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Study of Certain Physicochemical Properties of Water in Bordoibam Bilmukh Birds' Sanctuary (IBA), Wetlands of Assam, North Eastern India

Jayanta Sonowal^{1*} and Debojit Baruah²

¹*Department of Life Sciences, Dibrugarh University, Assam, India*

²*Department of Botany, Lakhimpur Girls' College, North Lakhimpur, Assam, India*

ABSTRACT

A study of certain physicochemical properties of water in relation to phytoplankton diversity of Bordoibam Bilmukh Birds' Sanctuary (IBA), Assam, North Eastern India, a wetland, has been carried out from August 2014 to July 2015. The entire wetland is divided into two zone i.e. core zone and buffer zone. Physicochemical properties of water like air and water temperature, free carbon dioxide (FCO₂), dissolved oxygen (DO), total dissolved solids (TDS), transparency, nitrate (NO₃), pH, chloride (Cl⁻) and current flow of water were analyzed. The primary objective of this study is to present a statistically meaningful water quality database of Bordoibam Bilmukh Birds' sanctuary by employing normal distribution analysis for better management of wetland environment. These databases will also help in future to assess the quality of water of the wetland. The result of present study showed that hydrological properties exhibit non uniform distribution in the study areas of the wetland and indicate that it is a pollution free environment.

Keywords: Bordoibam bilmukh, Wetland, Physicochemical properties

INTRODUCTION

Wetlands are important pool of aquatic plants and animals. Wetlands are among the most productive ecosystems in the world that provide habitat for large numbers of flora and fauna. Now attention has been curved to using the

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wetland systems and the plant species occurring in there as bio-energy sources and also for use in pollution abatement projects to filter sewage, agricultural run-off, leachate from landfills, and acid mine drainage mitigation [1-16]. According to Black [2], a wetland is an environment at the interface between truly terrestrial ecosystems and aquatic systems making them inherently different from each other or yet dependent on both. Aquatic and wetlands plants are mostly confined to the marshes and wetland habitats. These wet or water logging state form the diverse habitat for specific plants and animals communities, which in broader sense, is known as wetland. The wet form like marshes, swamps, bogs and similar other areas and are the source of many valuable aquatic flora and fauna collectively termed as wetlands [5,17]. In the functioning of aquatic ecosystems both the productivity and the efficiency of ecosystem operations are governed by many constraints. Major environmental regulations include physical factors and the availability of resources required at various physiological ranges. Wetlands hydrology, a primary driving force influence wetland ecology, development and persistence, is yet poor understood. The biological productivity of any aquatic body is influenced by climatic factors i. e. air temperature, wind velocity and rainfall have a great bearing on wetland fisheries [14-19]. The productivity and diversity of aquatic flora and fauna in a wetland is depended on physicochemical characteristics of water. The nutrients available in the water are playing a key role in the manner of proper balancing of the aquatic ecosystem. The diversity and composition of phytoplankton is correlated with different physicochemical parameters of water [10]. Certain physicochemical properties of water indicate the pollution scenario of water environment. Phytoplankton could be used as the indicator of physicochemical status of any water body [6,11,19].

Bordoibam Bilmukh Bird's Sanctuary is also a wetland. Assam government has declared Bordoibam Bilmukh wetland as Birds' Sanctuary in the month of July 1996. Bordoibam Bilmukh Birds' Sanctuary is belong to North Lakhimpur district of Assam, Northeast India, located in between Dhemaji and Lakhimpur district of Assam and it is 450 km away from state capital Dispur, Guwahati; it is 35 km far from headquarters of Dhemaji district and 50 km from Lakhimpur district that situated in between 27°20'N (Latitude) and 94°20'E (Longitude) [19].

Bordoibam Bilmukh Birds' sanctuary is harbor of aquatic plants, animals and variety of rare and migratory birds. At present the Bordoibam Bilmukh Birds' sanctuary is under big trouble from anthropogenic activities. Owing to lack of proper safety of the sanctuary, the resources are exploited un-judicially by local people. As the sanctuary is surrounded by villages and tea garden, household wastes and industrial chemical effluent may be contaminated in the water, so it is utmost necessary to study the water quality to understand the water environment. Some parts of the sanctuary are used for agricultural purposes in different seasons for different crops by the local people. Sanctuary is explicitly chosen for cattle grazing and fishing in dry seasons when migratory birds are coming for breeding. There are many raising problems faced by the sanctuary. Therefore it is crucial to assess the issues and look for the find out immediate strategies to stop such activities in the sanctuary. The purpose of the present study is to assess the water quality of Bordoibam Bilmukh Birds' Sanctuary, an Important Birds' area of Assam, Northeast India which is considering as wetland for future assessment and scrutinize of the sanctuary.

