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A study on physicochemical parameters of an aquaculture body in Mysore city, Karnataka, India

K.L. Sachidanandamurthy and H.N. Yajurvedi
Department of Zoology, Manasagangotri, University of Mysore, Mysore-570 006, India.

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Abstract: *Monthly changes in water quality parameters (physicochemical) of a rain fed lake (Bilikere) in Mysore city, were investigated for two calendar years (2002 and 2003) to assess the suitability of this lake for pisciculture. Although there were monthly fluctuations in water temperature, total suspended solids (TSS), dissolved oxygen (DO), nitrite and ammonia, they were within the desirable limits. On the other hand, total alkalinity and hydrogen sulphide throughout the study period and pH for a major part, were higher than the desirable limits. Other parameters viz; turbidity, biological oxygen demand (BOD), phosphate, and nitrate in a few months were higher than the desirable limits for waters used for fish culture. The high levels of these factors are due to the entry of agricultural run off and occasional flow of sewage into the lake. In addition dense algal growth was noticed at times of the year which is caused by surge in nutrients level whenever there was a rainfall. Since, the lake has a great aquacultural potential, it is suggested that control of nutrient load that enters the lake occasionally, might help the lake to continue its mesotrophic status.*

Key words: *Water quality parameters, Fresh water bodies, Physicochemical parameters, Bilikere lake.*

Introduction

Contamination of water bodies might lead to a change in their trophic status and render them unsuitable for aquaculture. Several Physicochemical or biological factors could act as stressors and adversely affect fish growth and reproduction (Iwama *et al.*, 2000). Hence, regular monitoring of physicochemical and biological water quality parameters is essential to determine status of lakes with reference to fish culture. Banerjea (1967) reported water quality and soil condition of several fishponds in relation to fish production in India. Several lakes and tanks that are situated in and around Mysore city are being extensively used for fish culture. Studies (Hosmani, 1987; Naganandini and Hosmani, 1998) correlating seasonal variation in plankton density with physicochemical properties of water of these lakes did not focus on suitability of these water bodies for fish culture. Further, studies on comparison of pattern of monthly variation in physicochemical parameters for two consecutive calendar years might reveal whether changes are seasonal fluctuations or due to other factors. Present study aims at investigating monthly variations if any, in physicochemical water quality parameters, and if so, whether or not they are within desirable limits.

Materials and Methods

Physicochemical characteristics of water of Bilikere lake were studied at monthly intervals (January to December) in the years 2002 and 2003 by choosing three different sampling spots (S_1 - near the outlet for agricultural use, S_2 - central region of the lake and S_3 - region where agricultural runoff is likely to enter) representing different regions of the lake. Samples were collected separately from each spot in two liter polythene jerry cans. Temperature and pH were measured on spot at the time of sample collection using portable kit. For determination of dissolved oxygen, water was fixed in the field and brought to the laboratory in an icebox for further processing. Total alkalinity, turbidity, TSS, BOD, hydrogensulphide, phosphate, nitrite, nitrate and ammonia were determined separately, for three samples, in the laboratory, employing methods described in APHA (1995) and Trivedi and Goel (1986). The average (mean±SE) for each parameter per month was computed, considering the values from three spots. The significant difference if any in the mean values of each parameter of twelve months was determined by one way ANOVA, followed by Duncan`s new multiple range test (DMRT) (Steel and Torrie, 1960). Similar procedures were followed for both years.

Results and Discussion

Bilikere lake (i.e. 12º, 19^{1}, 47^{11}N and 76º, 27^{1}, 45^{11}E., 810.46MSL) a rain fed perennial water body is situated 26 kilometer west of Mysore in a suburban area and has an area of 32.5 acres. The depth of water is about 3 to 3.5mt when the lake is full. Sewage from the neighboring settlements occasionally flows into the lake. The water of this lake is utilized for agriculture, fish culture and domestic purpose. The lake was slightly muddy during summer and monsoon and was clear during winter. At times it was slightly greenish (August and October). Although occasionally there was fishy or foul smell in late summer (May), the lake was not emanating any distinctive odour during rest of the year. Table 1, shows monthly variations in physicochemical factors for two calendar years.

