

# Seasonal Variation of Phytoplankton in Bibi Lake, Ahmedabad, Gujarat, India

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**ABSTRACT:** The present study reports on community structure of freshwater algae in Bibi Lake, Ahmedabad. The distribution of phytoplankton is not always uniform and varies spatially and also at time scales. Phytoplankton dynamics or the time dependent changes in phytoplankton biomass are the result of a complex interplay of physical, chemical and biological processes, among all nutrient availability plays a key role in determining the phytoplankton population density. In the present study 27 genera and 27 species were reported which belong to class Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae.

**KEYWORDS:** Seasonal variation, quantitative analysis, phytoplankton, Bibi lake, freshwater.

## I. INTRODUCTION

Algae are primary producers in any ecosystem. The growth of phytoplankton determined by changes in hydrological and abiotic parameters both in space and time. Biotic and Physico-chemical parameters have been reported to affect the seasonal changes in the structure of phytoplankton community (Baykal *et. al.*, 2011; Gupte and Solanki, 2015). Fluctuation and diversity in phytoplankton are widely used as biological determinates of water quality in lakes (Ghosh *et. al.*, 2012). The distribution of phytoplankton is not always uniform and varies spatially and also at time scales (Bhanuet. *al.*, 2014). Phytoplankton dynamics or the time dependent changes in phytoplankton biomass are the result of a complex interplay of physical, chemical and biological processes, among all nutrient availability plays a key role in determining the phytoplankton population density (Verma *et. al.*, 2014; Qureshimatva *et. al.*, 2015). Phytoplankton population largely dependent on nutrient availability, light penetration and mixing with in the water column however nutrient availability. Phytoplankton, such as *Microcystis*, *Anabaena*, *Nostoc* and *Aphanizomenon*, usually breakout and stand stably, leading to problems with hypoxia, toxins and changes in the structure of biological communities (Bhanuet. *al.*, 2014).

## II. MATERIAL AND METHOD

### Study area:

**Location:** Vatva-Narol road, Vatva, Ahmedabad

**Latitude:** 22°57'38.65" N

**Longitude:** 72°36'37.09" E

**Area covered:** 11,425 m

**Maintained by:** Ahmedabad Municipal Corporation, Govt. of Gujarat.

### Methods for collecting and identification of algae:

**Microscopic floating algae** (the phytoplankton) can be collected with a mesh net (e.g. with 25-30 µm pores) or, if in sufficient quantity (i.e. colouring the water), by simply scooping a jar through the water. 1 L of water was taken in polythene bottles and filtered through the net and concentrated in a 100 ml bottle. Samples were as close to the water surface as possible in the morning hours and preserved for further analysis.

### Labelling:

The samples were labelled with date, time of sampling and volume measured and pasted on polyethylene bottles.

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**Preservation of the sample:**

For a phytoplankton sample to be analysed for an extended period, 4% Formaldehyde preservatives is used.

**Quantitative analysis of Phytoplankton:**

Detailed analyses of phytoplankton population are done by estimating the number in each species. The phytoplankton consisting individual cells, filaments and colonies are counted as individual cells. When colonies of species are counted, average number of cell per colony is counted, and in filamentous algae, the average length of the filament has to be determined. For this analysis Sedgwick Rafter Counting cell was used, it has approximately 50 mm long, 20 mm wide and 1mm deep. The total volume of the cell is 1 ml.

$$\text{Formula (n)} = \frac{(a \times 1000) c}{l}$$

Where,

n = Number of Plankton/ litter of water

a = Average no of plankton in one small counting chamber of S-R cell.

C = ml of plankton concentrate.

l = Volume of original water filtered in litter.

**Phytoplankton identification:**

From the concentrated sample, the slides for the plankton were prepared. Then these slides were placed under microscope and the phytoplankton was observed in 100 X in binocular microscope. The images of the phytoplankton were captured by using digital camera. Further, the Phytoplankton is identified by using the books ‘The Fresh Water Algae’ by Priscott; Fresh Water Diatoms of Maharashtra by Sarode and Kamat (1984) and ‘Marine & Freshwater Plankton by Davis (1966).

### III. RESULT AND DISCUSSION

Quantitative analysis of phytoplankton was done monthly and counted the number of planktons in 1 ml concentrated sample collected from the Bibi Lake each month for 1 year (September 2013 to August 2014). The Quantitative analysis of phytoplankton populations is summarized in Table No. 1. In the present study 27 genera and 27 species were reported which belong to class Chlorophyceae, Cyanophyceae, Bacillariophyceae and Euglenophyceae. The highest number of species found in the class Chlorophyceae 11 genera and 11 species followed by Bacillariophyceae 7 genera and 7 species, Cyanophyceae 7 genera and 7 species and Euglenophyceae 2 genera and 2 species were reported.

