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Appraisal of water quality of lentic water body in Hassan District, Karnataka with Respect to Trophic Status

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ABSTRACT:

Lentic bodies are very important part of our natural Heritage. They have been widely utilized by mankind over the centuries to the extent that very few, if any are now in a "Natural" condition. Channarayapatna water body was chosen for a water quality study because currently this water body was found to be altered due to anthropogenic and agricultural activity. We have found a general relationship between trophic status of a water body and the aquatic plants present there. We have also found the alteration of water quality due to the presence of various aquatic plants. The present study was carried out to determine the physico-chemical characteristics in water in Channarayapatna water body, Hassan District, Karnataka of India during January to December 2011 and also compared seasonal variations in the water quality. The minimum and maximum values of atmospheric and surface water temperatures (°C), salinity (%), pH and dissolved oxygen (ml/L) were: 26.0-35.0; 25.0-33.5; 8.0-35.0; 7.2-8.2 and 2.8-5.5 respectively. The ranges of nitrate, nitrite, phosphate and silicate were: 5.2-14.3; 0.8-3.2; 0.3-2.20 and 0.2-0.8 respectively.

Keywords:
Physico-chemical parameters, Water body, trophic status.

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INTRODUCTION

Limnology is an interdisciplinary science which involves a great deal of laboratory studies to understand the structural and functional aspects and problems associated with the freshwater environment, from a holistic point of view (Adoni *et al.,* 1985). Aquatic biodiversity is threatened primarily by human abuse and mismanagement of both living resources and the ecosystems that support them. Most of the ponds are getting polluted due to domestic waste, sewage, industrial and agricultural effluents (Shiddamallayya and Pratima, 2008; Shekhar *et al.,* 2008). The requirement of water in all lives, from micro-organisms to man, is a serious problem today because all water resources have reached to a point of crisis due to unplanned urbanization and industrialization.

Fresh water habitats are located in different parts of the country especially in rural areas and are mainly used as a source of drinking water, irrigation and for fish production by the local fisherman communities. Water quality is defined in terms of the chemical physical and biological contents of water. The water quality of rivers and water body changes with the seasons and geographic areas, even when there is no pollution present. Scientific management of water bodies will assist to enhance the concept of sustainable utilization. Besides, the evaluation of ecological status, present fishery status and potential for fish production will help in implementation of developmental activities and improvement of fish production in water habitats.

The quality of water is now the concern of experts in all countries of the world. The water quality depends on the location of the source and the state environmental protection in a given area. Therefore, the quality and the nature of water may be determined by physical and chemical analysis (Abdo, 2005).

Channarayapatna water body is at the an longitude: 76°.25', latitude: 12°.55' an area of 217 hectare with the capacity of water body 170.41 mcft and total population around the water body is 33253 with a, distance from the village is of 1 km. The water from this body is used for agriculture, fishery, washing animals, clothes, vessels etc. The water body is polluted due to the human activity like drainage water was connected earlier but now it is diverted, human and animal excreta and refusal disposal, detergents, fertilizers etc.

The aim of the present study is to determine the distribution of physical variables (air and water temperatures, chemical variables (DO, pH, Electrical Conductivity, NO_2^-, NO_3^-, PO_4^{3-} and SiO_2) in the water of Channarayapatna lentic ecosystem during one year period to assess the environmental status of the water of Channarayapatna water body.

MATERIALS AND METHODS

Sampling for the physico-chemical parameters were done on two stations for three Seasonal variations. The water samples were collected in plastic bottles and partially tested in the field, as well as in the laboratories. Temperature was measured using mercury in glass thermometer accurate to 0.1°C. pH was measured using portable pH meter model type Elico 256. Dissolved oxygen was determined by modified Winkler azide method. Biochemical oxygen demand (with duration of 5 days of incubation at 20°C) and salinity (by titrometric method) were also estimated. Nitrate, Nitrite, Phosphate and Silica were done using Shimadzu spectrophotometer model UV 1800. The digestion and titration method was carried out according to the procedures by APHA, AWWA and WEA (1998).

RESULTS AND DISCUSSIONS

The physico-chemical characteristics and statistical data are given in the Table-1 and Table-2 respectively.

