Impact of seasonal fluctuation on phytoplankton diversity in fresh water lake of Arekurahatti in Navalgund of Dharwad

R.V. AIRSANG AND H.C. LAKSHMAN

SUMMARY: Physico-chemical analysis is considered to be the main feature to assess the quality of water for its best utilization for drinking and irrigation. There is a need to understand the interaction between climatic and biological processes in the water. In the present investigation, the monthly variation in different physico-chemical characteristics like pH, temperature, electric conductivity, alkalinity etc. were analyzed from May 2012 to April 2013, to know the water quality and impact of seasonal fluctuation on phytoplanktons in Arekurahatti lake of Navalgund Taluk. The surface water samples from fixed spots were collected and analyzed at an interval of one month for a period of 12 months. The results revealed that the variations in pH, temperature and other physico-chemical parameters played an important role in the phytoplankton distribution in different seasons. Therefore, it can be concluded that Arekurahatti lake water can be used only for domestic purposes and not for consumption. It was also found that there was rich diversity of phytoplanktons especially Cyanophyceae and Bacillariophyceae members.

EXPERIMENTAL METHODOLOGY

Navalgund is a taluka which comes under Dharwad district, Karnataka state, India. It is located 47 kms away from Dharwad and 374 kms from Bangalore. Geographically it is situated in between latitude 15° 34' 0, 120° N longitude 75° 22' 0, 120° E and altitude 1896 feet (578 m). Approximate population for 7 km radius from this point 37443. Winter temperature 20°C, summer temperature 39°C. Arekurahatti lake is large sized lake (14 acres) situated in the village Arekurahatti.

Water samples were collected for the estimation of physico-chemical parameters from the Arekurahatti lake of Navalgund taluk for a period of twelve months from May 2012 to April 2013 at an interval of one month. The samples were collected in pre-cleaned polyethylene carbonyl cans of one litre with necessary precautions and utmost care (APHA, 1995). Samples were brought to the laboratory to study their physical and chemical parameters. Winklerization was made in separate 300 ml BOD bottles for the estimation of dissolved oxygen. From the collected sample of the lentic water body, sedimentation was made in acid Lugol's solution and the supernatant was discarded. The phytoplankton sediment was concentrated to 30 ml by centrifugation. Micro photographs were taken by using high resolution microscope.

EXPERIMENTAL FINDINGS AND DISCUSSION

The results of the physico-chemical analysis of Arekurahatti lake is presented in Table 1. pH is an important quality parameter which influences the survival and nourishment of biological life. Maximum pH value was observed in the month of August and September because of less rain fall with hot sunny days and lowest pH value in the month of January in Arekurahatti lake (Table 1).

It has been well documented that the variation in water temperature can be correlated with seasonal variation. The water was comparatively warmer in the May and April months as because of the less rain fall and hot sunny days. The temperature reduced to 20°C in the month of January (during winter season). Electric conductivity (EC) was varying from the minimum 220µs/cm to maximum of 330µs/cm in Arekurahatti lake. In the present study, alkalinity was increased in the month of October and very least in the month of May. Turbidity was acceptable only in the month of May in Arekurahatti Lake (WHO, 1990). Total dissolved solids (TDS) were high in the month of May and April and low in the month of November and February in Arekurahatti lake (Fig. 1).

Calcium was found high in the month of February. Total hardness and magnesium was found high in the month of January. But total hardness, calcium and magnesium were found minimum in the month of May. Sodium and sulphates were found high in the month of September and these were found minimum in the month of December and March. Chloride and nitrate were found maximum in the month of June and minimum in the month of April and September, respectively.

