

VARIATIONS IN DISSOLVED OXYGEN AND BIOCHEMICAL OXYGEN DEMAND IN TWO FRESHWATER LAKES OF BODHAN, ANDHRA PRADESH, INDIA

Venkata Ramanaiah Solanki, S. Samba Murthy, Amarjit Kaur and S. Sabita Raja

Department of Zoology, University College of Science, Osmania University, Hyderabad-500 007, India

ABSTRACT

Dissolved oxygen and biochemical oxygen demand (BOD) have been assessed at different sites of the two lakes, Bellal and Pandu of Bodhan. In the Bellal lake dissolved oxygen varies from 4.40 to 13.70 mg/L. In the month of February the dissolved oxygen was much higher than the normal range, although most of the samples showed dissolved oxygen within normal range. The maximum value of BOD in Bellal lake was recorded at 40.20 mg/L. Dissolved oxygen in Pandu was found to be low in most of the water samples. Oxygen deficient was prominent, which has detrimental effect on other physicochemical factors and population density. The average value of biochemical oxygen demand in Pandu lake was found to be 60.32 mg/L which is comparatively more than that Bellal lake. The depletion of dissolved oxygen and higher values of biochemical oxygen demand were due to domestic sewage and industrial outlet into the Pandu lake. The depletion of dissolved oxygen in Bellal Lake might be due to agricultural runoff. The Pandu lake can be considered transforming from mesotrophic to eutrophic lake. However, the Bellal lake is oligotrophic in its current situation. Contrarily Bellal Lake is least polluted as it has high dissolved oxygen and the low biochemical oxygen demand.

INTRODUCTION

Temporary ponds are found throughout the world, and though there are considerable regional differences in their type and method of formation, many physical, chemical and biological properties are quite similar. The high variability of abiotic factors, and the often comparably variable composition of the fauna, appears particularly important. The worldwide distribution of this water body type leads to a large variety of temporary pond types due to climatic and geological differences. The limnology of tropical lakes is of great interest and has become a main field of contemporary limnological research to overcome the lack of knowledge. Tropical lakes are warm water lakes situated in the tropical and subtropical parts of Asia, Africa, Central and South America. The chemical and physical properties as well as the biological processes of tropical lakes differ significantly from those of temperate lakes due to temperature and thermal stratification, radiation and primary production, diversity of fauna and flora and metabolic processes in the water body (Gunter Gunkel 2000).

Domestic sewage reduces dissolved oxygen and increases biochemical oxygen demand levels in water bodies due to presence of excessive quantities of organic matter. Dissolved oxygen is an important factor that determines the quality of water in surface waters like lakes and rivers. The higher the concentration of dissolved oxygen the better is the water quality. Dissolved oxygen is an important indicator of ability of a water body to support aquatic life. Oxygen enters the water by absorption directly from the atmosphere or by aquatic plants and algal photosynthesis. Oxygen is removed from the water by respiration and decomposition of organic matter.

Biochemical oxygen demand (BOD) is the amount of oxygen required by microorganisms to decompose organic substances present in water. When sewage enters lakes or streams, microorganisms begin to decompose the organic materials and oxygen is consumed. When the dissolved oxygen levels drop too low, many aquatic species perish. When organic compounds decompose without oxygen, it gives rise to undesirable odours.

The present work has been carried out on Bellal and Pandu lakes of Bodhan to study the dissolved oxygen and biochemical oxygen demand variations.

MATERIALS AND METHODS

The two lakes Bellal and Pandu lie in the Bodhan town in Nizamabad district of Andhra Pradesh. The town is located at 18-14° N latitude and 77-53° E longitude. Lake Bellal is located on the south side of Bodhan and Pandu is on the north side of the town.

Bellal lake is an irrigation lake having 346 MCFT capacity. It supplies 12 lakhs gallons of water every day for drinking purpose. The Pandu lake is a storage tank for agricultural purposes. It receives water from Bellal through a connecting canal called Sharabathi canal.

With consideration of the sources of inflow to the lakes, three different sampling sites were selected in both the lakes. The water was collected in polyethylene bottles of two-litre capacity. These samples were transported to laboratory in an ice box to avoid unpredictable changes in physico-chemical characteristics. Dissolved oxygen and BOD in the surface water were determined monthly for a period of two years from August 2002-July 2004. Dissolved oxygen was determined by Winkler's iodometric method and BOD by 5day BOD test method (APHA 1989).

