Chapter- 1
Introduction

Kaptai Lake is the largest lake in Bangladesh and one of the largest man-made freshwater lakes in south-east Asia (Fernando, 1980). It was impounded by damming the River Karnaphuli at Kaptai in the Chittagong Hill Tracts for hydropower generation as the primary purpose. The lake covers an area of approximately 58,300 ha and 68,800 ha at full surface level (Aquatic Research Group, 1986). The maximum and mean depths of the reservoir are respectively 35m and 9 m. The mean water level fluctuation is 8.14 m and the water reserve is 524.7 $\times 10^6$ m^3 (Aquatic Research Group, 1986). The primary purpose of the lake was hydropower generation, while fisheries, navigation, flood control and irrigation are secondary activities. It has great importance in navigation to the remote part of the region, water supply to the river bank villages, suburban and urban areas and Chattogram municipal area, freshwater fisheries and flow regulation for the Chattogram city and the seaport. From the beginning, Kaptai Lake has a unique freshwater ecosystem and rich in fish biodiversity. This lake supports small- scale fisheries with rich fish species diversity (Mahmood, 1986) that consist 49-71 indigenous and five exotic species. The lake contains 76 freshwater fish species, of which 68 are indigenous and the rest are exotic, in addition, there are also a few species of freshwater prawn (Rahman and Hasan, 1992). The commercial exploitation of fisheries resources from the reservoir was initiated in 1965. 12,696 metric ton of fish production was reported in the fiscal year of 2019-20 (DoF, 2020).

Knowledge of the quantity and composition of planktonic organisms is a necessity for successful management of an aquatic eco-system. Plankton abundance and distribution are indicators of an area's diversity and provide information about its ecology. Because fisheries and other species rely on plankton for sustenance, it is widely acknowledged that the world's richest fisheries are intimately linked to plankton production. Planktons are known to not only be an important member of the lotic community, but also to contribute significantly to the freshwater ecosystem's biological production. Kaptai Lake transports a lot of nutrients and makes it easier for a lot of plankton to grow in the area. With a thorough understanding of phytoplankton and zooplankton, it is feasible to direct fishing exploitation to the correct site at the right time based on abundance, composition in space and time. According to recent studies, the production of large fishes in Kaptai Lake has reduced dramatically. Maintaining a healthy aquatic ecosystem of the lake, which is dependent on the abiotic qualities of water and the biological variety of the ecosystem, is critical for increasing production levels. Monitoring phytoplankton and zooplankton communities is required to predicatively model the ecosystem (Deborah and Robert, 2009).

The autotrophic components of the plankton community, phytoplanktons are an important feature of aquatic ecosystems. Microalgae, or phytoplankton, are similar to terrestrial plants in that they possess chlorophyll and require sunlight to live and thrive. The majority of phytoplanktons is buoyant and floats in the upper layers of the ocean, where sunlight can enter. Inorganic nutrients like nitrates, phosphates, and sulfur are also required by phytoplanktons, which they convert into proteins, lipids, and carbohydrates. Directly or indirectly, they are the basis of primary production in all water bodies. The productive status of a water body, whether it is oligotrophic or eutrophic one, depends on the qualitative and quantitative abundance of plankton. Therefore, a good understanding of phytoplankton abundance in relation to primary productivity is essential to improve the fish production.

Zooplanktons are the floating or weakly swimming heterotrophic components of plankton community that drift with water currents. They, along with phytoplanktons, make up the planktonic food supply on which practically all aquatic organisms rely. Zooplanktons play a very important role in the aquatic system due to their link between phytoplankton and higher tropic levels. Their activities decrease phytoplankton populations by grazing, enhance phytoplankton development by producing nutritional compounds that are eventually metabolized (Ketchum, 1962); and serve themselves as food for predators. Zooplankton contains a large reservoir of concentrated vitamin A, which is vital for fish species to improve their production. It is an essential component of the food chain Lake Ecosystem. It is known as both primary and secondary consumer as it comprises the second and third tropic levels of the food chain. The tertiary consumers of the food chain consume these zooplanktons. Thus zooplanktons maintain the link between primary producers and tertiary consumers, which balance the ecosystem of the lake and ultimately increase the production of fish species. Zooplanktons inhibit the lake from blooming by grazing more phytoplankton. They also emit CO_2 during their respiration. The emitted CO_2 is a critical component of photosynthesis-based primary production. In brief, zooplanktons affect Lake Ecosystem processes by grazing on primary production of an aquatic ecosystem (phytoplanktons), serve as a media to pass energy through food chain, recycle nutrients and organic material and serve as prey for both vertebrate and invertebrate planktivores.

Primary productivity refers to the rate at which energy is transformed to organic molecules by photosynthetic producers (photoautotrophs) who get their energy and nutrients from sunlight, and chemosynthetic producers (chemoautotrophs) who get their chemical energy from oxidation. The total amount of organic matter produced by photosynthetic organisms is known as primary productivity. Heterotrophic species such as bacteria, fungi and fishes rely on primary productivity for sustenance. Photoautotrophs are responsible for nearly all of Earth's primary productivity, which in this case, refers to the phytoplanktons. The whole fixation of solar (or chemical) energy by primary producers within an ecosystem is termed as gross primary production. Some of this production is utilized by autotrophs in support of their own respiration. Net primary production refers to the fraction of gross primary production that remains after primary producers have utilized some of their gross primary productivity for their own respiration. The net primary productivity supports the productivity of all other organisms, known as heterotrophs, in ecosystems. Therefore, it is necessary to study the abundance of plankton community and its relationship with the primary productivity of Kaptai Lake. Also, the findings from this study will help in further research works to correlate primary productivity and fish production of Kaptai Lake. The primary objectives of this study are:

- To identify plankton community of Kaptai Lake
- To estimate the primary productivity of Kaptai Lake
- To establish an inter-relationship between plankton abundance and primary productivity of Kaptai Lake

Chapter- 2
Review of Literature

Kaptai Lake, one of the most important freshwater bodies, is rich in fish biodiversity. Every year considerable amount of fish is produced from this vast artificial lake which and which is an important part of the total inland water catch of our country. Though study of biological parameters is very important for the proper maintenance of a waterbody, very few works have been done on the study on planktons and primary productvity of Kaptai Lake. So literature on planktons and primary productivity of other aquatic bodies has also been reviewed.

2.1. Phytoplankton

Chowdhury and Khair (1983) performed a research on phytoplanktons of Kaptai Lake and recorded 11 genera under the class Bacillariophyceae, 16 genera under the class Chlorophyceae, 4 genera under the class Cyanophyceae, 2 genera under the class Dinophyceae and 1 genus under the class Euglenophyceae .

Aquatic Research Group (1986) carried out an experiment on hydrobiology of the Kaptai reservoir where a total of 81 species of phytoplakton were reported under the classes Cyanophyceae, Chlorophyceae, Euglenophyceae, Bacillariophyceae, Cryptophyceae, Dinophyceae and Chrysophyceae.

Ferdoushi et al. (2015) performed a limnological study in Ramsagar Lake, Dinajpur and reported a total of 21 species of phytoplankton belonging to the classes of Euglenophyceae, Cyanophyceae, Bacillariophyceae and Chlorophyceae. Abundance of total phytoplankton varied from 16.11×10^3 cells/L to 57.83×10^3 cells/L throughout the period of study.

Ferdoushi et al. (2019) identified twenty two species of phytoplanktons under the classes of Cyanophyceae, Bacillariophyceae, Chlorophyceae and Euglenophyceae in Shuksagaor Lake, Dinajpur. Total phytoplankton abundance varied from 5.07×10^3 cells/L to 25.90×10^3 cells/L during the study period.

Lake Bogakain, Bandarban had been limnologically investigated for the first time by Khondker et al. in 2010. A total of 40 species of phytoplankton were recorded from the lake of where Chlorophyceae was the dominant class followed by Cynaophyceae, Bacillariophyceae, Cryptophyceae, Euglenophyceae, Dinophyceae and Chrysophyceae.

2.2. Zooplankton

The zooplankton population of Kaptai Lake was investigated with reference to water quality from July, 2013 to December, 2014. Bashar et al. (2015) recorded 10 genera of zooplankton under 3 orders namely Cladocera, Rotifera and Copepoda. The abundance of zooplankton varied from 2659 individuals/L to 5313 individuals/L throughout the study period.

Haque et al. (2018) recorded a total of 9 genera of zooplanktons from three major groups during three season's (Rotifera, Copepoda and Cladocera) observation at pre-monsoon, monsoon and post-monsoon.

Ferdoushi et al. (2015) performed a limnological study in Ramsagar Lake, Dinajpur and reported a total of eight species of zooplankton belonging to the groups of Copepoda, Rotifera, Cladocera and Crustacea. The highest average number of zooplankton was found in August and the lowest average number in January.

Ferdoushi et al. (2019) identified eight species of zooplanktons under the groups of Copepoda, Rotifera, Cladocera and Crustacea in Shuksagaor Lake, Dinajpur. Rotifera was reported as the dominant group followed by Copepoda and Cladocera.

2.3. Primary Productivity

Ahmed et al. (1994) studied primary productivity in the Kaptai reservoir from the year of 1989 to 1991. The recorded annual average gross primary productivity was 361.8 ± 84.0 mg C m-3 d-1 while the net primary production was 183.2 ± 62.0 mgC/m^3/d during 1989-90. The annual average gross primary productivity was 525.6 ± 140.4 mgC/m^3/d and 242.7 ± 70.8 mgC/m^3/d during 1990-91.

Bhouyain and Sen (1990) recorded the gross primary productivity to vary from 18.14 mg C/m^3/hr to 105.72 mgC/m^3/hr while the net primary productivity varied from 1.87 mg C/m^3/hr to 66.93 mgC/m^3/hr in Foy's Lake during the study period.

Khondker et al. (1988) recorded the gross primary productivity of Dhanmondi Lake to be quite low. The gross primary productivity of Dhanmondi Lake varied from 0.17 to 2.70 mg O_2 $l^{-1}h^{-1}$.

Sontakke and Mokashe (2014) recorded gross primary productivity and net primary productivity of two freshwater lakes (Mombatta and Kagzipura) of Aurangabad district, Maharashtra, India**.** Seasonal record of in Mombatta Lake showed lower gross primary productivity of (0.66 ± 0.17)` gC/m3/hr in monsoon and a higher range of (1.65 ± 0.15) gC/m3/hr in summer season, whereas in Kagzipura Lake also it showed minimum value of (1.19 ± 0.78) gC/m3/hr in monsoon and maximum value of (2.50 ± 0.90) gC/m3/hr in summer season. Seasonal record of net primary productivity at Mombatta Lake showed lower value of (0.60 ± 0.17) gC/m3/hr in monsoon and higher value of (1.45 ± 0.23) gC/m3/hr in summer season, whereas in Kagzipura Lake also it showed lower value of (1.12 ± 0.73) gC/m3/hr) in monsoon but higher value of (2.38 ± 0.88) gC/m3/hr in winter season.