### Table 1: Analysis of physico-chemical parameters in Arekurahatti lake (May-2012 to April-2013)

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<tbody>
<tr>
<td>pH</td>
<td>8.5</td>
<td>8.4</td>
<td>8.6</td>
<td>8.7</td>
<td>8.7</td>
<td>8.2</td>
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<td>8.2</td>
<td>7.7</td>
<td>7.9</td>
<td>8.3</td>
<td>8.4</td>
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<tr>
<td>Temperature°C</td>
<td>29°C</td>
<td>26°C</td>
<td>27°C</td>
<td>28°C</td>
<td>28°C</td>
<td>28°C</td>
<td>24°C</td>
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<td>20°C</td>
<td>24°C</td>
<td>28°C</td>
<td>29°C</td>
</tr>
<tr>
<td>EC µs/cm</td>
<td>330</td>
<td>300</td>
<td>250</td>
<td>300</td>
<td>310</td>
<td>260</td>
<td>220</td>
<td>230</td>
<td>240</td>
<td>220</td>
<td>290</td>
<td>330</td>
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<td>Alkalinity mg/l</td>
<td>2.7</td>
<td>2.7</td>
<td>5.6</td>
<td>6</td>
<td>4.4</td>
<td>6.92</td>
<td>5.6</td>
<td>4</td>
<td>5.6</td>
<td>5.2</td>
<td>2.8</td>
<td>4.12</td>
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<tr>
<td>Turbidity NTU</td>
<td>5.1</td>
<td>10</td>
<td>27</td>
<td>54</td>
<td>82</td>
<td>12</td>
<td>2.8</td>
<td>3.5</td>
<td>4.5</td>
<td>6.4</td>
<td>3</td>
<td>6</td>
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<tr>
<td>TDS mg/l</td>
<td>170</td>
<td>154</td>
<td>128</td>
<td>154</td>
<td>159</td>
<td>133</td>
<td>112</td>
<td>117</td>
<td>123</td>
<td>112</td>
<td>149</td>
<td>170</td>
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<tr>
<td>Calcium mg/l</td>
<td>40</td>
<td>48</td>
<td>106</td>
<td>146</td>
<td>80</td>
<td>100</td>
<td>80</td>
<td>140</td>
<td>140</td>
<td>180</td>
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<tr>
<td>Magnesium mg/l</td>
<td>12.15</td>
<td>20.9</td>
<td>6.32</td>
<td>37.42</td>
<td>35.47</td>
<td>56.37</td>
<td>29.16</td>
<td>30.62</td>
<td>68.04</td>
<td>14.58</td>
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<td>12.64</td>
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<tr>
<td>Total hardness mg/l</td>
<td>90</td>
<td>134</td>
<td>132</td>
<td>300</td>
<td>226</td>
<td>332</td>
<td>200</td>
<td>266</td>
<td>420</td>
<td>240</td>
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<td>112</td>
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<td>Potassium mg/l</td>
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<td>1.8</td>
<td>1.7</td>
<td>3.2</td>
<td>2.9</td>
<td>3.1</td>
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<td>1.9</td>
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<td>Sodium mg/l</td>
<td>45</td>
<td>25</td>
<td>24</td>
<td>45</td>
<td>52.5</td>
<td>49</td>
<td>26</td>
<td>20</td>
<td>38</td>
<td>30</td>
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<td>40</td>
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<tr>
<td>Total phosphates mg/l</td>
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<td>6.3</td>
<td>5.9</td>
<td>6.4</td>
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<td>2.8</td>
<td>1.7</td>
<td>1.6</td>
<td>1.8</td>
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<tr>
<td>Chloride mg/l</td>
<td>32</td>
<td>52</td>
<td>38</td>
<td>38</td>
<td>39.2</td>
<td>38</td>
<td>44</td>
<td>34.6</td>
<td>38</td>
<td>36</td>
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<tr>
<td>Sulphate mg/l</td>
<td>10</td>
<td>8</td>
<td>7.5</td>
<td>12.6</td>
<td>14.4</td>
<td>5.4</td>
<td>10.5</td>
<td>11.7</td>
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<td>7.9</td>
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<tr>
<td>Nitrates mg/l</td>
<td>0.6</td>
<td>1.8</td>
<td>0.4</td>
<td>0.6</td>
<td>0.1</td>
<td>0.8</td>
<td>1.5</td>
<td>1.4</td>
<td>0.9</td>
<td>0.7</td>
<td>0.3</td>
<td>0.4</td>
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<tr>
<td>Dissolved oxygen mg/l</td>
<td>5.8</td>
<td>6.6</td>
<td>6.8</td>
<td>6.5</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>6.5</td>
<td>6.2</td>
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<tr>
<td>Chemical oxygen demand mg/l</td>
<td>73.6</td>
<td>22.4</td>
<td>16</td>
<td>19.2</td>
<td>25.6</td>
<td>32</td>
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<td>28</td>
<td>30</td>
<td>31</td>
<td>15.7</td>
<td>37.3</td>
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<tr>
<td>Biological oxygen demand mg/l</td>
<td>1.6</td>
<td>6.6</td>
<td>5.6</td>
<td>2.5</td>
<td>2.1</td>
<td>2.0</td>
<td>5.0</td>
<td>5.0</td>
<td>2.3</td>
<td>3.7</td>
<td>5.2</td>
<td>0.003</td>
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In summer (Mahadev et al., 2010), Total alkalinity is due to salts of weak acids and bicarbonates. The highly alkaline water is not potable. Chloride concentration is the most useful parameter for evaluating the atmospheric input to sub-surface water (Shiva Kumar et al., 2009). High concentration of chloride in the water gives an undesirable taste to water. This higher concentration of chloride reduced the algal population in the present work.

