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Study on the fluctuation in the physicochemical parameters of Shiroli Lake, Kolhapur

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Abstract
Present investigation deals with the assessment of seasonal fluctuation in the physicochemical parameters of Shiroli lake for the period of one year. Various physicochemical parameters, like air temperature, water temperature, Electric conductivity, pH, Transparency, Total Dissolved Solids, Dissolved oxygen, Free CO2, Hardness, Total alkalinity, Calcium, Magnesium, were studied. The results indicated that the seasonal variation in the physicochemical parameters of lake water.

Keywords: lake water, physicochemical parameters, seasonal fluctuations

Introduction

Water is a major natural resource used for various purposes such as domestic, industrial, agricultural, and commercial uses. Its availability as an important resource is not only adequate but on the other hand this resource must be maintained clean, free from all the anthropogenic effect and its utilization should be sustainable (Postel *et al*,1996) [20]. It is a very important to support all life forms. Every living organism requires water, without which neither the life nor any development is possible (Anekar and Dongare, 2021) [1].

Present paper reports the seasonal fluctuation in water quality parameters of Shiroli lake so as to assess its status and suitability through the probability and aquaculture point of view and to compare observed levels of studied parameters with the corresponding BSI and WHO guidelines values.

Materials and Methods

Study area

About 10 tanks of varying sizes as 5 hector to 200 hector are present around the Kolhapur city, these tanks are utilized for different purposes like bathing for human being, irrigation and washing. As the representative of these lakes, Shiroli lake (Fig.5) was selected for the Limnobotanical study. Shiroli lake covers 11.61 hector area and it is situated at the western side of Shiroli Village in survey no. 503, which is about 6 miles from North West side of Kolhapur city at the height of 1816 feet from mean sea level. Earlier the water of this lake was utilized for the domestic and drinking purposes by the villagers but since last few decades, due to eutrophication of water body, contamination of domestic waste and sewage, it is not suitable for drinking purpose.

a. Outline map of lake

b. Satellite image of lake

c. Natural view of lake

Fig 1: Shiroli lake (L)

Water sampling

The water sample ware collected from Shiroli lake for physicochemical analysis. Samples were taken seasonally in the dried plastic cans of 2L capacity. For sampling event, water and air temperature was monitored and dissolved oxygen was fixed at the sampling site while EC, pH, TDS, DO, Free CO2, Alkalinity, Hardness, Calcium, Magnesium, Sodium, Potassium, Nitrate, and Phosphate were analyzed in the laboratory by using standard methods given by APHA (1985), Trivedy and Goel (1986).

Result and Discussion:

The values of different physicochemical parameters of the water sample of Shiroli lake during one year period are given in Table 1.

The maximum and minimum ambient temperature of Shiroli lake are ranges from 23.2 ° C to 28.3 ° C. Hence the highest temperature was recorded during summer season and lowest was during winter season. Many workers were observed similar trends while working on different water bodies (Singh and Mathur, 2005, Dwivedi and Pandey, 2002., and Koli and Muley, 2013) [35, 7, 14].

It is a hydrogen ion concentration of lake water. It gives indirect information about alkalinity, free CO_2, dissolved oxygen content in lake water and also determines suitability of water for different purposes. The pH of lake water observed alkaline range throughout the study period. Hence the value of pH ranges from 7.54 to 8.04. The maximum pH was recorded during summer season while minimum was monsoon season. According to Krishna Ram *et al.* (2007) [16] recorded the range of pH 6.7 to 8.4 is considered to be safe for maintaining productivity of aquatic life. Thus, the range of pH within 6.5-8.0 safe for human consumption and range like 6.0-9.0 is safe for aquatic life are suggested by Federal Environmental Protection Agency (FEPA). According to Jhingran (1982) [2], the range of pH in between 6.5 to 9 is most suitable for pond aquaculture.

EC is a numerical expression to measure the ability of an aqueous solution to carry electric current. Ability depends on the presence of mobility, ions, relative concentrations, their total concentration and temperature of measurement. The seasonal variations of electrical conductivity during study period are reported in Table -1. Hence the value of Electric conductivity ranges from 659 µmhos/cm to 991 µmhos/cm during study period. The value of EC observed higher in monsoon season and lowers in summer season. According to Srivastava *et al*. (1996) [3], the highest value of EC indicates a large amount of dissolved salts and making its unsuitable for human being for drinking purpose. Same results observed by many workers in various water bodies, Luharia and Harney (2016) [17] reported higher (267& 371µmhos/cm) value of EC during monsoon season while lower (120 & 120 µmhos/cm) value during summer season for Gawrala and Vinjasan lake of Bhadrawati, Chandrapur. Shinde *et al*. (2010) [21] have found high value (504.3 µmhos/cm) of EC in monsoon season while low value (259.5 µmhos/cm) in summer season for Harsool-Savangi dam, Aurangabad.

