FRESH WATER PHYTOPLANKTON DIVERSITY OF MAYANUR DAM, TAMIL NADU, INDIA

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ABSTRACT: *Phytoplankton community structure, composition and species diversity in aquatic ecosystem are determined by several physico-chemical parameters. Spatial and temporal variations in phytoplankton distribution are widely affected by the hydrochemical and physical factors. The influence of these factors on phytoplankton community alters species composition and their diversity in the marine ecosystem. Comprehencing the dynamic environmental parameters and their influence on phytoplankton productivity is extremely important as it plays a vital role in the food web and productivity. In addition, aquaculture and anthropogenic activities also significantly contribute to changes in the system. The phytoplankton recorded the presence of 28 species belonging to Cyanophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae and Dinophyceae. Chlorophyceae was represented by 11 species belonging to 11 genera. Of these, only four species were perennial Bacillariophyceae were represented by five species belonging to five genera of which three species were perennial Euglenophyceae was represented by three species belonging to three genera. Among these, only one species was perennial Dinophyceae was represented by a single species (C. hirudinella). It was only a seasonal species recorded during the second year with its peak in November. A closer perusal of class count reveals that February was dominated by Cyanophyceae while May was dominated by both Chlorophyceae and Euglenophyceae while August was dominated by Bacillariophyceae and November by Dinophyceae as evident by their peaks during these periods. Thus, eventhough all groups occurred in the system, each one preferred to record their peaks at a particular period of time.*

Key Words: *Phytoplankton, Mayanur Dam, Tamil Nadu.*

INTRODUCTION

Phytoplankton are the primary source of a food chain, which contributes to the major fishery resource around the world (Vajravelu *et al*., 2018). They are responsible for the formulation of a biological community and regulate the food web (Falkowski *et al*., 2008; Field *et al*., 1998). Phytoplankton act as an important component of the ecosystem, as they liberate oxygen during photosynthesis and aid in energy exchange process (Khan, 2003). They play a crucial role in mitigating the climate change and global warming, thereby recede the global CO_2 levels (Santhosh Kumar and Perumal, 2012). Phytoplankton community structure, composition and species diversity in aquatic ecosystem are determined by several physico-chemical parameters (Sin *et al*., 1999). Spatial and temporal variations in phytoplankton distribution are widely affected by the hydrochemical and physical factors. The influence of these factors on phytoplankton community alters species composition and their diversity in the marine ecosystem (Durate *et al*., 2006; Madhu *et al*., 2007). Generally, shallow water and estuaries show seasonal fluctuations among variables depending on the regional rainfall, tidal inflow and various abiotic and biotic processes, which play substantial role in nutrient cycle (Choudhury and Panigrahy, 1991).

Phytoplankton community is mostly dependent on nutrients and physical parameters in a coastal environment. The nutrient availability is frequently considered as a key factor regulating the phytoplankton abundance, growth and metabolism. Significant work has been done in relation to seasonal variation in phytoplankton species composition in the different coastal ecosystem of India (Menon *et al*., 2000; Sahu *et al*., 2012; Siva Sankar and Padmavathi, 2012; Sridhar *et al*., 2006). The present study area is highly influenced by seasonal changes in freshwater.

As phytoplankton species have different physiological requirements show diverse responses to physico-chemical parameters (Rawat and Seema Trivedi, 2018). Comprehencing the dynamic environmental parameters and their influence on phytoplankton productivity is extremely important as it plays a vital role in the food web and productivity. In addition, aquaculture and anthropogenic activities also significantly contribute to changes in the system. Hence the present study was attempted to analyse the phytoplankton composition in Mayanur Dam situated in Tamil Nadu, India.

MATERIALS AND METHODS

Physico-Chemical Variables

Water samples were drawn from surface water and stored in separate polyethylene bottles for later analyses in the laboratory, while some physico-chemical variables like [dissolved oxygen (DO), hydrogen-ion concentration (pH), free carbondioxide (free CO_2), phenolphthalein alkalinity (PPA) and methyl orange alkalinity (MOA)] were analysed in the field itself, others were analysed in the laboratory. Duplicate samples of all variables were taken and analysed and the average values taken.