The seasonal variation in total phytoplankton number was due to various factors such as temperature, intensity of light, bicarbonates and organic matter. Certain plankton population apparently disappears at a specified period and reappears during the other period. This disappearance may be due to the fact that some species either become to scare or occur in spores, which cannot be easily detected. However, on the return of favourable conditions, spore again germinates and planktons appear. It is also observed that some species which are present in less abundance during some months reappear during other months when the conditions become favourable.

The peaks of phytoplankton occur at different periods in different years. Therefore, only temperature was not
responsible for the fluctuation in numbers but high pH, alkalinity, carbon dioxide and nutrients are also responsible for their organic production. The phytoplankton population is rich in fertile water. Phosphorus is another factor that deviated considerably in the lake waters. Phosphates are common inside cells but can be excreted outside the cell or be associated with the exterior cell surface. Phosphatase enzymes cleave dissolved organic phosphorus to liberate phosphate. Excretion of extracellular phosphates increases when phosphorus becomes scarce. The ubiquitous nature of these compounds in lakes leads to rapid turnover of many organic phosphorus compounds leading to high amounts of phosphorus in lakes.

Chloride concentration is not a useful parameter for evaluating the atmosphere input to subsurface water (Shivkumar et al., 2009). High concentration of chloride in the water gives an undesirable taste to water. The chloride content varied from 22.0 mg/l to 52.0 mg/l. These values found in the Arekurahatti lake were within the acceptable range.

Infact in the present study, temperature, pH, alkalinity and nutrient content in Arekurahatti lake water played a vital role. During the investigation, phytoplankton distribution varied in different seasons between May 2012 to April 2013. Similar findings were reported by Mahadev et al. (2010). Dissolved oxygen (5.8mg/l to 9.0mg/l) content and BOD (0.0mg/l to 6.6mg/l) in Arekurahatti lake fluctuated much and always deviated from prescribed limits having a positive effect in changing the phytoplankton habitat (Hosamani et al., 2011).

Dissolved oxygen, phosphate, nitrate and pH are the most significant parameters operating in this water body.
High alkaline nature of water decreased the number of Cyanophyceae, Chlorophyceae and Euglenophyceae numbers. Calcium deficiency may be an important factor, which influenced the abundance of Bacillariophyceae members. Bacillariophyceae members are dominant over other members of Cyanophyceae and Chlorophyceae (Table 2 and 3). The investigation may suggest that the water of Arekurhatti lake may be used for domestic purposes but not for drinking/consumption according to drinking water quality standards (WHO, 1990).

Eight phytoplanktons which were found dominant have been presented with microphotographs (Plate 1).

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REFERENCES


