Study on Distribution and Diversity of Phytoplankton in Relation to Physico-chemical Parameters in Polachira wetland, Kerala

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ABSTRACT *Wetlands are combination of aquatic and terrestrial conditions, which are very important and productive aquatic ecosystems in the world that receives water from various sources like rivers, streams, precipitation and land over flow, infiltration from surface and sub-surface, streams and also from underground water as well. Phytoplankton community constitutes an important component in the faunal composition of the water body and sensitive indicators of pollution. The physico-chemical parameters and phytoplankton diversity were studied for a period of one year from February 2013 to January 2014. In the present study a total of 20 phytoplankton genera belonging to 4 classes namely Chlorophyceae (11 species), Cyanophyceae (3 species), Bacillariophyceae (3 species) and Euglenophyceae (3 species) were quantified in three seasons. Among the chlorophycean members Closterium sp and Euastrum sp were dominated. Among the cyanophycean members Oscillatoria proboscidea was dominated. Among the Bacillariophycean members Nitzschia sp was dominated. Among the euglenophyceae Euglena sp was dominated. Phytoplanktonic analysis is very essential because they act as primary producers, food for variety of aquatic organisms and an efficient bio-indicator for water quality.*

Keywords: *Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae*

INTRODUCTION

Wetlands are some of the most valuable ecosystems on Earth because they provide many ecological services. Conversely, these wetlands are seriously threatened by intensive anthropogenic activities and accelerated climate change. Plankton, is the most sensitive floating community which is the first target of water pollution, thus, any undesirable change in aquatic ecosystem affects diversity as well as biomass of the plankton community (Summarwar, 2012). The phytoplankton represents primary producers and is the base of food chains in aquatic ecosystems.

Carbon dioxide is the main source for providing carbon to phytoplankton that in turn serve as food for zooplankton and fish (Arya *et al*, 2011). The occurrence of large amount of nutrients like nitrate, nitrite and phosphate, are essential to improve the productivity by increasing the diversity and abundance of phytoplankton in the water. The occurrence of phytoplankton and algal blooms in the shallow water are also helpful to increase the productivity of wetlands because large surface area of wetlands is exposed to sunlight for photosynthetic activity (Mustapa, 2010). Phytoplankton study helps to depict the present conditions of aquatic environment. These are also widely used as bioindicators to monitor water quality, pollution and eutrophication in wetlands (Round, 1984). Phytoplankton constitutes the very base of nutritional cycles and serves as food for zooplankton, fishes and other aquatic organisms. Optimum levels of physico-chemical factors are required for the production of maximum amount of phytoplankton in the water (Sinha et al, 1991; Muhammad et al, 2005).

The basic information about diverse biotic components is very important for sustainable conservation procedures. The present investigation was carried out on the surface plankton population in the aquatic ecosystem of Polachira wetland in Kerala. The study is aimed at evaluating the abundance and diversity of phytoplankton as the water quality criteria and establishes the status of pollution using bio-indicator species.

MATERIALS AND METHOD

Sampling area

The present investigation was undertaken in the Polachira wetland (80 50’ 26.89”- N latitude, 760 42’ 0.3”longitude). Polachira is a wetland spread over 600 hectares located in Kollam district, Kerala, India. As a result of the biodiversity of fish and mussels, Polachira is a favourite destination of migratory birds. The wetland formed in the estuaries of the Ithikkara River and Paravur backwaters is encircled by small rivulets and is thickly vegetated. Sediment samples were collected from five different sampling stations (station 1-Thalachira, station 2- Polachira nadappalam, station 3- Mannathipara, station 4- Manalmukku, station 5- near Meenadu Bridge) of Polachira wetland. The water samples were collected from february 2013 to January 2014. The water quality parameters which have taken for analysis are temperature, pH, nitrate, nitrite phosphate and dissolved oxygen.

