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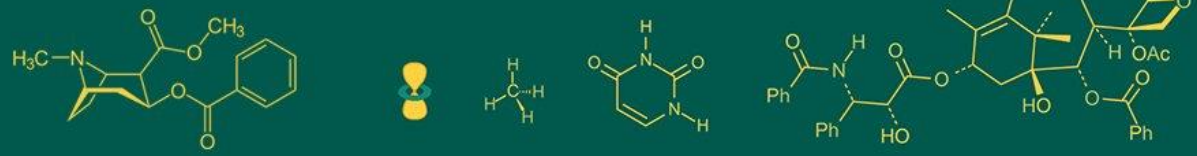

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Evaluation and quantification of phytoplankton diversity of *Ottu* reservoir in Haryana, India

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Abstract
The study was carried out in *the Ottu* reservoir in Sirsa city of Haryana, India. Evaluation and quantification of phytoplankton of the *Ottu* reservoir were monitored from March 2021 to June 2021. The evaluation of the phytoplanktonic population revealed that there 19 genera of phytoplankton belong to class Bacillariophyceae (3 genera), Cyanophyceae (3 genera), Chlorophyceae (11 genera), Euglenophyceae (2 genera) In various months maximum, 123 species of phytoplankton were observed in site two and site 4, and Chlorophyceae found the as dominant group. The highest quantity of phytoplankton was observed in site two, while the minimum quantity was observed in site 3. Shannon and Weaver's diversity index for phytoplankton was found to be maximum in site 1(2.78) and minimum in site 4 (2.05). In site 1 and site 2 significant difference (p<0.05) was observed for the phytoplanktons groups present every month from March to June. However, a non-significant difference was observed in sites 3 and site 4.

Keywords: *Ottu* reservoir, phytoplankton, shannon – weaver diversity index

1. Introduction
Water is an essential component of the environment, and it sustains life on the earth (Shyam *et al*., 2020) [19] with its immense water resources, the state of Haryana in north-eastern India has tremendous scope for augmenting fish production **(**Bhatnagar and Singh, 2010) [3]. The Ottu reservoir is situated at Ottu village (Near Rania) in the mid-south of Sirsa (Haryana) state between 29.29'21" North latitudes and 74.53' 38" East longitudes (Sunder and Khatri, 2018) [22]. The Ottu head is located near the village of Ottu, in the Sirsa district. It serves as a feeder for the Northern and Southern Ghaggar canals, which provide irrigation water to northern Rajasthan. The word plankton originated from the Greek word plankton which means drifter. Plankton need the mercy of water current for their movement. Planktons are divided into two major groups, i.e. phytoplankton and zooplankton. The planktons have tremendous significance in the biology of the aquatic system as they supply nourishment to aquatic organisms. The plankton form the bottom of the food pyramid. Zooplankton and phytoplankton represent a significant link within the aquatic organic phenomenon. At the same time, phytoplankton plays a phenomenal role in the biogenesis of organic material (Yadav, 2015) [24]. Phytoplankton is a single-celled, microscopic, plant community found in freshwater and marine ecosystems. Phytoplankton can be solitary or colonial and range in size from 500µm. Most phytoplankton is autotrophic, like most plants, and they possess the pigment chlorophyll, which allows them to fix solar energy via photosynthesis (Findlay and Kling, 2001) [5]. Phytoplankton is generally found in all varieties of water and is very useful to the surroundings relying upon their numbers. Phytoplankton is fundamental manufacturers of the aquatic food web. Phytoplanktons are significant in keeping the overall carbon cycle.
During photosynthesis, phytoplankton uses carbon and returns oxygen to the water and atmosphere. The amount of free oxygen in the air due to phytoplankton is estimated to be about 50%. Phytoplankton is a good indicator of environmental change, and they are also a good indicator of environmental change **(**Manickam *et al*, 2012) [10]. The phytoplankton comprises mainly diatoms, dinoflagellates, cocolithoides (Prymenophyceae), cyanophytes, and chlorophytes.