RESULTS AND DISCUSSION

Dissolved Oxygen: Dissolved oxygen is one of the important parameters in water quality assessment and reflects the physical and biological processes prevailing in waters. In the present studies dissolved oxygen varied from 4.40 to 13.70 mg/L in Bellal Lake, with an average 8.41 ± 3.05 mg/L. At the Station-I dissolved oxygen was lowest in the month of August (4.4 mg/L) at Station-II (5.2 mg/L) and at Station-III (4.8mg/L). It was maximum in the month of February (13.1mg/L) at Station-I and 13.6 mg/L at Station-II and Station-III in the month of January. Monthly variations are shown in Fig. 1 and mean values in Table 1.

Supersaturation of dissolved oxygen in Lake Bellal was observed most probably as a result of photosynthetic activity. The dissolved oxygen was observed to be more at Station-II as compared to Station-I and Station-III. These results are in conformity with Njenga (2004) in tropical lakes of Kenya and India. Dissolved oxygen was found to be high in the month of January when the water temperature was low. Thus, it has an inverse relationship with dissolved oxygen. However, Sreenivasan (1974) reported that the water temperature did not affect the dissolved oxygen much. Relatively higher values of dissolved oxygen might be due to increased solubility of oxygen at low temperature (Chatterjee & Raziuddin 2002).

Dissolved oxygen in Pandu lake varied from 1.70 to 6.40 mg/L, 2.00 to 7.10 mg/L and 2.80 to 7.60 mg/L with an average of 3.70 ± 1.58 mg/L; 1.45 ± 1.12 mg/L and 4.37 ± 0.23 mg/L for Stations-I, II and III respectively. At Station-I dissolved oxygen was low in May 2003 and 2004, i.e., 1.7 mg/L while it was highest in November 2002 (6.4 mg/L) and November 2003 and January 2004 (5.8 mg/L). At Station-II maximum dissolved oxygen was observed in November 2002 and 2003

Table 1: Average mean values of dissolved oxygen (mg/L) in Bellal lake.

Station	n	Mean	Std. Deviation	Std. Error
Station-I	24	8.0292	3.1363	0.6402
Station-II	24	8.6125	3.0306	0.6186
Station-III	24	8.6042	3.0797	0.6286
Total	72	8.4153	3.0512	0.3596

Table 2: Average mean values of B.O.D. (mg/L) in Bellal lake.

Station	n	Mean	Std. Deviation	Std. Error
Station-I	24	25.7667	7.8095	1.5941
Station-II	24	24.9250	7.7673	1.5855
Station-III	24	25.4833	7.8771	1.6079
Total	72	25.3917	7.7152	0.9092

Table 3: Average mean values of dissolved oxygen (mg/L) in Pandu lake.

Station	n	Mean	Std. Deviation	Std. Error
Station 1	24	3.7083	1.5830	.3231
Station 2	24	3.8500	1.4283	.2915
Station 3	24	4.3750	1.1268	.2300
Total	72	3.9778	1.4026	.1653

Table 4: Average mean values of B.O.D. (mg/L) in Pandu lake.

Station	n	Mean	Std. Deviation	Std. Error
Station 1	24	60.31667	9.65922	1.97168
Station 2	24	62.99167	11.5016	2.34775
Station 3	24	57.65833	8.25538	1.68512
Total	72	60.32	9.8	2.0

(7.1mg/L), and minimum in May 2003 and 2004 (2.0 mg/L). At Station-III maximum dissolved oxygen was recorded in November 2002 (7.6 mg/L) and minimum in August 2002 (3.0 mg/L) (Fig. 3 and Table 3).

It was found that there exists an inverse relation between dissolved oxygen and temperature. In summer with the increase in water temperature there was reduction in dissolved oxygen; whereas in winter months due to decrease in temperature the level of dissolved oxygen increased. These results are in conformity with Shrivasta et al. (2003) and Ahmed Masood & Krishna Murthy (1990).

The depletion of dissolved oxygen by the organic matter that accumulates in the lake during dry season resulted in the low level of dissolved oxygen of 1.7 mg/L. The decrease in oxygen may be the result of the high load of organic substances in the inflow from Sharbathi canal. This lack of oxygen is a good indication of the trophic state of the lake, which is overloaded with inorganic and organic matter and transforming into a eutrophic lake. The primary production and input of degradable organic substances create a demand for oxygen. The dissolved oxygen profile of Pandu lake indicates a stable oxycline conditions in different months.

