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SEASONAL FLUCTUATION OF PHYTOPLANKTON POPULATION IN JHAGRASISA BHERI OF EAST KOLKATA WETLAND

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ABSTRACT

Attempt was made to observe the seasonal variation of phytoplankton population along with some parameters on water quality of Jhagrasisa bheri, one of the wetlands in East, Kolkata, during 2012-2013 where the annual planktonic population ranged between 5,666.4 and 67,777.7 u/l with a mean value of 23,762.6 u /l.

The observed phytoplankters are within 21 genera belonging to 5 class voice, Chlorophyceae, Cyanophyceae, Bacillariophyceae, Euglenophyceae and Xanthophyceae. Chlorophyceae and Cyanophyceae are the dominant among all forms contributing 56.86 and 40.64% respectively of the total population in the ecosystem. The peak abundance of phytoplankton was registered during post-monsoon with a mean of 26,310.73 u/l, while the lower population was encountered in monsoon, mean value being 21,393.38 u/l. Among all groups, Euglenophyceae represented minimum population during the study period, showing 0.55% towards the annual value.

KEYWORDS: Bhery, Phytoplankton, Ecosystem, Wetland

INTRODUCTION

Wetlands are the link between land and water, and the most productive ecosystems in the world. Depending on the type of wetland, it may be filled mostly with trees, grasses, shrubs or moss. To be called a wetland, an area must be filled or soaked with water at least part of the year. Some wetlands are actually dry at certain times of the year. This ecosystem has many important functions that benefit people and animals, providing habitat for a wide variety and number of wildlife and plants.

Wetlands filter, clean and store water - in other words, acting like kidneys for other ecosystems. Some common names for different types of wetlands are swamps, marsh and bog depending on the type of wetland.

The East Kolkata Wetland (EKW) provides a range of ecosystem services which form the base of ecological security of the entire region and livelihoods of dependent communities. Being a dynamic ecosystem, the wetland is also subject to influence from various natural as well as human factors. Integrated management of EKW and its catchments are crucial for maintaining the rich productivity of the ecosystem as well as achieving wise-use of resources by the

communities. EKW is a perfect example of wise-use wetland ecosystem where usage of city sewage for traditional ways of fisheries and agriculture is practiced which is also happens to be the largest assemblage of sewage-fed fish ponds in the world in one place. They are also called as Bheri having flat bottom shallow wastewater-fed fish ponds, a specialty of the Eastern India (mostly in West Bengal) and has been reported to be the best example of an integrated resource recovery system where reuse of wastewater in fish culture began probably in 1930 through traditional way. The ecosystem is very productive owing to its high manorial value which helps to produce plankton especially phytoplankton, generating a huge quantity of oxygen and the system acts like the lungs of a region.

Since phytoplankton, the base of the aquatic food web, plays most significant role in augmenting fish production, the present study was undertaken to find out the biodiversity of phytoplankton in the Jhagrashisa bheri of EKW besides its quantitative estimation.

MATERIALS AND METHODS

The study was conducted in Jhagrasisa Bhery, a sewage-fed fish farmers in East Kolkata Region comprising of a cluster of different ponds, covering a total area of 53.34 ha. One of the ponds on the farm, measuring 22 ha was selected (Fig. 1) For the study. The pond holds the facility of an inlet for entry of sewage water from the feeder canal to fertilize the pond and an outlet through which about 40-50% of the used water is let out after some days and again fresh sewage water is taken to refertilize the berry. Such cyclic pattern of intake and retaining of sewage water in the pond is to utilize its nutrients vis-a-vis the production of natural fish food organisms for the growth of stock fishes. The pond is shallow, varying depth of 68-80 cm.

Figure 1: Showing Study Site, Marked as Red Arrow

The entire study period was divided into three seasons viz, pre-monsoon, monsoon and post-monsoon. The pre - monsoon period covers February to May months, June to September has been considered as monsoon while post-monsoon period includes October to January.