MATERIALS AND METHODS

For a systematic study of certain physicochemical properties of water, the Bordoibam Bilmukh Birds' sanctuary is

divided into two zones 1) Core zone – retaining water for whole year, 2) Buffer zone – where water retain only for summer season. The present study on physicochemical properties of water of Bordoibam Bilmukh Birds' Sanctuary, an Important Birds' area of Assam, Northeast India has been carried out from August 2014 to July 2015. Composite water samples (sub-surface and middle depth) was collected randomly from each sampling sites once in a month for one year with a 2L plastic hydrobios water sampler and transferred to clean 2L polythene containers and 250 ml capacity borosilicate glass bottles for further analysis of nitrate and chloride in the laboratory. On the other hand temperature, transparency, pH, dissolve oxygen (DO), total dissolve solids (TDS), free carbon dioxide (FCO₂) and current flow of water were measured in the sampling sites.

RESULTS AND DISCUSSION

Temperature

Temperature is one of the most important ecological factors, which controls the physiological behaviour and distribution of organisms. The temperature of wetland water varied in different seasons. Water temperature was found to be lower than atmospheric temperature.

- **Air temperature:** In buffer zone, air temperature of Bordoibam Bilmukh Birds' Sanctuary was observed between 23.6°C to 34.2°C. The lowest air temperature was recorded in winter and highest in the monsoon. In core zone it was observed from 19.6°C to 33°C. The lowest air temperature was recorded in the winter and highest in the monsoon (Figures 1 and 2).
- **Water Temperature:** Water temperature is one of the most important ecological factors which controls the physiological behaviour and distribution of organisms [12,20]. In buffer zone, the water temperature was observed between 24.6°C to 33.67°C. The lowest water temperature was recorded in post monsoon and highest in monsoon. In core zone, it was observed between 19°C to 30°C. Lowest water temperature as recorded in winter and highest in monsoon. The level of water temperature found to correlate with air temperature. However, the water temperatures were observed conducive for aquatic animals in both zones. Lowest value of water might have resulted due to receding water couple with heavy accumulation of organic wastes (Figures 1 and 2).

Water transparency

Water transparency is also an important aquatic ecological factor which reveals the level of sunlight penetration into the water. The ranges of water transparency of Bordoibam Bilmukh Birds' sanctuary were from 20.62 cm to 53.26 cm in buffer zone whereas in core zone it ranges were from 33.72 to 55.6 cm. In buffer zone, the lowest water transparency was recorded in pre-monsoon and highest in monsoon whereas in core zone it was recorded lowest in winter and highest in monsoon (Figures 1 and 2). The level of water transparency in both the zones was favourable for photosynthetic organisms, as sunlight able to reach up to bottom in the site. The maximum transparency was due to influx of rain water during rainy seasons. It is lowest during dry season due to increase of organic matter as well as due to increase fishing activities. The lowest level of water transparency in the area might

also have resulted due to anthropogenic activities like fishing, and cattle grazing and drinking during dry season.

pH

pH plays an important role in the growth of phytoplankton. It is one of the most important factors that serve as an index for water pollution. Water pH is the indicator of water buffer system of a particular aquatic ecosystem and representing the type of living organisms inhabited therein. Natural water commonly falls within the pH range from 4 to 9. In this present study pH were found within permissible limit throughout the year. In buffer zone, the pH of water was found between 6.94 to 8.9. The lowest pH was found in pre-monsoon and highest pH was found in monsoon. In core zone, pH of water was found between 6.6 to 8.88. Lowest was found in winter and highest was found in monsoon (Figures 1 and 2). The lower pH was due to high turbidity as well as uniform temperature during that season might have enhanced microbial activity, causing excessive production of CO₂ and reduced pH. It showed conformity with the findings Khan and Khan [8]. The value of pH ranges between 8 and 9 attributing increased primary productivity wherein carbonates, sulfate, nitrates and phosphates are converted to hydroxyl ions [12,21]. The earlier studies show that the range of pH of a majority of lakes and reservoirs lies between 6 and 9. This is in accordance with earlier reports by Wetzel [21] who reported that the value of pH ranges from 8 to 9 units in Indian waters. The present findings are also in conformity with the above. The lower pH during monsoon is due to high turbidity, and in summers, the high temperature enhances microbial activity, causing excessive production of CO₂ and reduced pH.

