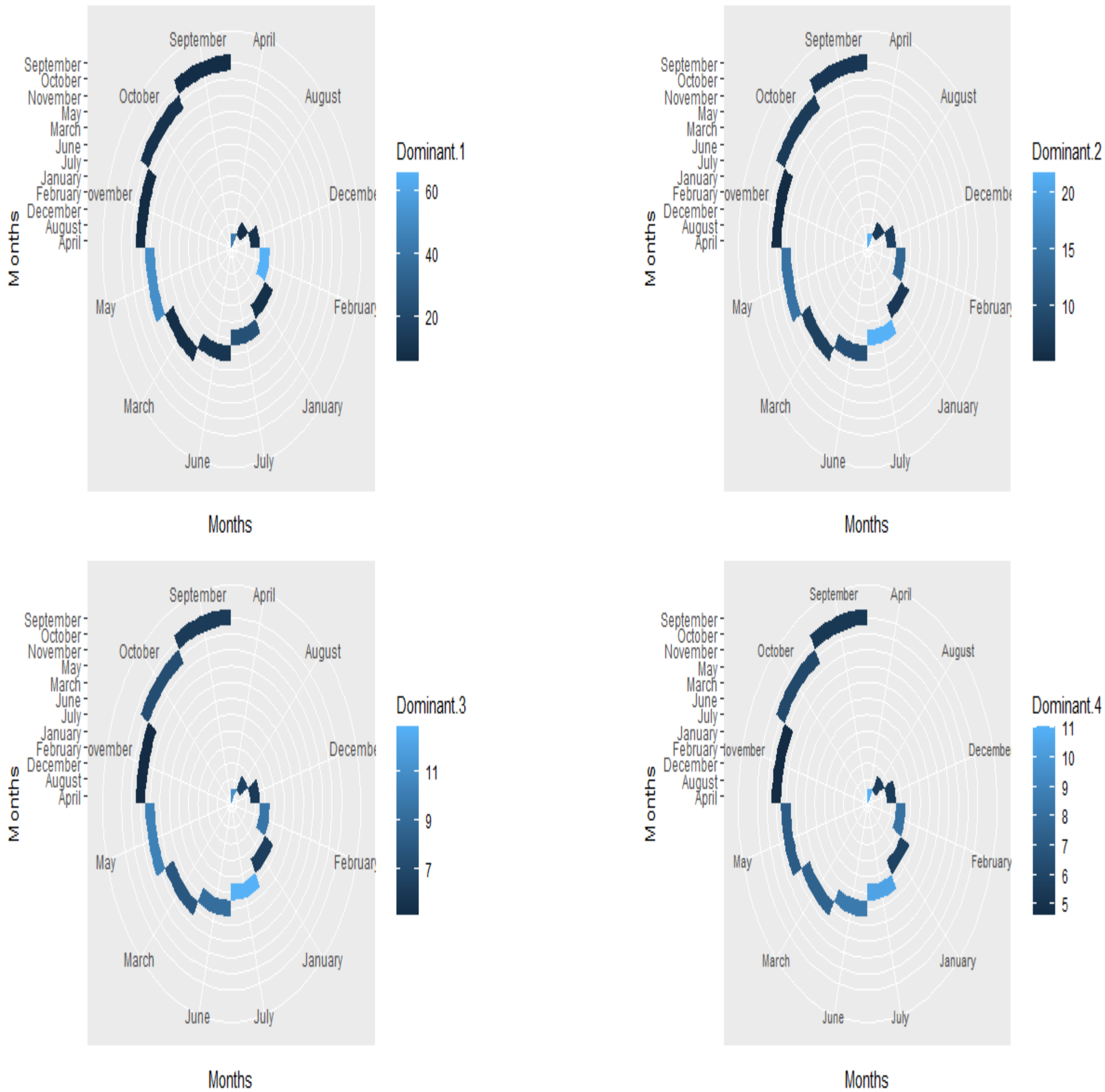

Fig. 11. Concentrations of dominant phytoplankton.

During the month of June, *Oscillatoria* (11.5×10^5 ind/l), *Trachlelomonas* (10.07×10^5 ind/l), *Pediastrum* (9.13×10^5 ind/l), and *Monoraphidium* (8.55×10^5 ind/l) were the most common. In July, the most common species were *Euglena* (24.78×10^5 ind/l), *Actinastrum* (21.65×10^5 ind/l), *Scenedesmus* (12.79×10^5 ind/l), and *Trachelomonas* (10.4×10^5 ind/l). The months of August saw a dominance of *Actinastrum* (8.4×10^5 ind/l), *Monoraphidium* (7.09×10^5 ind/l), *Scenedesmus* (6.53×10^5 ind/l), and *Trachlelomonas* (5.6×10^5 ind/l). The months of September were dominated by *Oscillatoria* (7.25×10^5 ind/l), *Trachlelomonas* (6.91×10^5

ind/l), *Peridinium* (6.06×10^5 ind/l), and Scenedesmus (5.29×10^5 ind/l). In October, *Oscillatoria* (9.76×10^5 ind/l), *Pinnularia* (7.35×10^5 ind/l), *Euglena* (7.2×10^5 ind/l), and *Carteria* (6.15×10^5 ind/l) took precedence. In the month of November, the most common species were *Nostoc* (6.21×10^5 ind/l), *Phacus* (5.19×10^5 ind/l), *Pinnularia* (5.05×10^5 ind/l), and *Scenedesmus* (4.61×10^5 ind/l) (Fig. 11). *Trachelomonas* was found as the second-longest taxon, and *Peridinium* and *Scenedesmus* were the most common species in lake Bogakain, Bandarban, Bangladesh [13]. *Actinastrum* and *Scenedesmus* showed lower values in Lake Ashura, Dinajpur, Bangladesh (2.97×10^3 ind/l), while *Scenedesmus* exhibited lower values in Ramsagar (1.48 ×10^4 ind/l) [1], [11]. Comparable abundances of *Oscillatoria*, *Actinastrum*, *Scenedesmus*, *Trachelomonas*, *Euglena*, *Phacus*, *Pinnularia*, and *Synedra* were observed in the limnological research of lake Ashura, Dinajpur, Bangladesh [1].

In the present investigation, the total density of dominant phytoplankton was 567.52×10$^{5/}$L, which is very close to the density of dominant phytoplankton (552.84×10^5 ind/l) in lake Ashura, Dinajpur, Bangladesh (Alfasane *et al*., 2012). In contrast, the density of dominant phytoplankton in Ramsagar, Dinajpur, Bangladesh was found 163.53×10^4 ind/l [11].

4. CONCLUSION

The lakes are very important for the ecosystem. The present study showed detailed findings on the diversity of algal flora in JP lake of Jahangirnagar University campus. Seasonal fluctuations and monthly variations in the composition of algal flora were found. Chlorophyceae and Euglenophyceae were found to be dominant in the studied area. According to the research, it can be concluded that the algal diversity was poor in the studied lake.

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