During the course of study, Plankton and water samples were collected monthly for a period of one year from October, 2012 to September, 2013 from three specified sites of the bheri – one in inlet region, other at middle and another at outlet region. For an analysis of the water quality a composite sample was taken by mixing water in equal amount from the selected sampling stations. Sampling was done regularly between 6.00 and 8.00 a.m. Water temperature and pH were recorded in situ by digital water proof pH and temperature meter (HANNA instrument, model: HI98129-HI98130). Water analysis for dissolved oxygen and free CO_2 was done on the spot while other parameters via, PO_4-P and NO_3-N were analyzed in the laboratory on the same day following standard methods (APHA, 1995).

For the study of phytoplankton, 50 liters of pond water from the selected sites was sieved through nylobolt plankton net of 40 µ mesh sizes and 1 liter of sieved water was filtered again through the same plankton net and finally concentrated to 10 ml. The filtrates were then immediately preserved in 5% buffered formalin for further studies in the laboratory. Identification up to genera level was done under the microscope with the help of available literatures (Ward and Whipple, 1954; Needham & Needham, 1962 and Prescott, 1964). Each sample was shaken well just before the examination. Finally, the quantitative estimation was done using a bright line Haemocytometer as per method described by Sharma (1980). Then the calculation followed to assess the density of plankton population: The haemocytometer slide is divided into two separate fields. Each field has a grid measuring 3 mm X 3 mm. Since, there is 1/10 mm space between the cover slip and the slide, the volume contained over the grid is 3mm X 3mm X 0.1 mm=0.9 mm^3. Thus, number of cells/liter = No. of cells/0.9mm^3 X 1000 mm^3/1 cm^3 X 1000 cm^3/1. The final values were obtained by dividing the above values by the concentration factor of the initial sample.

RESULTS

Environmental Parameters

During the tenure of the study, hydrochemical parameters were recorded regularly. The annual variation of temperature varied between 24.4^O and 34.9^{O}C with a mean value as 28.7^{O}C and water pH from 7.5 to 8.6, average being 8.14. In regard to other hydrological parameters, annual fluctuation of total alkalinity was registered as low as 40 ppm and as high as 242 ppm with the average of 124 ppm while free CO_2 was noted to be nil to 6.8 mg/l with the mean of 1.81 mg/l. A significance level of dissolved oxygen was recorded (5.2-10.0 mg/l) with a mean of 7.26 mg/l. Annual concentration of PO_4-P was registered in between 0.14 and 0.5 mg/l, averaging 0.28 mg/l, whereas the average value for $N0_3$-N was noted as 0.64 mg/l, minimum and maximum values being 0.01 and 0.64 mg/l respectively. During the study period, seasonal fluctuation of PO_4P, NO_3-N and silicate ranged from 0.25-0.30, 0.25-0.35 and 6.5-16.6 mg/l respectively.

Season wise study of these parameters reveals higher values of nutrients like PO_4-P, NO_3-N and silicate in post-monsoon period showing the respective values of 0.30, 0.35 and 16.6 mg/l. Table-1 shows the seasonal fluctuation of all hydrological parameters.

Phytoplankton

The phytoplankton community as a whole in the ecosystem was founded to be represented by 21 genera belonging to 5 major groups, namely Chlorophyceae, Cyanophyceae, Bacillariophyceae, Euglenophyceae and Xanthophyceae. During the study period, annual population of phytoplankton ranged between 5,666.35 and 67,777.4 u/l (Fig. 2), average being 23,762.6 u/l. Post- monsoon (Oct-Jan) season represents the peak period for the plankton population averaging

26,310.73u/l followed by pre-monsoon months (Feb.-May.) With average population of 23,583.73 u/l. The lowest planktonic population was observed during monsoon (Jun.-Sept.) Season, mean value being 21,393.38 u/l (Table-2).

The quantitative study reveals that the Chlorophyceae was the most dominant group while Euglenophyceae showed the minimum populated family during the course of study. Season wise study (Table-2) reveals that the post-monsoon represents the peak period for Chlorophyceae, average value being 18,833.1u/l followed by pre-monsoon (12,221.9 u/l) and monsoon (9477.1 u/l). The frequently occurring taxa under Chlorophyceae are enlisted as pedestrian soap, Kirchneriella Sep, Chlorella sp, Scenedesmus sp, Dispora sip, and Ankistrodesmus sp.