Plankton is the essential constituent of trophic structure that helps transfer senergy to higher trophic levels. The phytoplankton constitutes 95% of the entire marine plant production (Yadav, 2015) [24]. Most fish and shellfish larvae in nature feed on small phytoplanktonic and zooplanktonic organisms (Das *et al*., 2012) [4].

2. Materials and methods

2.1 Study Area

The Ottu reservoir is about fourteen km. from Sirsa district in Haryana. The average depth of the reservoir is 2.2 m., and the area of a water body is about 67400 m^2.

2.2 Sampling sites

In the present research, four fixed sampling sites were selected for collecting phytoplankton from four different directions (East, West, North, and South) of the *Ottu* reservoir and named Sampling Site 1, Site 2, Site 3, and Site 4.

2.3 Collection of sample and analysis

The samples of Phytoplankton were collected by filtering 50L of water through a 50 µm mesh plankton net with a demarcating collecting tube. These samples were collected in 100ml plastic bottles and then concentrated to a standard volume of 50ml with distilled water. Four per cent buffered formalin was used to preserve the sample and brought to the laboratory for qualitative and quantitative analysis. The collected sample was observed under a high-quality compound microscope (Magnus™ MX21iLED) at 4X, 10X, 40X, and 100X to identify phytoplankton. The phytoplankton identification was made up to the genus level using the methods from (Ward and Whipple, 1959; Needham and Needham, 1962; APHA, 1998; Bhatnagar and Singh 2010) [23, 13, 2, 3]. For quantitative analysis of phytoplankton, organisms were counted in Sedgwick rafter cells, 1.0 ml of the concentrated sample was transferred to the cell compartment. Phytoplankton was allowed to settle; ten randomly selected chamber fields were counted under a microscope, and L-1 was calculated as follows.

Total No. of Planktons (L^{-1}) = (Pp × C × 100) /L

Where,
Pp = Number of phytoplankton counted in ten fields
C = Volume of final concentrate of the sample (ml)
L = Volume of water sample filtered
Species Diversity Index (d)
Shannon and Weaver Diversity Index was used to determine the species diversity of phytoplankton[16].
d = - ∑ (ni/N) log2 ni/N
d = Species diversity
ni = Number of individuals of i th species.
N = Total Number of individuals in the sample

2.4 Statistical analysis

The data obtained in the present investigation were subjected to analysis to a 2-factor analysis, utterly randomized design (CRD). The critical difference value at P = 0.05 level was used to compare different phytoplankton Groups and Months. All the values are the mean of 3 replications.