The atmospheric, surface water temperatures were measured using a mercury thermometer calibrated to 100°C. Atmospheric temperature was measured in shade, while surface water temperature was analysed by taking the surface water in a container and then measuring it. The water level of the lake was measured using a graduated rope provided with a weight at one end. The measurement was done on every sampling day at a particular spot. The transparency of the water column was measured using a Secchi's disc, while dissolved oxygen (DO) was estimated using unmodified Winkler's method (Ellis *et al*., 1984). Free carbondioxide (free CO_2) alkalinity (phenolphthalein and methyl orange) and total dissolved solids (TDS) were determined according to Saxena (1987). pH was measured with a digital pH pen (Hanna) and electrical conductivity using a water analysis kit. Nutrients like phosphate, silicate, ammonia-nitrogen, nitrite-nitrogen, sulphate, calcium and magnesium were estimated according to APHA (1989). Nitrate-nitrogen (NO_3-N) was estimated after Mackereth (1961) and chloride after Strickland and Parsons (1972). While oxidizable organic matter, nitrogenous organic matter and suspended solids were done following APHA (1995), Trivedy and Goel (1986) and Taylor (1949), biological oxygen demand (BOD) was estimated following the procedure of Sawer and Brandey (1946) and chemical oxygen demand (COD) as per Moore *et al*. (1949).

Phytoplankton Analysis

Surface water samples were collected with the help of a satin net (pore diameter 4.5 μm) fitted to an aluminium frame around 8:00 a.m. for a period of two years (2016-17 and 2017-18). Collection was done on a monthly basis. The counting of algae was done using a Sedgwick-Rafter Counting Cell (Saxena, 1987). Samples were isolated and identified by standard manuals (Geitler, 1932; Desikachary, 1959; George, 1962; Starmach, 1966; Pennak, 1978; Rippka *et al*., 1979; Adoni and Vaishya, 1985; Trivedy *et al*., 1987; Sridharan, 1989; Kanungo *et al*., 2005). While phytoplankton population density was estimated by drop method as described by Pearsall *et al*. (1946), counting and identification of algae and euglenoids were done by following Pennak (1978), Prescott *et al.* (1982), Adoni and Vaishya (1985), Trivedy *et al*. (1987) and Sridharan (1989). In addition, diversity indices were also calculated following Trivedy *et al*. (1987). Finally, the results obtained in the present study were statistically treated for a meaningful discussion.

RESULTS AND DISCUSSION

The phytoplankton recorded the presence of 28 species belonging to Cyanophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae and Dinophyceae (Tables 1-5). Cyanophyceae were represented by eight species belonging to 8 genera. However, among these species only three species were perennial (*Anabaena circinalis, Microcystis aeruginosa* and *S. major*), while the others were perennial. Even though each species recorded a particular time of the year to occur in maximum number, as a group, Cyanophyceae recorded minimal counts during September/ October and maximal counts uniformly in February.

A perusal of literature reveals contrasting results. Ghosh *et al.* (1974) reported that Cyanophyceae preferred the monsoon period to record their highest counts while Singh (1981) recorded their preference for summer season. However, Kastooribai (1991) recorded their preference for January and February, while Jayanthi (1994) suggested that this group preferred May and June to record highest counts. Sivakami (1996) while working on aquatic systems in Tamil Nadu recorded Cyanophyceae to dominate in February in one system and November in another pond. Affan *et al.* (2005), however, recorded Cyanophyceae to record their maximal counts in the spring to autumn months while Rajagopal *et al.* (2010) observed that this group recorded highest counts in June and Sirajunisa (2014) recorded highest Cyanophyceae counts in June.