Cyanophyceae ranked the second highest populated phytoplankton group in this Bheri where higher value was registered during both pre- and monsoon seasons (Table-2), respective average value being 11,084.1 and 11,083.0 u/l. Post-monsoon represented a lower population period (6,811.0 u/l) as compared to the former two seasons. The qualitative study indicates that Microcystis sp, Merismopedia Sep, Chrococcus sip, and Spirulina sp. Were the common tax of this group.

Two genera of Bacillariophyceae viz, Frustularia and Mastogloia were enlisted from the study site, of which predominant form is Frustularia sp. It is noteworthy to mention that none of the any member under this group has been recorded in pre-monsoon months, but above mentioned two genera of this group were noted in another two seasons of which monsoon represents the higher populated period (Table-2).

Population of Euglenophyceae represented the minimum amongst the recorded phytoplankton groups. The total population of this group irrespective of seasons was registered as 1555.4 u/l. Unlike Bacillariophyceae, members of this group were found in all seasons with the mean population of 129.6 u/l. Season wise study indicates that both pre-monsoon and monsoon showed identical and lower values showing mean values of 83.3 and 83.32 u/l respectively as compared to other season (Table- 2). Euglena sp. Under this group has been found to be the dominant and common form in all the seasons.

Xanthophyceae consisted only 0.9% of the total phytoplankton population. The higher population of this group has been registered during post- monsoon (416.65 u/l) followed by monsoon and pre-monsoon (Table- 2). The enlisted only tax under this group is Goniochloris sp.

Table 1: Season Wise Average Values of Hydrological Parameters

Parameters	Pre-monsoon	Monsoon	Post-monsoon
Temperature (^{0}C)	29.0	30.03	26.23
pH	8.2	8.1	8.0
Alkalinity (mg/l)	169.7	86.5	117.5
Free CO_2 (mg/l)	3.3	1.0	1.1
D.O. (ppm)	6.6	9.1	6.0
PO_4-P (mg/l)	0.28	0.26	0.30
NO_3-N (mg/l)	0.28	0.25	0.35
Silicate (mg/l)	9.6	6.5	16.6

Table 2: Season Wise Average Population (U/L) of Different Phytoplankton Groups

Seasons	Cyanophy-Ceae	Chlorophy-Ceae	Bacillariophy-Ceae	Euglenophy-Ceae	Xanthophy-Ceae	Season Wise Total
Pre-mon	11,084.1	12,221.9	X	83.33	194.4	23,583.73
Monsoon	11,083.0	9,477.1	527.75	83.33	222.2	21,393.38
Post-Mon	6,811.0	18,833.1	27.78	222.2	416.65	26,310.73
Group wise total	28978.1	40,532.1	555.53	388.86	833.25	

DISCUSSIONS

It is well established that environmental parameters have a great impact on the productivity of any ecosystem, and nutrients like NO_3-N, PO_4-P and silicate play an important role in the relative productivity and fishery potential of different water bodies. As a whole, these elements exert vital activity in the food chain of any ecological niche. The present observation on seasonal variation in phytoplankton population reveals that the favorable period for primary producer is in post- monsoon season when nutrient accumulation is higher which also corroborates with the observation of Singh, (1960) who observed the similar trend of result from the study of inland water bodies of Uttar Pradesh. While studying on comparative evaluation of sewage-fed and feed-based aquaculture, Datta et.al. (2000) found a higher phytoplankton number from sewage-fed ponds during post-monsoon, which is also an identical observation of the present study.

On studying phytoplankton population in Beel, Keshri et.al. (2013) found the highest population density during post-monsoon followed by pre-monsoon and monsoon, which also supports the present study (Table-1). The workers also documented the dominancy of Chlorophyceae in monsoon and post-monsoon, which differs slightly from the present study were dominancy of this group was recorded in post-monsoon (AV. 18,833.1 u/l) followed by pre-monsoon and monsoon (Table-2). This difference may be due to the physical and hydrological conditions of the studied ecosystem.