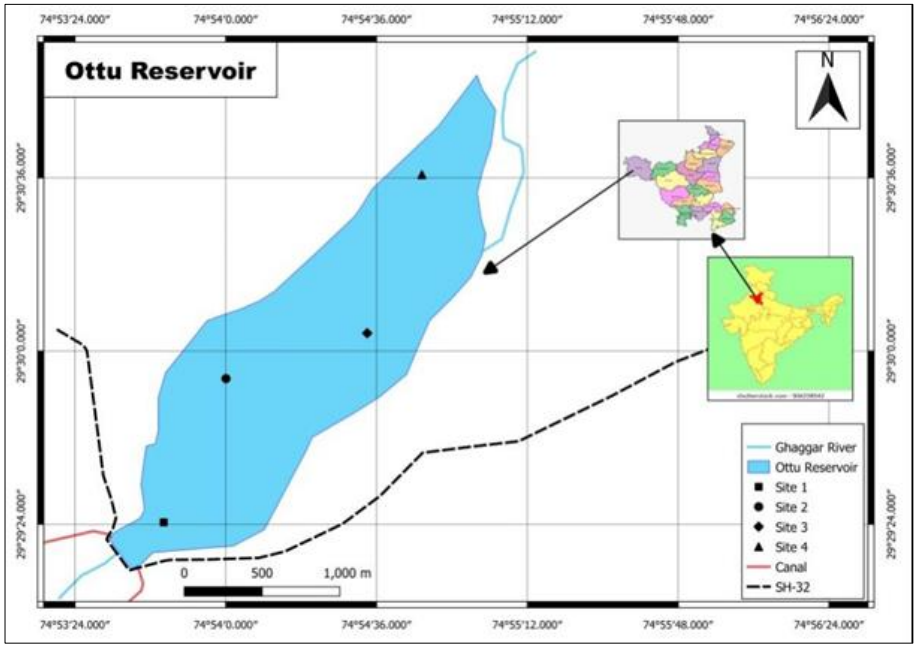

Fig 1: Map of *Ottu* reservoir with various sampling sites

3. Results

3.1 Phytoplankton

In *the* ottu reservoir, the phytoplankton population was represented by 19 genera and belonged to four major groups. Chlorophyceae (11 genera) represented by *Chlorella*, *Coleastrum*, *Pediastrum*, *Oocysts*, *Ankistrodesmus*, *Closterium*, *Scenedesmus*, *Desmodesmus*, *Protoccocus*, *Eudorina* and *Chlamydomonas*., Bacilloriophyceae (3 genera) represented by *Navicula*, *Syndera*, and *cyclotella*., Euglenophyceae(2 genera), represented by *Euglena*, *Phacus*, and Cyanophyceae (3 genera), represented by *Anabaena*, *Microcystis*, and *Aphanizomenon*. Some phytoplankton species in the Ottu reservoir are shown in (Fig 6). A total of 90 species of phytoplankton was observed during Monthly distribution in site one and the highest percentage composition was shown (Fig 2) by group Chlorophyceae (67%) and the least showed by group Baciliriophyceae (2%). In sites 2, 3 and 4, total

phytoplankton species were discovered. 123, 80, 123. In all sampling sites, the Chlorophyceae group was found to be the most dominant. In contrast, the minor, dominant group varied in sites 1 and 3, and the less dominating group was Bacillariophyceae, while in sites two and four were Cyanophyceae and Euglenophycea. The percentage distribution of sampling sites is given in Fig (2,3,4, 5). The monthly distribution of different phytoplankton species and groups at sampling sites is shown in table 1.