Transparency is universally proportional to the turbidity and directly proportional to the amount of suspended organic and inorganic matter. The other factors such as rainfall, existing weather conditions, nature of water body, wind velocity and plankton growth are responsible for affecting the transparency of lake water. In the present study seasonal variation in the value of transparency during the study period is given in Table- 1. In Shiroli lake (L4) 26.50 cm to 39.21 cm transparency range is recorded. Hence the highest value of transparency was observed in winter season while lowest in monsoon season. Khan and Chowdhary (1994) have observed maximum concentration of transparency during winter and summer may be due to absence of rainwater, gradual settlement of suspended particles. Shinde *et al*. (2011) [24] have found low transparency in monsoon due to influx of rain water from catchment area, high turbidity, cloudiness and low light penetration in water.

The TDS are the solids present in the lake water in the form off dissolved state. It is mostly consist of inorganic salts namely potassium, sodium, sulphates, calcium, carbonates, magnesium, bicarbonates, phosphates, nitrates etc and contains total of organic matter (Kotaiah and Swamy, 1994) [15]. The value of seasonal fluctuation of Total Dissolved Solids during study period is depicted in Table-1. The value TDS ranges from 445mg/L to 636mg/L. In the present study the higher value of TDS recorded in monsoon while lower value in summer season. Gupta and Singh (2000) [10] have observed higher value of TDS

in Damodar River may be due to addition of sewage and industrial waste water. WHO (1993) [26] has classified water quality on the basis of range of TDS value in the following way such as the TDS level less than 300mg/L is excellent, 300-600mg/L is good, 600-900mg/L is fair, 900-1200mg/L is poor and value above 1200mg/L is unacceptable for human being. According to this classification quality of water of all the four studied lakes are found in the category of good to fair. Hence, the water of this lake is not used by human being for domestic as well as irrigation purposes.

Table 1: Seasonal variation in the physicochemical parameters in the Shiroli lake

Parameter/ season	Monsoon	Winter	Summer	Average
Temperature (°C)	24.8±1.85	23.2±3.81	28.3±2.07	25.43±2.6
pH	7.56±0.064	7.85±0.16	8.04±0.03	7.81±0.24
EC(µmhos/cm)	978±0.015	744±0.019	689±0.028	803± 153.4
Transparency	26.50±6.5	39.21±5.1	30.71±5.6	32.14± 6.47
Total dissolved solids (mg/L)	636±10.1	467.4±18.01	445±19.05	516.13±104.4
DO (mg/L)	1.17±0.078	2.87±0.61	1.34±0.34	1.79± 0.93
Alkalinity (mg/L)	87.9±9.05	107.2±6.07	120±9.7	105.03±16.15
Hardness (mg/L)	224.06±17.21	179.3±7.4	249.08±12.3	217.48±35.35
Sodium (mg/L)	23.08±2.03	20.83±1.37	32.25±1.80	25.38±6.04
Potassium (mg/L)	16.35±0.49	15.9±0.22	20.58±2.26	17.61±2.58
Nitrate-N (mg/L)	1.55±0.32	2.23±0.09	2.56±0.67	2.11±0.51
Phosphate-P (mg/L)	2.07±0.48	2.53±0.28	3.02±0.10	2.54±0.47

The higher amount of oxygen is observed in that place where there is a good aquatic life. In Shiroli lake the amount dissolved oxygen recorded ranges from 1.17mg/L to 2.87mg/L. Hence the highest value of dissolved oxygen was recorded during winter season and the lowest value was recorded during monsoon season due to highly turbid water reducing the rate of photosynthesis. Concentration of dissolved oxygen in water are fluctuated by high water temperature, various types and number of amount of dissolved or suspended particles, aquatic plants, water agitation, light penetration by Jayaraju *et al*. (1994) [12].

Alkalinity is defined as determination the capacity of lake waters to neutralize a strong acid. It is usually imparted by the salts of bicarbonates, carbonates; nitrate, silicates, phosphate and borate etc, together with the hydroxyl ions in Free State have found Balai *et al*. (2016) [5].

The seasonal variations of the alkalinity during the study period are found in Table-1. In this lake the value of alkalinity ranges from 87.9mg/L to 120mg/L. Hence the highest value of alkalinity was observed during summer season and lowest value was recorded during monsoon season Many researchers have reported a similar pattern of variations in alkalinity, which support our present result. Patil (2014) [29], Ranveer *et al*. (2008) [28], and Kumbhar (2006) [30]. According to Jackson (1961), the value of alkalinity below 50mg/L, indicates low photosynthetic rate of lake water. On the basis of this statement the studied lakes showed high photosynthetic rate.

