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Phytoplankton community, ecological status and bloom forming algae of a temple pond in Kanyakumari District

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Abstract
Phytoplankton occupies a remarkable position as a primary producer in the food chain of aquatic ecosystem. Their distribution depends on various hydrobiological variables. The seasonal observation of phytoplankton showed a total of 52 species belonging to four classes namely Bacillariophyta 16, Chlorophyta 22, Cyanophyta 11, and Euglenophyta 3. Due to eutrophication, few microalgal mainly *chroococcus turgidus, Oscillatoria limosa, Microcystis aeruginosa and Anabaena circularis species over grow and form algal blooms*. The algal diversity studies and bloom formation serve as to indicate the water quality of the freshwater environment.

Keywords: Phytoplankton, Blooms, Bacillariophyta, Chlorophyta, Cyanophyta, Euglenophyta

1. Introduction
Wetlands are regarded as a sensitive ecosystem with immense importance which comprises with surface film of water, and bottom mud (Keddy 2010) [19]. Its biological parts includes plankton, fishes, aquatic plants and birds. In all aquatic ecosystems plankton function as good indicators for water quality. Phytoplankton community serves as a bio-indicators for the health of the aquatic ecosystem, as primary producers and also controls the dynamics of productivity (Anitha Devi *et al.*, 2013) [2]. Diversity of phytoplankton are influenced by a number of factors like nutrient, physico-chemical parameters, carbon exchange and biological interaction (Rajagopal *et al* 2010) [27] Interaction between phyto and zooplankton maintain the hydrological regimes for aquatic bio-diversity (Bunn and Arthington, 2002). Phytoplankton includes blue green algae, green algae, diatoms, desmids, euglenoids, silicoflagellates, coccolithophytes etc which are important among aquatic flora of all aquatic ecosystem (Misra, 2001). Freshwater bodies likes rivers, streams, lakes, etc are directly help in the growth of human civilization. These resources are bioming day by day at the faster rate of deterioration and the water quality is now a global problem. The present study is an attempt to investigate the ecological status, water quality and bloom forming algal community of freshwater in Mahadevar temple pond of Thiruvithancode village of Kanyakumari district. (fig.1)

2. Materials and Methods
Water samples were collected monthly from January to December 2014 in Mahadevar temple pond for the analysis of physico-chemical factors such as P^H, temperature, total alkalinity, dissolved oxygen, Phosphate, nitrates and biological oxygen demand following the standard methods of APHA (1998) [4]. Phytoplankton samples were taken in Sedgewick Rafter Cell and the results are expressed as number of organism per litre of sample. Identification was done with the standard books and monographs Desikachary (1959) [11], Presscott (1978) [26] and Turner (1982) [35].

3. Results and Discussion
In the present investigation the results of seasonal variation of physico- chemical parameters are reported in table 1. Data on the water quality parameters have a direct influence upon the distribution, and ecological status of the phytoplankton in the pond. Four different groups were reported which belonged to Cyanophyceae, Bacillariophyceae, Chlorophyceae and Euglenophyceae. The phytoplankton comprises 52 species of which 11 belonged to Cyanophyceae, 22 to Chlorophyceae, 16 to Bacillariophyceae and 3 to Euglenophyceae. The percentage contribution was different with the 29.08% of Cyanophyceae, 33.79% of Chlorophyceae, 28.16% of Bacillariophyceae and 8.79% of Euglenophyceae to the phytoplankton population (fig.2).

