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Limnological studies of Balapur pond of Prayagraj Uttar Pradesh, India

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Abstract

The aim of the present study was to investigate the physico-chemical parameters like temperature, transparency, pH, dissolved oxygen, BOD, free CO₂ and alkalinity of Balapur pond of Prayagraj (U.P.), India. The study was conducted over a period of one year from April 2019 to March 2020. A significant level of variation was found with respect to these parameters throughout the study period. Systematically analyzed month wise samples indicated that the water quality of the pond studied is although having some pollutants but is more or less suitable for fish culture purposes.

Keywords: Balapur pond, Limnological parameters, plankton, fish culture

Introduction

Limnology is the study of the physical, chemical, geological and biological aspects of all naturally occurring fresh water. Freshwater habitats such as lakes, ponds, dams, reservoirs are known as lentic (still) while running water such as rivers, mountain streams are known as lotic (flowing). Limnological studies of such water bodies reveal interaction of parameters influencing the productivity of the aquatic ecosystems (Alam, 2001) [1]. Due to rising human population and industrialization, the per capita water needs have increased to a great extent. The lentic water resources such as ponds, tanks and lakes, situated near human settlements, are getting polluted as they constantly receive solid and liquid wastes. However, much information is needed particularly with reference to specific water bodies of small dimension.

In India, a number of ponds, lakes and reservoirs are naturally found but they are not being utilized properly due to lack of insufficient study of their limnology. The study of different water parameters is very important for understanding the metabolic events in the aquatic ecosystem. One of the most important features of ponds is the presence of standing water, which naturally provides habitat for wetland biota including both plants as well as animals. A large number of micro-organisms and invertebrates feed on the decaying plants and these micro-organisms and invertebrates in turn provide food for wetland species including fishes.

Pond water is useful for farming since ancient times but the unsustainable farming has multiple effects (Verma 2017a) [42] and disturbs the ecological balance (Verma 2018a) [33]. Aquatic ecosystem maintains the ecological, social and economic functions that interconnect the organisms including humans. It is helpful in maintaining the biodiversity. The biodiversity has values (Verma 2016a) [40] and explored at three levels *namely*: ecosystem diversity, species diversity and genetic diversity. The genetic diversity acts as a buffer for biodiversity (Verma, 2017b) [43]. The biodiversity helps to maintain the ecological balance. There is a necessity of ecological balance for widespread biodiversity (Verma 2017c) [30] and the biodiversity loss has ecological impact (Kumar Ajay *et al.*, 2017) [6]. The ecological balance is must for human survival (Verma 2018b) [34]. The climate change has a huge impact on biodiversity (Prakash *et al.*, 2019) [18] and farmers' practices (Mandal *et al.*, 2020) [7].

Prakash *et al.*, (2015a, 2015b, 2015c and 2016) [11-13] and Verma *et al.*, (2016a and 2016b) [40, 41] performed the limnological and ichthyological studies of Alwara Lake of Kaushambi (U.P.) while Verma *et al.*, (2017a, 2017b and 2018) [42, 43] and Prakash *et al.*, (2017, 2019a and 2019b) [36, 37] studied the fresh water bodies for distribution and conservation of fishes, other chordates and other properties. Verma (2016b, 2016c, 2016d, 2016e, 2017d, 2017e, 2018c, 2019a, 2019b, 2019c and 2020), [41, 26, 27, 31, 32, 35-38] Singh *et al.*, (2016) [22], Ranjan and Prakash (2019) [20] and Prakash (2020a and 2020b) [9, 10] and Prakash *et al.*, (2020) [44] studied the limnological parameters as well as biodiversity and conservation status of fishes in the various lentic and lotic fresh water bodies of Uttar Pradesh. Singh *et al.*, (2020) [7] studied the

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macrophytes. In the present investigation an attempt has been made to assess the variations in physico-chemical parameters of a fresh water perennial pond “Balapur pond” situated at Koraon block and tehsil of Prayagraj district of Uttar Pradesh. The pond (photo 1) studied is approximately 62 Kilometers ahead from Prayagraj District head quarter.