As to the differences in the season of dominance of Cyanophyceae, Ganapati *et al.* (1943) suggested that they reached the peak while temperature, pH, alkalinity silicates and phosphates were high. Correlation of Cyanophyceae with the above parameters showed a positive correlation with temperature (0.46), pH (0.56), alkalinity (0.92), silicates (0.48) and phosphate (0.38). Hutchinson (1967) however, suggested that the group reached their peak when pH was between 7 and 9. In the present study also pH was within this range. That is why probably Cyanophyceae was recorded throughout the year. Nevertheless, Sahai and Sinha (1969) Hegde and Bharathi (1985), Sivakami (1996) and Sirajunisa (2014) also suggested that higher cyanophycean counts were obtained when calcium, oxidizable organic matter, ammonia, phosphate and nitrate were recorded in high concentrations. Correlation between these parameters also reveals a positive relationship (Tables 1-6).

In the present study, Cyanophyceae formed 28.6% of the total phytoplankton. A perusal of literature reveals that Cyanophyceae formed 11.3 to 66.3% of the phytoplankton in various freshwater systems across India. Hegde and Bharathi (1985) recorded levels to range from 11.4 to 21.65% in three systems while Singh (1990) recorded 27%, Jayanthi (1994) recorded 40% and Sivakami (1996) observed this group to form 46.6%. Recently Sirajunisa (2014) recorded a Cyanophycean percentage of 30 in a system in Tamil Nadu. Thus, the percentage levels recorded in the present study are in line with the observation made by others.

A perusal of the various cyanophycean species reveals that *M. aeruginosa* was the most dominant one followed by *S. major* and *A. ciranalis*. Literature reveals that *M. aeruginosa* has been reported to be the commonest algae to occur in almost all tropical ponds. Further, it has also been reported as the dominant algae in many freshwater systems of Tamil Nadu (Ganapati, 1950, 1955; Sreenivasan, 1968a, b; Melack *et al.,* 1982; Nandan and Patel, 1983; Sivakami, 1996; Sirajunisa, 2014).

Regarding the importance of blue green algae to aquaculture, Prasad and Padmavathi (1994) suggested that they are important in fish production as they are preferred as food by zooplankton like rotifers in addition to carps while Ayyappan *et al.* (1990) reported that *Spirulina* has a high potential as a feed supplement for carp fries.

Chlorophyceae was represented by 11 species belonging to 11 genera. Of these, only four species were perennial (*C. vulgaris, E. elegans, P. duplex* and *U. zonata*). Further, eventhough Chlorophyceae were recorded throughout the period of study, the minimal count was recorded in August and the maximum in May throughout the period of study.

Literature reveals that chlorophytes appeared to prefer different seasons in different aquatic systems. Thus Kohli (1981) recorded highest counts in January and February while Kundanagar and Zutshi (1985) recorded maximal chlorophycean counts in May/June and Kastooribai (1991) observed their peak in October. Sivakami (1996) on the other hand, recorded maximal counts during the period between October and February while Affan *et al*. (2005) recorded maximal counts in the rainy season and Rajagopal *et al*. (2010) observed highest counts in June.

Pearsall (1932) suggested that Chlorophyceae occurred when NO_3 and PO_4 were moderate and organic matter high. However, Melack *et al*. (1982) later suggested that PO_4 influenced their growth more than NO_3 and NH_3 in African lakes. A perusal of correlation between Chlorophyceae and PO_4 appeared to show a higher positive correlation (0.72) than that of NO_3 (0.64) and NH_3 (0.66). Gonzalves and Joshi (1946) nevertheless, reported that higher pH with paucity of calcium also favoured this group.

In this study, a comparison of the percentage contribution of this group revealed that it formed 39.3% of the total phytoplankton. Literature reveals that this group formed 7 - 45.3% of the total phytoplankton in various aquatic systems. While Hegde and Bharth (1985) reported this group to form only 7.32% of the phytoplankton, Kastooribai (1991) recorded this group to form 15% and Jayanthi (1994) observed this group to form 17.5% in one system and 40% in another pond. Sivakami (1996) later suggested this group to represent 18.8% while Rajagopal *et al*. (2010) recorded this group to form 45.3% of the phytoplankton. Thus it appears that the percentage composition of this group is in line with the observation made by others.