i) Cyanophyceae
Seasonal observation showed maximum contribution during non-monsoon season (Table1) Members like *Microcystis aeruginosa, Anabaena circularis, Chroococcus turgidus, Oscillatoria princeps, Merismopedia minima, Eucapsis sp* and *Synechocystis sp* were collected. The physico-chemical factors such as high P^H, temperature, dissolved oxygen, phosphate and nutrients have favoured the growth of blue green algae. Higher P^H during non-monsoon season of the present observation favours the growth of *Chroo coccus, Oscillatoria* and *Microcystis as* reported earlier by Kavitha and Balasingh (2007) [18]. Naik *et al*. (2005) [35] *has observed* that maximum value of P^H and nitrate content of the aquatic ecosystem also favours the growth of Cyanophyceae. Several researches have pointed out the importance of phosphate and nitrate on the growth of Cyanobacteria as pre-

requisite element for its abundance (Ashokkumar and Singh 2000; Chellapa *et al.,* 2004; and Harilal 2005) [5, 9]. Moreover leaching of fertilizers from the surrounding fields, temperature between 20-30^{0}C also increase to the growth of Cyanobacteria.

In the present study 3 species of *Oscillatoria*, 2 species of *chroococcus* and 2 species of *Microcystis* were collected. Misra (2007) has reported 5 species of *Microcystis* and 5 species of *Oscillatoria* in his studies. Distribution of *Microcystis, Oscillatoria* and *Merismopedia* indicates the presence of polluted as well as eutrophic nature of the pond.

ii) Chlorophyceae

The seasonal observation of Chlorophycean members showed great fluctuations in their distribution. In the present investigation maximum luxurious growth of green algae were reported during northeast and southwest monsoon with higher percentage contributions, similar to the earlier reports (Jayasankara *et al.,* 2010; and Ramanujam *et al.,* 2012). Higher dissolved oxygen concentration, influence of surrounding water in the temple pond, average temperature and phosphate concentration may influence the growth of green algal members similar to the earlier findings of Balasingh *et al*., (2008) [6] Ram *et al.,* (2009) [28] and Rajagopal *et al.*,(2010) [27].

iii) Bacillariophyceae

Seasonally this group was more abundant during monsoon season and registered low members in non-monsoon season. It was mainly influenced by high dissolved oxygen content, P^H, water temperature and nitrate concentration. Similar investigation of distribution was made by Kumar *et al.,* (2005) [20] Padhi *et al*. (2010) [24] and Bhattacharya *et al*., (2011) [7].

Bacillariophyta was reported with 9 genus 16 species. 5 species of Navicula, 2 species of Pinnularia, and 3 species of *Fragillaria* of the present observation was previously pointed out by Ramanujam and Siangbood (2009) [30] and Bhoslae *et al.,* (2010 b) [10] in their studies. Luxurious growth of *Navicula* and *Fragillaria* species in the present observation pointed out the eutrophic nature of the pond as evidenced by the report of Bhattacharya *et al.,* (2011) [7].

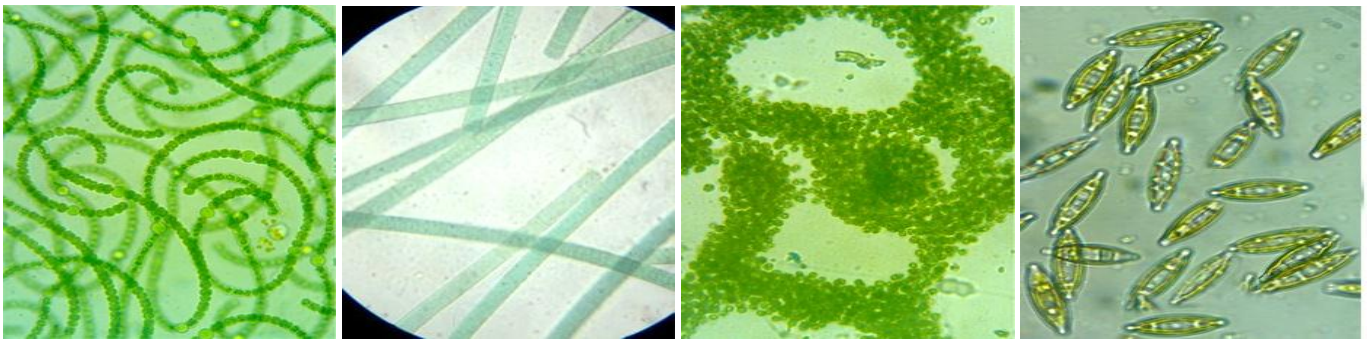
iv) Euglenophyceae

Euglenophyceae is represented as a minor group with three genus *(Euglena, Phacus* and *Trachelomonas*) collected during monsoon seasons. Factors such as P^H. DO and average temperature were responsible for its abundance which is in agreement with the previous report of Thirugumoorthy and Selvaraju, (2009) [34] and Jasprica *et al.,* (2006) [14] who found *Euglena, Phacus* and *Trachelomonas* from the freshwater ponds. The collected algae during the study period is shown in Table 3.

