



## Assessment of water quality and phytoplankton diversity of Purbasthali Oxbow Lake, West Bengal, India

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### Abstract

*The present study deals with the study of water quality and phytoplankton diversity at Purbasthali Oxbow Lake (23°27'5"N 88°20'35"E), West Bengal, India. Collected samples were analyzed according to APHA (1998) for different physicochemical parameters and such as water temperature, pH, turbidity, alkalinity, total dissolved solids, total hardness, chlorides, phosphate, nitrates, dissolved oxygen and biological oxygen demand for a period of three year from January 2013 to December 2016. The results indicated that physicochemical parameters of the water were within the permissible limits and can be used for domestic, irrigation and pisciculture. The present study revealed the presence of 35 species of phytoplankton's, in which 5 species of cyanophyceae and 20 species of chlorophyceae and 10 species of bacillariophyceae. The high relative abundance of chlorophyta is an indicator of productive water ecosystem.*

**Keywords:** Water quality, Physicochemical parameters, Phytoplankton, Oxbow Lake.

### Introduction

Wetlands are the most productive and biologically diverse ecosystem in the world which serves as an ideal habitat for different types of plants, animals and microorganisms<sup>1-3</sup>. The healthy aquatic ecosystem is depended on the quality of the water, which determines by the physicochemical and biological parameters. Study of the physicochemical characteristics of an aquatic ecosystem is essential for understanding of its biological productivity and diversity<sup>4-7</sup>. Planktons are valuable indicators of environmental conditions in aquatic ecosystems, because they respond directly and sensitively to many physical, chemical and biological changes in such ecosystems. Phytoplankton plays a key role in maintaining equilibrium between abiotic and biotic components of an aquatic ecosystem<sup>8-11</sup>.

Purbasthali Oxbow Lake also known as Chupi Char is created by the Ganges River on its Western bank, in Burdwan district of West Bengal, India. This lake harbors a number of aquatic plants in the submerged as well as floating state, on which thrive a large number of organisms. Due to abundant food available throughout the year in the form of aquatic crustaceans, insects, mollusks, fishes etc. the lake attracts a number of birds throughout year. This Lake is recognized as globally important for migratory birds as thousands of migratory birds stop here to feed and rest every winter during their long-distance migrations. The large and productive oxbow Lake is an important source of income and nutrition for the surrounding areas. Fish population in this lake is an important source of income which helps the development of the local community in this area. In recent times various anthropogenic activities, including tourist activity in this region causing water pollution problem or excessive

eutrophication as because the water circulation is restricted. Information on the water quality of this lake is essential to provide guidelines for the management and conservation of wetlands<sup>12,13</sup>. The present study was conducted to analyze the water quality related to the physicochemical parameters and diversity of phytoplankton in this lake.

### Materials and methods

**Study area:** The study area is Purbasthali Oxbow lake (88°19'45" to 88°22' E longitude 23° 26' to 23° 26'45" N latitude) also known as Chupi Char created by the Ganges river on its Western bank, in Burdwan district of West Bengal, India. This area is only 8 km from the Nabadwip city. The lake was formed by the meandering river, over last 40 years, the area has transformed into a closed loop, allowing emergence of the oxbow lake. This channel of water course that feeds the oxbow lake with thin connectivity with the main river with shoals forming at the river mouth. The process of rapid and growing sedimentation threatens to cut off the channel in near future. The oxbow lake of Purbasthali sprawls over an area 3.50 km<sup>2</sup>. The water depth of this lake varies between is 1.0 m to 4.5m.

**Methods: Physicochemical parameters:** Lake Water samples were collected for physicochemical analysis for three years from January 2013 to December 2016. The samples were collected in sterilized bottles and preserved for analysis following the standard method of APHA. The pH of water sample was determined with the help of a pH meter. The conductance of water samples was measured using conductometer. TDS (mg/l) were analyzed with the help of TDS meter. Total hardness (mg/l), calcium (mg/l), magnesium (mg/l), chloride (mg/l),

Dissolved Oxygen (mg/l), BOD (mg/l), nitrate (mg/l), phosphate (mg/l), sulphate (mg/l) and total alkalinity(mg/l), hardness (mg/l), Iron(mg/l) etc were determined separately, for these samples, in the laboratory, employing standard methods described in APHA (American Public Health Association, 1998)<sup>14</sup>.

**Phytoplankton diversity:** Water samples from the lake were collected using phytoplankton net and fixed immediately using 4% formaldehyde in Lugol's Iodine solution. The sample was left undisturbed for 24 hours to allow the settling of phytoplanktons and then the settled part of the solution was transferred in other capped glass jar. The subsamples were observed under high power of microscope (Magnus Olympus Binocular Microscope, MLX-B Plus). The checklist of the phytoplankton species was prepared by the identification key given by various authors<sup>15-18</sup>.