Keshri et. al. (2013) further observed the dominancy of Cyanophyceae in Pre-monsoon. The reason behind the higher population of this group during the season is due to heat stress tolerating capacities and higher nutrient level. A similar trend of the population of this group has also been observed in the present study were more or less the same number has been registered in pre-monsoon and monsoon followed by post-monsoon (Table 2) but not dominating over Chlorophyceae group except in the monsoon season.

Xanthophyceae, Bacillariophyceae and Euglenophyceae showed the minimum population (Fig.3) in the present study of which Xanthophyceae represented the higher value comparatively (Table 2). Critical study documents that Euglenophyceae represented the minimum percentage (0.55%) of composition among the three (Fig.3). Bacillariophyceae and Euglenophyceae became the second and third lower groups respectively in the present study. None of the members of Bacillariophyceae were registered during pre-monsoon months and monsoon season shows the peak period of this group (Table 2). Keshri et.al. (2013) observed the same trend where the lowest percentage composition of phytoplankton population was represented by the members of Euglenophyceae and Bacillariophyceae. Table 2 depicts the lower value of Euglenophyceae in Pre-monsoon and monsoon and Xanthophyceae in Pre-monsoon whereas lean period for Bacillariophyceae was in post-monsoon season.

Study of Khatri (1978) in the lake of Lakhotia in Rajasthan focused a positive relationship between phytoplankton and nutrients like PO_4 and NO_3 during summer and monsoon. The present observation also reveals that in all the seasons

the phytoplankton population is directly related to the values of NO_3-N and PO_4 (Fig. 4 and 5).

Bohra (1976) and Misra et. Al (1978) noted a negative relationship between PO_4, NO_3 and phytoplankton whereas Vyas (1968) found a positive relationship between these as found in the present observation (Fig. 4 and 5).