Sample collection and analytical method

The water quality investigation was carried out according to the standard methods (**APHA. 2012**). The phytoplankton samples were collected through plankton nets (60µ) and preserved in 4% formaldehyde for further analysis. The phytoplankton samples were analyzed by using Sedgwick rafter cell. The samples were then reduced to known volume of 15ml and 30 ml in a centrifuge. Enumeration of phytoplankton was done by Sedgwick Rafter cell method (Trivedy and Goel, 1986) and counting its entire contents up to the statistical accuracy. Identification of phytoplankton was made as per the observations made by Presscott (1962) and Sarma and Khan (1980) Each sample was counted three times and taken as average value.

The diversity of phytoplankton was calculated by Shannon's diversity index [13].

H= Ó -(Pi* ln Pi) si

=1 …(1)

Where: H = the Shannon diversity index

Pi = fraction of the entire population made up of species i

S = numbers of species encountered

Ó = sum from species 1 to species S

Results and Discussion

The different species of phytoplanktons were recorded at different stations during the study period. It include the following order Chlorophyceae>Cyanophyceae> Bacillariophyceae>Euglenophyceae. From the Chlorophyceae 11 species, 3 species from the Cyanophyceae, 3 species from the Bacillariophyceae and 3 species from the Euglenophyceae were observed. Chlorophyceae include *Ankistrodesmus* sp., *Closterium* sp.,*Microsterias* sp.,*Pediastrum* sp., *Scenedesmus* sp., *Euastrum* sp., *Hyalothera* sp., *Netrium* sp., *Pandorina* sp., *Staurastrum* sp. and *Triploceras* sp. The identified Cyanophyceaen members are *Oscillatoria* sp., *Spirulina* sp. and *Lyngbya* sp. Bacillariophyceae consists of *Navicula* sp., *Nitzschia* sp. *and Stauroneis* sp. *Astasia* sp., *Euglena* sp. *and Phacus* sp. were included in the group Euglenophyceae. The Physico-chemical parameters of the water were compared to the phytoplankton population by correlation (Tables 1).

Chlorophyceae shows significant and positive correlation with phosphate (r= 0.953) and cyanophyceae (r= 0.638). It shows positive correlation with water temperature(r=0.36) and euglenophyceae (r= 0.494). Cyanophyceae shows significant and positive correlation with phosphate (r= 0.710). It shows positive correlation with water temperature(r=0.44), dissolved oxygen(r= 0.20) and euglenophyceae (r= 0.38). The temperature was shown as positive correlation with chlorophyceae and cyanophyceae indicated the growth and population is favorable with increasing the temperature (Adesalu et al. 2012). Bacillariophyceae shows positive correlation with pH(r=0.21) and phosphate(r=0.11). Euglenophyceae shows positive correlation with water temperature(r=0.32), dissolved oxygen (r=0.10), nitrite(r=0.20), phosphate(r=0.45), chlorophyceae(r= 0.49) and cyanophyceae(r= 0.38). The pH was found as positive correlation with Bacillariophyceae which indicates high pH tends to increases the population of phyto-plankton production. The changes in pH levels in aquatic system appear to correlate with changes in temperature, dissolved oxygen, and phytoplankton production (Celia et al. 1994). In the present study, blue-green algae were observed to be in abundance in hotter months which indicated that temperature due to light intensity stimulated the growth of blue-green algae. Normally, it is noticed that the high temperature and low dissolved oxygen are favourable to the growth of blue-green algae (Ningule et al. 2016).