Table 1 Monthly variations in physico-chemical parameters of lentic water body during January to December 2011

Parameter	Stations	Oct.	Nov.	Dec.	Jan.	June	July	Aug.	Sept.	Feb.	March	April	May
Atmospheric temperature (°C)	North side of the water body	30.0	29.0	32.0	34.0	32.0	34.0	26.0	28.5	35.0	33.0	30.0	31.0
	South side of the water body	30.0	29.5	32.0	35.0	33.0	34.5	27.0	28.5	35.0	33.0	30.0	31.5
Surface water (temperature (°C)	North side of the water body	29.0	28.0	29.0	33.0	30.0	33.0	25.0	27.0	33.5	31.5	28.5	28.5
	South side of the water body	29.0	28.0	30.0	33.0	31.0	33.0	26.0	27.5	33.0	32.0	29.0	29.0
Electrical Conductivity µmohs/cm	North side of the water body	56.0	42.0	75.3	68.5	52.6	85.0	74.8	98.5	54.3	66.3	98.6	56.8
	South side of the water body	48.9	48.6	68.9	57.3	54.2	68.9	87.9	98.6	52.4	89.6	46.3	75.6
pH	North side of the water body	7.4	7.3	8.0	8.1	8.1	8.2	7.2	7.5	8.2	8.0	7.4	7.7
	South side of the water body	8.0	8.1	8.1	8.2	8.1	8.2	4 .7	8.0	8.0	8.1	7.9	8.7
Dissolved Oxygen (mg/L)	North side of the water body	5.0	3.1	3.1	2.9	3.0	2.8	5.5	4.8	2.9	3.2	4.2	3.5
	South side of the water body	4.6	3.1	3.0	3.1	2.9	2.9	5.2	4.5	2.8	3.1	4.0	3.4
Nitrate (mg/L)	North side of the water body	13.6	6.4	10.5	9.4	11.3	9.3	14.2	11.7	8.2	11.0	14.3	12.2
	South side of the water body	14.3	5.2	9.3	9.0	10.5	8.3	8.9	9.0	7.1	10.7	6.7	10.6
Nitrite (mg/L)	North side of the water body	2.3	2.0	1.2	1.0	1.2	1.0	3.2	2.9	1.0	2.1	2.7	2.2
	South side of the water body	2.1	1.8	1.2	1.0	1.1	1.0	3.0	2.4	0.8	2.0	2.6	1.9
Phosphate (mg/L)	North side of the water body	2.0	0.6	0.5	0.4	0.8	0.6	2.2	1.8	0.8	1.0	2.0	1.2
	South side of the water body	1.8	0.6	0.5	0.3	0.8	0.6	2.0	1.7	0.8	0.9	1.6	1.0
Silica (mg/L)	North side of the water body	6.0	5.0	5.0	6.0	4.0	5.0	6.0	4.0	5.0	3.0	5.0	6.0
	South side of the water body	5.0	4.0	4.0	6.0	4.0	5.0	4.0	4.0	3.0	4.0	5.0	4.0

Water and Air Temperature

Temperature is basically important for its effects on certain chemical and biological activities in the organisms attributing in aquatic media. In the Indian subcontinent the temperature in most of water bodies ranges between 7.8 to 38.5°C (Singhal *et al*., 1986). There were variations in air and water temperatures across the two stations, however these variations were not significantly different (P>0.05) across the stations. In the present study, air temperature varied between 26-35.0 (31.2±2.64)°C and water temperature ranged from 27.0-35.0 (31.6±2.63)°C (Table 1 and 2) and also seasonal variation in the atmospheric and water temperature are give in Figure-1. These values were within the acceptable levels for survival, metabolism and physiology of aquatic organisms. Water temperature has some positive and negative effects on plant growth. The most suitable water temperature for plant growth is 20-35°C, Temperature over 30°C can cause regression in growth and decay in plants Kara *et al.,* (2004). The variation is mainly related with the temperature of atmosphere and weather conditions.

pH

pH is influenced by acidity of the bottom sediment and biological activities. High pH may result from high rate of photosynthesis by dense phytoplankton blooms. pH higher than seven but lower than 8.5 according to Abowei, (2010) is ideal for biological productivity, but pH at <4 is detrimental to aquatic life. The pH values of water bodies (water bodys) was found in alkaline side (pH>7) (Goldman and Horne, 1983). In general the pH values are higher in winter than other seasons. The variation can be due to the exposure of dam water to atmosphere, biological activities and temperature changes (Adebowale *et al.,* 2008). In the present study and pH was both alkaline. The pH ranged between 7.2 to 8.2 in station 1 and 7.9 to 8.2 in station 2, respectively with overall mean value of 7.9±0.21. pH varied with seasons (Figure-2) and variations were statistically different at 5% level (P<0.05) across the stations.