2.4. Inter-relationship among parameters

Nurfadillah et al. *(*2019) studied the relationship of primary productivity and phytoplankton abundance in Muara Kuala Raja, Bireuen district, Aceh. Based on Principal Component Analysis, the recorded phytoplankton abundance and primary productivity showed a close relationship of 96%.

Nurdin et al. (2020) conducted a research on Phytoplankton and the correlation to primary productivity, chlorophyll-*a*, and nutrients in Lake Maninjau, West Sumatra, Indonesia and concluded that phytoplankton abundance are not correlated to net primary productivity and gross primary productivity whereas there is a positive relationhip between net primary productivity and gross primary productivity.

Chapter- 3

Materials and Methodology

3.1. Sampling site:

The present study was done in Kaptai Lake, Rangamati, Bangladesh. It is one of the largest man-made lakes in south-east Asia which covers an area of approximately 58,300 ha and 68,800 ha at full surface level. The maximum and mean depths of the reservoir are respectively 35m and 9 m. Initially the reservoir was made or the purpose of hydropower generation. Now, the waterbody is playing significant recreational role in fisheries, navigation, flood control, irrigation and tourism.

For the purpose of the study, four different sampling points were selected inside the lake (Figure - 1). They are as follows:

1. Jolojan Ghaat (22°39'29.45" N and 92°10'39.31" E)
2. Kandemu (22°39'41.46" N and 92°13'36.48" E)
3. Shubholong Jhorna (22°42'31.17" N and 92°14'33.16" E)
4. Shubholong Bazar (22°42'34.65" N and 92°15'56.50" E)

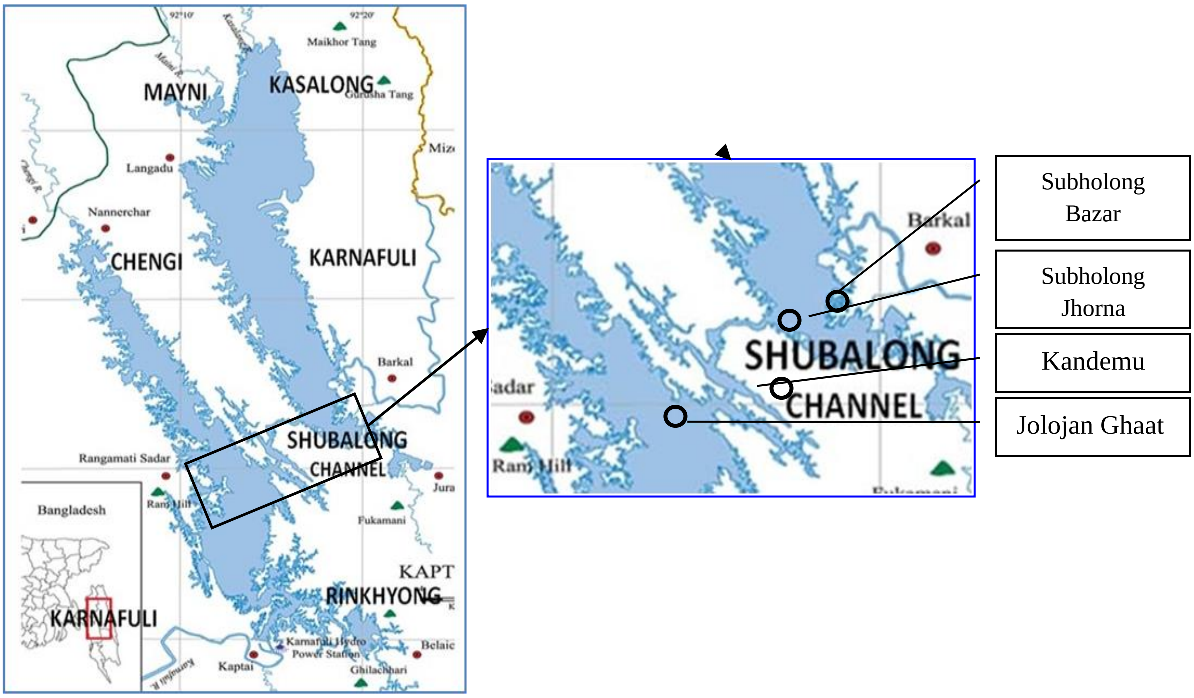

Figure 1: Map of the sampling site

3.2. Study period:

The present study was conducted during the time period of September, 2021 to February, 2022.

3.3. Sample collection:

CVASU research vessel was occupied for the sampling purpose of the present study.

- **Sample for planktonic study:** Water sample for qualitative and quantitative studies of phytoplankton and zooplankton was collected from the surface of lake water. Plankton net of the mesh size of 20 µm was used for this purpose. The water flow was measured by a flow meter. 2-4 drops of 10% Ethanol was added to the sample bottle immidiately after sampling for preservation purpose.
- **Sample for primary production study:** Two BOD bottles (one light bottle and one dark bottle) of 250 ml were taken for each station. Dark bottles were prepared by wrapping BOD bottles with black tape to prohibit the sunlight penetration to the sample water.

3.4. Identification of plankton species:

The process of identification of the phytoplankton and zooplankton was carried out in the laboratory using Digital LCD microscope (Optika - B 190) at 40X. Taxonomic identification up to genus level of phytoplankton was done by following the text book of Belcher and Swale (1976) while identification of zooplankton was done by following Bhuyan et al. (2020).

3.5. Determination of plankton abundance

Abundance of the phytoplankton and zooplankton was determined using Sedgewick Rafter cell by following Rahman and Hasan (1992). The process is as follows:

1. At first, sample was taken in the S-R cell and placed under microscope at 10X.
2. There were about 1000 quadrates in the Sedgwick Rafter cell. The number of plankton cells from ten squares was counted.
3. Then the number of plankton cells/L was calculated by using following equation-

   Number of plankton, $N = \frac{A \times C}{F \times V \times L} \times 1000$

Where,

V = Volume of the Sedgwick Rafter cell field
F = Number of field count
C = Volume of final concentration of sample
A = Total no. of plankton counted
L = Volume of original water
N = Number of plankton cells per liter

3.6. Determination of primary productivity

Light and dark bottle method (Gaarden and Gran, 1927) was used to estimate the primary productivity.

Procedure:

1. Two BOD bottles were filled with water sample in round stoppered bottles (1 Light bottle, 1 dark bottle and 1 control light bottle) avoiding air bubbles.
2. The dark bottle was wrapped with aluminum foil and kept in a black bag to protect from light.
3. One of the light bottles was used for estimating the initial dissolved oxygen as control.
4. The bottles were normally incubated for a period of 3 hrs between dawn to midday or sunset in the respective depths
5. At the end of incubation period, the bottles were retrieved.
6. The oxygen content in the sample was determined by using DO meter (EcoSense DO200A)
7. **Calculation:** The following formulae was used to estimate Primary Productivity:

Gross Primary Productivity (mgC/m^3/hr) =

$$\frac{(\mathrm{O2LB}) - (\mathrm{O2DB}) \times 1000}{\mathrm{PQ} \times \mathrm{t}} \times 0.375$$

Net Primary Productivity (mgC/m^3/hr) =

$$\frac{(\mathrm{O2LB}) - (\mathrm{O2IB}) \times 1000}{\mathrm{PQ} \times \mathrm{t}} \times 0.375$$

Here,

O_2IB = Initial concentration of oxygen

O_2LB = Concentration of oxygen in the light bottle

O_2DB= Concentration of oxygen in the dark bottle

PQ = Coefficient of photosynthetic = 1.2

t = Time of incubation (3 hours)

0.375 = Conversion factor to convert oxygen production values into its carbon equivalents

3.7. Data analysis and interpretation: All the calculations and graphical analysis of collected data were performed by using Microsoft Excel (Version 16). Statistical analysis was carried out by using SPSS (version 25).

Photo Gallery

Plate 1: CVASU Research Vessel

Plate 2: Sample collection

Plate 3: Measurement of dissolved oxygen

Plate 4: Plankton identification

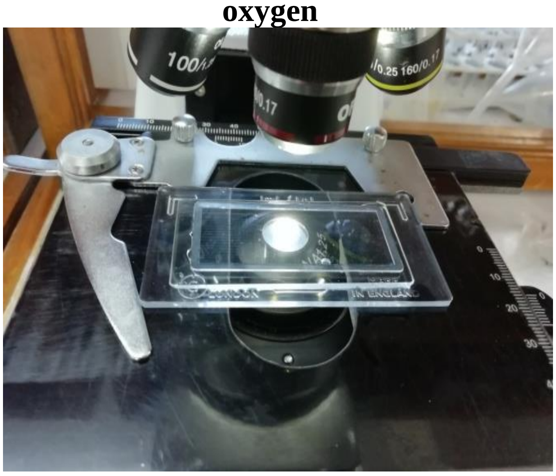

Plate 5: Plankton cell count

Chapter- 4

Results

4.1. Phytoplankton

Planktonic study was done on Kaptai Lake including phytoplankton species identification, their abundance, percentage of different class and monthly variation.

4.1.1. Phytoplankton identification

A total of 15 genera of phyplankton were identified under 4 classes from 4 stations of Kaptai Lake. The identified classes were: Chlorophyceae, Cyanophyceae, Dinophyceae and Euglenophyceae. Plates 6 – 25 show the pictures of identified phytoplanktons along with their class genus name.

10 genera were identified under the class Chlorophyceae: *Actinastrum, Cosmarium, Chlamydomonus, Mougeotia, Pandorina, Pediastrum, Spirogyra, Staurastrum, Xanthidium and Zygnema* (Plate 6 – 20); 6 species were identified under the genera *Staurastrum* which are: *Staurastrum gracile, S. johnsonii, S. leptocladum, S manfeldti, S. pingue* and *S. rotula*. 3 genera were identified under the class Cyanophyceae: *Anabaena, Aphanothece* and *Gleocapsa* (Plate 21 – 23). Genus *Ceratium* (Plate - 24) and *Phacus* (Plate – 25) were identified under the class of Dinophyceae and Euglenophyceae respectively.