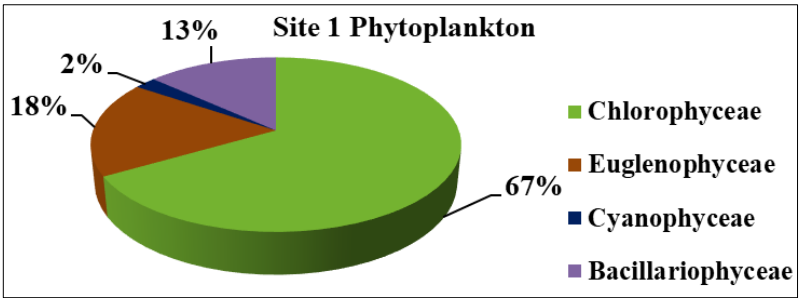

Fig 2: Percentage variation of different phytoplankton groups at site 1

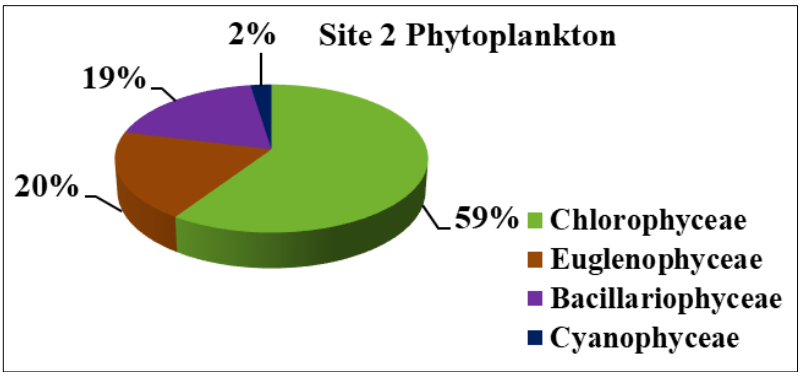

Fig 3: Percentage variation of different phytoplankton groups at site 2

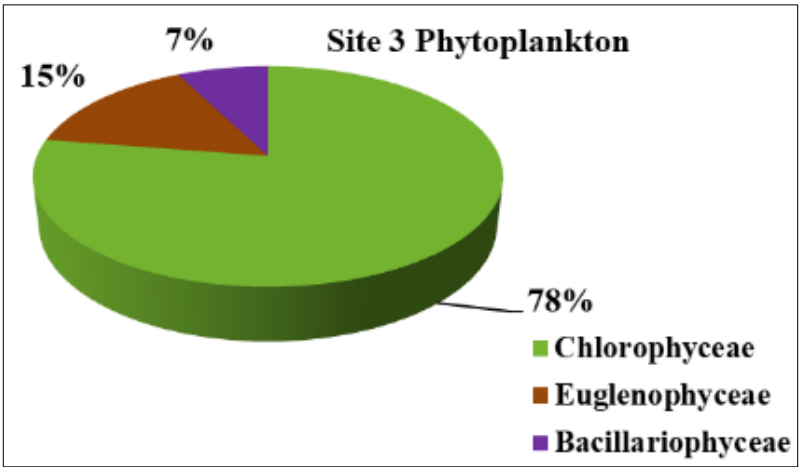

Fig 4: Percentage variation of different phytoplankton groups at site 3

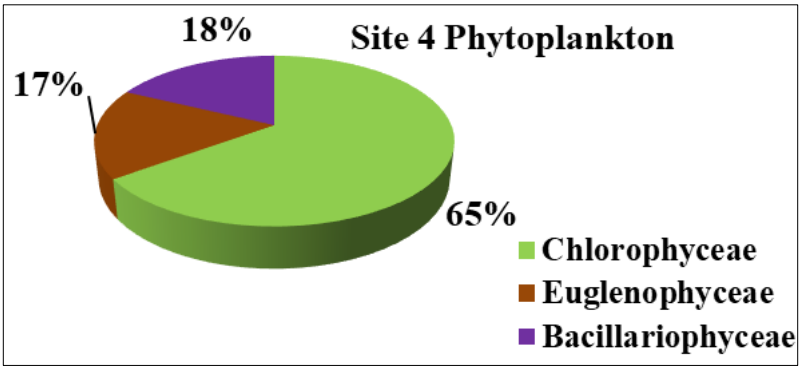

Fig 5: Percentage variation of different phytoplankton groups at site 5

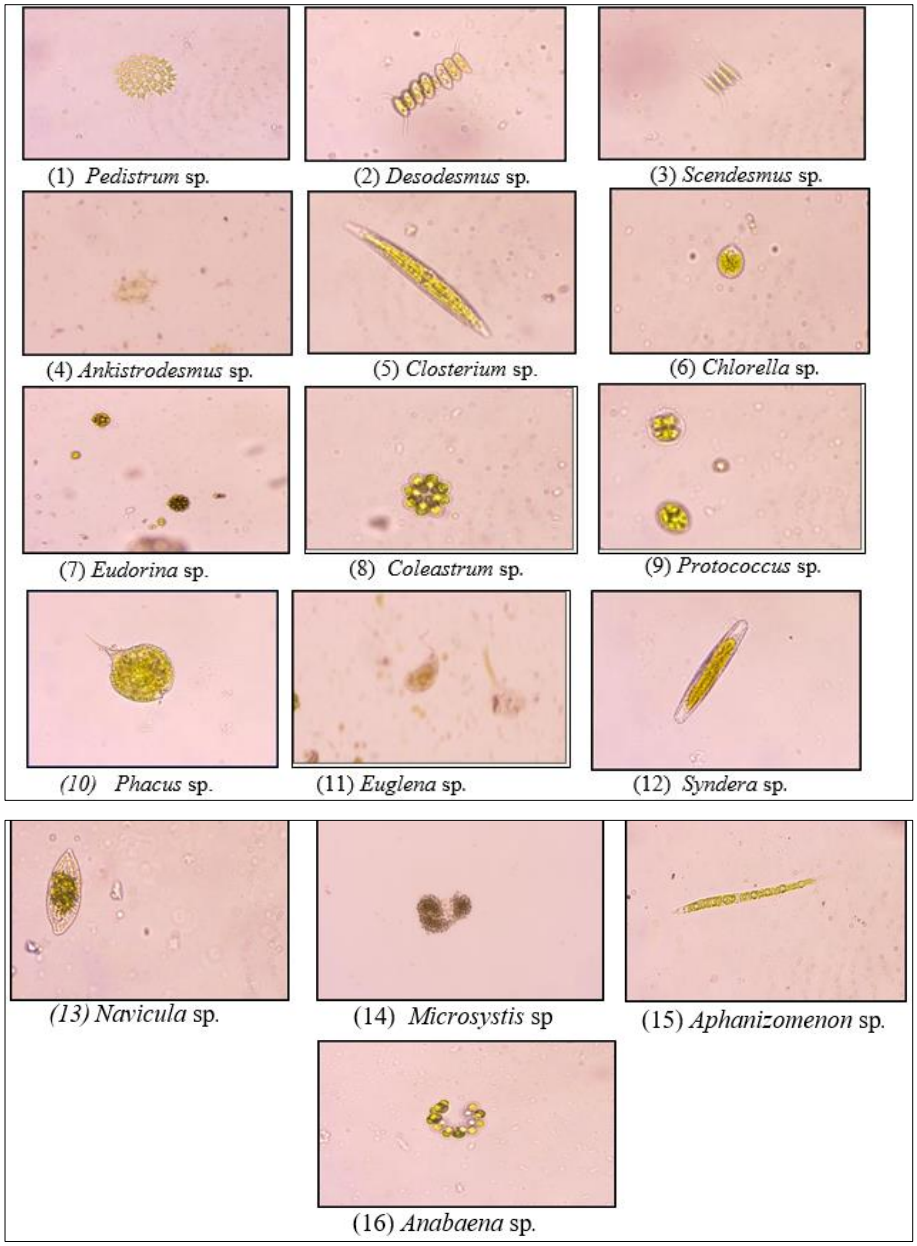

Fig 6: Different phytoplankton species found in Ottu reservoir

3.2 Quantitative analysis

Quantitative analysis for total phytoplankton was different at sampling sites. The total phytoplankton count estimated in the Ottu reservoir was 82,840no/L. The maximum phytoplankton count was recorded in sampling site 2, and the minimum at site 3—table 2 shows the quantity of phytoplankton in different sampling sites.

4. Species diversity index

The maximum value of the Shannon and Weaver diversity index was recorded in May (2.78) and the minimum in April (2.05). Site 1 showed the highest diversity among different sampling sites, and site 3 showed minimum diversity. The Species diversity index of phytoplankton in different sampling sites and months is shown in table 3.

5. Statistical Analysis

5.1 Statistical analysis for Phytoplankton groups

Statistical analysis for Phytoplankton groups showed that in sampling site 1 and site 2 significant difference ($p<0.05$) was observed for the phytoplankton groups present every month from March to June. However, a non-significant difference was observed in site 3 and site 4 (Table 4).

6. Discussion

6.1 Phytoplankton

Phytoplankton is an integral part of the aquatic flora. Phytoplankton is the leading primary producer and has an important position in the aquatic ecosystem; the productivity of the aquatic ecosystem is entirely dependent on phytoplankton. The diversity of phytoplankton components in the aquatic ecosystem is a reliable indicator for monitoring water bodies (Sunder and Khatri, 2018) [22].