According to Pearsall (1932), Chlorophyceae are typical of a warm Calcarious lake moderately rich in available nitrogen while Palmer (1959) suggested that the presence of chlorophycean species like Scenedesmus indicates pollution and Jayanthi (1994) reported that the presence of Chlorophyceae are important for aquaculture as they are preferred by zooplankton which in turn are food for many fish species.

Bacillariophyceae were represented by five species belonging to five genera of which three species were perennial (*N. sigimoidea, P. major* and *S. ulna*). Eventhough each species preferred a certain time of the year to record their highest counts, the group as a whole appeared to prefer August as the highest count was recorded in this month.

Literature reveals that Jayanthi (1994) reported Bacillariophyceae preferred February and March, while Kastooribai (1991) suggested this group to record maximum counts in March - May and Kundangar and Zutszhi (1985) recorded their preference during March to September. Singh (1990) reported this group to prefer August while Hegde and Bharathi (1985) recorded their preference in February / March. However, Rajagopal *et al.* (2010) suggested that this group preferred July to record their highest counts.

Literature reveals that Hecky and Kilham (1988) observed that a high concentration was noted between high ranges in alkalinity and certain diatom assemblages dominated when water had a high concentration of NO_3 and PO_4 which was evident in the present study also. Hegde and Bharathi (1985) suggested that high levels of Ca, SiO_2, DO and lower concentrations of NH_3 and oxidizable organic matter affected diatom population. The same condition appears to be true in this present study also as there was a strong positive correlation between this group and Ca (0.84) and DO (0.93). Nevertheless, Wetzel (1983) reported that of all the aspects of chemical determination of succession and productivity, the negative relationship between diatoms and silicate concentration is among the most apparent. This was true in the present study also as a negative correlation was obtained between diatoms and silicate concentration (–0.74).

In terms of percentage, Bacillariophyceae formed 17.8% of the total phytoplankton in the present study. Literature reveals that this group represented 4.6 to 57.9% of the phytoplankton. Singh (1990) reported this group to form 4.6% while Hegde and Bharathi (1985) recorded this group to form 14.7% and Jayanthi (1994) suggested this group to represent 23.6% of phytoplankton. Sivakami (1996) on the other hand, reported this group to form 45.88% while Kastooribai (1991) recorded this group to form 50.6% and Hegde and Bharathi (1985) observed this group to form 57.9% in another system. A comparison of the percentage contribution of Bacillariophyceae obtained in the present study with those of others, reveals that the levels are comparable eventhough it was on the lower side in the present study.

Euglenophyceae was represented by three species belonging to three genera. Among these, only one species was perennial (*E. viridis*) and recorded its peak in May. However, as a group, Euglenophyceae recorded as lowest count in June and the highest count in May. Literature reveals that Singh (1981) and Haque *et al*. (1990) also reported their preference to occur in high numbers during the summer season as was noticed in the present study. However, Sukumaran (1989) reported their preference during the months of April, June, September and December while Singh (1990) suggested that they preferred December and Kastooribai (1991) observed that this group preferred January and October. On the other hand, Jayanthi (1994) reported its preference during September and October while Sivakami (1996) recorded its preference for July and August. Recently, Affan *et al.* (2005) recorded their preference during the autumn months while Rajagopal *et al*. (2010) suggested its preference for June.

According to Wetzel (1983), the development of euglenoids occur when ammonia and dissolved nitrogen compounds are higher in addition to organic matter. This appears to be true in the present study also as there was a positive relationship between euglenoids and NH_3 (0.48), NO_2 (0.56) as well as NO_3 (0.76). However, Hegde and Bharathi (1985) observed maximum euglenoid growth to occur when there was high free CO_2, oxidizable organic matter and chloride. In the present study, there was a positive correlation with free CO_2 (0.84) indicating their interrelationship. Singh (1990) on the other hand reported that there was a direct relationship with Fe. However, Fe was not analysed in the present study.