Although temperature showed significant fluctuations in both years of study, it remained around lower limits of range of temperature (28 to 32ºC, IFAS University of Florida, Circular 1051) conducive for optimum growth of fish in tropical waters. Low turbidity (20-30 NTU, Zweig, 1989) and low concentration

Table – 1: Monthly variations in physicochemical parameters of Bilikere lake.

Parameters → Months↓	Temp (°C)	pH	Turbidity (NTU)	TSS	Total-alkalinity	DO	BOD	Hydrogen sulphide	Phosphate	Nitrite	Nitrate	Ammonia (NH_4^+) (μg/lit)
Jan	24.03^{a}	9.66^{d}	4.86 ± 0.1^{a}	0.007 ± 0^{c}	626.66 ± 43^{g}	$8.65\pm0.1^{a,b}$	9.62 ± 0.6^{c}	0.32 ± 0^{b}	0.183 ± 0^{b}	0.260 ± 0^{e}	0.1767 ± 0^{a}	$37.33\pm3.7^{d,e,f}$
	23.80^{b}	9.52^{e}	9.06 ± 0.3^{a}	0.14 ± 0^{b}	630.00 ± 75^{e}	$8.73\pm0.7^{a,c}$	10.91 ± 1.9^{c}	1.12 ± 0^{e}	$0.953\pm0^{c,d}$	0.6667 ± 0.1^{c}	0.6333 ± 0.1^{b}	30.666 ± 9.3^{c}
Feb	25.06^{b}	9.34^{a}	6.86 ± 1^{a}	$0.55\pm0^{b,f}$	773.33 ± 26^{e}	10.80 ± 0.1^{c}	$11.84\pm0.5^{a,c}$	$0.49\pm0.1^{a,b}$	$0.113\pm0^{a,b}$	0.00 ± 0^{a}	0.2167 ± 0^{a}	$19.00\pm2^{a,b,c}$
	25.46^{f}	$9.25^{a,b}$	$10.24\pm1.1^{a,b}$	$0.54\pm0^{d,e}$	913.33 ± 35^{f}	$9.08\pm0.1^{c,d}$	$12.85\pm1.0^{a,c}$	$0.646\pm0^{a,c}$	$0.706\pm0.2^{b,c}$	0.0053 ± 0^{a}	0.3467 ± 0^{a}	$18.666\pm0.8^{a,b}$
Mar	25.06^{b}	$9.16^{a,c}$	7.20 ± 2.3^{a}	$0.33\pm0^{d,e}$	776.66 ± 14^{e}	$8.51\pm0.5^{a,b}$	$12.90\pm1.2^{a,b,c}$	$1.19\pm0.1^{c,d,e}$	0.0066 ± 0^{a}	$0.0017\pm0^{a,b}$	$0.730\pm0.1^{c,d}$	8.33 ± 3.3^{a}
	26.03^{g}	$9.28^{a,d}$	$15.0\pm0.9^{a,b,c}$	$0.23\pm0^{a,b}$	$260.00\pm11^{a,b}$	$6.74\pm0.2^{a,b}$	$13.26\pm0.8^{a,c}$	$0.753\pm0^{a,b}$	0.0043 ± 0^{a}	0.0033 ± 0^{a}	$0.240\pm0^{a,c}$	$9.666\pm1.2^{a,b}$
Apr	26.06^{f}	8.91^{b}	7.03 ± 2.3^{a}	$0.16\pm0^{c,d}$	870.00 ± 15^{f}	7.56 ± 0.1^{a}	18.19 ± 0.2^{b}	$0.84\pm0.2^{a,c,d}$	0.004 ± 0^{a}	0.001 ± 0^{a}	$0.323\pm0^{a,b}$	$22.00\pm4.1^{a,b,c,e}$