**Table 1: Monthly variation and Quantitative analysis of freshwater algae in Bibi Lake (2013-14).**

| <i>Monthly variation and Quantitative analysis of freshwater algae in Bibi Lake</i> |                   |                           |  |         |         |         |         |         |         |         |         |         |         |         |
|---|-------------------|---------------------------|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Sr. no  | Class             | Botanical Name            | Total No. of phytoplankton in 1 ml concentrated sample |         |         |         |         |         |         |         |         |         |         |         |
|   |                   |                           | Se<br>pt   | O<br>ct | No<br>v | De<br>c | Ja<br>n | Fe<br>b | Ma<br>r | Ap<br>r | Ma<br>y | Ju<br>n | J<br>ul | Au<br>g |
| 1   | CHLOROPHYCEA<br>E | <i>Ankistrodesmus sp.</i> | 0  | 0       | 1       | 0       | 0       | 1       | 1       | 0       | 0       | 0       | 1       | 0       |
| 2   |                   | <i>Chlamydomonas sp.</i>  | 3  | 2       | 4       | 2       | 2       | 1       | 1       | 1       | 2       | 2       | 1       | 1       |
| 3   |                   | <i>Chlorella sp.</i>      | 14   | 13      | 12      | 14      | 14      | 10      | 9       | 17      | 54      | 1       | 3       | 5       |
| 4   |                   | <i>Closterium sp.</i>     | 3  | 1       | 15      | 4       | 4       | 1       | 7       | 62      | 5       | 4       | 2       | 4       |
| 5   |                   | <i>Cosmerium sp.</i>      | 3  | 4       | 5       | 6       | 5       | 4       | 1       | 4       | 5       | 6       | 7       | 6       |

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|    |                       |                             |           |           |           |           |           |           |           |            |           |           |           |           |
|----|-----------------------|-----------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|-----------|
| 6  |                       | <i>Desmidium sp.</i>        | 1         | 0         | 0         | 0         | 1         | 1         | 3         | 2          | 4         | 4         | 2         | 0         |
| 7  |                       | <i>Pandorina sp.</i>        | 2         | 1         | 2         | 5         | 4         | 3         | 2         | 7          | 8         | 6         | 2         | 2         |
| 8  |                       | <i>Pediastrum duplex</i>    | 6         | 7         | 3         | 1         | 4         | 8         | 14        | 11         | 7         | 5         | 6         | 4         |
| 9  |                       | <i>Scenedesmus sp.</i>      | 5         | 4         | 7         | 6         | 2         | 4         | 7         | 4          | 5         | 2         | 4         | 7         |
| 10 |                       | <i>Spirogyra sp.</i>        | 0         | 0         | 0         | 2         | 1         | 0         | 0         | 0          | 0         | 0         | 0         | 0         |
| 11 |                       | <i>Zygnema sp.</i>          | 5         | 4         | 6         | 1         | 6         | 0         | 3         | 7          | 8         | 5         | 2         | 6         |
|    |                       | <b>Total</b>                | <b>42</b> | <b>36</b> | <b>55</b> | <b>41</b> | <b>43</b> | <b>33</b> | <b>48</b> | <b>115</b> | <b>98</b> | <b>35</b> | <b>30</b> | <b>35</b> |
|    |                       |                             |           |           |           |           |           |           |           |            |           |           |           |           |
| 12 | BACILLARIOPHY<br>CEAE | <i>Cycotella sp.</i>        | 0         | 0         | 0         | 0         | 1         | 0         | 0         | 4          | 0         | 0         | 0         | 0         |
| 13 |                       | <i>Fragillaria sp.</i>      | 5         | 4         | 3         | 2         | 7         | 8         | 3         | 2          | 2         | 6         | 3         | 1         |
| 14 |                       | <i>Navicula sp.</i>         | 4         | 1         | 7         | 6         | 5         | 4         | 2         | 4          | 0         | 1         | 3         | 3         |
| 15 |                       | <i>Nitzschia sp.</i>        | 5         | 4         | 1         | 4         | 5         | 6         | 7         | 6          | 1         | 2         | 2         | 3         |
| 16 |                       | <i>Pinnularia sp.</i>       | 0         | 4         | 1         | 1         | 3         | 2         | 8         | 8          | 3         | 1         | 0         | 0         |
| 17 |                       | <i>Pleurosigmaangulatum</i> | 1         | 1         | 3         | 2         | 4         | 4         | 2         | 0          | 7         | 2         | 2         | 6         |
| 18 |                       | <i>Synedra sp.</i>          | 4         | 8         | 14        | 11        | 7         | 5         | 6         | 4          | 2         | 2         | 1         | 2         |
|    |                       | <b>Total</b>                | <b>19</b> | <b>22</b> | <b>29</b> | <b>26</b> | <b>32</b> | <b>29</b> | <b>28</b> | <b>28</b>  | <b>15</b> | <b>14</b> | <b>11</b> | <b>15</b> |
|    |                       |                             |           |           |           |           |           |           |           |            |           |           |           |           |
| 19 | CYNOPHYCEAE           | <i>Anabaena sp.</i>         | 7         | 9         | 6         | 2         | 4         | 7         | 14        | 15         | 10        | 14        | 8         | 6         |
| 20 |                       | <i>Cylindrospermum sp.</i>  | 3         | 5         | 6         | 9         | 7         | 4         | 14        | 18         | 17        | 2         | 3         | 6         |
| 21 |                       | <i>Merismopedia sp.</i>     | 1         | 3         | 2         | 2         | 5         | 7         | 4         | 3          | 8         | 9         | 2         | 2         |
| 22 |                       | <i>Microcystis sp.</i>      | 14        | 19        | 21        | 32        | 21        | 20        | 22        | 14         | 14        | 19        | 10        | 14        |
| 23 |                       | <i>Oscillatoria sp.</i>     | 19        | 11        | 15        | 14        | 3         | 15        | 18        | 11         | 17        | 18        | 24        | 13        |
| 24 |                       | <i>Phormidium sp.</i>       | 0         | 0         | 0         | 4         | 2         | 0         | 0         | 0          | 0         | 0         | 0         | 0         |
| 25 |                       | <i>Spirulina sp.</i>        | 5         | 4         | 8         | 6         | 3         | 4         | 14        | 16         | 12        | 14        | 12        | 7         |