Free Carbon Dioxide (FCO₂)

In buffer zone, the FCO₂ of water found between 2.44 mg/l to 4.2 mg/l. Lowest FCO₂ was recorded in monsoon and highest was recorded in post-monsoon. In core zone, FCO₂ was found between 2.84 mg/l to 4.4 mg/l. Lowest FCO₂ was recorded in monsoon and highest was recorded in winter. The level of FCO₂ is inversely proportional to the level of DO (Figures 1 and 2). The maximum level of FCO₂ might be due to high rate of decomposition of organic matters by the microbes resulting in rapid production of CO₂ [8].

Dissolved oxygen (DO₂)

Available oxygen in water is essential for aquatic fauna. The availability of oxygen is depending on the photosynthetic efficiencies of aquatic flora. In present study, in buffer zone, dissolved oxygen was found between 7.16 mg/l to 8.46 mg/l. Lowest DO was found in pre-monsoon and highest DO was found in monsoon. In core zone, it was recorded between 4.1 mg/l to 8.4 mg/l. Lowest was recorded in winter and highest was recorded in monsoon. The lowest level of DO was due to less rainfall and increasing fishing activity and highest was due to reverse of these (Figures 1 and 2). Presence of dissolved oxygen in water may be due to direct diffusion from air and photosynthetic activity of autotrophs. In the present study a strong correlation was also observed between pH and dissolved oxygen; with the lowering of pH, dissolved oxygen was also lowered. The addition of a variety of biodegradable pollutants produces from domestic sources are stimulates the growth of microorganisms, which consume the dissolved oxygen. The values further deplete during summers because at high temperature, the oxygen

holding capacity of water decreases.

Chloride (Cl⁻): The enhancement of chloride level in aquatic medium is due to animal origin. In buffer zone, the range of Chloride was found between 5.1 mg/l to 6.64 mg/l. Lowest being in monsoon and highest being in post-monsoon. In core zone, the chloride observed between 5.22 mg/l to 7.90 mg/l. Lowest being in monsoon and highest being in winter. Munwar [13] suggested that high value of chloride is an indication of pollution of animal origin. Similar observation was also made by Thresh et al. [20]. It has been suggested that chloride content also increased with degree of eutrophication [8]. Present findings are showing the low chloride level and the study area is free from pollution (Figures 1 and 2).

Nitrate (NO⁻²₃): Nitrate is the eutrophication causing nutrient leading to extensive algal and other phytoplankton growth. In present study, in buffer zone, nitrate concentration of water temperature was observed between 1.58 mg/l to 3.24 mg/l. Lowest being in monsoon and highest being in post-monsoon. In core zone, it observed between 1.5 mg/l to 3.12 mg/l. Lowest being in winter and highest being in monsoon. The highest value of nitrate may be due to the decrease the water level effecting concentration and the release of nutrient during decomposition, which in turn increased with the rise temperature [4]. However the seasonal mean variations of nitrate concentration was within the permissible limit (Figures 1 and 2).

Total dissolved solids (TDS)

Water is a good solvent and picks up the impurities easily from the vicinity. Normally water contains solids materials both in dissolved and suspended forms. Total dissolve solids may have an influence on the acceptability of the water in general [7]. In present study, in buffer zone, TDS of water was observed between 61.68 ppm to 119.6 ppm. In buffer zone, lowest TDS was recorded in monsoon and highest was recorded in pre-monsoon. In core zone, it was observed between 57.6 ppm to 164 ppm. Lowest was recorded in winter and highest was recorded in monsoon . The higher concentration of TDS may be due to addition of solids from the runoff water. Marker [9] has made the same observation. the amount of total solids are influenced by the activity of plankton and organic materials (Figures 1 and 2).

Current flow: There are two inlet streams through which water flow into the Bordoibam Bilmukh Birds' Sanctuary. The current flow of water of the wetland was measured in two locations namely – i) Tengarah Jan and ii) Na-Nadi Suti. No water was found in the both of inlet water channel from October 2014 to February 2015 in Tengarah Jan and from November 2014 to January 2015 in Na-Nadi Suti. Therefore water flow was observed from March to September in the study period. When monsoon started the level of water in inlet channels were raised. The average highest velocity of water flow was observed in the month of July 2015 in the Tengarah Jan at 0.30 m/sec. and lowest was observed at 0.09 m/sec in the month of March 2015. In Na-Nadi Suti, the average highest velocity of water flow was observed in the month of August 2014 at 0.35 m/sec. and lowest was observed in the month of September 2015 at 0.09 m/sec (Figure 3).