	29.00^{a}	$9.42^{d,e}$	$22.43\pm4.9^{f,g}$	0.27 ± 0^{a}	$293.33\pm6.6^{a,b}$	6.26 ± 0.4^{b}	$17.42\pm2.6^{a,b,c}$	$0.803\pm0^{a,b}$	0.006 ± 0^{a}	0.0026 ± 0^{a}	$0.2267\pm0^{a,c}$	20.00 ± 2^{b}
May	31.06^{j}	$8.96^{b,c}$	16.20 ± 1.7^{e}	$0.42\pm0.1^{e,f}$	1020.00 ± 5.7^{c}	11.61 ± 0.5^{c}	14.43 ± 1.4^{e}	$0.53\pm0.2^{a,b}$	$0.0076\pm0^{a,b}$	$0.0043\pm0^{a,b}$	$0.306\pm0.1^{a,b}$	63.33 ± 6^{g}
	29.00^{a}	$9.23^{a,b}$	$15.93\pm0.5^{b,c,f}$	$0.25\pm0^{a,b}$	250.00 ± 5.7^{a}	$6.88\pm0.3^{a,b}$	26.64 ± 2.9^{d}	0.32 ± 0^{d}	0.0053 ± 0^{a}	0.0053 ± 0^{a}	$0.4533\pm0.1^{a,b}$	42.00 ± 3.9^{d}
Jun	25.46^{e}	9.33^{a}	$26.60\pm1.5^{b,c}$	$0.63\pm0.1^{a,b}$	$1036.66\pm51^{c,d}$	14.24 ± 0.2^{d}	61.37 ± 2.7^{d}	$1.24\pm0.1^{d,e}$	$0.0093\pm0^{a,b}$	$0.0046\pm0^{a,b,c}$	$0.386\pm0^{a,b,c}$	$53.50\pm4.2^{f,g}$
	28.20^{i}	$9.28^{a,d}$	$18.86\pm2.1^{c,f}$	0.30 ± 0^{a}	$310.00\pm10^{a,b}$	13.37 ± 0.4^{f}	41.89 ± 1.4^{e}	$0.606\pm0^{a,c}$	0.0066 ± 0^{a}	0.006 ± 0^{a}	$0.3867\pm0^{a,b}$	31.667 ± 4.2^{c}
Jul	27.06^{c}	8.88^{b}	38.93 ± 4.9^{d}	0.80 ± 0^{a}	1023.33 ± 21^{c}	$8.60\pm0.3^{a,b}$	57.04 ± 4.7^{d}	$0.86\pm0^{a,c,d}$	0.60 ± 0^{d}	0.1567 ± 0^{d}	$0.3733\pm0^{a,b,c}$	$46.66\pm14.5^{d,f,g}$
	25.00^{e}	$9.14^{a,b,c}$	50.16 ± 1.1^{h}	0.30 ± 0^{a}	$320.00\pm11^{a,b,c}$	$7.90\pm0.2^{a,b,c}$	56.76 ± 2.3^{f}	$0.463\pm0.1^{c,d}$	0.005 ± 0^{a}	0.0034 ± 0^{a}	0.0018 ± 0^{c}	$19.266\pm1.3^{a,b}$
Aug	24.03^{a}	9.22^{a}	$32.83\pm1^{c,d}$	$0.72\pm0^{a,b}$	1103.33 ± 8.8^{d}	16.20 ± 0.8^{e}	$16.22\pm1.6^{a,b}$	$0.53\pm0.1^{a,b}$	1.08 ± 0^{e}	$0.003\pm0^{a,b}$	$0.2633\pm0^{a,b}$	$16.50\pm3.5^{a,b}$
	24.83^{d}	$9.11^{b,c}$	$31.16\pm1.2^{d,e}$	$0.48\pm0^{e,f}$	1016.66 ± 14^{g}	$12.48\pm0.4^{e,f}$	$20.27\pm0.8^{b,d}$	$0.80\pm0^{a,b}$	1.733 ± 0.1^{e}	$0.0096\pm0^{a,b}$	$0.440\pm0^{a,b}$	$9.666\pm1.2^{a,b}$