Material and methods

Monthly sampling of pond water was done from April, 2019 to March, 2020. Observations were made for water temperature, transparency and pH at the site, while for rest of the parameters, analysis was made in the laboratory as per standard procedures of APHA (2005) [2]. Planktonic flora and fauna were collected from marginal and centre of pond using plankton net following standard procedures and later identified in the laboratory.



Photo 1: A view of Balapur pond

Result and discussion

The results of the study are given in table 1 and 2. It is a well-known fact that physico-chemical characteristics of the water

play an important role in determining the status of the aquatic ecosystems. Climatic conditions of the area also influence these parameters to great extent.

Table 1: Monthlies variations in physico-chemical characteristics of Balapur Pond

Months	Temp (°C)	Trans (cm)	pH	DO (mg/l)	F CO ₂ (mg/l)	Alkalinity (mg/l)	Chloride (mg/l)	BOD (mg/l)
April	22.4	32.6	8.0	7.9	15.2	115.0	19.5	7.2
May	28.9	34.5	8.4	8.1	15.1	120.0	20.8	7.5
June	32.6	30.5	8.6	7.4	15.4	138.0	25.5	7.4
July	35.5	25.8	7.9	8.2	16.4	135.0	24.5	8.0
Aug.	28.1	22.3	7.8	8.2	16.8	90.0	19.1	8.5
Sept.	26.3	20.2	7.8	8.8	17.4	78.0	12.5	8.7
Oct.	22.1	26.3	7.8	8.8	17.8	84.0	10.5	7.9
Nov.	19.8	27.0	7.7	9.2	18.4	90.0	11.8	7.4
Dec.	15.3	27.5	8.5	9.7	20.5	95.0	15.6	7.0
Jan.	14.2	28.0	8.2	10.4	21.4	84.0	17.5	6.0
Feb.	16.6	29.0	7.7	10.2	22.8	80.0	18.2	6.5
Mar.	20.4	30.2	7.9	8.4	19.7	82.0	16.4	6.7

Water temperature is an important parameter because it not only influences the physical and chemical characteristics of water but also the biota in a water body by affecting activities such as behavior, respiration and metabolism. The water temperature varied from 14.2 to 35.5°C, showing maximum range in summer and minimum in winter. This variation of water temperature was directly related to atmospheric temperature having more effect directly or indirectly on all life processes (Welch, 1952) [45]. Almost similar results have also been reported by Narayana *et al.*, (2008) [8], Jawale (2009) [5] and Prakash *et al* (2015a) [11].

Transparency describes how easily light can pass through a substance. In ponds, lakes this means how deep sunlight penetrates through the water. Plants and algae need sunlight to grow, so they are only able to grow in areas of lakes where the sun light penetrates. Water transparency depends on the amount of particles in the water. The more particles mean the less water transparency. The water transparency is measured with a Secchi disk. The transparency of water body is affected by several factors like planktonic growth, rainfall, sun's position in the sky, angle of incidence of rays, cloudiness, visibility and turbidity due to suspended inert

particulate matter. In the present investigation, the maximum value was recorded in summer and minimum value was recorded in monsoon. Low value of transparency in monsoon may be due to influx of rain water from catchments area, clouding, less penetration of light and high turbidity due to suspended inert particulates matter. However, high value of transparency in summer may be due to clear atmosphere and high light penetration. This investigation is also close conformity with finding of Prakash *et al* (2015a) [11].

The pH is a measure of the acidity or alkalinity of an aqueous solution. Its different values at different areas in all the three seasons of the year were significant. The variation in pH is due to the presence or absence of free carbon dioxide, carbonate and planktonic density. The pH of the water ranged from 7.7 to 8.6, showing alkaline nature. The alkaline pH is a usual feature of productive water bodies as reported earlier by Ayappaan and Gupta (1981) [3].