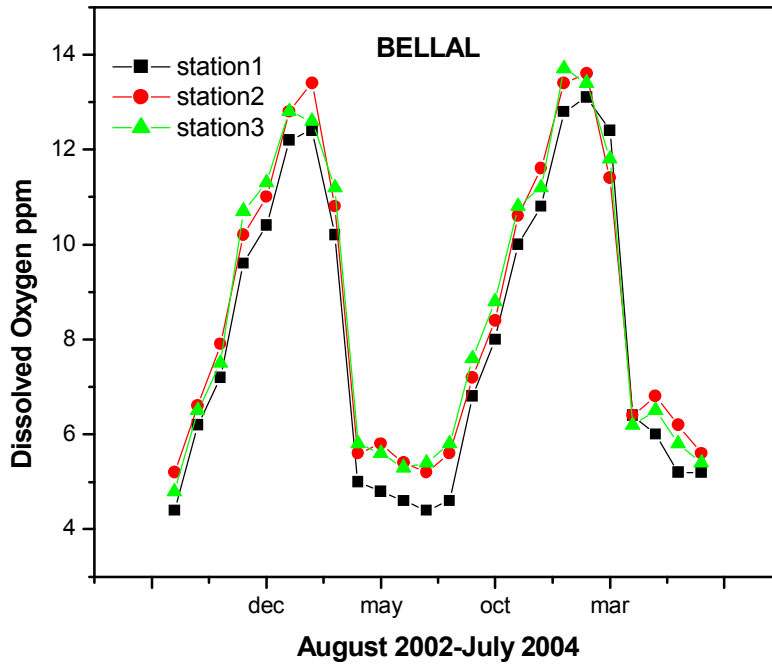


Fig 1: Monthly variations of D.O. in Bellal lake.

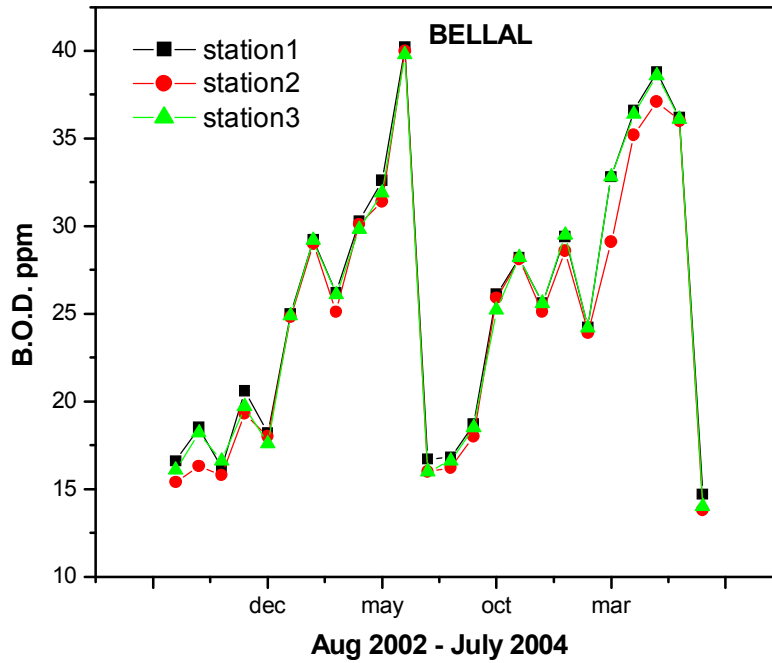


Fig 2: Monthly variations of B.O.D. in Bellal lake.