Sep	30.03^{h}	9.21^{a}	25.56 ± 2.2^{b}	$0.75\pm0^{a,b}$	433.33 ± 8.8^{b}	19.80 ± 1.1^{f}	$14.59\pm1.4^{a,b,c}$	1.43 ± 0.1^{e}	$0.0096\pm0^{a,b}$	$0.0016\pm0^{a,b}$	0.9667 ± 0.1^{d}	$40.33\pm5.4^{d,f}$
	30.06^{k}	9.06^{c}	$32.00\pm1.1^{d,e}$	0.42 ± 0^{f}	433.33 ± 8.8^{d}	15.26 ± 0.4^{g}	$21.07\pm4.0^{b,d}$	$0.946\pm0^{b,e}$	0.166 ± 0^{a}	$0.008\pm0^{a,b}$	1.1667 ± 0.1^{e}	$15.00\pm1.5^{a,b}$
Oct	27.06^{c}	9.34^{a}	24.80 ± 0.6^{b}	$0.78\pm0^{a,b}$	$380.00\pm15^{a,b}$	11.20 ± 0.8^{c}	$17.39\pm0.8^{a,b}$	$0.72\pm0.1^{a,b,c}$	$0.1067\pm0^{a,b}$	$0.0038\pm0^{a,b}$	$0.630\pm0.2^{b,c,d}$	$34.66\pm2.4^{c,d,e}$
	27.50^{h}	$9.21^{a,b,c}$	$28.10\pm2.5^{d,g}$	0.71 ± 0^{c}	$396.66\pm29^{c,d}$	$11.48\pm0.8^{e,f}$	$18.88\pm0.5^{a,b}$	$0.826\pm0^{a,b}$	1.266 ± 0.1^{d}	$0.08\pm0^{a,b}$	0.9067 ± 0^{d}	$17.00\pm0.5^{a,b}$
Nov	27.23^{g}	9.29^{a}	$31.13\pm3.4^{b,c}$	$0.70\pm0^{a,b}$	340.00 ± 10^{a}	$10.26\pm0.6^{b,c}$	$16.21\pm0.3^{a,b}$	$0.75\pm0^{a,b,c}$	0.0022 ± 0^{a}	$0.0073\pm0^{b,c}$	$0.623\pm0^{b,c,d}$	$31.36\pm1.3^{b,c,d,e}$
	28.13^{j}	$9.16^{a,b,c}$	36.04 ± 3.2^{e}	$0.62\pm0^{c,d}$	$343.33\pm8.8^{b,c}$	$10.80\pm1.2^{d,e}$	$18.97\pm2.2^{a,b}$	$0.82\pm0^{a,b}$	$0.362\pm0.3^{a,b}$	$0.42\pm0.3^{b,c}$	0.90 ± 0^{d}	$10.00\pm0.7^{a,b}$
Dec	23.06^{d}	9.89^{e}	8.33 ± 1.7^{a}	$0.25\pm0^{c,d,e}$	$360.00\pm15^{a,b}$	7.83 ± 0.2^{a}	$14.50\pm0.5^{a,b,c}$	$0.46\pm0.1^{a,b}$	0.400 ± 0^{c}	0.01 ± 0^{c}	$0.720\pm0.1^{c,d}$	$18.20\pm2.4^{a,b,c}$
	24.60^{c}	9.52^{e}	$10.70\pm1.2^{a,b}$	$0.60\pm0^{c,d}$	$293.33\pm8.8^{a,b}$	$8.72\pm0.9^{a,c}$	$16.44\pm1.5^{a,b,c}$	0.366 ± 0^{d}	0.180 ± 0^{a}	$0.0096\pm0^{a,b}$	$0.420\pm0^{a,b}$	8.166 ± 1.3^{a}
ANOVA	5172.33	14.791	27.864	13.797	147.965	44.469	97.538	5.421	82.388	18.548	4.855	8.946
F-Value	9404.27	8.601	34.610	24.3111	94.264	20.211	39.947	9.859	18.564	3.279	18.658	9.823