Class - Chlorophyceae

Plate 6 – *Actinastrum*

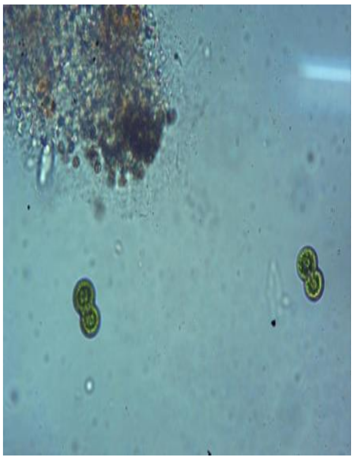

Plate 7 – *Cosmarium*

Plate 8 – *Chlamydomonus*

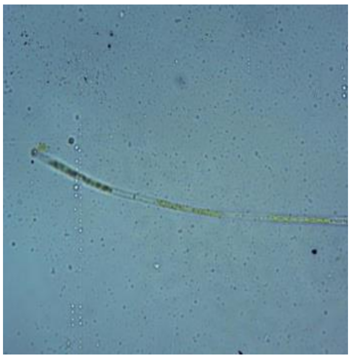
Plate 9 – *Mougeotia*

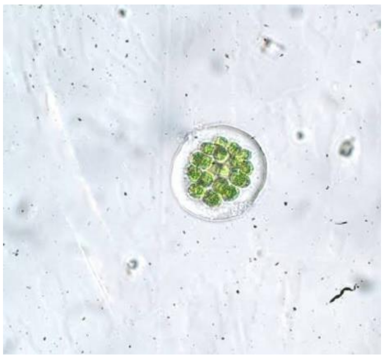
Plate 10 – *Pandorina*

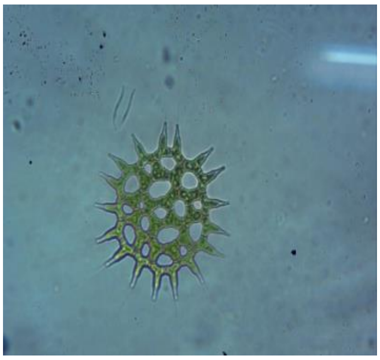
Plate 11 – *Pediastrum*

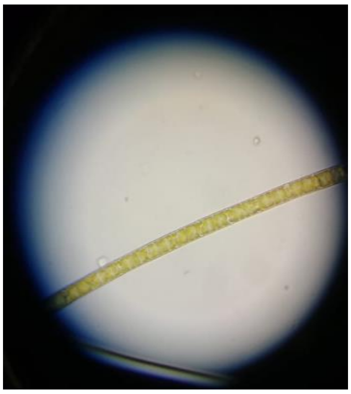
Plate 12 - *Spirogyra*

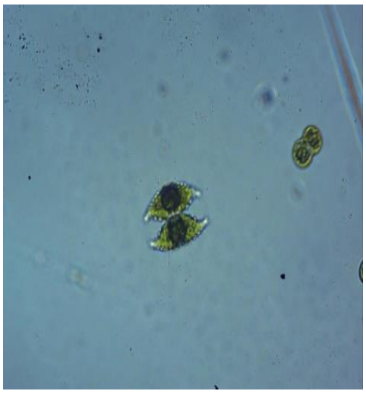
Plate 13 - *Staurastrum gracile*


Plate 14 - *Staurastrum johnsonii*


Plate 15 - *Staurastrum leptocladum*


Plate 16 - *Staurastrum manfeldti*


Plate 17 - *Staurastrum pingue*

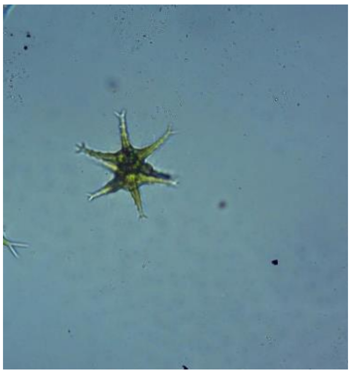
Plate 18 - *Staurastrum rotula*

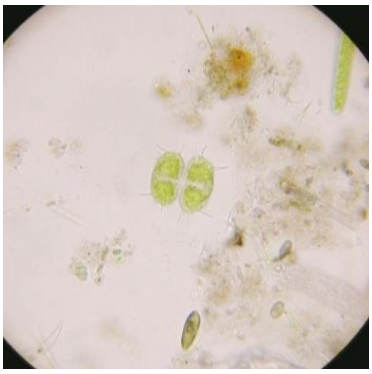
Plate 19 - *Xanthidium*

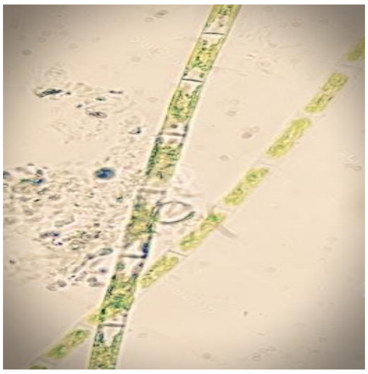
Plate 20 – *Zygnema*

Class – Cyanophyceae

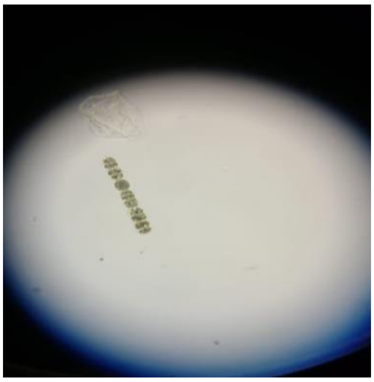

Plate 21 - *Anabaena*

Plate 22 – *Aphanothece*

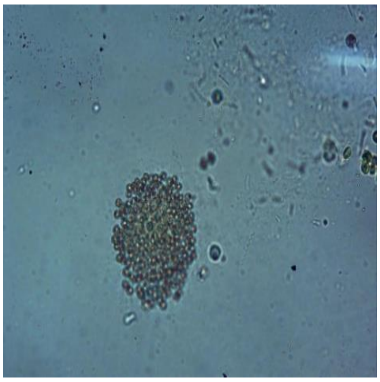

Plate 23 – *Gleocapsa*

Class – Dinophyceae

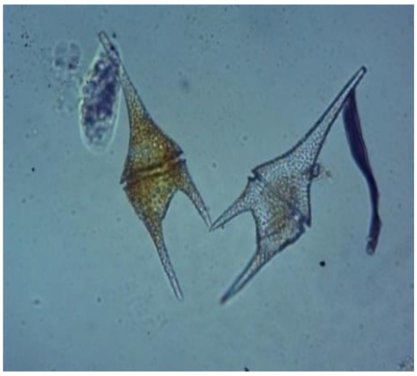

Plate 24 – *Ceratium*

Class – Euglenophyceae

Plate 25 – *Phacus*

4.1.2. Phytoplankton abundance

Total phytoplankton abundance in Kaptai Lake was found highest in the month of October at Shubholong Jhorna station which was recorded to be 32.22 × 10^3 cells/L. The minimum value was observed in January at Jolojan Ghaat station which was 11.21 × 10^3 cells/L. Figure – 2 shows the total phytoplankton abundance in four stations of Kaptai Lake throughout the study period.

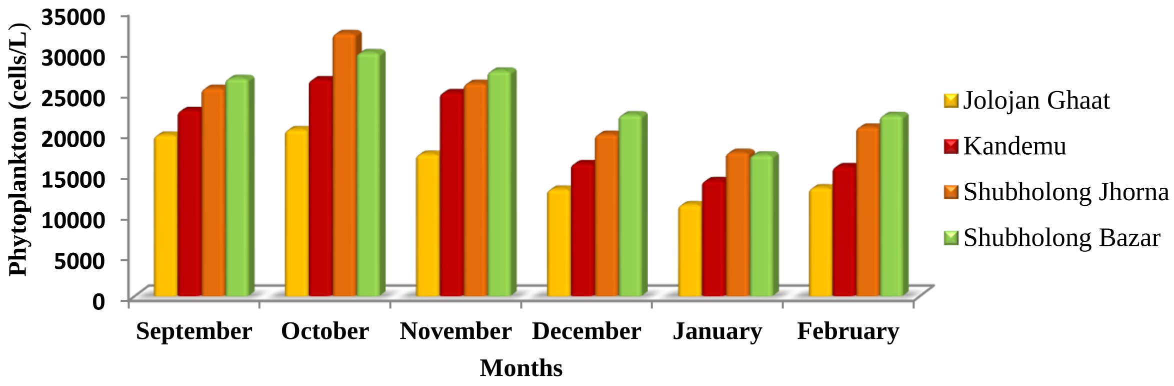

Figure - 2: Total phytoplankton abundance in four sampling stations

The highest mean phytoplankton abundance was (24.315 ± 4.595) ×10^3 cells/L which was recorded in Shubholong Bazar station whereas the lowest value was observed in Jolojan Ghaat station which was (15.860 ± 3.850) ×10^3 cells/L. No significant variance of mean phytoplankton abundance was found among the sampling stations. Figure – 3 is showing the mean phytoplankton abundance with standard deviation in four stations of Kaptai Lake. Table - 1 is showing the mean values and ranges of different plankton species in four sampling stations.

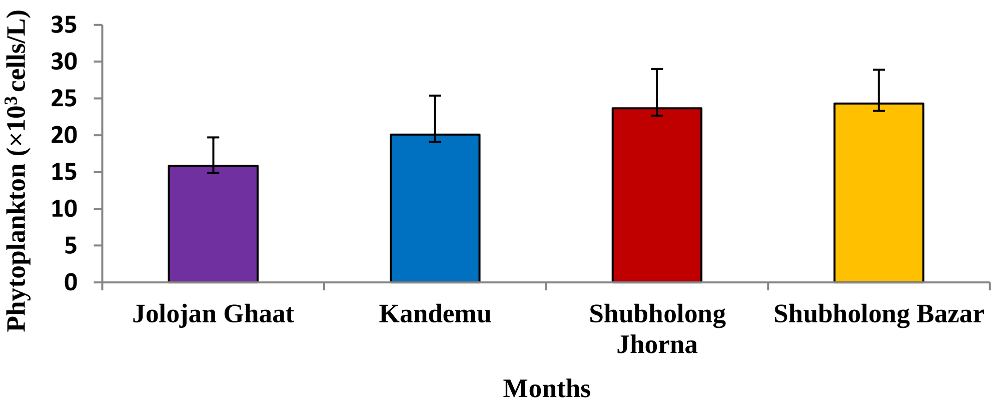

Figure - 3: Mean values (±SD) of phytoplankton abundance in four sampling stations