In terms of percentage, euglenoids formed 10.7% of the total phytoplankton. Literature reveals that euglenoid percentage varied from 0.003 to 28% in various aquatic systems. While Singh (1981) recorded levels ranging from 0.03 to 1.56%, Jayanthi (1994) recorded levels ranging from 7.7 - 9.0% in three different stems. Haque *et al*. (1990) however, recorded a level of 19%¸ while Sivakami (1996) recorded a level of 19.87% and Rajagopal *et al.* (2010) a level of 0.7%. A comparison of these levels with that obtained in the present study reveals comparable results.

Dinophyceae was represented by a single species (*C. hirudinella*). It was only a seasonal species recorded during the second year with its peak in November. In terms of percentage, it represented 3.6% of the total phytoplankton species. This species appears to be unique to this area as there appears to be no literature regarding the presence of this species in this region. Nevertheless Welch (1952) observed that this species occurs from the arctic region where it is free and pelagic for only a few weeks of the year to the warm constantly open waters of the tropics where it is perennial. However, in the present study, the species was not perennial. Palmer (1959), nevertheless, suggested that the presence of this species in a system usually indicates pollution. Based on this criterion, the system under study can be termed as polluted.

A perusal of total phytoplankton count reveals that, in general, for both the years of study, there was a gradually increasing trend from June to reach the peak in March followed by a decline till May. Thus, minimal count was invariably recorded in June and the maximum in March. A closer perusal of class count reveals that February was dominated by Cyanophyceae while May was dominated by both Chlorophyceae and Euglenophyceae while August was dominated by Bacillariophyceae and November by Dinophyceae as evident by their peaks during these periods. Thus, eventhough all groups occurred in the system, each one preferred to record their peaks at a particular period of time. Hutchinson (1964) suggested that algal populations oscillate temporarily in abundance dominating for a period and then become extremely rare. Alternatively, some species enter the resting stage and leave the area for a period of time (Philipose, 1960; Livingstone and Jaworshki, 1980; Middleton and Souter, 2015). Thilman (1982), however, suggested that temperature, salinity, turbidity and nutrient concentration also play an important role in influencing the phytoplankton community. Chellappa *et al*. (2009) suggested that planktonic growth and development are mainly steered by available solar energy input, hydrodynamic forces such as stratification and mixing in the resulting levels of nitrogen and phosphorus.

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Table-1: Monthly Occurrence of Cyanophyceae in the System (i/l)

S. No.	Species	Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1.	*Anabaena circinalis*	2016-17	110	120	130	140	160	170	190	220	180	140	120	130
		2017-18	120	140	160	180	190	200	220	290	230	220	180	160
2.	*Microcystis aeruginosa*	2016-17	1300	1400	1600	1200	1100	1200	1400	1600	1700	1800	1500	1300
		2017-18	1400	1400	1300	1300	1200	1300	1400	1500	1800	1900	1600	1500
3.	*Oscillatoria limosa*	2016-17	10	20	30	20	-	-	-	10	40	60	10	10
		2017-18	20	20	70	20	-	-	-	10	30	80	40	10
4.	*Spirulina major*	2016-17	240	260	300	400	420	620	680	700	740	580	200	100
		2017-18	260	280	200	200	300	440	600	780	820	660	250	200
5.	*Chroococcus giganteus*	2016-17	-	-	-	10	30	80	10	-	-	-	-	-
		2017-18	-	-	-	10	40	70	30	10	-	-	-	-
6.	*Lyngbya limnetica*	2016-17	-	-	-	-	-	-	10	20	40	60	20	10
		2017-18	-	-	-	-	-	-	20	20	70	80	30	20
7.	*Synechocystis aquatilis*	2016-17	20	40	40	30	20	10	-	-	-	-	-	-
		2017-18	20	40	60	30	10	10	-	-	-	-	-	-
8.	*Phormidium calcicola*	2016-17	-	-	-	-	-	-	10	80	30	10	10	-
		2017-18	-	-	-	-	-	-	10	40	20	20	10	-
Total Count		**2016-17**	**1680**	**1840**	**2100**	**1800**	**1530**	**2080**	**2300**	**2630**	**2730**	**2650**	**1860**	**1550**
		2017-18	**1720**	**1890**	**1790**	**1580**	**1740**	**2120**	**2280**	**2650**	**2950**	**2960**	**2110**	**1890**