The total phytoplankton genera found during the study on *the Ottu* reservoir was 19 and belonged to 4 significant groups, i.e. Bacillariophyceae (3genera), Chlorophyceae (11 genera), Euglenophyceae (2genera), and Cyanophyceae (3 genera). A similar group was found by Sundar and Khatri (2018) [22] during the study on *the Ottu* reservoir. (Nandigam *et al*., 2016) [12] also recorded similar phytoplankton groups *viz*: Chlorophyceae (44 genera), Cyanophyceae (20 genera), Bacillariophyceae (15 genera) and Euglenophyceae (3

genera) and (Senthil Kumar and Siva Kumar, 2008; Summarwar, 2012) [17, 21] also found the same group during their study. In contrast (Kumar *et al*., 2015) [9] found a significant group *viz.* Cyanaphyceae, Chlorophyceae, Bacillariophyceae, and Desmidiaceae.

During the present investigation in *the Ottu* reservoir, the most dominant phytoplankton group observed was Chlorophyceae (66.10%), followed by Euglenophyceae (17.54%), Bacillariophyceae (15.41%), and Cyanophyceae (1.20%) and alike dominant group Chlorophyceae found by (Ahmed *et al*, 2003; Shyam *et al*, 2020) [1, 19] with 95.0% and 50% respectively. In contrast, Priyanka *et al*. (2014) [15] found groups Chlorophyceae, Bacillariophyceae, Cyanophyceae, and Dinophyceae.

6.2 Quantity of phytoplankton

The total phytoplankton quantity was found to be 82,840 no/ L. found a load of phytoplankton maximum in summer (11,300- 51,850 No/1) and recorded the highest count of phytoplankton (51,850) in and around the estuarine environment. (Matta *et al*., 2018) [11] also found the total number of plankton (Average 893.8 no/l of phytoplankton and 293.31 no/l of zooplankton). The total phytoplankton population ranges from 1190 to 3930 units×103/l observed by Sundar and Khatri, (2018) [22]. (Singh *et al*., 2023) [16] conducted a similar study on Okhla Barrage and also found a total phytoplankton count of 13,000 per liter in October.

6.3 Shannon – Weaver diversity index

Shannon index is carried out on organic structures through a mathematical system utilized in conversation place through Shannon. This is the maximum preferred index. Generally, outcomes come between 1.5 and 3.5, rarely exceeding as much as 4.5.

6.4 Shannon and Weaver diversity index for phytoplankton

During the study period of *the Ottu* reservoir, the range of Shannon and Weaver diversity index for phytoplankton of different sampling sites showed variation in their values. Shannon and Weaver diversity index in sampling site 1 ranged from (2.78- 2.20), in site 2 vacillated from (2.38- 2.08) in site 3 extended from (2.59 – 2.20), and in site 4 fluctuated from (2.21 – 2.05). Six also recorded the diversity index (H), and the value varied between 2.34 to 2.45. The minimum (2.34) was observed during the monsoon season, while the maximum value (highest heterogeneity) detected (2.45) was post-monsoon.

Pandey *et al.* (2014) [14] also recorded a diversity index in monsoon (H= 1.297) followed by winter (H= 1.289) and summer (H= 1.222). Matta *et al*, (2018) [11] recorded the Shannon-Weiner index (1.58). Shannon Index (H) for phytoplankton is highest in Axr (0.6829) and lowest in CV (0.5387), as recorded by (Hossain *et al*., 2017) [8].

7. Conclusion

The present study provides a vision of the distribution and diversity of phytoplankton in the Ottu reservoir. Information about phytoplankton is essential in understanding the functioning and trophic dynamics of different water bodies. The highest quantity of phytoplankton was observed in site two, while the minimum quantity was observed in site 3. Chlorophyceae (11 genera) group were dominant, followed by Bacillariophyceae (3 genera), Cyanophyceae (3 genera) and Euglenophyceae (2 genera). Some actions, such as refraining from washing clothes, bathing animals, disposing of agricultural waste, avoiding chemical fertilizers, and other human activities, should be taken to reduce pollution. This helps the maintenance of ecological balance in freshwater bodies.