Table – 1: Mean values (±SD) and range of phytoplankton abundance

Class	Genus	Jolojan Ghaat (×10^3 cells/L)	Kandemu (×10^3 cells/L)	Shubholong Jhorna (×10^3 cells/L)	Shubholong Bazar (×10^3 cells/L)
Chlorophyceae	*Actinastrum*	0.997 ± 0.874	1.543 ± 1.226	1.931 ± 1.231	1.761 ± 1.159
		0.00 - 2.345	0.00 - 3.40	0.51 - 3.56	0.76 - 3.86
	Cosmarium	1.951 ± .634	2.197 ± .499	2.606 ± .972	2.815 ± .876
		1.210 - 2.950	1.59 - 2.95	1.89 - 4.54	1.93 - 4.46
	Chlamydomonus	0.216 ± 0.173	0.510 ± 0.401	0.636 ± 0.271	0.591 ± 0.155
		0.00 - 0.529	0.22 - 1.29	0.29 - 0.98	0.44 - 0.76
	Mougeotia	0.125 ± 0.198	0.161 ± 0.250	0.261 ± 0.431	0.436 ± 0.676
		0.00 - .438	0.00 - 0.51	0.00 - 1.02	0.00 - 1.32
	Pandorina	1.232 ± 0.641	1.487 ± 0.609	1.711 ± 0.637	1.765 ± 0.536
		0.798 - 2.345	0.91 - 2.50	0.76 - 2.57	1.21 - 2.42
	Pediastrum	1.215 ± 0.780	1.493 ± .986	1.060 ± 0.651	1.286 ± 0.866
		0.354 - 2.118	0.44 - 2.72	0.47 - 2.19	0.24 - 2.42
	Spirogyra	0.645 ± 0.454	1.243 ± 0.699	1.465 ± 0.555	1.621 ± .8123
		0.00 - 1.286	0.53 - 2.35	0.98 - 2.50	0.83 - 3.10
	Staurastrum	1.415 ± 0.413	1.735 ± 1.097	2.573 ± 1.101	2.160 ± 1.303
		0.787 - 1.816	0.82 - 3.78	1.73 - 4.69	0.83 - 4.46
	Xanthidium	1.285 ± 0.805	1.561 ± 0.970	1.758 ± 1.143	1.875 ± 1.596
		0.197 - 2.572	0.27 - 2.57	0.39 - 3.56	0.00 - 4.01
	Zygnema	0.788 ± 0.576	0.829 ± 0.709	1.140 ± 0.779	1.165 ±.0.873
		0.00 - 1.437	0.00 - 1.89	0.00 - 2.27	0.00 - 2.35
Cyanophyceae	*Anabaena*	1.366 ± 0.617	1.870 ± 0.873	1.883 ± 0.567	2.090 ± 0.680
		0.768 - 2.345	1.13 - 3.40	1.26 - 2.80	1.21 - 3.03
	Aphanothece	2.267 ± 0.878	2.560 ± 0.804	3.123 ± 1.052	3.473 ± 1.068
		1.513 - 3.949	1.74 - 4.10	2.12 - 4.94	2.33 - 5.41
	Gleocapsa	.755 ± 0.538	0.697 ± 0.376	0.870 ± 0.501	0.748 ± 0.551
		0.00 - 1.664	0.00 - 1.06	0.00 - 1.44	0.00 - 1.40
Dinophyceae	*Ceratium*	1.085 ± 0.423	1.650 ± 0.821	1.820 ± 0.832	1.870 ± 0.670
		0.695 - 1.664	0.84 - 2.95	0.90 - 3.10	0.84 - 2.50
Euglenophyceae	*Phacus*	0.511 ± 0.144	0.653 ± 0.329	0.825 ± 0.248	0.790 ± 0.254
		0.266 - 0.681	0.45 - 1.32	0.51 - 1.13	0.51 - 1.13
	Total	15.860 ± 3.850	20.093 ± 5.300	23.668 ± 5.336	24.315 ± 4.595
		11.21 - 20.42	14.16 - 26.55	17.62 - 32.23	17.31- 29.88

4.1.3. Phytoplankton community composition

In the present study, Chlorophyceae was the highest abundant class of phytoplankton which varied from 51.14% to 69.09% of total phytoplankton composition; followed by Cyanophyceae (19.49% to 31.88%), Dinophyceae (4.57% to 10%) and Euglenophyceae (2.70% to 4.79%). Figure – 4 is showing the percentage of different phytoplankton classes throughout the study period.

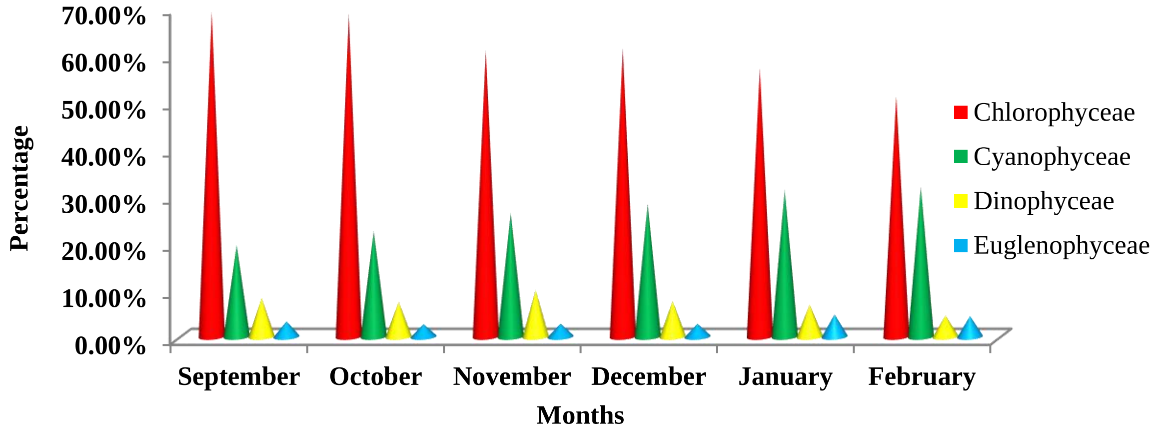

Figure – 4: Percentage of different classes of phytoplankton

The most abundant phytoplankton of Kaptai Lake was found to be *Aphanothece* which varied from 9.03% to 25.53% of tota phytoplankton composition; while the least abundant phytoplankton was *Mougeotia* which varied from 0.00% to 4.57%. Figure – 5 shows the percentage of different phytoplankton genus.

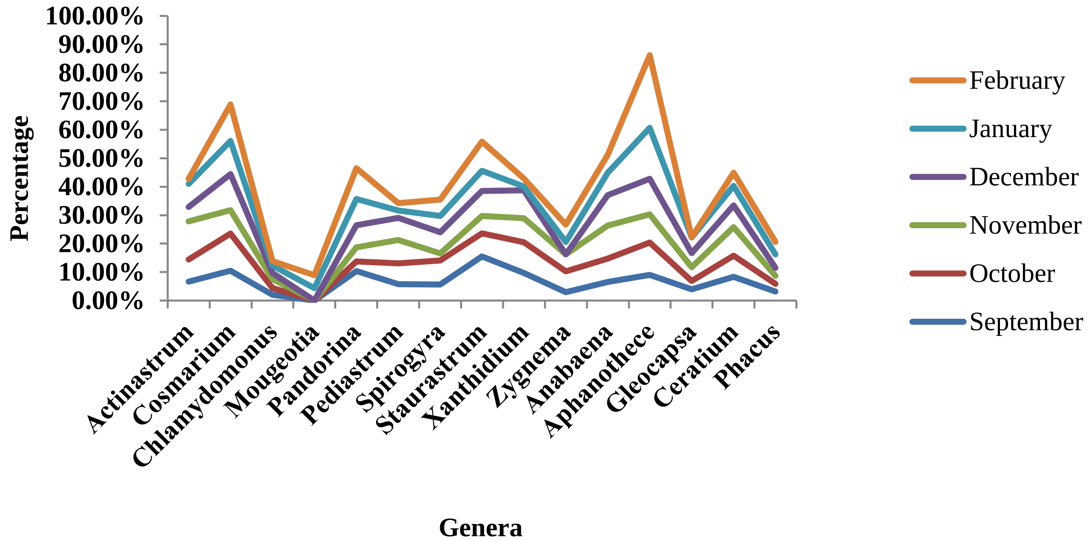

Figure – 5: Percentage of different genera of phytoplankton

4.1.4. Temporal variation of phytoplankton abundance

There were no outliers, as assessed by boxplot; data was normally distributed for each group, as assessed by Shapiro-Wilk test ($p > 0.05$); and there was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = 0.860$). Data is presented as mean ± standard deviation. Tukey post hoc analysis revealed that the mean decrease of phytoplankton abundance of October to phytoplankton abundance of December (0.94×10^3 cells/L, 95% confidence interval [1.15×10^3 cells/L, 2.42×10^3 cells/L], $p = 0.041$) was statistically significant; as well as phytoplankton abundance of October to phytoplankton abundance of January (1.22×10^3 cells/L, 95% confidence interval [1.03×10^3 cells/L, 1.99×10^3 cells/L], $p = 0.005$) and February (0.93×10^3 cells/L, 95% confidence interval [1.14×10^3 cells/L, 2.46×10^3 cells/L], $p = 0.045$). No other group differences were statistically significant. Figure – 6 is showing the temporal variation of total phytoplankton abundance.

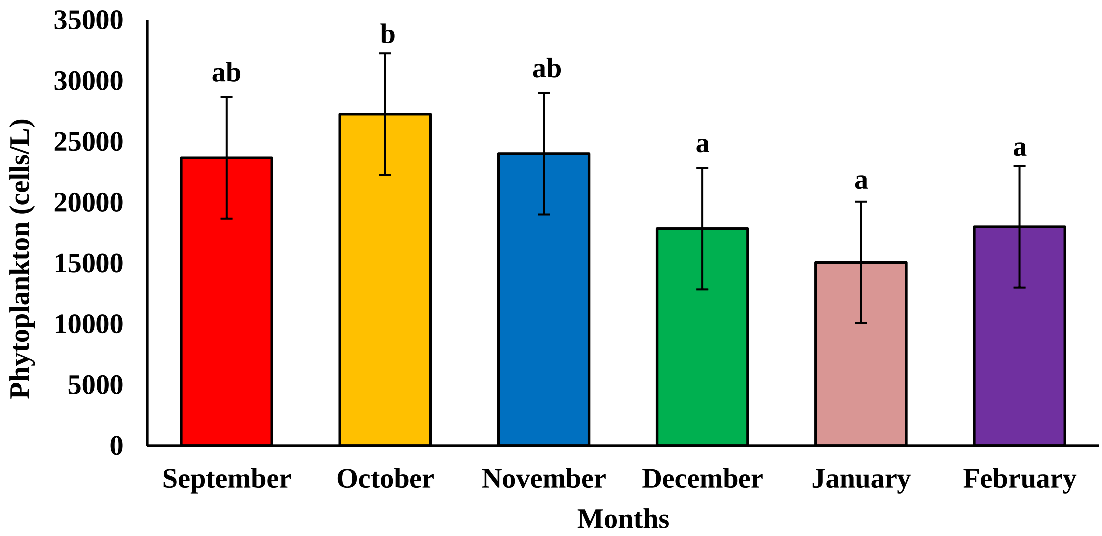

Figure – 6: Temporal variation of phytoplankton abundance (Mean ± SD)

4.2. Zooplankton

Planktonic study was done on Kaptai Lake including zooplankton species identification, their abundance, percentage of different class and monthly variation.