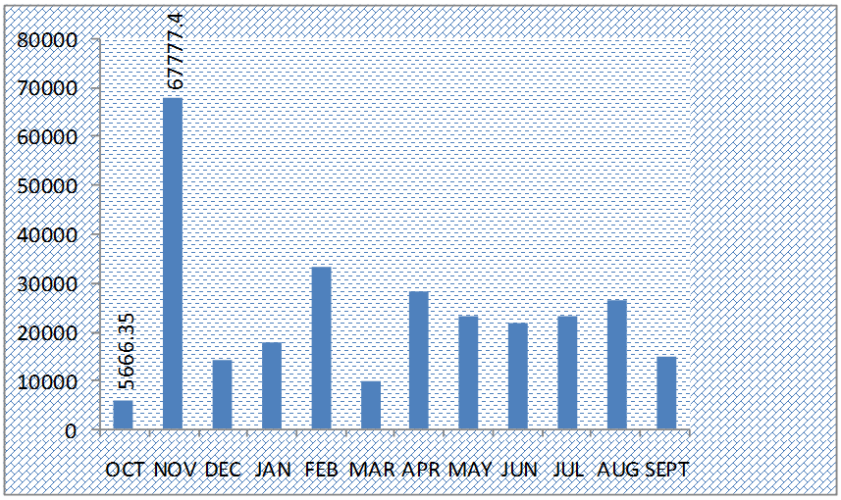

Figure 2: Planktonic Population in Different Months

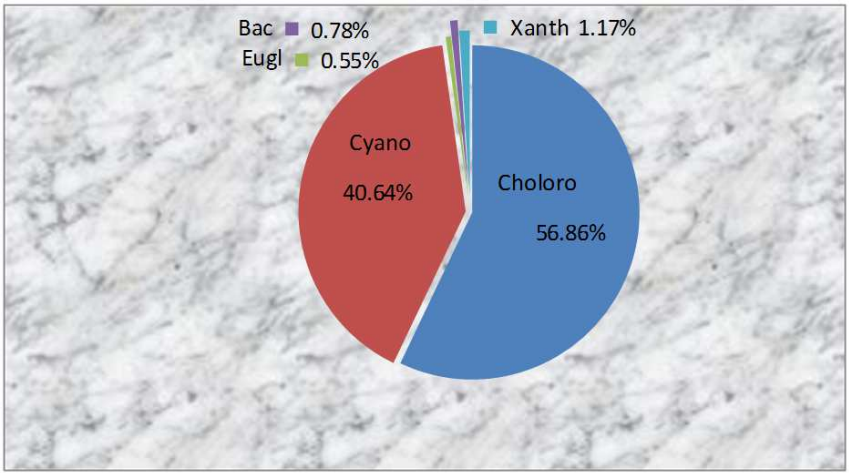

Figure 3: Yearly Contribution (%) of Various Phytoplankton Groups in Population

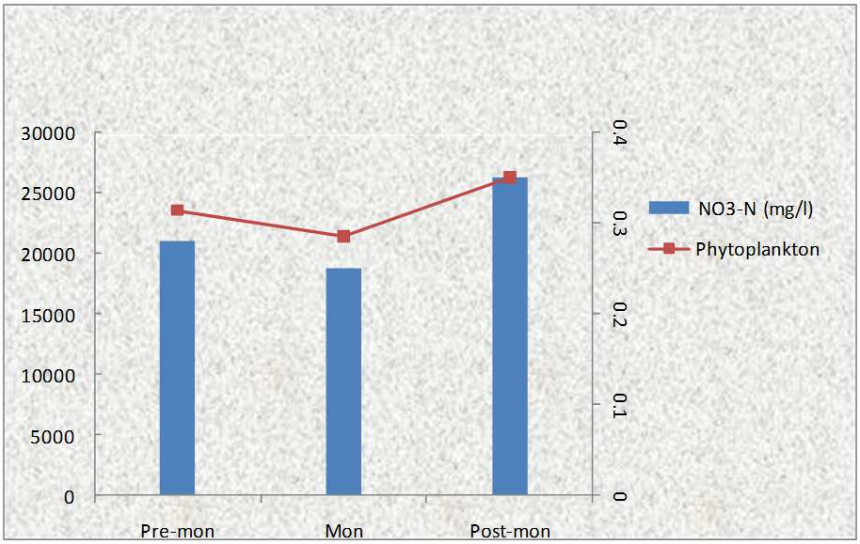

Figure 4: Season Wise Average Value of NO_3-N (Mg/L) and Phytoplankton Population (U/L)

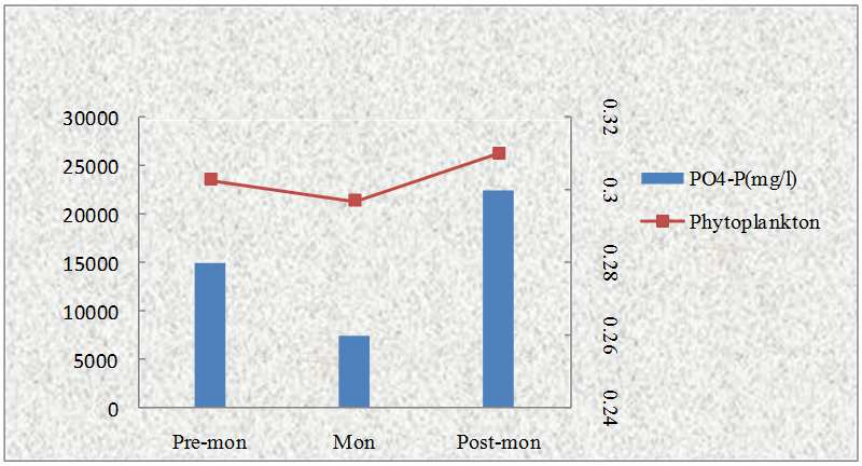

Figure 5: Season Wise Average Value of PO_4-P and Phytoplankton Population (U/L)

CONCLUSIONS

The present study offers base line information on seasonal phytoplankton distribution and abundance together with some hydrological status of the eco-system which may be a useful tool for further ecological assessment and monitoring the wetland as a whole in the East Kolkata Wetland Region. The study may also enlighten to enumerate the appropriate time to stock fish therein to explore the productivity of the vast water resources through fish culture thereby augmenting fish production horizontally. Further, it is concluded that since post-monsoon exerts the higher planktonic productivity compared to other seasons, fish, seeds may be released during this period to obtain higher production with the fullest utilization of the growth period.

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