Table 1: Monthly distribution of different phytoplankton species and groups at sampling sites

Group	Species	Site 1				Site 2				Site 3				Site 4			
		March	April	May	June	March	April	May	June	March	April	May	June	March	April	May	June
Chlorophyceae	*Chlorella sp*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Closterium sp	-	+	+	+	-	+	+	+	-	+	+	+	-	-	+	+
	Colostrum sp	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+
	Oocystis sp	-	+	+	-	-	-	-	-	-	-	+	-	-	-	+	-
	Pedistrum sp	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Scenedesmus sp	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Desodesmus sp	+	-	+	+	+	-	+	+	+	-	+	+	+	-	+	+
	Protococcus sp	-	+	+	+	-	-	+	-	+	-	+	-	+	-	-	-
	Eudorina sp	-	+	-	-	-	+	-	-	-	+	-	-	-	+	-	-
	Akinstrodesmus sp	-	+	-	-	-	-	-	-	-	+	-	-	-	+	-	-
	Anacystis sp	-	+	-	-	-	+	-	+	-	+	-	-	-	+	-	-
Euglinophyceae	*Euglena sp*	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+
	Phacus sp	+	-	+	-	+	+	+	+	+	-	-	-	+	-	-	-
Bacilliriophyceae	*Navicula sp*	-	+	+	-	+	+	+	+	-	+	-	-	+	+	-	+
	Syendra sp	+	-	+	+	+	-	+	+	+	-	+	-	+	-	+	+
	Cyclotella sp	-	-	-	+	-	-	-	+	-	-	-	+	-	-	-	+
Cyanophyceae	*Anabaena sp*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
	Microcystis sp	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-
	Aphanizomenon sp	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2: Quantity of phytoplankton in different sampling sites

Sampling sites	Phytoplankton no/litre
Site 1	17,850
Site 2	24,510
Site 3	16,000
Site 4	24,480

Table 3: Species diversity index of phytoplankton in different sampling sites and months

Month	Sampling sites			
	Site 1	Site 2	Site 3	Site 4
March	2.21	2.23	2.20	2.32
April	2.52	2.08	2.27	2.05
May	2.78	2.38	2.59	2.21
June	2.20	2.34	2.15	2.21

Table 4: Statistical analysis for Phytoplankton groups in different sites

Statistical Analysis	Site 1		Site 2		Site 3		Site 4	
CD at 5%	Phytoplankton group	Total Months	Phytoplankton groups	Total Months	Phytoplankton groups	Total Months	Phytoplankton groups	Total Months
	1.28	1.28	1.07	N/A	1.24	N/A	1.46	N/A
	P*M=2.57		P*M= 2.14		P*M= N/A		P*M= N/A	

Here P= Phytoplankton groups and M= Month, TWO WAY ANOVA (Mean of three replication)