4.2.1. Zooplankton identification

A total of 8 genera of zooplankton were identified under 4 groups. The identified groups were: Rotifera, Crustacea, Arthropoda and Protozoa. 5 genera: *Brachionus, Euchlanis, Keratella, Polyarthra* and *Asplanchna* were identified under the group Rotifera which was the dominant group. Nauplius, *Cyclops* and *Paramecium* were identified under the group Crustacea, Copepoda and Protozoa respectively. Plates 26 - 33 show the pictures of identified zooplanktons with their groups and genus name.

Group – Rotifera

Plate 26 - *Brachionus*

Plate 27 - *Euchlanis*

Plate 28 – *Keratella*

Plate 29 - *Polyarthra*

Plate 30 – *Asplanchna*

Group - Crustacea

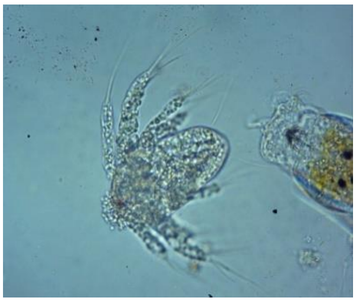

Plate 31 - Nauplius

Group - Copepoda

Plate 32 - *Cyclops*

Group – Protozoa

Plate 33 – *Paramecium*

4.2.2. Zooplankton abundance

Total zooplankton abundance was found highest (5.06×10^3cells/L) in the month of October at Shubholong Bazar station while the minimum value (1.92×10^3cell/L) was observed in January at Jolojan Ghaat station. Figure – 7 shows the total zootoplankton abundance in four stations throughout the study period.

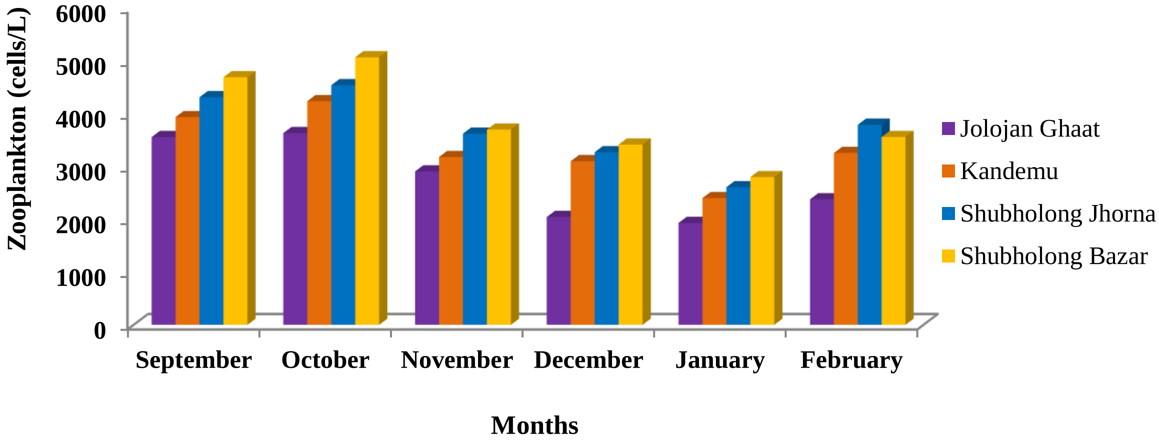

Figure – 7: Total zooplankton abundance in four sampling stations

The highest mean zooplankton abundance was ($3.871 \pm .847$) $\times 10^3$ cells/L which was recorded in Shubholong Bazar station whereas the lowest value was observed in Jolojan Ghaat station which was (2.740 ± 0.743) $\times 10^3$ cells/L. No significant variance of mean zooplankton abundance was found among the sampling stations. Figure – 8 is showing the mean zooplankton abundance with standard deviation in four stations of Kaptai Lake.

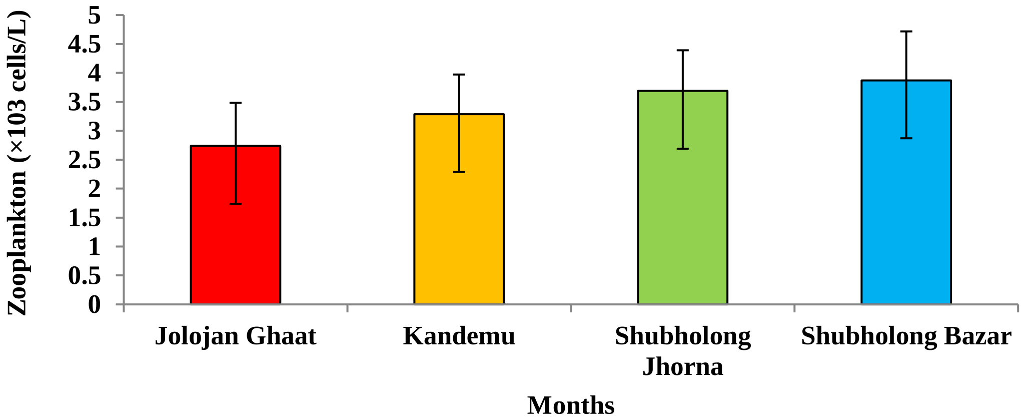

Figure – 8: Mean values (±SD) of zooplankton abundance in four stations

Table - 2 is showing the mean values and ranges of different plankton genus in four sampling stations.

Table - 2: Mean values (±SD) and range of zooplankton abundance

Group	Genus	Jolojan Ghaat ($\times10^3$ cells/L)	Kandemu ($\times10^3$ cells/L)	Shubholong Jhorna ($\times10^3$ cells/L)	Shubholong Bazar ($\times10^3$ cells/L)
Rotifera	*Brachionus*	0.151 ± 0.098 0.00 - 0.23	0.130 ± 0.105 0.00 - 0.30	0.183 ± 0.104 0.00 - 0.27	0.170 ± 0.089 0.07 - 0.29
	Euchlanis	0.143 ± 0.125 0.00 - 0.29	0.167 ± 0.151 0.00 - 0.30	0.258 ± 0.234 0.00 - 0.61	0.178 ± 0.171 0.00 - 0.38
	Keratella	1.176 ± 0.388 0.64 - 1.59	1.127 ± 0.460 0.50 – 1.70	1.288 ± 0.364 0.73 - 1.74	1.266 ± 0.328 0.83 - 1.74
	Polyarthra	0.405 ± 0.180 0.19 - 0.68	0.638 ± 0.170 0.40 - 0.83	0.660 ± 0.179 0.36 - 0.91	0.735 ± 0.222 0.36 - 0.98
	Asplanchna	0.155 ± 0.064 0.07 - 0.23	0.130 ± 0.144 0.00 - 0.38	0.196 ± 0.151 0.00 - 0.00	0.321 ± 0.167 0.17 - 0.53
Crustacea	Nauplius	0.578 ± 0.230 0.36 - 0.91	0.685 ± 0.266 0.30 - 0.91	0.778 ± 0.273 0.39 - 1.16	0.846 ± 0.271 0.43 - 1.06
Arthropoda	*Cyclops*	0.060 ± 0.056 0.00 - 0.15	0.122 ± 0.053 0.10 - 0.23	0.198 ± 0.092 0.10 - 0.30	0.245 ± 0.085 0.13 - 0.38
Protozoa	*Paramecium*	0.076 ± 0.093 0.00 - 0.22	0.058 ± 0.092 0.00 - 0.20	0.126 ± 0.104 0.00 - 0.23	0.105 ± 0.123 0.00 - 0.33
	Total	2.740 ± 0.743 1.93 - 3.63	3.288 ± 0.685 2.30 – 4.20	3.690 ± 0.702 2.61 - 4.54	3.871 ± 0.847 2.80 - 5.07

4.2.3. Zooplankton community composition

Rotifera was the highest abundant group of zooplankton which varied from 64.02% to 80.58% in the present study, followed by Crustacea (16.66% to 31.24%), Arthropoda (3.96% to 5.96%) and Protozoa (0.00% to 6.73%). Figure - 9 shows the percentage of different zooplankton groups throughout the study period.

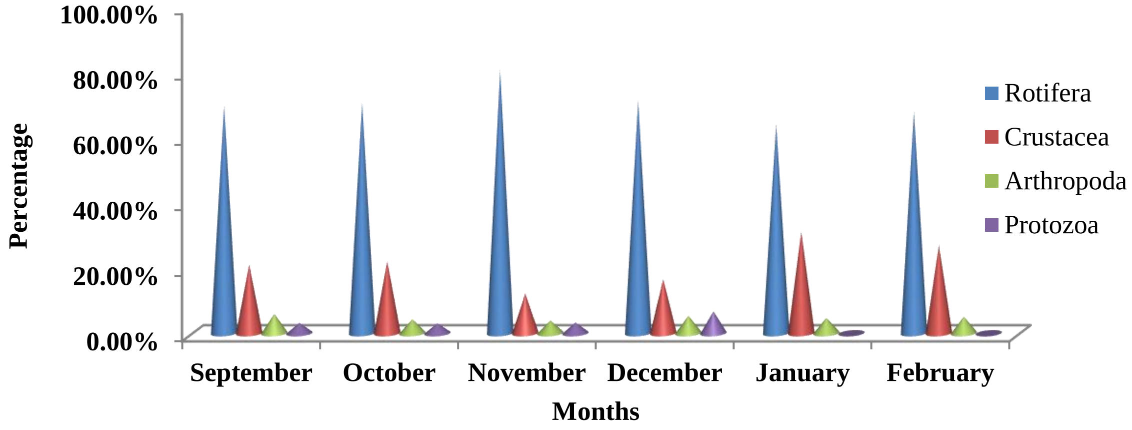

Figure – 9: Percentage of different groups of zooplankton

The most abundant zooplankton was Nauplius which varied from 12.20% to 31.24% of total zooplankton composition; while the least abundant zooplankton was *Paramecium* which varied from 0.00% to 6.73% throughout the study period. Figure – 10 shows the percentage of different zooplankton genus.