v) Bloom formation

During the study period in the middle of December 2014 the pond looks dark green by the luxurious growth of *Chroococcus minor, C. tenax, Oscillatoria princeps, O. sancta, O. Formosa, Anabaena circularis* and *Microcystis aeruginosa Chroococcus* bloom was pointed out by Johnson *et al.,* (2003) [16] in the freshwater ecosystem of Hyderabad city. In the river Cauvery Somasekar (1988) [33] has investigated the blooms of *chroococcus minutes* and *Oscillatoria princeps* as the river water was polluted by paper mill effluents. Shamal and Balasingh (2007) [18, 32] also reported the blooms of *Euglena* species *chroococcus minutes* and *Oscillatoria princeps* in the freshwater environment of Kanyakumari district, during September and October months as the pond was exposed to constant sunshine, low salinity and rich nitrogenous material. *Microcystis aeruginosa* one of the dominant bloom forming algae was reported by Rani and Reddy (2004) [31] *and* Chowdhary and Mishra (2007) [7] in their studies. Jemi (2012) [13] and Singh (2013) also reported the blooms of *Microcystis aeruginosa, Oscillatoria limosa* and *Chroococcus turgidus* in their studies. Such blooms indicated the presence of eutrophicated nature and organic pollution of the pond. (Jose *et al.,* 2008; and Ansari *et al.,* 2008) [17, 3].

In the present observation presence of Anabaena, Oscillatoria, Navicula and Microcystis (plate 1) indicated the polluted nature of pond. The distribution pattern was represented as Chlorophyceae > Cyanophyceae> Bacillariophyceae> and Euglenophyceae (Table 2).



(a): Anabaena **(b):** Oscillatoria **(c):** Microcystis **(d):** Navicula

Fig 1: Bloom forming algae observed in the study area

Table 1: Seasonal variation of physico –chemical parameters in the Mahadevar Pond in Kanyakumari District.

Seasons	Temp^{0}C	P^H	DO mg/l	BOD mg/l	T. alkalinity mg/l	Phosphate mg/l	Nitrate mg/l
SWM	26.65±0.74	7.98±0.19	8.43±1.08	1.25±0.13	43.0±7.46	0.14±0.01	1.57±0.56
NEM	24.6±0.69	7.35±0.13	7.48±0.16	1.18±0.16	51.60±2.56	0.07±0.01	1.26±0.44
NMS	30.28±0.84	7.18±0.17	7.50±0.5	2.65±0.14	59.75±6.48	0.09±0.01	0.80±0.68

Table 2: Seasonal variation of phytoplankton groups in the Mahadevar pond.

Seasons	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae
SWM	18812	16250	10528	4150
NEM	13324	11415	6485	1840
NMS	11869	8818	20665	5400
Total	44005	36483	37678	11390

Fig 1: Study area

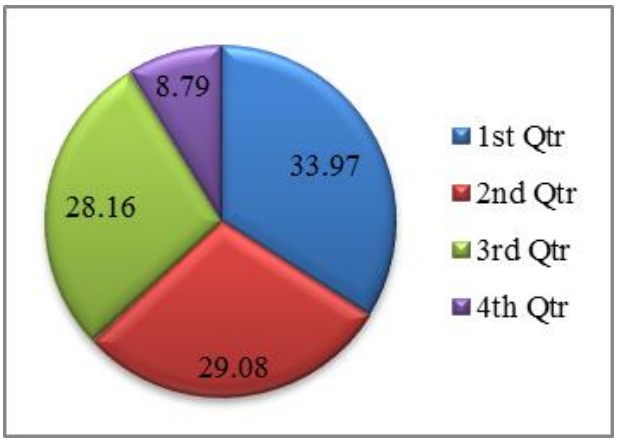


Fig 2: Percentage contribution of different (Mahadevar temple pond) groups in the temple pond

Table 3: Phytoplankton collected from the Mahadevar temple pond during the year 2014.