'–' Represents nil value

Table-2: Monthly Occurrence of Chlorophyceae in the System (i/l)

S.No.	Species	Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1.	*Chlorella vulgaris*	2016-17	160	280	600	580	490	400	360	260	260	180	70	80
		2017-18	200	400	700	660	610	460	380	300	260	200	160	80
2.	*Eudorina elegans*	2016-17	90	110	130	150	160	120	90	80	60	80	80	90
		2017-18	90	120	130	160	180	160	120	90	50	70	80	80
3.	*Pediastrum duplex*	2016-17	20	30	30	30	60	70	80	160	170	120	40	20
		2017-18	20	20	20	40	80	90	100	160	190	160	40	20
4.	*Scenedesmus abundans*	2016-17	10	20	30	20	-	-	-	-	-	-	-	-
		2017-18	10	30	40	20	-	-	-	-	-	-	-	-
5.	*Spirogyra quinine*	2016-17	-	-	-	-	10	60	70	80	90	100	30	20
		2017-18	-	-	-	-	10	30	40	50	70	120	40	10
6.	*Ulothrix zonata*	2016-17	70	60	30	20	10	10	10	10	10	10	10	10
		2017-18	90	50	40	10	10	10	10	10	10	10	10	20
7.	*Zygnema stellinum*	2016-17	-	-	-	-	-	-	10	80	70	60	10	10
		2017-18	-	-	-	-	-	-	10	80	50	40	10	20
8.	*Ankistrodesmus falcatus*	2016-17	-	-	-	40	60	160	90	10	-	-	-	-
		2017-18	-	-	-	30	70	170	120	10	-	-	-	-
9.	*Chlamydomonas simplex*	2016-17	20	40	80	20	10	-	10	40	20	10	60	10
		2017-18	20	40	60	20	10	-	10	40	10	20	70	10
10.	*Closterium striolatum*	2016-17	-	10	30	20	-	-	-	10	40	20	-	-
		2017-18	-	10	40	10	-	-	-	20	60	20	-	-
11.	*Volvox aureus*	2016-17	-	-	-	-	10	30	100	20	-	10	80	100
		2017-18	-	-	-	-	10	40	80	30	-	20	100	120
Total Count		**2011-12**	**370**	**550**	**930**	**880**	**840**	**910**	**850**	**710**	**760**	**620**	**380**	**340**
		2012-13	**500**	**670**	**1030**	**950**	**1010**	**1010**	**930**	**840**	**730**	**690**	**510**	**360**

'–' Represents nil value

Table-3: Monthly Occurrence of Bacillariophyceae in the System (i/l)

S. No.	Species	Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1.	*Nitzschia sigmoidea*	2016-17	210	240	460	220	220	220	220	220	220	440	320	240
		2017-18	210	210	440	270	210	210	210	210	260	450	320	240
2.	*Navicula radiosa*	2016-17	10	-	-	10	30	90	60	20	20	30	10	40
		2017-18	10	-	-	10	20	80	50	10	10	20	10	60
3.	*Synedra ulna*	2016-17	40	20	60	70	90	60	20	10	10	10	10	10
		2017-18	40	20	60	70	80	70	50	20	20	10	10	10
4.	*Cyclotella comta*	2016-17	-	-	-	-	-	-	-	-	-	-	-	-
		2017-18	-	-	-	-	10	20	20	10	-	-	-	-
5.	*Pinnularia major*	2016-17	20	40	40	40	40	10	30	40	50	20	20	20
		2017-18	40	50	20	20	20	20	40	50	60	30	20	20
Total Count		**2016-17**	**280**	**300**	**590**	**340**	**380**	**380**	**330**	**290**	**300**	**500**	**360**	**310**
		2017-18	**300**	**280**	**520**	**310**	**340**	**400**	**370**	**300**	**340**	**510**	**360**	**330**