NOTE:- All parameters other than temperature, pH, turbidity, and ammonia are mg/liters, all values in the upper row are for the year 2002 and those in lower row are for 2003. Mean values with same superscript letters for a given year are not significantly different and those with different superscript letters are significantly ($p < 0.05$) different as judged by DMRT.

of suspended solids (< 25 mg/liter, Maitland, 1990) are desirable for fish culture as high level of turbidity affects photosynthetic process and high particulate matter clogs fish gills. In the present study, turbidity and total suspended solids although showed significant variations in both years, they were in the desirable range. Similarly, the DO content although showed significant monthly variations, in both the years, it remained well above the minimum level (>5ppm, Banerjea, 1967) to support good fish production, throughout the year. Exceptionally high DO content (19.80mg/liter) in September 2002, might be due to the increased photosynthetic activity facilitated by increased temperature and pH and decreased turbidity. BOD showed significant monthly variations during two years study period and remained within desirable limits, since waters with BOD more than 35mg/liter are not considered good quality for fish culture (Pande and Sharma, 1999). High BOD in June and July (pre monsoon and monsoon) might be due to high rate of organic decomposition and the entry of agricultural runoff (Bhatt *et al., 1999)* along with the sewage. There was a sharp decline in BOD in late monsoon (September) and continued to be low through winter. This may be due to low temperature, which slows down the microbial activity as reported by Bhatt *et al*. (1999). Phosphate concentration was either less than or within the normal range (0.1mg to 0.2mg/liter, Sreenivasan, 1965) for the sustenance of phytoplankton density, which form food for fish. However, in a few months (August, October, December and January) it exceeded the normal range, resulting in dense phytoplankton growth, which might be either due to phosphate rich agricultural runoff reaching the lake (monsoon) or prevalence of low temperature (winter) resulting in slower utilization by phytoplankton. Concentration of ammonia showed a similar pattern of variation in both the years. It is reported that, the ammonia level is to be limited to 0.2 to 2.0mg/liter (ionised ammonia or NH_4^+) for fish culture (Joseph *et al*., 1993). During our study ammonia concentration was very well with in this range.

On the other hand monthly significant variations in total alkalinity and pH in both the years were undesirable, as they were higher than levels conducive for fish culture (alkalinity, less than 100 mg/liter and pH >9 and 5.5 to 6.5, not suitable, Schroeder, 1980; Banerjea, 1967). Presence of hydrogen sulphide in water bodies is an indication of pollution (Oslen and Sommerfeld, 1977), and for fish culture, hydrogen sulphide less than 0.002mg/liter (Iwama *et al*., 2000) is preferred. It is evident from the present study that during majority of months in both years the lake contained high levels of hydrogen sulphide, which could render a typical taste and produce objectionable smell at times. Nitrate concentration showed a similar pattern of variation in both the years and its concentration was higher than the minimum level (0.1mg/lit), during most part of the study period, which might be a cause for algal growth at times.

It is stated that nitrite 0.015mg/liter is optimum for rearing salmonids (Iwama *et al*., 2000). Here, nitrite level showed significant variations amongst different months but with in the desirable range except a couple of months.