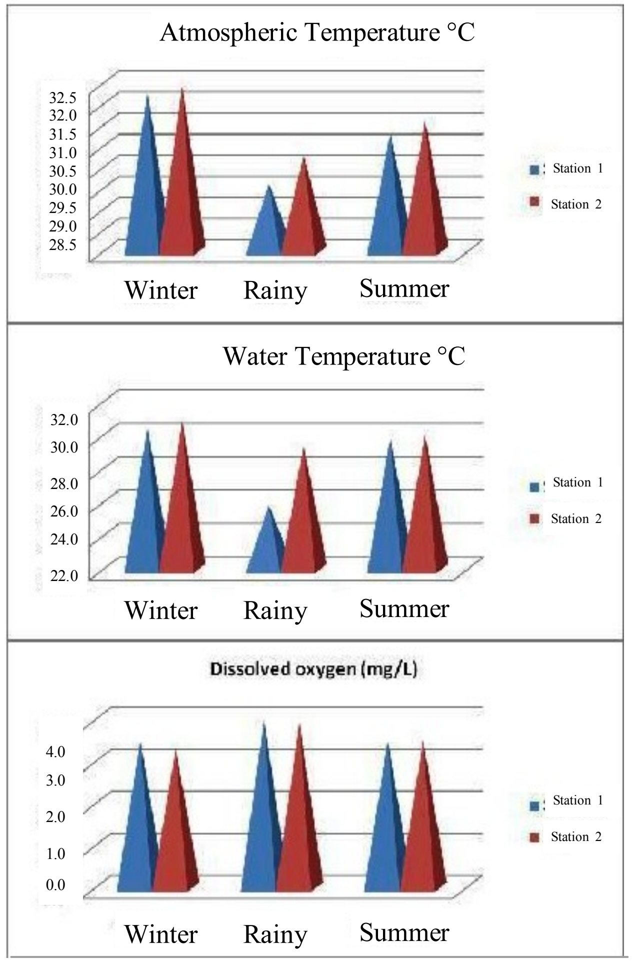

Figure 1: Seasonal variation in Atmospheric temperature, water temperature and Dissolved Oxygen in lentic water body

Electrical Conductivity (EC)

EC is a good indicator of total dissolved ions in aquatic ecosystem. The electrical conductivities of the water samples generally varied significantly (P<0.05) and ranged from 345.5 to 742.8 µmohs/cm throughout the study period (Table 1). Higher conductivities were observed at station 1 in winter and spring seasons (Figure-2), suggesting that there could be other non point sources of pollution entering into the receiving water body that resulted in the high values. The maximum values 92, 74 and 69 µmohs/cm were recorded at Station 1, which may be receiving the sewage and other waste of surrounding villages. These results agree with that finding El-Sayed, (2008) on the same area and nearby Keiskamma River (Fatoki *et al.,* 2003).

Dissolved Oxygen (DO)

DO is one of the important parameter in water quality assessment. It reflects the physical and biological processes prevailing in the water. Non polluted surface water is normally saturated with DO. The DO varies from 2.8 to 5.5 mg/L during the study. These values indicate relatively large organic pollution. The high temperature and low DO during summer create favorable conditions for the development of blue-green algae (Jayaraju *et al.,* 1994). The dissolved oxygen profile throughout the seasons varied significantly ($P < 0.05$) and ranged from 3.3 to 3.5 mg/L during winter; 3.9 to 4.0 mg/L during rainy season and 3.5 mg/L during summer season (Figure 1). The DO content in water body which was observed to deplete faster than DO from the receiving water body could be attributed to the presence of degradable organic matter which resulted in a tendency to be more oxygen demanding. The DO values obtained from this study are similar to those reported elsewhere (Fatoki *et al.,* 2003; Jaji *et al.,* 2007; Obire *et al.,* 2003).