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|    |                | Total              | 49       | 51       | 58       | 69       | 45       | 57       | 86       | 77        | 78       | 76       | 59       | 48       |
|----|----------------|--------------------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|
| 26 | EUGLENOPHYCEAE | <i>Euglena sp.</i> | 0        | 4        | 2        | 2        | 3        | 3        | 2        | 7         | 5        | 5        | 3        | 2        |
| 27 |                | <i>Phacus sp.</i>  | 5        | 3        | 1        | 1        | 2        | 6        | 7        | 6         | 1        | 2        | 2        | 3        |
|    |                | <b>Total</b>       | <b>5</b> | <b>7</b> | <b>3</b> | <b>3</b> | <b>5</b> | <b>9</b> | <b>9</b> | <b>13</b> | <b>6</b> | <b>7</b> | <b>5</b> | <b>5</b> |

**Note: No. of colonies was taken for counting Microcystis.**

Graph No. 1 shows the class wise distribution of phytoplankton in Bibi Lake, Cyanophyceae was most dominate throughout the year followed by Chlorophyceae, Bacilariophyceae and Euglinophyceae. The Growth of Chlorophyceae was highest during the summer season because of more nutrition. Cyanophyceae was dominant class in whole year because of the high concentration of nitrate found in the lake which supports the growth of Cyanophyceae.

In the present investigation, the dominance of Cyanophyceae like *Anabaena sp.*, *Microcystis sp.*, *Spirulina sp.* and *Oscillatoria sp.* were dominant whole year especially in summer and forming blooms in the lake. *Microcystis* and *Spirulina* both form the blooms in the Bibi lak. *Oscillatoria* and *Anabeana* also found throughout the year. In class Chlorophyceae *Ankistrodesmus sp.*, *Chlamydomonas sp.*, *Chlorellasp.*, *Closterium sp.*, *Cosmerium sp.*, *Desmidium sp.*, *Pandorina sp.*, *Pediastrum duplex*, *Scenedesmus sp.*, *Spirogyra sp.* and *Zygnema sp.* were recorded. Among them *Chlorellasp.* and *Closterium sp.* were dominate on the Chlorophyceae. The Class Bacilariophyceae represented by *Cycotellasp.*, *Fragillariasp.*, *Naviculasp.*, *Nitzschiasp.*, *Pinnulariasp.*, *Pleurosigma angulatum* and *Synedra sp.* *Synedra sp.* was dominate in the class Bacillariophyceae. Euglinophyceae only 2 species *Euglenasp.* and *Phacussp.* found throughout the year.

