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Ecological Study of a Lentic Water Body In Relation To Bacterial Population

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Abstract
Physico-chemical analysis and study of bacterial population were carried out on water samples of Kavalkere pond in Bannerghatta Biological Park, Bangalore. The bacterial population abundance largely depend on the physico-chebmical conditions prevailing in the water of the pond. The study shows the importance of heterotrophic food chain in the trophic characteristics of a lentic water system

Key words: Physico-chemical, Analysis, Bacteria, Coliforms, population, trophic.

1. Introduction

Bacteria act as decomposers in a heterotrophic food chain of an aquatic system. Therefore it is important to study different bacterial population of a water body to understand the ecological status of the water body. Several workers have studied bacterial characteristics of drinking water bodies. Few like Ayyappan, Manoharachary have contributed to bacteriological analysis of ponds and lakes in India.

Bannerghatta National Park located 22 km south of Bangalore, was declared as National Park in 1971 by Government of Karnataka for the conservation of wildlife. Bannerghatta National Park has several perennial water bodies, amongst them Kavalkere which is situated in the Zoo area was selected for the present study.

Research on habitat and ecology is essential to a National Park to monitor ecological changes and human impact in order to provide crucial data for continuous planning and management of the National Park. Research may also help in providing valuable insights for ecosystem conservation and management of protected areas.

This is a rare study as it involves habitat of a National Park or a Wildlife spot contributing a bit in developing strategies for the proper management of National Parks and conservation of wildlife in the country.

2. Materials and Methods

The water samples were collected from a selected location in each pond once in every month for 16 monthsr. Water samples were collected in sterilized glass bottles. Physico-chemical analysis and bacterial enumeration were undertaken following standard methods of APHA. Water temperature and pH were checked in the field using mercury thermometer and digital pH pen respectively. Physico-chemical analysis of samples for parameters like dissolved oxygen, total alkalinity, total iron, phosphate, silica and nitrate nitrogen were carried out in the laboratory within four hours of collection according to standard methods described by APHA.

Bacterial enumeration was done by 'serial dilution and plating technique' and 'most probable number (MPN)' method. Dilutions of water samples used were 10^{-1} and 10^{-2}. Sterile petri plates with respective agar media for different types of bacteria inoculated with diluted water samples were incubated in a bacteriological incubator at 37°C for 24 hr and then colony forming units were counted.

For MPN method sterile tubes containing liquid broth media inoculated with diluted samples were incubated in incubator for 48hr to 72hr and MPN were estimated using standard MPN table.

3. Results and discussion

3.1 Physico-chemical Analysis

Physico-chemical characters like temperature, pH, alkalinity, free carbon dioxide, dissolved oxygen, phosphate, nitrate, silica, iron etc., are very important biotic factors of an aquatic ecosystem which play major role in productivity and sustaining of organisms in the system. Many of them like phosphate, nitrate act as limiting factors in the growth of organisms

The findings of physico-chemical characteristics of water are given in Table 1 in the form of ranges of parameters.

Table 1. Physico-chemical characteristics

Parameters	Values (range)
Water temperature(°C)	22.0 – 26.2
pH	7.4 – 8.3
Free CO_2 (mg l^{-1})	0.0 – 3.2
Conductivity (µ mho cm^{-1})	141.21 – 303.00
Total hardness (mg $CaCO_3$ l^{-1})	39 - 97
Total alkalinity (mg $CaCO_3$ l^{-1})	72 – 88
Nitrate-nitrogen (mg l^{-1})	Traces – 0.25
Nitrite-nitrogen (mg l^{-1})	Traces – 0.20
Phosphate (mg l^{-1})	Traces - 0.29
Silica (mg l^{-1})	0.01 – 0.15
Total iron (mg l^{-1})	0.02 - 0.40
Dissolved O_2 (mg l^{-1})	8.0 – 11.0
Dissolved organic matter (mg l^{-1})	3.0 – 11.0

3.1.1 *Water temperature*: The range of water temperature recorded was 22.0 – 26.2°C. The minimum temperature was recorded in December and the maximum in March.
3.1.2 *pH*: Water was found to be slightly alkaline throughout the study period with pH ranging from 7.4 to 8.3. The pH was slightly lesser in June and September probably due to rain.
3.1.3 *Free Carbon dioxide*: The free CO_2 content of water ranged from 0.0 to 3.2 mg per litre. The higher CO_2 level was observed in winter months which may be due to decreased photosynthetic activity by lower density of planktons.
3.1.4 *Conductivity*: Conductivity ranged from 141.21 to 303.00 µ mho cm^{-1}. It also remained low during rainy season.
3.1.5 *Total hardness:* The total hardness of water remained ranged between 39 and 97 mg per litre.
3.1.6 *Total Alkalinity*: The total alkalinity due to both carbonate and bicarbonate ions ranged between 72 to 88 mg per litre.
3.1.7 *Nitrate-nitrogen*: It ranged from traces to 0.25 mg per litre, minimum during January and maximum in September. Nitrate is an important factor for all aquatic organisms which may also act as a limiting factor.
3.1.8 *Nitrite-nitrogen*: It ranged from traces to 0.20 mg per litre, minimum during January and maximum in September. Nitrite is also an important factor for all aquatic organisms which may also act as a limiting factor.
3.1.9 *Phosphate*: Phosphate is also a limiting factor for aquatic plants and microbes. It ranged between traces to 0.29 mg per litre.
3.1.10 *Silica*: Silica content varied from 0.01 to 0.15 mg per litre.
3.1.11 *Total iron*: It ranged from traces to 0.4 mg per litre. Iron is an important factor for phytoplankton.
3.1.12 *DissolvedO_2*: The dissolved oxygen concentration ranged from 8 to 11 mg per litre, minimum during summer and maximum during winter. Comparatively high oxygen level may be due to lower water temperature. Water temperature was the controlling factor for dissolved oxygen content.
3.1.13 *Dissolved organic matter*: Dissolved organic matter ranged from 3 to 11 mg per litre, maximum during rainy season.