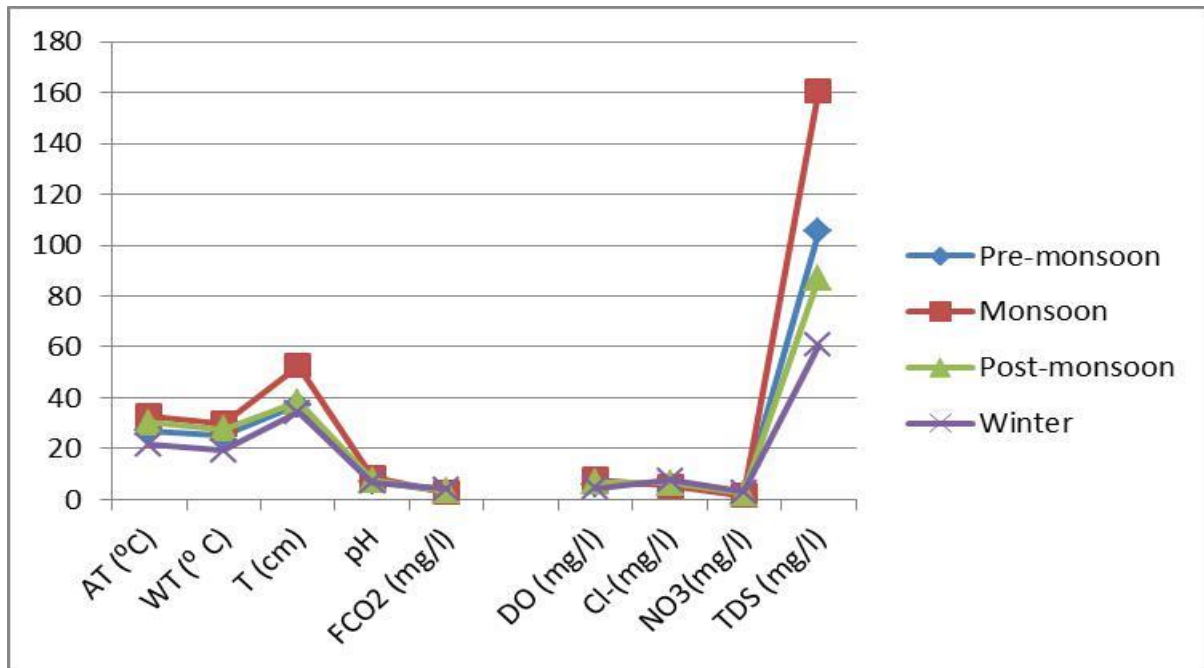


Figure 1: Physicochemical parameters of water in core zone from August 2014 to July 2015