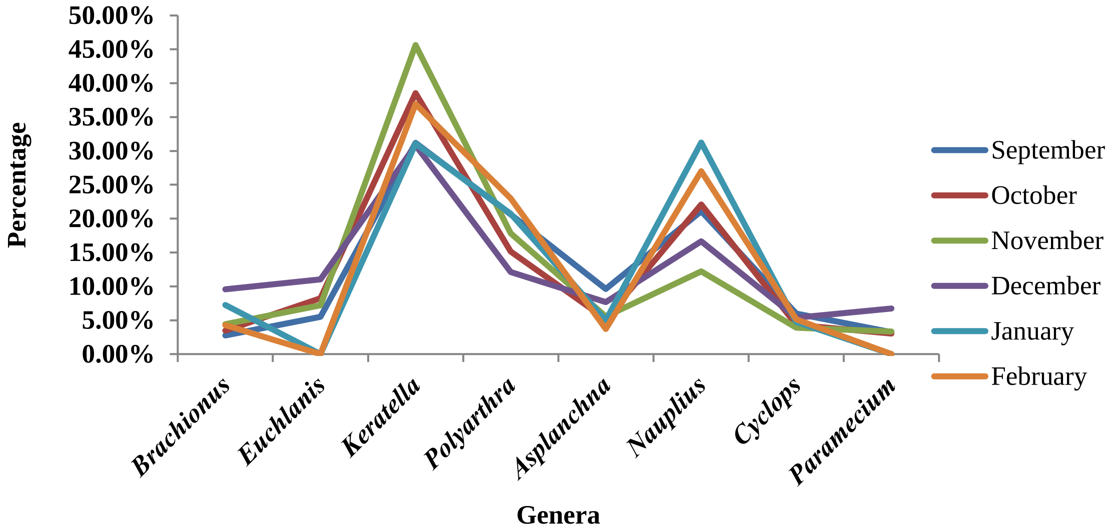

Figure - 10: Percentage of different genera of zooplankton

4.2.4. Temporal variation of zooplankton abundance

There were no outliers in the zooplankton data, as assessed by boxplot; data was normally distributed for each group, as assessed by Shapiro-Wilk test ($p > 0.05$); and there was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = 0.900$). Data is presented as mean ± standard deviation. Tukey post hoc analysis revealed that the mean decrease of zooplankton abundance of September, 2021 to zooplankton abundance of January, 2022 (1.69×10^3 cells/L, 95% Confidence Interval [0.512×10^3 cells/L, 2.867×10^3 cells/L]) was statistically significant ($p = 0.003$); as well as the decrease from October, 2021 to December, 2021 (1.41×10^3 cells/L, 95% confidence interval [0.235×10^3 cells/L, 2.590×10^3 cells/L], $p = 0.014$) and January (1.94×10^3 cells/L, 95% confidence interval [0.758×10^3 cells/L, 3.113×10^3 cells/L], $p = 0.001$) but no other group differences were statistically significant. Figure – 11 is showing the temporal variation of total zooplankton abundance (Mean ± SD) of Kaptai Lake.

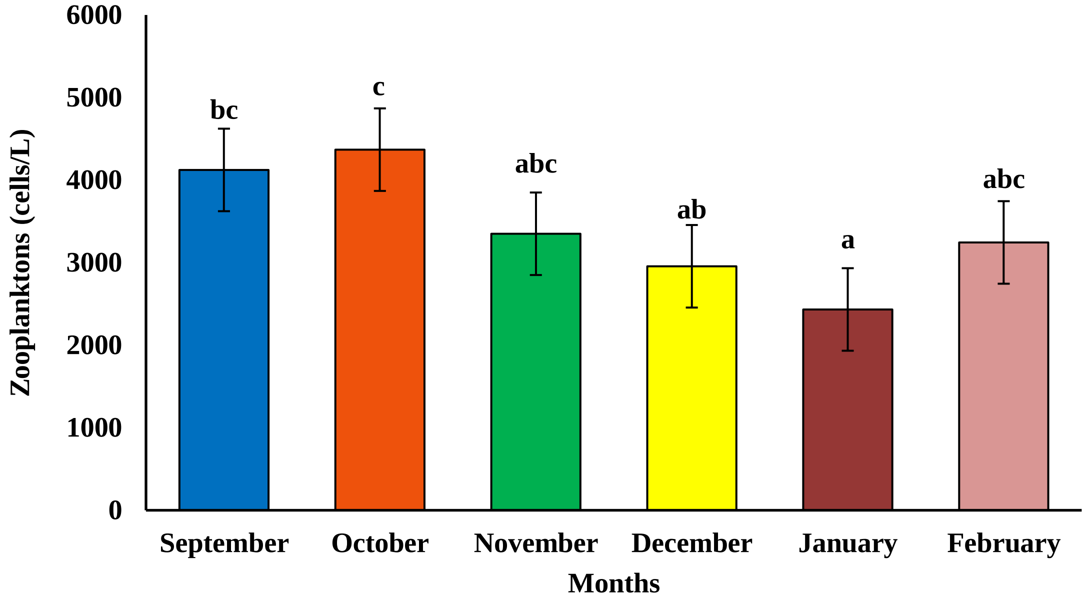

Figure – 11: Temporal variation of zooplankton abundance (Mean ± SD)

4.3. Primary productivity

In Kaptai Lake, gross primary productivity varied from 208.34 mgC/m^3/day to 576.12 mgC/m^3/day (Figure-12) and net primary productivity varied from 121.42 mgC/m^3/day to 208.34 mgC/m^3/day (Figure-13) throughout the study period. In both cases, the highest values were recorded in Kandemu station in the month of December whereas the lowest values were observed in Jolojan Ghaat in the month of September. Mean gross primary productivity of four stations of Kaptai Lake throughout the period of study was (359.16 ± 104.51) mgC/m^3/day whereas net primary productivity was recorded to be (209.81 ± 60.87) mgC/m^3/day. Statistical analysis revealed no significant difference ($P > 0.05$) among gross primary productivity records for different months.

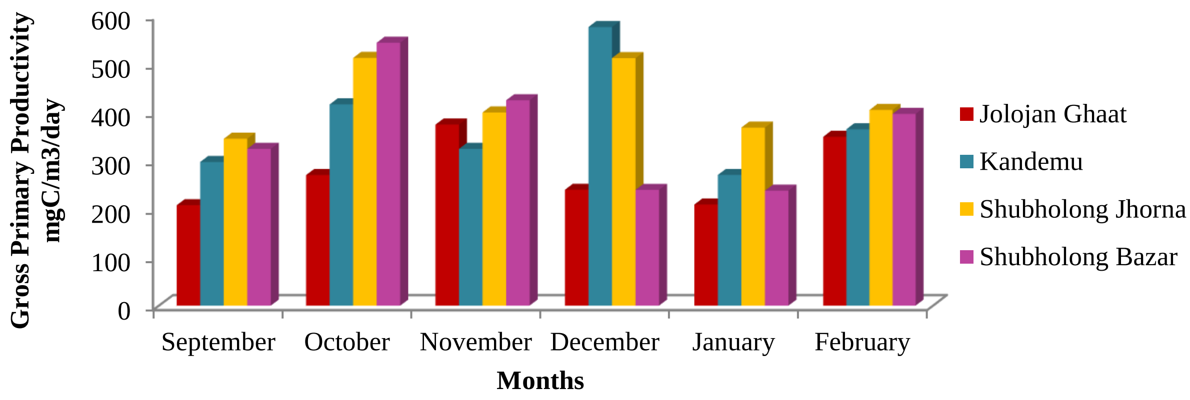

Figure – 12: Gross primary productivity of four sampling stations

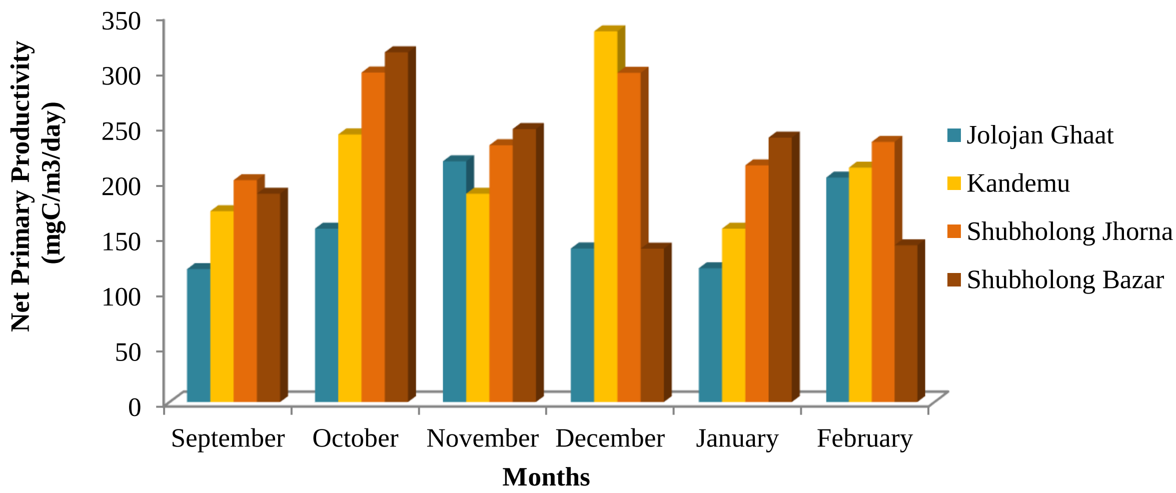

Figure – 13: Net primary productivity of four sampling stations

4.4. Inter-relationship among parameters

A Pearson's product-moment correlation was run to assess the relationship among the following parameters: phytoplanktpn abundance, zooplankton abundance, gross primary productivity and net primary productivity. Preliminary analyses showed the relationship to be linear with all variables normally distributed, as assessed by Shapiro-Wilk's test (p > 0.05), and there were no outliers. Phytoplankton abundance showed a statistically significant, strong positive correlation with zooplankton abundance, r (24) = 0.897, *p* = 0.00 at significance level of 0.01 and a moderate positive correlation with gross primary productivity, r (24) = 0.452, *p* = 0.027 at significant level of 0.05. There was a statistically significant, moderate positive correlation between zooplankton abundance and gross primary productivity, r (24) = 0.460, *p* = 0.024 at significance level of 0.05. There was also a statistically significant, strong positive correlation between gross primary productivity and net primary productivity, r (24) = 0.894, *p* = 0.00 at significant level of 0.05. Figure – 14 shows the correlation matrix plot among phytoplankton abundance, zooplankton abundance, gross primary productivity and net primary productivity.