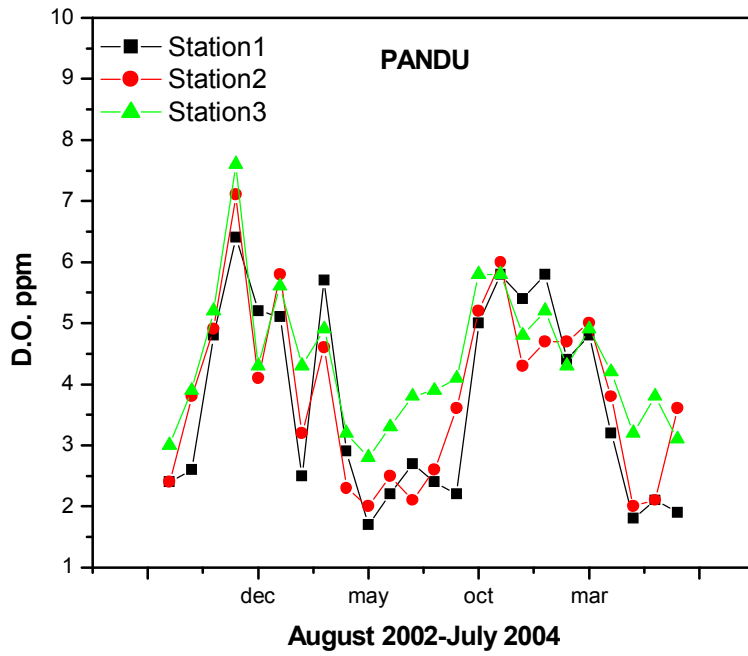


Fig. 3: Monthly variations of dissolved oxygen in Pandu lake.

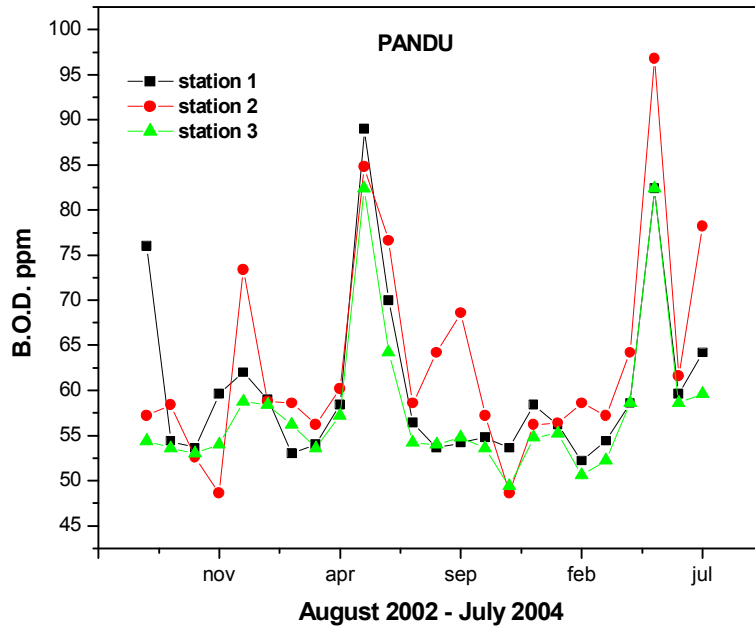


Fig 4: Monthly variations of B.O.D. in Pandu lake.

Biochemical Oxygen Demand (BOD): In the present work, during the period of investigation, BOD varied from 13.80 to 40.20 mg/L with an average 25 ± 39 7.71 mg/L in Bellal lake. The maximum values were recorded in June 2003 and July 2004 at all the stations. The average values are given in the Table 2 and monthly variations in Fig. 2. It is clear that the BOD is less at Station-II as compared with the other two stations. The observed increase in BOD value might be due to biological activities at elevated temperatures. BOD is the major criterion used in stream pollution control where organic loading must be restricted to maintain desired dissolved oxygen. In unpolluted waters BOD is lower while it is high in polluted waters (Hussain et al. 2004).

Monthly variations of BOD in the range of 13.80 mg/L to 40.20 mg/L are indicators of slow eutrophication of the lake. These results are in agreement with Devaraju et al. (2005) in Maddur lake.

BOD in Pandu lake varied from 52.20 to 89.00 mg/L, 48.60 to 96.80 mg/L and 49.40 to 82.40 mg/L with an average of 30.15 ± 4.82 , 31.49 ± 5.75 and 28.82 ± 4.12 for Stations-I, II and III respectively. At Station-I maximum BOD was recorded in May 2003 and 2004 (89 mg/L), and minimum in the months of October 2003 (52.2mg/L) and February 2004 (26.1 mg/L). At Station-II BOD was maximum in the months of May 2003 and 2004 (48.6 mg/L and 48.4 mg/L), and minimum in November 2003 and 2004 (24.2 mg/L). At Station-III, BOD was maximum in May (41.2 mg/L), and minimum in November 2004 (24.7mg/L) (Fig. 4 and Table 4). The low levels of dissolved oxygen were due the high organic load. The BOD levels indicate high concentration of biodegradable organic matter and high oxygen consumption by heterotrophic organisms. Most of the lakes in India are seriously polluted with high BOD levels. Similarly, many rivers in India have levels of DO as low as 0-2 mg/L, and BOD levels as high as 50-200 mg/L.

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