Table 1 Showing Correlation between different Parameters in Water with phytoplanktons of Polachira wetland for the study period

	TEMP	PH	DO	NO_{2-}	NO_{3-}	PO_4-	chl.phy	cya.phy	bac.phy	eug.phy
TEMP	1.00									
PH	0.30	1.00								
DO	-0.39	-0.57	1.00							
NO_{2-}	-0.14	0.28	-0.25	1.00						
NO_{3-}	-.728**	-0.20	0.37	-0.28	1.00					

PO_4-	0.53	-0.04	-0.47	-0.13	-0.35	1.00				
chl.phy	0.35	-0.16	-0.35	-0.03	-0.20	.953**	1.00			
cya.phy	0.44	-0.37	0.06	-0.54	-0.10	.710**	.638*	1.00		
bac.phy	-0.10	0.21	-0.34	-0.08	-0.27	0.09	-0.07	-0.06	1.00	
eug.phy	0.32	-0.46	0.05	0.20	-0.35	0.45	0.49	0.38	-0.39	1.00

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed
TEMP- Water Temperature, DO- Dissolved Oxygen, , NO_2- Nitrite, NO_3- Nitrate, PO_4- Phosphate, Chl.Phy- Cl
Cya.Phy- Cyanophyceae, Bac.Phy- Bacillariophyceae, Eug.Phy- Euglenophyceae,

The pi diagrams (Fig. 1) indicate that the Chlorophyceae were more dominant in all the stations and followed by Cyanophyceae, Bacillariophyceae and then Euglenophyceaen members. In the present study, Shannon-Weiner diversity index (Fig. 2) ranges 1.62-1.86 which indicated moderate level of pollution status of the wetland (Wilham *et al.,* 1968). The plankton was shown seasonal variation in the creek and the planktonic communities served as indicator for change in the ecosystem (Saravanakumar et al. 2008).

Figure 1. Percentage of Phytoplankton distribution in Polachira Wetland

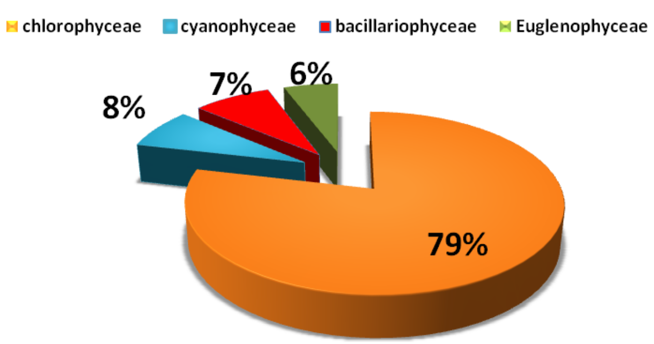
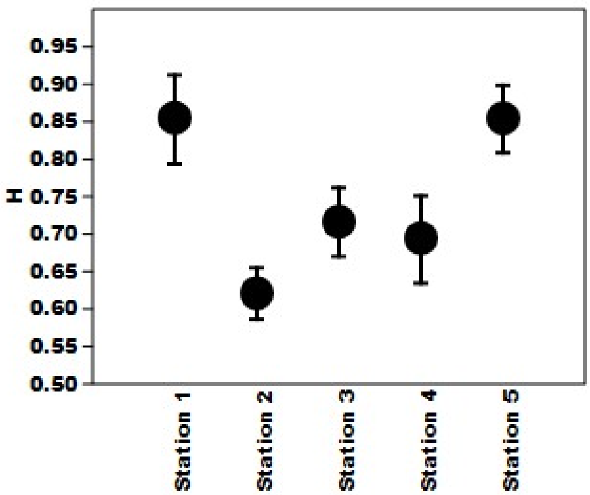


Figure 2. Shannon-Weiner diversity index (H) at different stations of Polachira wetland



Conclusion

From the above results, it could be concluded that the Chlorophyceae were identified as seasonally dominated followed by Cyanophyceae, Bacillariophyceae and Euglenophyceae. Shannon- Weiner diversity index ranges 1.62-1.86, it is clear that the wetland water show moderate pollution level. So, phytoplankton study along with water quality amnalysis is very crucial since they act as primary producers and an efficient bio-indicator for water quality. The present investigation provides fundamental information on plankton distribution and abundance of Polachira wetland which may unravel the details on the energy turnover of the wetland ecosystem. It will serve as an essential tool for further ecological assessment and monitoring of the wetland ecosystem. The observations of the present study have shown the requirement of phytoplanktons as index of water quality.

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