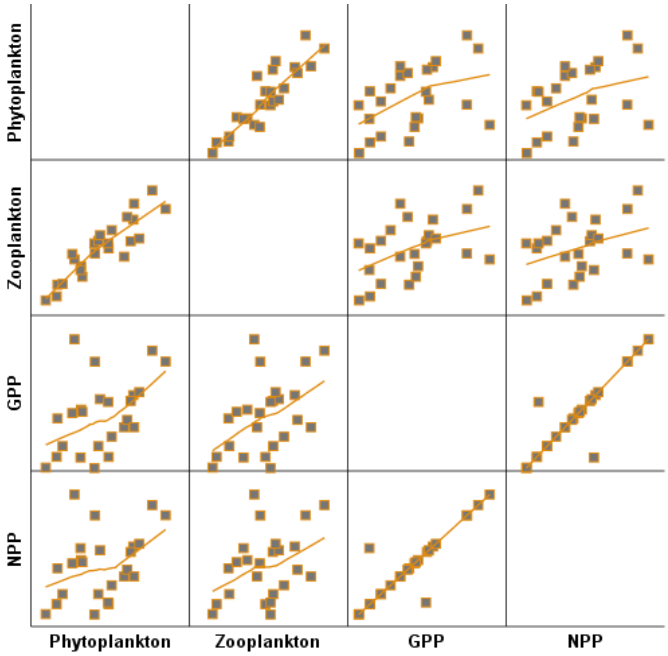

Figure – 14: Correlation matrix plot among different parameters

Chapter – 5

Discussion

5.1. Phytoplankton

The present study showed that a total of 15 genera of phytoplanktons were identified from Kaptai Lake under the class Chlorophyceae, Cyanophyceae, Dinophyceae and Euglenophyceae. The identified 10 genera under the class Chlorophyceae were *Actinastrum*, *Cosmarium, Chlamydomonus*, *Mougeotia*, *Pandorina*, *Pediastrum*, *Spirogyra*, *Staurastrum, Xanthidium and Zygnema;* whereas 6 species were identified under the genera *Staurastrum*: *Staurastrum gracile*, *S. johnsonii, S. leptocladum, S manfeldti, S. pingue* and *S. rotula. Anabaena sp.*, *Aphanothece sp.* and *Gleocapsa sp.* were recorded under the class Cyanophyceae. *Ceratium sp.* and *Phacus sp.* were identified under the class of Dinophyceae and Euglenophyceae respectively. Also, a total of 81 species of phytoplakton under the classes Cyanophyceae (5 species), Chlorophyceae (21 species), Euglenophyceae (3 species), Bacillariophyceae (4 species), Cryptophyceae (4 species), Dinophyceae (2 species) and Chrysophyceae (1 species) were reported by Aquatic Research Group (ARG) in their hydrobiological study in Kaptai reservoir in 1986.

Total phytoplankton abundance in Kaptai Lake varied from 11.21×10^3 cells/L to 32.22×10^3 cells/L throughout the study period. The highest phytoplankton abundance was recorded in the month of October at Shubholong Jhorna station while the minimum value was observed in January at Jolojan Ghaat station. A relevant study conducted by Ferdoushi et al. (2015) in Ramsagar Lake recorded the highest phytoplankton abundance (57.83×10^3 cells/L) in July and lowest (16.11×10^3 cells/l) in January. Ferdoushi et al. (2015) also carried out the limnological study in Shuksagar Lake where total phytoplankton abundance was found higher (25.90×10^3 cells/L) in the month of February, whereas the minimum value was observed (5.07×10^3cells/L) during April. As we know, water temperature and nutrient availability vary seasonwise; the reason behind higher and lower abundance in different months could be the difference of these two factors. In all these cases, Chlorophyceae was found to be the dominant group. Khondhker et al. *(*2010) also recorded Chlorophyceae as the dominant group of phytoplankton in Bogakain Lake and Kaptai Lake of Bangladesh.

5.2. Zooplankton

The present study recorded a total of 8 genera of zooplankton under 5 groups: Rotifera, Crustacea, Arthropoda and Protozoa. *Brachionus, Euchlanis, Keratella, Polyarthra and Asplanchna* were identified under the group Rotifera which was the dominant group. Nauplius, *Cyclops* and *Paramecium* were identified under the group Crustacea, Copepoda and Protozoa respectively. Bashar et al. (2015) recorded 10 genera of zooplankton under 3 orders namely Cladocera, Rotifera and Copepoda from Kaptai Lake. Haque et al. (2018) also reported the presence of 9 genera of zooplanktons under the groups Rotifera, Copepoda and Cladocera in Kaptai Lake.

Total zooplankton abundance in Kaptai Lake varied from 1.92×10^3 cells/L to 5.06×10^3cells/L throughout the time period. A similar pattern of result was recorded by Bashar et al. (2015) where the zooplankton abundance varied from 2659 cells/L to 5313 cells/L in Kaptai Lake.

5.3. Primary productivity

Mean gross primary productivity of four stations of Kaptai Lake throughout the period of study was (359.16 ± 104.51) mgC/m^3/day. This result ties well with the findings of Ahmed et al. (1994) which recorded annual average gross primary productivity of Kaptai Lake to be (361.8 ± 84.0) mgC/m^3/day during 1989-90. But a higher annual average gross primary productivity, (525.6 ± 140.4) mgC/m^3/day was recorded during 1990-91 which is much higher than that of present study. The availability of nutrients for primary producers has long been thought to be the main limiting factor for primary productivity which could be compromised by changed levels of dissolved oxygen and temperature.

Mean net primary productivity of Kaptai Lake throughout the period of study was (209.81 ± 60.87) mgC/m^3/day. A similar pattern of result was obtained in Ahmed et al (1994) where annual average net primary productivity of Kaptai Lake was reported to be (183.2 ± 62.0) mgC/m^3/day during 1989-90 and (242.7 ± 70.8) mgC/m^3/day during 1990-91. The reason behind the slight unlikeness between the present study and Ahmed et al. (1994) is probably the difference of study period of both cases. The study period by Ahmed et al. (1994) was carried on for two years whereas the present study lasted only for 6 months.

Sontakke and Mokashe (2014) studied primary productivity of two freshwater lakes (Mombatta and Kagzipura) of Aurangabad district, Maharashtra, India; where gross primary productivity of Mombatta Lake and Kagzipura Lake in winter was reported to be respectively (1.53 ± 0.19) gC/m3/hr and (2.50 ± 0.90) gC/m3/hr, whereas the net primary produtivity was (1.46 ± 0.19) gC/m3/hr and (2.38 ± 0.88) gC/m3/hr respectively. The study indicated that water body was polluted and leaded towards eutrophication. Comparing to this study, we can say that Kaptai Lake is not led to eutrophication and indicates its condition to be quite healthy.

5.4. Inter-relationship among parameters

In the present study, Phytoplankton abundance showed a statistically significant, a moderate positive correlation with gross primary productivity, r (24) = .452, p = .027 at significant level of 0.05. There was a statistically significant, moderate positive correlation between zooplankton abundance and gross primary productivity, r (24) = .460, p = .024 at significance level of 0.05. The result demonstrated that phytoplankton and zooplankton abundance had significant effect on the gross primary productivity of Kaptai Lake in the present study. A similar conclusion was reached by Nurfadillah et al. (2019) where a close relationship of 96% was seen between the recorded phytoplankton abundance and primary productivity based on Principal Component Analysis in Muara Kuala Raja, Bireuen district, Ace; meaning abundance of phytoplankton has a positive correlation to primary productivity. Also a statistically significant, strong positive correlation was observed in the present study between gross primary productivity and net primary productivity, r (24) = 0.894, p = 0.00 at significant level of 0.05.

Chapter – 6

Conclusion

This research was conducted to identify the plankton community, their abundance, primary production and the inter-relationship among these parameters of Kaptai Lake. Phytoplanktons are the primary producers of a waterbody on which the whole ecosystem depends for its food web. Zooplanktons play a vital role by feeding on them and passing the energy through food chain to higher trophic levels, ultimately maintaining the whole ecosystem. This study informs us that plankton abundance has an apparent effect on the primary productivity of Kaptai Lake. Findings from research also indicate less abundance of plankton and a lower rate of primary productivity of the lake in comparison with other freshwater lakes. As an evident relationship had been established between plankton abundance and primary productivity, it can be said that the phenomena of decreased plankton abundance and primary productivity are inter-related. Moreover, long-term study would be necessary to deduce if there is any significant reduction in plankton abundance and primary produtivity of Kaptai Lake as well as its effect on lake's fish production.

Chapter- 7

Recommendation and Future Perspective

According to this research work, the following recommendations are suggested:

- ✓ Physical, chemical and biological characteristics of Kaptai Lake should be monitored on a regular basis.
- ✓ Necessary steps should be taken to improve the lake's overall condition and maintain it.
- ✓ Further research work should be conducted to correlate primary productivity and fish production of Kaptai Lake.
- ✓ People should be made aware of the importance of Kaptai Lake.
- ✓ Gained information will help anyone for their further research.

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Appendices

Appendix 1: Phytoplankton abundance data in Jolojan Ghaat station

Class	**Genus**	**Sep, 2021 (cells/L)**	**Oct, 2021 (cells/L)**	**Nov, 2021 (cells/L)**	**Dec, 2021 (cells/L)**	**Jan, 2022 (cells/L)**	**Feb, 2022 (cells/L)**
Chlorophyceae	*Actinastrum*	605.17	1739.87	2345.04	465.98	826.06	0.00
	Cosmarium	2950.21	2345.04	1210.34	1997.07	1416.10	1791.69
	Chlamydomonus	226.94	529.53	0.00	199.71	196.68	146.26
	Mougeotia	0.00	0.00	0.00	0.00	314.69	438.78
	Pandorina	2345.04	832.11	832.11	798.83	904.73	1681.99
	Pediastrum	1588.58	1966.81	2118.10	865.40	354.03	402.22
	Spirogyra	378.23	1285.99	0.00	998.53	550.71	658.17
	Staurastrum	1739.87	1815.52	1285.99	1730.79	786.72	1133.52
	Xanthidium	2571.98	1588.58	1361.64	1264.81	196.68	731.30
	Zygnema	1134.70	1437.28	1285.99	0.00	432.70	438.78
Cyanophyceae	*Anabaena*	907.76	1739.87	2345.04	1531.09	904.73	767.87
	Aphanothece	1512.93	2193.75	1966.81	1664.22	2320.84	3949.03
	Gleocapsa	1664.22	756.47	832.11	532.55	747.39	0.00
Dinophyceae	*Ceratium*	1512.93	1664.22	1134.70	798.83	708.05	694.74
Euglenophyceae	*Phacus*	605.17	529.53	680.82	266.28	550.71	438.78
	Total	19743.74	20424.56	17398.70	13114.08	11210.81	13273.13

*Sep=September, Oct=October, Nov=November, Dec=December, Jan=January, Feb=February

Appendix 2: Phytoplankton abundance data in Kandemu station

Class	Genus	Sep, 2021 (cells/L)	Oct, 2021 (cells/L)	Nov, 2021 (cells/L)	Dec, 2021 (cells/L)	Jan, 2022 (cells/L)	Feb, 2022 (cells/L)
Chlorophyceae	*Actinastrum*	1588.58	2420.69	3404.09	665.69	1180.09	0.00
	Cosmarium	2496.33	2950.21	1588.58	2329.91	1770.13	2047.65
	Chlamydomonus	302.59	605.17	1285.99	332.84	317.72	219.39
	Mougeotia	0.00	0.00	0.00	0.00	453.88	511.91
	Pandorina	2496.33	907.76	1361.64	1131.67	1089.31	1937.95
	Pediastrum	1739.87	2723.27	2496.33	1065.10	499.27	438.78
	Spirogyra	1588.58	2345.04	529.53	1464.52	544.65	987.26
	Staurastrum	3782.33	2118.10	1134.70	1464.52	816.98	1096.95
	Xanthidium	2420.69	2571.98	2118.10	1397.95	272.33	585.04
	Zygnema	378.23	1891.16	907.76	0.00	408.49	1389.47
	Anabaena	1437.28	2345.04	3404.09	1730.79	1134.70	1170.08
	Aphanothece	1739.87	2571.98	2269.40	2463.05	2224.01	4095.29
	Gleocapsa	605.17	832.11	1059.05	732.26	953.15	0.00
Dinophyceae	*Ceratium*	1664.22	2269.40	2950.21	998.53	1180.09	841.00
Euglenophyceae	*Phacus*	529.53	605.17	453.88	465.98	1316.25	548.48
	Total	22769.60	26551.93	24963.35	16242.82	14161.03	15869.25