'–' Represents nil value

Table-4: Occurrence of Euglenophyceae and Dinophyceae in the System (i/l)

S. No.	Species	Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Euglenophyceae														
1.	*Euglena viridis*	2016-17	110	140	120	120	120	120	120	160	170	300	400	500
		2017-18	110	140	120	110	110	110	110	160	180	200	600	600
2.	*Phacus suecica*	2016-17	-	-	-	-	120	260	120	110	-	-	-	-
		2017-18	-	-	-	-	160	280	180	120	-	-	-	-
3.	*Trachelomonas hispida*	2016-17	10	50	20	10	-	-	-	-	-	-	-	-
		2017-18	20	60	30	20	-	-	-	-	-	-	-	-
Total Count		2016-17	120	190	140	130	240	380	240	270	170	300	400	500
		2017-18	130	200	150	130	270	390	290	280	180	320	600	600
Dinophyceae														
1.	*Ceratium hirudinella*	2016-17	-	-	-	-	-	-	-	-	-	-	-	-
		2017-18	-	-	-	-	10	30	20	10	-	-	-	-
Total Count		2016-17	-	-	-	-	-	-	-	-	-	-	-	-
		2017-18	-	-	-	-	**10**	**30**	**20**	**10**	-	-	-	-

'–' Represents nil value

Table-5: Classwise Count of Phytoplankton in the System (i/l)

S. No.	Class	Year	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
1.	*Cyanophyceae*	2016-17	1680	1840	2100	1800	1530	2080	2300	2630	2730	2650	1860	1550
		2017-18	1720	1890	1790	1580	1740	2120	2280	2650	2950	2960	2110	1890
2.	*Chlorophyceae*	2016-17	370	550	930	880	840	910	850	710	760	620	380	340
		2017-18	500	670	1030	950	1010	1010	980	840	730	690	510	360
3.	*Bacillariophyceae*	2016-17	280	300	590	340	380	380	330	290	300	500	360	310
		2017-18	300	280	520	310	340	400	370	300	340	510	360	330
4.	*Euglenophyceae*	2016-17	120	190	140	130	240	380	240	270	170	300	400	500
		2017-18	130	200	150	140	270	390	290	280	180	320	600	600
5.	*Dinophyceae*	2016-17	-	-	-	-	-	-	-	-	-	-	-	-
		2017-18	-	-	-	-	10	30	20	10	-	-	-	-
Total Count		**2016-17**	**2450**	**2880**	**3760**	**3150**	**2990**	**3750**	**3720**	**3900**	**3960**	**4070**	**3000**	**2700**
		2017-18	**2650**	**3040**	**3490**	**2980**	**3360**	**3950**	**3920**	**4080**	**4200**	**4480**	**3580**	**3180**

'–' Represents nil value

Table-6: Physio-chemical variables of fresh water, Mayanur Dam

S. No.	Parameter	Unit	Ranges
1.	Water Temperature	°C	27-34
2.	pH	°C	7-9
3.	Dissolved Oxygen	mg/l	6.8-10.4
4.	Free CO_2	mg/l	0-1.6
5.	Salinity	‰	18-28
6.	Calcium	mg/l	48-82
7.	Magnesium	mg/l	20-36
8.	Phosphate	mg/l	0.06-1.2
9.	Nitrate-N	mg/l	0.02-0.04
10.	Ammonia-N	mg/l	0.07-0.16
11.	Biological Oxygen Demand	mg/l	12.0-42.5
12.	Chemical Oxygen Demand	mg/l	8.0-31.0
13.	Oxidizable Organic Matter	mg/l	20.0-44.5
14.	Total Dissolved Solids	mg/l	60.0-210.0