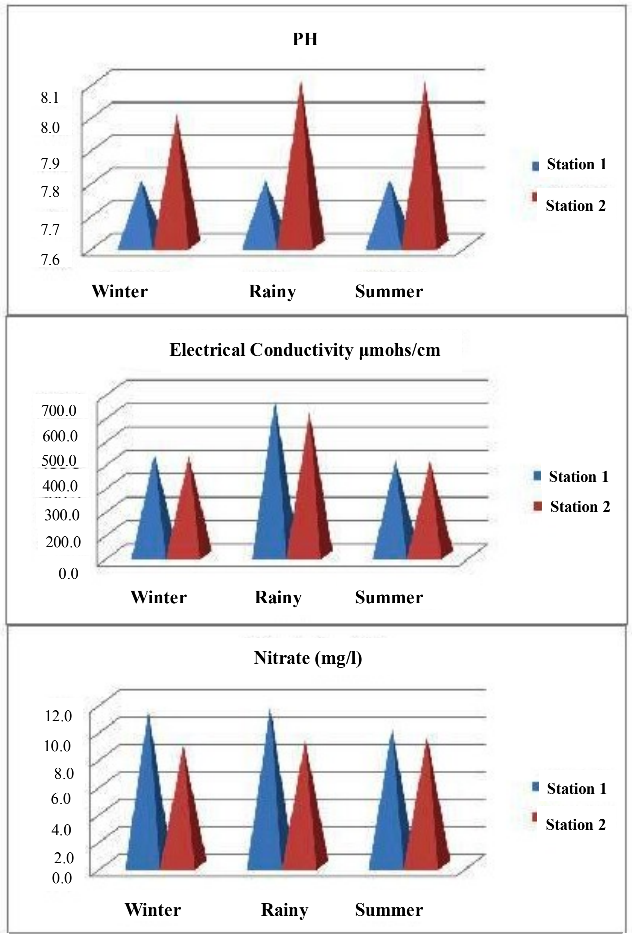

Figure 2. Seasonal Variation in pH, Electrical Conductivity and Nitrate in lentic water body

Table 2 Maximum, Minimum, Median and Standard deviation of physico-chemical parameters of the lentic water body

Parameter	Stations	Max	Min	Median	Std
Atmospheric temperature (°C)	North side of the water body	35.0	26.0	31.2	± 2.64
	South side of the water body	35.0	27.0	31.6	± 2.63
Surface water (temperature (°C)	North side of the water body	33.5	25.0	29.7	± 2.62
	South side of the water body	33.0	26.0	30.0	± 2.36
Electrical Conductivity µmohs/cm	North side of the water body	74.8	56.0	47.4	±39.51
	South side of the water body	87.9	48.9	48.0	±14.79
pH	North side of the water body	8.2	7.2	7.8	± 0.38
	South side of the water body	8.2	7.9	8.1	± 0.09
Dissolved Oxygen (mg/L)	North side of the water body	5.5	2.8	3.7	± 0.95
	South side of the water body	5.2	2.8	3.6	± 0.81
Nitrate (mg/L)	North side of the water body	14.3	6.4	11.0	± 2.44
	South side of the water body	14.3	5.2	9.1	± 2.33
Nitrite (mg/L)	North side of the water body	3.2	1.0	1.9	± 0.79
	South side of the water body	3.0	0.8	1.7	± 0.71
Phosphate (mg/L)	North side of the water body	2.2	0.4	1.1	± 0.66
	South side of the water body	2.0	0.3	1.0	± 0.57
Silica (mg/L)	North side of the water body	6.0	3.0	5.0	± 0.95
	South side of the water body	6.0	3.0	4.3	± 0.78