Physico-chemical analysis reveals that water of the pond is not polluted.

3.2 Bacterial Analysis

The bacterial properties are given in Table 3 in the form of range of values and discussed in detail below;

Table 3. Bacteriological properties (No. in the bracket indicate maximum)

Sl.No.	Type of Bacteria	Counts (No. ml^{-1}) - range
1	Total Coliforrms	65 – 250 (950)
2	Aerobic heterotrophic bacteria	180 – 630 (2000)
3	Nitrogen fixing bacteria – Aerobic	18 – 98
	Anaerobic	8 – 45
4	Ammonifying bacteria	220 – 450 (1240)
5	Nitrifying bacteria	8 – 55 (140)
6	Ureolytic bacteria	130 – 360 (850)
7	Phosphate bacteria	6 – 36 (185)
8	Methanogenic bacteria	3 – 16(32)
9	Iron bacteria	0 – 26(42)
10	Amylolytic bacteria	6 – 36(122)
11	Proteolytic bacteria	8 – 42(205)

3.2.1 Total coliforms
Coliforms are generally estimated from a water body to check its potability as it is an indicator of contamination of water by faecal matter. Water of Kavalkere pond shows Colifirms in the range of 65 – 250 per ml of water, with a maximum of 950 in November 2014. It is higher due to the washings of Zoo area that contain animal faecal matter is lead to the pond. Further, it is high in the rainy season.

3.2.2 Aerobic heterotrophic bacteria
Aerobic heterotrophic bacteria numbers varied in a range of 180 – 630 per ml. During rainy season hetrotrophic bacteria number increased with a maximum 2000 per ml in November 2014. This may be due to more dissolved oxygen content of water during rainy season.

32.3 Nitrogen fixing bacteria
Water contained aerobic nitrogen fixing bacteria in the range of 18 - 98 per ml and anaerobic nitrogen fixing bacteria in the range of 8 – 45 per ml and their numbers were more in summer than in winter and rainy season. The study showed the contribution of these bacteria in nitrogen fixation.

3.2.4 Ammonifying bacteria
Ammonifying bacteria counts 220 – 450 per ml was higher due to washings of zoo area bringing in more organic matter which probably provides substrate for these bacteria.

3.2.5 Nitrifying bacteria
The counts of nitrifying Nitrobacter were varied from 8 – 55 per ml with a maximum of 140 per ml during November 2014. These counts were slightly higher due to high counts

of ammonifying bacteria which make the required substrate for Nitrobacter available.

3.2.6 Ureolytic bacteria
Number varied from 130 – 360 per ml with a maximum 850 per ml observed in November 2014. The number was higher during summer season when water temperature was high. The higher number of ureolytic bacteria were also coinciding with the higher number of ammonifying bacteria , both actively engaged in decomposing activity.

3.2.7 Phosphate bacteria
They varied between 6 – 36 per ml, with a maximum of 185 noticed in November 2014. These are the bacteria that are responsible for solubilising inorganic phosphate. Their presence also corresponds to the phosphate content of water.

3.2.8 Methanogenic bacteria
Methanogenic bacteria numbers range from3 – 32 per ml. Their presence may be due to animal faecal matter coming with washings from zoo area,which provide substrate for their activity.

3.2.9 Iron bacteria
The number of iron bacteria were low, ranging from 3 – 26 per ml.

3.2.10 Amylolytic bacteria
The counts of Amylolytic bacteria varied between 6 to 36, with a maximum of 122 in November 2014. The numbers were more during rainy season.

3.2.11 Proteolytic bacteria
These ranged from 8 to 42 with high of 205 noticed in November 2014.

4. Conclusion

The physico- chemical analysis of water showed that water of Kavalkere is not polluted even though washings of Zoo area carry animal faecal matter adding to the organic content in the pond. This is mainly because of the activities of ammonifying bacteria, ureolytic bacteria and methanogenic bacteria which cause the decomposition of organic matter leading to satisfactorily good water quality. From this it also evident that most of the coliforms present in the water are not of faecal origin.
If the release of Zoo area washings to the pond is avoided the water can be used to feed the animals.

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