## Results and discussion

The Table-1 shows the mean values of the physicochemical parameters with the standard error of the Purbasthali oxbow

lake from January 2013 to December 2016. Temperature is basically important factor in an ecosystem for various chemical and biological activities of the organisms of an aquatic ecosystem. The mean temperature was found in the range between 25°C and 32°C in this area. The maximum and minimum temperature was recorded as 15.1°C and 35.1°C in the winter and summer month's respectively. The pH values of lake water were found in the alkaline side. The pH ranges from 8.6 to 9.1 in pre-monsoon and post-monsoon. In general the pH values are higher in winter than other seasons. In present observation the EC varies from 141 to 152  $\mu\text{S}/\text{cm}$  in various seasons. Turbid lake water is usually an aesthetic problem and is caused by runoff from surrounding area around the lake. In our study, the amount of turbidity recorded highest amount in pre monsoon as 5.0 NTU and lowest in post monsoon as 4.2 NTU. Sedimentation of suspended solid and presence of submerged aquatic plants also may reduce the turbidity of water. Total alkalinity is a measure of the concentration of carbonate and bicarbonate ions in the water. Alkalinity was found to be 110.60 ppm, 123.15 ppm and 134.06 ppm in the pre monsoon, monsoon and post monsoon period respectively.

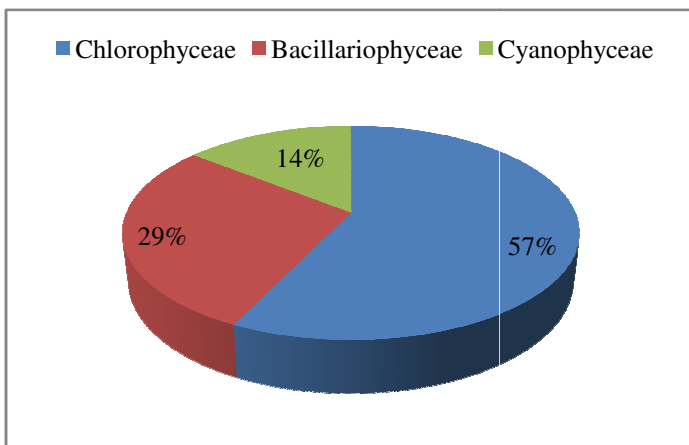
**Table-1:** Physicochemical parameters of Purbasthali oxbow lake.

Sl.No.	Parameters	Pre-monsoon (mean $\pm$ SE)	Monsoon (mean $\pm$ SE)	Post-monsoon (mean $\pm$ SE)
1	Water Temp ( $^{\circ}\text{C}$ )	32.0 $\pm$ 2.58	29.2 $\pm$ 1.45	25.1 $\pm$ 2.73
2	pH	8.6 $\pm$ 0.86	8.8 $\pm$ 0.80	9.1 $\pm$ 1.02
3	Conductivity ( $\mu\text{S}/\text{cm}$ )	152 $\pm$ 14.16	144 $\pm$ 12.02	141 $\pm$ 10.54
4	Turbidity (NTU)	5.0 $\pm$ 1.15	4.6 $\pm$ 1.08	4.2 $\pm$ 1.96
5	Chloride (mg/l)	16.5 $\pm$ 1.02	14.5 $\pm$ 1.06	14.1 $\pm$ 1.25
6	Total Alkalinity (mg/l)	110.60 $\pm$ 8.89	123.15 $\pm$ 10.05	134.06 $\pm$ 10.04
7	TDS (mg/l)	150 $\pm$ 17.12	145 $\pm$ 16.54	142 $\pm$ 14.11
8	Salinity (ppt)	0.52 $\pm$ 0.021	0.48 $\pm$ 0.011	0.44 $\pm$ 0.017
9	Total Hardness (mg/l)	110.60 $\pm$ 15.21	102.43 $\pm$ 12.01	101.87 $\pm$ 14.67
10	Calcium (mg/l)	21.0 $\pm$ 2.54	19.25 $\pm$ 2.02	20.14 $\pm$ 2.98
11	Magnesium (mg/l)	14.30 $\pm$ 1.93	15.84 $\pm$ 2.85	12.85 $\pm$ 1.98
12	Nitrate (mg/l)	0.12 $\pm$ 0.018	0.14 $\pm$ 0.015	0.72 $\pm$ 0.020
13	Phosphate (mg/l)	0.44 $\pm$ 0.08	0.45 $\pm$ 0.12	0.62 $\pm$ 0.09
14	Sulphate (mg/l)	24.23 $\pm$ 3.15	22.02 $\pm$ 2.19	22.78 $\pm$ 3.89
15	DO (mg/l)	6.5 $\pm$ 0.65	6.8 $\pm$ 0.72	7.1 $\pm$ 0.85
16	BOD (mg/l)	2.1 $\pm$ 0.087	2.6 $\pm$ 0.091	2.9 $\pm$ 0.097
17	Fluoride (mg/l)	0.22 $\pm$ 0.017	0.20 $\pm$ 0.013	0.24 $\pm$ 0.019
18	Nitrate nitrogen (as N) mg/l	0.12 $\pm$ 0.007	0.15 $\pm$ 0.016	0.12 $\pm$ 0.011
19	Iron (mg/l)	0.25 $\pm$ 0.017	0.22 $\pm$ 0.011	0.22 $\pm$ 0.016