Name of the Algae	Seasons		
Chlorophyta	**SWM**	**NEM**	**NMS**
Gleocystis maor Gerneck	+	-	-
Ankistrodesmus falcatus. var. acicularis (cords)	++	+++	+
Ankistrodesmus spiralis Turner) Lomn	-	++	-
Chlorococcum humicola Nag	++	++	+++
Chlorella vulgaris Bayernick	+++	+++	-
Coelastrum microsporum Maeg	+	+	++
Pediastrum boryanum (Turp)	+	++	+
• constructum Hassall	-	++	++
• tetras (Her) Ralfs	+++	++	++
• simplex Meyan	+	-	+
• angulossum (Her)Menegh	-	+	+
Senedesmus abundans (Kircher) Chodat	++	++	++
• quadricauda Turpin	+++	++	++
• dimorphus (Turpin) Kuetz	++	++	+
• obliques (Turpin) Kuetz	-	+	+
Closterium ehrenberg (Menegh)	+++	++	+
• quadrum (Lund)	-	+	++
Spirogyra purvispora Wood	++	++	+++
Netrium digitus (Ehrenberg)	++	++	++
Microsteria radians Turner	-	+	-
Zygnema sp	++	+	-
Pithophora sp	+	+	+
Bacillariophyta			
Amphora ovalis kuetz	+	++	++
Coconeis placentula Ehrenberg	++	+++	_
Cymbella cistula	++	++	++
Fragilaria capucina Desma zierce	+++	+++	+++
• intermedia (Grun)	+++	+++	++
• virescens Ralfs	+	++	+
Gyrosigma sp	+	++	-
Navicula cuspidate kuetz	++	+	-
Radiosa	-	++	++
halophila	-	+	-

Viridula	+	+++	+
• hispida (Grun)	+	++	+
Nitzschia palea kuetz	++	++	-
Pinnularia simplex Her	+	+	-
• nobilis (Nitzsch)	+	+	+++
Synedra ulna (Nitzch) Her	+	+	+++
Cyanophyta			
*Chroococcus minor (kuetz) Nageli	-	++	+++
,, tenax (kichn) Hieron	++	++	-
Merismopedia elegans Lemn	++	+	+
*Microcystis aeruginosa kuetz	-	++	+++
* incerta Kurtz	+++	+++	+++
Anabaena circularis	+	++	+
*Oscillatoria princeps Vaucher ex. Gomont.	+++	+	+
• sancta Kuetz	-	+++	+
• Formosa Bory	++	++	++
Synechocystis pevalekii Ercegovic	++	+++	+
Spirulina princeps (Kuetz) Gomont	-	++	+
Euglenophyta			
*Euglena acus Huebner	-	+	-
*Phacus cylindricus Pochmann	++	-	+
Trachelomonas volocina Ehren	-	+	+

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5. Conclusion
The present study was indicated that the temple pond is polluted due to their bloom forming algae such as *Anabaena, Oscillatoria, Navicula, Microcystis and Chlorella.* Water temperature is lesser level than atmospheric temperature. The P^H levels were almost neutral condition was found. There is only least biological oxygen demand were observed. Dissolved oxygen followed the desirable limit. Chemical characters like total alkalinity, phosphate and nitrate are present in the limited level which favours the growth of phytoplanktons.
Awareness should be created among the people in an around villages regarding water pollution and its effects. It is also suggested that all the freshwater ponds should be regularly monitored to preserve and maintain the aquatic systems which would benefit the organisms and their environment.

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