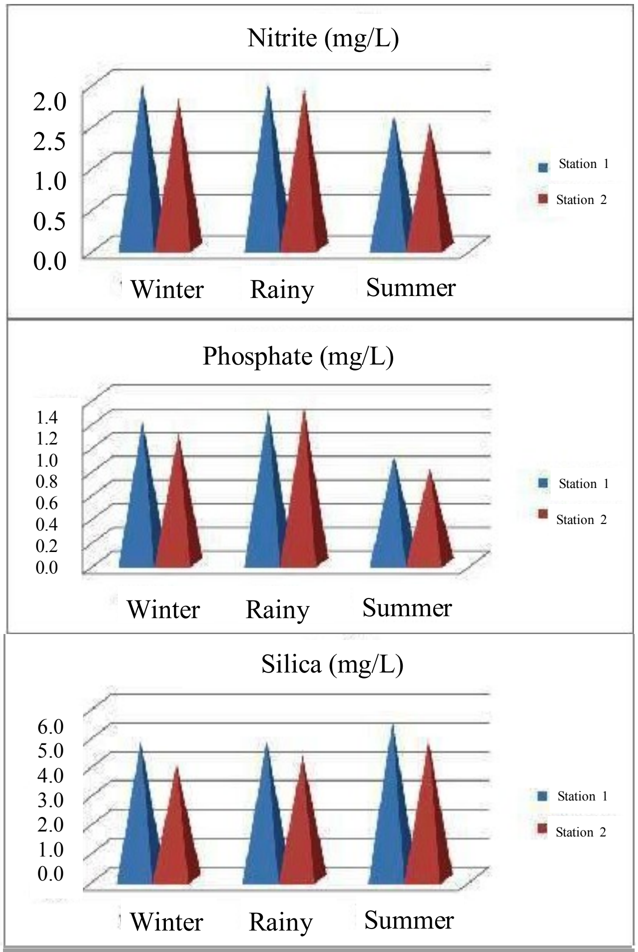

Figure 3. Seasonal Variation in Nitrate, Phosphate and Silica in lentic Water body

Nitrates, Nitrite, Phosphates and Silica

NO_2^- and NO_3^-concentrations were found slight variations at two locations during twelve collection months, Table 1. NO_2^- and NO_3^- were ranged between 0.8-3.2 mg/L and 5.2-14.3 mg/L respectively. The maximum value of NO_3^- 14.3 mg/L at station 1 during April and at station 2 during October mainly related to the anthropogenic activities of surrounding villages that discharge at this station. This may be attributed to the oxidation of ammonia by nitrifying bacteria and biological nitrification (Seike *et al.,* 1990). The lower values recorded during winter 5.2 to 6.4 mg/L may be related to the denitrifying bacteria (Merck, 1980). The nitrate concentration during rainy and summer (Figure-3) could be due to leaching and surface run-off of fertilizer from nearby farmlands into the water.

The Phosphate content of dam water bodies were found in the range of 1.1 mg/L to 1.3 mg/L Before rainy season it is found to be 1.1 – 1.2 mg/L and after rainy season it is 0.8 to 0.9 mg/L. Phosphates lead to eutrophication which could also lead to unpleasant taste and odour of the water when algae die and decompose thus deteriorating the quality of the water (Kolo, 1996). The high concentration of Phosphate before rainy (Figure – 3) season is due to the leaching of Phosphate fertilizer from the agricultural land.

The silicate content was higher than that of the other nutrients like nitrite and phosphate and the recorded high monsoon values could be due to large influx of freshwater derived from land drainage carrying silicate leached out from rocks and also from the bottom sediment (Govindasamy *et al.,* 2000; Rajasegar, 2003). The observed low summer and winter (Figure – 3) values could be attributed to the uptake of silicates by phytoplankton for their biological activity (Ashok Prabu *et al.,* 2008; Saravanakumar *et al.,* 2008).

CONCLUSION

These results can serve as a reference for future studies of chemical, trace metals and biological indicators of pollution in the Channarayapatna water body to assess the impact on the aquatic organisms and its ecological conditions. Channarayapatna water body is moderately polluted. The study showed that there is a need for continuous pollution monitoring programme of the surface waters (lentic ecosystem) in rural setting. Finally, the study has revealed that there was an adverse impact on the physico-chemical characteristics of the receiving watershed as a result of the discharge of sewage from the surrounding villages and also increased number of macro vegetation indicates that the water quality of this lentic ecosystem is going towards eutrophied condition.

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