Hardness of water is defined as quantifying the capacity of water to react with soap. The amount of hardness in the water of Shiroli lake recorded, ranges from 179.3mg/L to 249.08mg/L. The maximum value of hardness was recorded during summer season with slight variation In monsoon season. Hence the minimum value was recorded during winter season. Sawant and Chavan (2013) [31] also observed higher value of harness in summer. Harney *et al*. (2013) [11] have also recorded that total hardness become maximum in summer and minimum in winter at Pindavani pond.

Sodium is one of the most naturally occurring cation. It is highly soluble in water and imparts softness in contrast to hardness. The seasonal variation values of sodium during the study period are represented in Table -1. The sodium concentration of Shiroli lake ranges from 20.83mg/L to 32.25mg/L during study period. The highest concentration of sodium is observed in summer and lowest in winter season. Saxena and Saksena (2012) [25] have observed high (16.4mg/L) value of sodium during summer season due to low water volume and high rate of evaporation, whereas the low concentration (8.55mg/L) of sodium in winter season due to utilization of sodium by plankton and other aquatic organisms. Patil *et al*. (2013) [27] have observed high (12 mg/L) value of sodium during summer season while low (7mg/L) during winter season in freshwater reservoir from Ajara tahsil Kolhapur. Garg *et al*. (2010) [8] has found higher and lower concentration of sodium during summer and winter season at Ramsagar reservoir, India.

Potassium is the most important naturally occurring elements present in lake water. According to Trivedy and Goel (1986), the concentration of potassium usually remains lower than that of sodium, magnesium and calcium. It plays important role in the metabolism of freshwater ecosystem. The amount of Potassium in the water of Shiroli lake recorded, ranges from 15.9mg/L to 20.58 mg/L. The maximum value of potassium was recorded during summer season with slight variation in monsoon season. Hence the minimum value was recorded during winter season. Tasleem Begum (2016) [6] has been found higher (2.45mg/L) concentration of potassium during summer season while lower (1.30mg/L) during winter season at Narsarhatalab of Shahdol, district, (M.P). According to Wetzel (2001) [32] observed under low potassium concentration, the growth rate and photosynthesis rate of blue-green algae becomes poor and rate of respiration is also increased.

Nitrate is the most highly oxidized form of nitrogen compound is generally observed in fresh water and it is very important elements for the growth, reproduction and survival of organisms in water. During present study the seasonal fluctuation of the nitrate values are depicted in Table-1. The nitrate concentration of Shiroli lake ranges from 1.55mg/L to 2.56mg/L during study period. The highest concentration of sodium is observed in summer and lowest in monsoon season. Many workers observed similar finding in various water bodies namely Murthuzasab *et al*. (2010) [19], Sahni and Yadav (2012) [22] and Thakor *et al*. (2011) [23].

Phosphate is a very essential nutrient for plant growth and a fundamental element in the metabolic reaction of plants and animals. It controls algal growth and primary productivity. Excess amounts of phosphorus can cause eutrophication leading to excessive algal growth called algal blooms (Gayathri, *et.al*.,2013) [9]. During present study the seasonal variation values of the phosphate are found in Table- 1. The Phosphate concentration of Shiroli lake ranges from 3.02mg/L to 2.07mg/L during study period. The highest concentration of sodium is observed in summer due to low water level, fast evaporation and mineralization of decaying materials in lake water. and lowest in monsoon season. Meshram *et al*. (2015) [18] observed higher concentration (0.368 mg/L) in the month of May and low concentration (0.069 mg/L) in the month of October in

Balsamudra lake. Balakrishna *et al.* (2013) [4] have recorded range of phosphate varied from 1.0 mg/L to 2.6 mg/L; hence they also observed higher value of phosphate during the month of December while lower value found in the month of September at Nagaramlake, Warangal, Andhra Pradesh. In the studied lake, the higher concentration of phosphate is observed due to addition of detergents, sewage and decomposition of organic matter likes plants and animals in lake water, which indicates polluted nature of water.

Conclusion

The present study has highlighted the fluctuations in the various physicochemical parameters during monsoon, winter, and summer seasons. Water of studied lake exhibits high concentration alkalinity, hardness, sodium, potassium, nitrate and phosphate due to addition of detergent and soup by washing clothes surround the lakes which make the water more concentrated during summer season.

Hence the studied physicochemical parameters were appears to be within permissible limit given by WHO (1984), so the water of this lake is suitable for domestic as well as irrigation purpose only.

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