It is evident from our study that several water quality parameters viz., temperature, pH, turbidity, DO, BOD and ammonia show monthly variations and pattern of variations was similar in both years, whereas other parameters viz., TSS, total alkalinity, hydrogen sulphide and phosphate although showed significant monthly variations but pattern was not similar during same period in consecutive years. This is a significant observation, which could be made only by studies in consecutive years, and indicates that parameters which exhibit monthly variations, but do not follow a pattern, are due to factors other than seasonal climatic changes. Interestingly, the parameters, which did not follow a similar pattern in consequitive years, were not in the desirable range for fish culture. Hence, these observations will be useful in undertaking corrective measures. It is possible that local factors like release of sewage, dumping of organic debris, release of inorganic nutrients, detergents etc, may be responsible.

It is to be noted that concentration of phosphate, a key nutrient responsible for eutrophication remained low and phytoplankton diversity was more during majority of months. Hence, the lake can be classified as mesotrophic. Further, although majority of physicochemical parameters viz., temperature, TSS, DO, nitrite and ammonia were in normal range a few viz., turbidity, BOD, phosphate and nitrate were in normal range in majority of months, and others viz., hydrogen sulphide, pH and total alkalinity were in undesirable concentrations throughout the year. Hence, immediate corrective measures have to be taken before conditions worsen and the lake becomes eutrophic. Either preventing sewage release into lake or its proper treatment before release could improve condition so that full potential of lake can be utilized.

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References

APHA.: Standard methods for the examination of water and wastewater, American public health association , 19th Edition, Washington USA (1995).

Banerjea, S.M.: Water quality and soil condition of fish ponds in some states of India in relation to fish production. *Indian J. Fish.,* **14(1&2),** 115-144 (1967).

Bhatt, L.R., P. Lacoul, H.D. Lekhak and P.K. Jha: Physicochemical characteristics and phytoplankton of Taudaha lake, Kathmandu. *Poll. Res.,* **18(4),** 353-358 (1999).

Hosmani, S.P.: Algal species diversity indices as a measure of water pollution. *Acta Botanica Indica,* **15,** 320-322 (1987).

Iwama, G.K., M.M. Vijayan, and J.D. Morgan: The stress response in fish. Icthyology, Recent research advances 453 pp. Oxford and IBH Publishing Co, Pvt. Ltd, N. Delhi (2000).

Joseph, K. Buttner, Richard W. Soderberg and Daniel E. Terlizzi: An introduction to water chemistry in freshwater aquaculture. NRAC Fact sheet. **170** (1993).

Maitland, P.S.: Biology of Fresh Waters. 269pp. Chapman and Hall. USA (1990).
Naganandini, M.N. and S.P. Hosmani: Ecology of certain inland water of Mysore district occurrence of cyanophycean bloom at Hoskere lake. *Poll. Res.,* **17(2),** 123-125 (1998).
Oslen, R.D. and M.R. Sommerfeld: The physicochemical limnology of a desert reservoir. *Hydrobiologia,* **55,** 117-129 (1977).
Pande, K.S. and S.D. Sharma: Studies on water quality index for Ramaganga river at Moradabad, UP. *Poll. Res.,* **18 (3),** 327-333 (1999).
Schroeder, G.L.: Fish farming in manure loaded ponds. ICLARM-SEARCA conference in integrated agriculture and aquaculture farming systems. *ICLARM procedings.,* **4,** 73-86 (1980).
Sreenivasan, A.: Limnology and productivity of tropical upland impoundments in Nilgiris, Madras state India. *Phycos.,* **7(1),** 146-160 (1965).
Steel, G.D. and J.H. Torrie: Principles and procedures of statistics with special reference to the biological sciences, McGraw-Hill, New York/London (1960).
Trivedi, R.K. and P.K. Goel: Chemical and Biological methods for water pollution studies 209 pp. Enviromedia publications, Karad (1986).
Zweig, R. D.: Evolving water quality in a common carp and blue tilapia high production pond. *Hydrobiologia,* **171,** 11-21 (1989).

Correspondence to:
K.L. Sachidanandamurthy
D.O.S in Zoology, Manasagangotri
University of Mysore, Mysore - 570 006
(Karnataka), India
E-mail: sachi_kl@rediffmail.com