8. References

1. Ahmed KKU, Ahamed SU, Hossain MRA, Ahmed T, Barman S. Quantitative and qualitative assessment of plankton: some ecological aspect and water quality parameters of the river Meghna, Bangladesh. Bangladesh Journal of Fisheries Research. 2003;7(2):131-140.
2. APHA, AWWA, WPCF. Standard methods for the examination of water and waste water. 20th edition. New York: American Public Health Association; 1998.
3. Bhatnagar A, Singh G. Culture fisheries in village ponds: a multi-location study in Haryana, India. Agriculture and Biology Journal of North America. 2010;1(5):961-968.
4. Das P, Mandal SC, Bhagabati SK, Akhtar MS, Singh SK. Important live food organisms and their role in aquaculture. Frontiers in aquaculture. 2012;5(4):69-86.
5. Findlay DL, Kling HJ. Protocols for measuring biodiversity: phytoplankton in freshwater. Winnipeg: Department of Fisheries and Oceans; c2001. p. 1-10.
6. Ghosh S, Barinova S, Keshri JP. Diversity and seasonal variation of *phytoplankton* community in the Santragachi Lake, West Bengal, India. QScience Connect. 2012;3(1):1-19.
7. Gireesh R, Varghese M, Thomas VJ. Phytoplankton-collection, estimation, classification and diversity, Teaching Resource. Marine biology Central Marine Fisheries Research Institute. 2015;24-28.
8. Hossain MRA, Pramanik MMH, Hasan MM. Diversity indices of plankton communities in the River Meghna of Bangladesh. International Journal of Fisheries and Aquatic Studies. 2017;5(3):330-334.
9. Kumar S, Sharma BK, Sharma SK, Upadhyay B. Primary productivity and phytoplankton diversity in relation to fisheries potential of the Lake Udai Sagar, Udaipur. International Journal of Fauna and Biological Studies. 2015;2(5):09-12.
10. Manickam N, Bhavan PS, Vijayan P, Sumathi G. Phytoplankton species diversity in the Parambikulam-Aliyar irrigational canals (Tamil Nadu, India). International Journal of Pharma and Bio Sciences. 2012;3(3):289-300.
11. Matta G, Gjyli L, Kumar A, Machel J. Hydrochemical characteristics and planktonic composition assessment of River Henwal in Himalayan Region of Uttarakhand using CPI, Simpson's and Shannon-Weaver Index. J Chem Pharm Sci. 2018;11(1):122-130.
12. Nandigam J, Rangaiah SG, Geddada MNR. A study on seasonal changes of *microalgae* in relation to the physico-chemical parameters of Satyavaram Pond, Srikakulam Dist, India. Indian J Geo Mar Sci. 2016;45(12):1660-1668.
13. Needham JG, Needham PR. A guide to the study of freshwater biology. 5th ed. Liolden-day. Inc.; 1962.
14. Pandey BN, Siddhartha R, Tanti KD. Phytoplanktonic diversity and their relationships with certain Physico-chemical properties of Swamp of Purnia, Bihar (India). Ann Exp Biol. 2014;2(1):17-27.
15. Priyanka M, Anita B, Girish C. Phytoplankton Diversity of Western Yamuna Canal and River Yamuna in Yamunanagar, Haryana. Int Res J Environ Sci. 2014;3(2):1-7.
16. Singh A, Ravikant, Verma S, Mehta P, Jatav SK, Yadav S. Study of hydrobiological parameters and their effect on plankton diversity in Yamuna river at Okhla barrage. J Exp Zool. 2023;27:000-000.
17. Senthilkumar R, Sivakumar K. Studies on phytoplankton diversity in response to abiotic factors in Veeranam lake in the Cuddalore district of Tamil Nadu. J Environ Biol. 2008;29(5):747-752.
18. Shannon EE, Weaver W. The mathematical theory of communication. Univ. of Illinois Press; 1963.
19. Shyam R, Kumar P, Badola S. Seasonal variation in the planktonic diversity of Tumaria reservoir of Kashipur Uttarakhand India. Environ Conserv J. 2020;21(3):119-125.
20. Smitha PG, Byrappa K, Ramaswamy SN. Physico-chemical characteristics of water samples of Bantwal Taluk, south-western Karnataka, India. J Environ Biol. 2007;28(3):591.

21. Summarwar S. Studies on plankton diversity in Bisalpur reservoir. Int J Life Sci Bot Pharm Res. 2012;1(4):64-73.
22. Sunder S, Khatri AK. Studies of Phytoplankton Diversity in Ottu Reservoir, Sirsa (Haryana), India. Res J Recent Sci. 2018;6(1):1295-1296.
23. Ward HB, Whipple GC. Assessment of environmental changes in the Iraqi Marshes by index of biological integrity. Freshw Biol. 1959;3(7):1248.
24. Yadav P. Studies on biodiversity of zooplankton in Kass lake during rainy and winter seasons. Int J Res Biosci Agric Technol. 2015;3(2):399-402.