The amount of Total Dissolved Solid recorded between 142-150 mg/l during the study. The amount of oxygen that is dissolved in the water is very important for fish and other aquatic life. Dissolved oxygen level below about 4mg/l can begin to have detrimental effects on aquatic life. During investigation maximum DO level was found in the post monsoon period (DO =7.1mg/L) and minimum value observed during the pre monsoon period (DO =6.5mg/L), may be due to the inverse relationship between temperature and dissolve oxygen. In our study fluoride was found in a trace amount (0.22-0.24ppm) in the lake water. Phosphate is very important nutrient which causing eutrophication leading to extensive algal growth. The results of present study showed that maximum phosphate concentration was observed in the post-monsoon period i.e. 0.062 mg/L and minimum in pre-monsoon period, which is 0.44mg/L. It is evident from the data that seasonally phosphate concentration in the lake was more in summer followed by rainy followed by a decline in winter season. The increase in the concentration of phosphate during post-monsoon may be due to incoming water from the catchment area of agricultural fields and from domestic sewage. All other parameters including fluoride and iron were found to be within the maximum permissible limit suggested by BIS.

In Purbasthali oxbow lake, the phytoplankton population was represented by three groups' viz. Chlorophyceae (greens), Bacillariophyceae (diatoms) and Cyanophyceae (blue greens) as shown in Table-2.

A total of 35 phytoplankton taxa were recorded in the Purbasthali oxbow lake of which 19 belong to Chlorophyceae, 5 to Cyanophyceae, 11 to Bacillariophyceae (Table-2). The major taxa of phytoplankton in terms of frequency and abundance were Spirogyra sp, Anabaena sp, Oscillatoria sp, Nostoc sp and Navicula sp. Seasonal variations in phytoplankton diversity was not noticeable, although the highest number of species was recorded in pre-monsoon, followed by that in monsoon, post-monsoon. Division wise distribution of phytoplankton identified in Purbasthali oxbow lake is shown in Figure-2.



**Figure-2:** Division wise distribution of phytoplankton in Purbasthali oxbow lake.

**Table-2:** Phytoplankton species identified in Purbasthali Oxbow Lake.

Bacillario-phyceae	Chloro-phyceae	Cyano-phyceae
<i>Actinastrum sp.</i>	<i>Ankistrodesmus sp.</i>	<i>Anabaena sp.</i>
<i>Aulacoseira sp.</i>	<i>Chlorococcum sp.</i>	<i>Lyngbya sp.</i>
<i>Cymbella sp.</i>	<i>Closteriopsis sp.</i>	<i>Merismopedia sp.</i>
<i>Gomphonema sp.</i>	<i>Closterium sp.</i>	<i>Nostoc sp.</i>
<i>Gyrosigma sp.</i>	<i>Cosmarium sp.</i>	<i>Oscillatoria sp.</i>
<i>Navicula sp.</i>	<i>Eudorina sp.</i>	
<i>Nitzschia sp.</i>	<i>Microspora sp.</i>	
<i>Pinnularia sp.</i>	<i>Oedogonium sp.</i>	
<i>Pleurosigma sp.</i>	<i>Oocystis sp.</i>	
<i>Synedra sp.</i>	<i>Pediastrum sp.</i>	
	<i>Protococcus sp.</i>	
	<i>Scenedesmus sp.</i>	
	<i>Sphaeroszoma sp.</i>	
	<i>Spirogyra sp.</i>	
	<i>Staurostrum sp.</i>	
	<i>Ulothrix sp.</i>	
	<i>Volvox sp.</i>	
	<i>Westella sp.</i>	
	<i>Zygnema sp.</i>	
	<i>Pandorina sp.</i>	

The generic diversity of chlorophyceae was highest with 19 genera during the period of study in the lake under investigations (Table-2) followed by bacillariophyceae and cyanophyceae. *Spirogyra sp* were recorded as the major dominant genus in the sampling lake under investigation.

## Conclusion

The water quality analysis of the water samples from January 2013 to December 2016 revealed that the water of Purbasthali oxbow Lake is alkaline. The water quality of the study area remained within the safe limits, which shows that water of this

lake is fit to support the aquatic ecosystem. The increasing phosphate concentration due to surface runoff from catchment area may lead to eutrophication in the near future. It is very important to monitor water quality of this lake in a regular interval, for seasonal variations and prevent every possible source of pollution around the lake. The lake also shows the dominance of chlorophyceae over bacillariophyceae and cyanophyceae. The present study could be beneficial for environmentalists or policy makers to strategize the conservative measure to maintain its ecological health.

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