The oxygen supply in water comes mainly from photosynthetic activity of plants but also by atmospheric diffusion. The dissolved oxygen (DO) is one of the most important and limiting parameter of water quality assessment, which maintains aquatic life. It regulates the metabolic process of aquatic organisms. The maximum dissolved oxygen was recorded in winter and minimum dissolved oxygen was recorded in the summer season. The highest dissolved oxygen in winter may be due to low temperature and minimum dissolved oxygen in summer may be due to high metabolic rate of organisms. Dissolved oxygen concentration showed variation between 7.4mg/L and 10.4mg/L, the higher values being noted in post winter months due to high photosynthetic activity (Alam, 2001) [1].

Carbonate alkalinity of the pond was absent throughout the study period. The total alkalinity was mainly due to bicarbonates which varied from 78.0mg/L to 138.0mg/L, showing minimum range in post monsoon and maximum in summer months. The present finding of high alkalinity value

is due to influx of domestic sewage rich in alkalinity causing chemicals such as soap and detergents and also due to presence of bicarbonate system and high value of pH in alkaline side (David *et al.*, 1969) [4] showing that the pond is of productive nature.

Free carbon dioxide in a water body is generally derived from the atmospheric sources, biotic respiration and decomposition of organic matter by saprophytes. In the present study, the FCO₂ was ranged between 15.1 and 22.8 ppm. The FCO₂ concentration in the pond was maximum during rainy months and minimum during winter months. The appearance of high concentration of free carbon dioxide during monsoon months could probably be associated with active decomposition of organic matter. The present finding is similar to that of Verma (2019b) [37]. In the present study the chloride level was in tolerance limit showing no significant harmful effect.

Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain temperature over a specific time period. The study showed that BOD ranged from 6.0 mg/l to 8.7 mg/l *i.e.*, minimum in winter and maximum in monsoon. During monsoon, higher BOD values attributed to the enhanced biological activity at higher temperature. This investigation is also close conformity with finding of Verma (2019b) [37].

The results of macro algae, phytoplankton and zooplankton populations in the Balapur Pond indicate that the water of this pond is not yet seriously polluted since it contains freshwater algae *Chara* and *Nitella* and phytoplankton *Volvox* in the central region of pond. Most other plankton also comprised of non-indicator organisms. During the present study, presence of *Chlorella*, *Oscillatoria*, *Anacystis*, and *Scenedesmus* is considered as indicator of organic pollution because all these genera were collected from polluted marginal water.

Table 2: Plankton Population of Balapur Pond

Sampling place	Macro algae	Phytoplankton	Zooplankton
Marginal	<i>Oedogonium</i> <i>Spirogyra</i> <i>Chlorella</i>	<i>Oscillatoria</i> <i>Scenedesmus</i> <i>Gomphonema</i> <i>Pediastrum</i> <i>Phacus</i> <i>Chlorella</i> <i>Chlamydomonas</i> <i>Cledophora</i> <i>Closterium</i> <i>Diatoma</i> <i>Nitzschia</i> <i>Anabaena</i> <i>Botryococcus</i> <i>Chroococcus</i> <i>Lyngbya</i> <i>Merismopedia</i> <i>Nostoc</i>	<i>Daphnia</i> <i>Cyclops</i> <i>Mesocyclops</i> <i>Heliadiaptomus</i> <i>Alona</i> <i>Bosmina</i> <i>Ceriodaphnia</i> <i>Brachionus</i> <i>Filinia</i>
Central	<i>Oedogonium</i> <i>Spirogyra</i> <i>Chara</i> <i>Nitella</i>	<i>Navicula</i> <i>Volvox</i> <i>Pediastrum</i>	<i>Daphnia</i> <i>Cyclops</i> <i>Diaptomus</i> <i>Euchlanis</i>

Conclusion

The present immunological studies of Balapur pond suggest its nutrient rich status and because of small size it could be gainfully used for fish culture. Authors suggest appropriate care of this pond in order to maintain the proper water level of surrounding areas. Thus based on the findings it can be concluded that the pond water was not suitable for bathing and drinking but it can be used for fish culture.

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