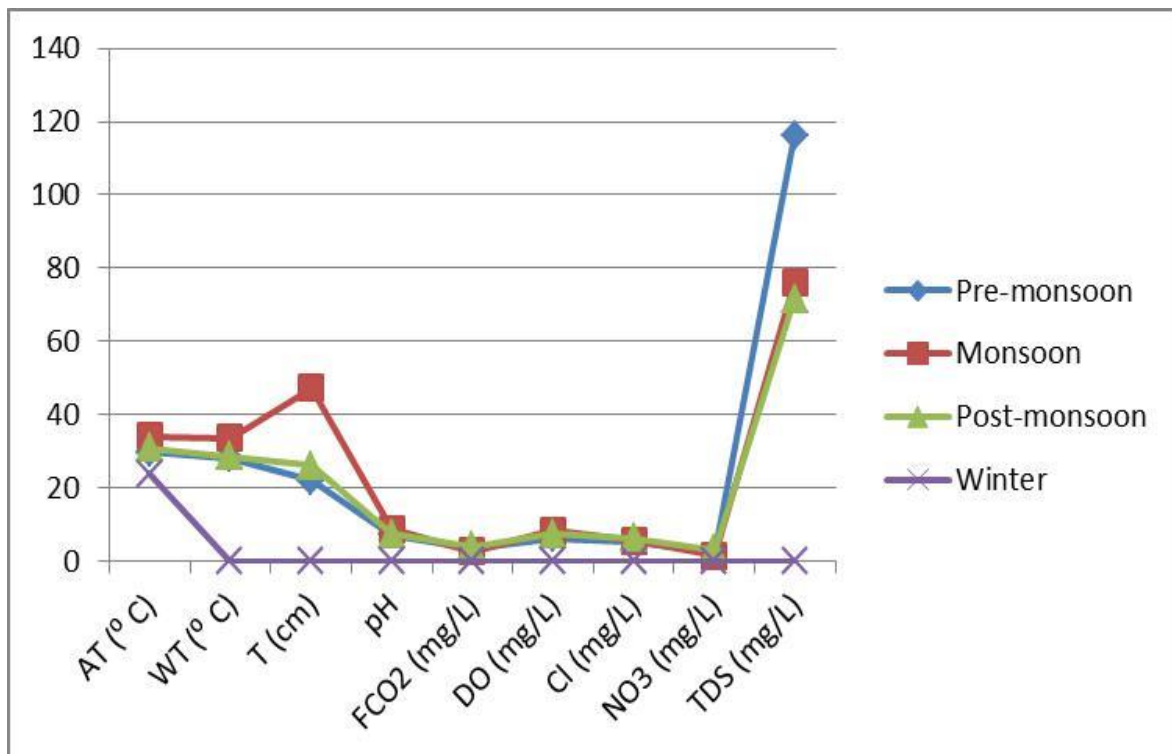


Figure 2: Physicochemical parameters of water in buffer zone from August 2014-July 2015

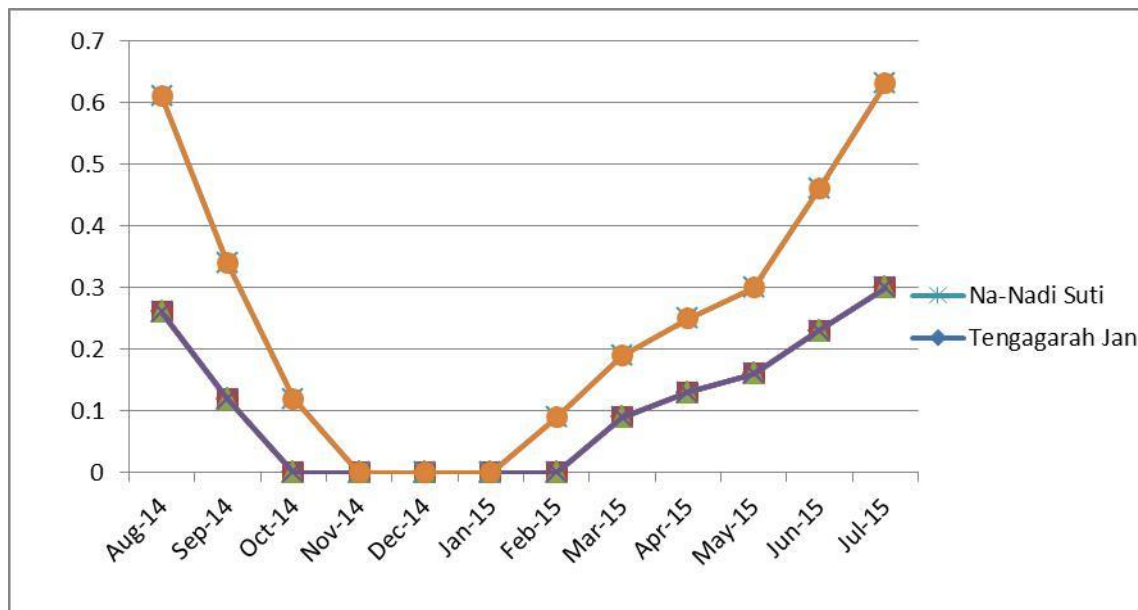


Figure 3: Current flow of water in Na-Nadi Suti and Tengagarah Jan from August 2014-July 2015

CONCLUSION

The Bordoibam Bilmukh Birds' Sanctuary is a wetland and playing a very important role from the point of ecosystem management and conservation. This sanctuary is the breeding ground for many migratory and endemic birds' so it is urgent need to conserve the wetlands. The water quality is immensely influential for aquatic biodiversity and ecosystem productivity. The physicochemical properties of the wetlands were found within the range of pollution indicator index. From this points of view water ecosystem is still check of pollution, so necessary measure should be taken immediately before reaching pollution zone.

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