*Sep=September, Oct=October, Nov=November, Dec=December, Jan=January, Feb=February

Appendix 3: Phytoplankton abundance data in Shubholong Jhorna station

Class	Genus	Sep, 2021 cells/L	Oct, 2021 cells/L	Nov, 2021 cells/L	Dec, 2021 cells/L	Jan, 2022 cells/L	Feb, 2022 cells/L
Chlorophyceae	*Actinastrum*	1891.16	3555.39	3252.80	998.53	1376.77	511.91
	Cosmarium	2118.10	4538.79	2269.40	2263.34	1888.14	2559.56
	Chlamydomonus	907.76	680.82	983.40	532.55	432.70	292.52
	Mougeotia	0.00	0.00	0.00	0.00	550.71	1023.82
	Pandorina	2571.98	756.47	1285.99	1597.65	2084.82	1974.52
	Pediastrum	907.76	907.76	2193.75	1397.95	472.03	475.35
	Spirogyra	1437.28	2496.33	983.40	1597.65	1101.41	1170.08
	Staurastrum	4690.08	2647.63	2042.46	1730.79	1809.46	2522.99
	Xanthidium	2193.75	3555.39	1891.16	1863.93	393.36	658.17
	Zygnema	756.47	2269.40	1664.22	0.00	944.07	1206.65
Cyanophyceae	*Anabaena*	1739.87	2798.92	2269.40	1797.36	1258.76	1426.04
	Aphanothece	2496.33	3782.33	2118.10	2529.62	2871.54	4936.29
	Gleocapsa	680.82	1210.34	1437.28	865.40	1022.74	0.00
Dinophyceae	*Ceratium*	2193.75	1891.16	3101.51	1930.50	904.73	914.13
Euglenophyceae	*Phacus*	907.76	1134.70	605.17	732.26	511.37	1060.39
	Total	25492.87	32225.41	26098.05	19837.54	17622.61	20732.41

*Sep=September, Oct=October, Nov=November, Dec=December, Jan=January, Feb=February

Appendix 4: Phytoplankton abundance data in Shubholong Bazar station

Class	Genus	Sep, 2021 cells/L	Oct, 2021 cells/L	Nov, 2021 cells/L	Dec, 2021 cells/L	Jan, 2022 cells/L	Feb, 2022 cells/L
Chlorophyceae	*Actinastrum*	2193.75	756.47	3857.97	1464.52	1534.11	767.87
Chlorophyceae	*Cosmarium*	2345.04	4463.14	2798.92	2463.05	1927.47	2888.64
Chlorophyceae	*Chlamydomonus*	453.88	756.47	756.47	465.98	668.72	438.78
Chlorophyceae	*Mougeotia*	0.00	0.00	0.00	0.00	1298.09	1316.34
Chlorophyceae	*Pandorina*	2420.69	1210.34	1210.34	2063.64	1455.44	2230.47
Chlorophyceae	*Pediastrum*	1210.34	2420.69	1059.05	2196.77	236.02	585.04
Chlorophyceae	*Spirogyra*	1966.81	3101.51	832.11	1264.81	1219.42	1352.91
Chlorophyceae	*Staurastrum*	4463.14	2269.40	1437.28	1331.38	826.06	2632.69
Chlorophyceae	*Xanthidium*	2042.46	4009.27	2798.92	2396.48	0.00	0.00
Chlorophyceae	*Zygnema*	529.53	2345.04	1891.16	0.00	865.40	1352.91
Cyanophyceae	*Anabaena*	2118.10	2118.10	3025.86	2596.19	1455.44	1206.65
Cyanophyceae	*Aphanothece*	2798.92	3782.33	3177.15	2329.91	3343.58	5411.63
Cyanophyceae	*Gleocapsa*	756.47	378.23	1361.64	1397.95	590.04	0.00
Dinophyceae	*Ceratium*	2496.33	2345.04	2420.69	1730.79	1376.77	841.00
Euglenophyceae	*Phacus*	907.76	680.82	983.40	532.55	511.37	1133.52
	Total	26703.22	29880.37	27610.98	22234.02	17307.92	22158.45

*Sep=September, Oct=October, Nov=November, Dec=December, Jan=January, Feb=February

Appendix 5: Zooplankton abundance data in Jolojan Ghaat station

Group	Genus	Sep, 2021 cells/L	Oct, 2021 cells/L	Nov, 2021 cells/L	Dec, 2021 cells/L	Jan, 2022 cells/L	Feb, 2022 cells/L
Rotifera	*Brachionus*	0.00	226.94	145.24	226.94	226.94	73.13
	Euchlanis	151.29	151.29	290.48	272.33	0.00	0.00
	Keratella	1588.58	1588.58	1307.17	635.43	869.93	1060.39
	Polyarthra	680.82	378.23	363.10	272.33	189.12	548.48
	Asplanchna	226.94	226.94	145.24	136.16	113.47	73.13
Crustacea	Nauplius	832.11	907.76	435.72	363.10	453.88	475.35
Copepoda	*Cyclops*	75.65	0.00	0.00	45.39	75.65	146.26
Protozoa	*Paramecium*	0.00	151.29	217.86	90.78	0.00	0.00
	Total	3555.39	3631.03	2904.83	2042.46	1928.99	2376.73

Appendix 6: Zooplankton abundance (cells/L) data in Kandemu station

Group	Genus	Sep, 2021 cells/L	Oct, 2021 cells/L	Nov, 2021 cells/L	Dec, 2021 cells/L	Jan, 2022 cells/L	Feb, 2022 cells/L
Rotifera	*Brachionus*	75.65	226.94	75.65	338.90	157.34	146.26
	Euchlanis	302.59	302.59	151.29	387.31	0.00	0.00
	Keratella	1059.05	1664.22	1739.87	823.03	590.04	1170.08
	Polyarthra	832.11	756.47	605.17	435.72	590.04	841.00
	Asplanchna	378.23	151.29	75.65	290.48	78.67	109.70
Crustacea	Nauplius	907.76	907.76	378.23	435.72	826.06	804.43
Copepoda	*Cyclops*	226.94	151.29	151.29	145.24	157.34	182.83
Protozoa	*Paramecium*	151.29	75.65	0.00	242.07	0.00	0.00
	Total	3933.62	4236.20	3177.15	3098.48	2399.51	3254.29

*Sep=September, Oct=October, Nov=November, Dec=December, Jan=January, Feb=February

Appendix 7: Zooplankton abundance data in Shubholong Jhorna station

Group	Genus	Sep, 2021 cells/L	Oct, 2021 cells/L	Nov, 2021 cells/L	Dec, 2021 cells/L	Jan, 2022 cells/L	Feb, 2022 cells/L
Rotifera	*Brachionus*	151.29	0.00	157.34	272.33	254.17	265.93
Rotifera	*Euchlanis*	378.23	605.17	236.02	317.72	0.00	0.00
Rotifera	*Keratella*	1134.70	1739.87	1573.45	1134.70	730.75	1429.36
Rotifera	*Polyarthra*	907.76	680.82	708.05	363.10	603.66	698.06
Rotifera	*Asplanchna*	453.88	0.00	236.02	226.94	127.09	132.96
Crustacea	Nauplius	756.47	983.40	393.36	590.04	794.29	1163.43
Copepoda	*Cyclops*	302.59	302.59	157.34	226.94	95.31	99.72
Protozoa	*Paramecium*	226.94	226.94	157.34	136.16	0.00	0.00
	Total	4311.85	4538.79	3618.93	3267.93	2605.27	3789.47

Appendix 8: Zooplankton abundance data in Shubholong Bazar station

Group	Genus	Sep, 2021 cells/L	Oct, 2021 cells/L	Nov, 2021 cells/L	Dec, 2021 cells/L	Jan, 2022 cells/L	Feb, 2022 cells/L
Rotifera	*Brachionus*	226.94	151.29	213.32	290.48	66.57	66.48
Rotifera	*Euchlanis*	75.65	378.23	284.43	326.79	0.00	0.00
Rotifera	*Keratella*	1361.64	1739.87	1493.26	1053.00	832.11	1130.19
Rotifera	*Polyarthra*	983.40	832.11	711.08	363.10	632.40	897.51
Rotifera	*Asplanchna*	529.53	529.53	284.43	254.17	166.42	166.20
Crustacea	Nauplius	983.40	1059.05	426.65	580.97	965.25	1063.71
Copepoda	*Cyclops*	378.23	302.59	213.32	217.86	133.14	232.69
Protozoa	*Paramecium*	151.29	75.65	71.11	326.79	0.00	0.00
	Total	4690.08	5068.32	3697.60	3413.17	2795.90	3556.79

*Sep=September, Oct=October, Nov=November, Dec=December, Jan=January, Feb=February

Appendix 9: Gross primary productivity data

Months	Jolojan Ghaat mgC/m^3/day	Kandemu mgC/m^3/day	Shubholong Jhorna mgC/m^3/day	Shubholong Bazar mgC/m^3/day
September, 2021	208.34	297.92	345.84	325
October, 2021	270.84	416.67	512.5	543.75
November, 2021	375.12	324.96	400.01	425.04
December, 2021	240.24	576.12	512	240
January, 2022	209.66	270.94	368.87	238.43
February, 2022	349.92	365.32	405.12	397.16

Appendix 10: Net primary productivity data

Months	Jolojan Ghaat mgC/m^3/day	Kandemu mgC/m^3/day	Shubholong Jhorna mgC/m^3/day	Shubholong Bazar mgC/m^3/day
September, 2021	121.42	173.62	201.53	189.38
October, 2021	157.84	242.82	298.65	316.85
November, 2021	218.61	189.37	233.09	247.67
December, 2021	140.01	335.733	298.35	139.84
January, 2022	122.19	157.88	214.95	239.93
February, 2022	203.93	212.88	236.07	142.83

Brief biography of the author

Farzana Yasmin Nupur passed the Secondary School Certificate Examination in 2012 with GPA 5.00 followed by Higher Secondary Certificate Examination in 2014 with GPA 5.00. She graduated in 2020 from the Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University (CVASU), Khulshi – 4225, Chattogram. Now, she is a candidate for the degree of MS in Fisheries Resource Management under the Department of Fisheries Resource Management, Faculty of Fisheries, CVASU. She has immersed interest to work on the identification of plankton community and it's inter-relationship with primary productivity of Kaptai Lake.