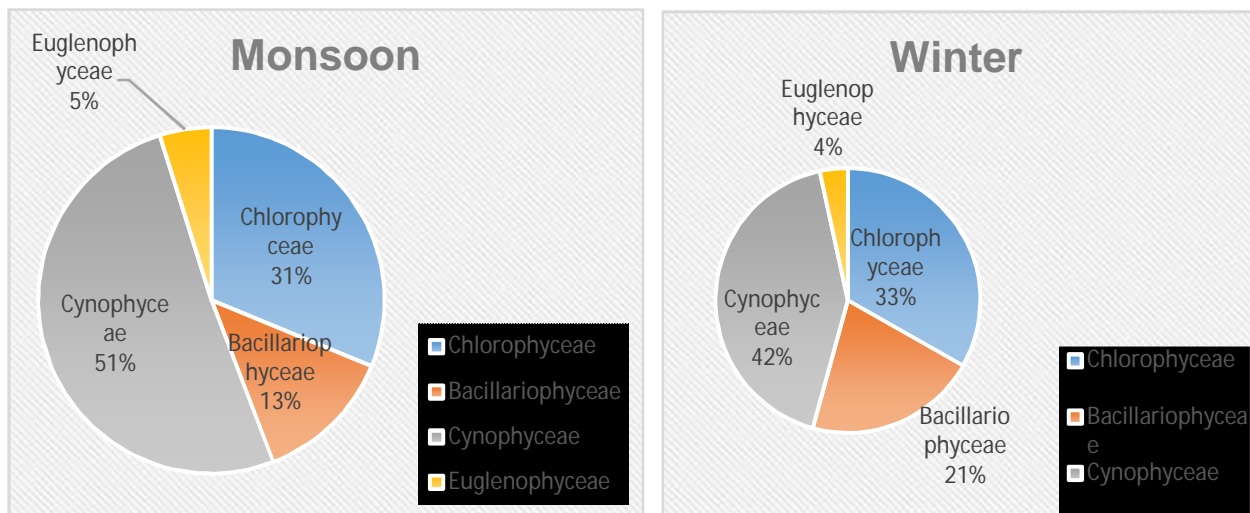
Table No. 2 and Graph No. 2 represent the quantitative analysis class wise. Cyanophyceae class ranges from 55 to 74 ml/L the maximum numbers of Cyanophyceae found during summer 74 and minimum in winter 55. Class Chlorophyceae ranges between 35 to 73 ml/L, the maximum number of Chlorophyceae found during the summer season 73 and minimum in monsoon 35. Bacillariophyceae ranges from 14 to 27 ml/L the maximum number found in winter and minimum in monsoon. Euglinophyceae ranges 5 to 8 ml/L maximum during summer and minimum during monsoon.

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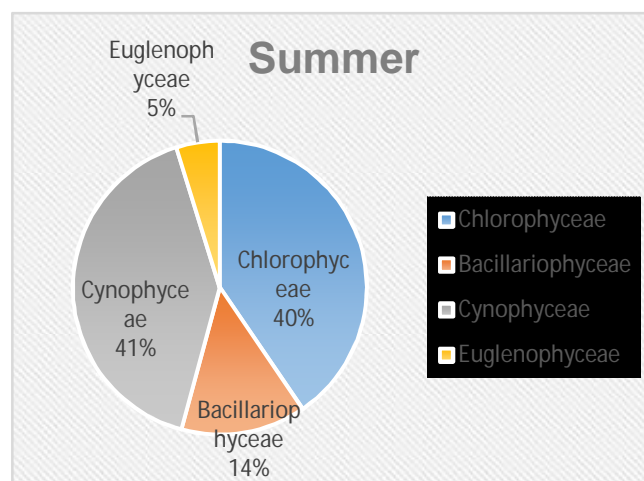
**Graph No. 1: Season-wise distribution of phytoplankton class.**



**Table 2: Summary of Phytoplankton class count/ ml.**

| Total No. of phytoplankton in 1 ml concentrated sample of Bibi Lake (2013-14) |     |     |     |     |     |     |     |     |     |     |     |     |
|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Class   | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
| <b>CHLOROPHYCEAE</b>  | 42  | 36  | 55  | 41  | 43  | 33  | 48  | 115 | 98  | 35  | 30  | 35  |
| <b>BACILLARIOPHYCEAE</b>  | 19  | 22  | 29  | 26  | 32  | 29  | 28  | 28  | 15  | 14  | 11  | 15  |
| <b>CYNOPHYCEAE</b>  | 49  | 51  | 58  | 69  | 45  | 57  | 86  | 77  | 78  | 76  | 59  | 48  |
| <b>EUGLENOPHYCEAE</b>   | 5   | 7   | 3   | 3   | 5   | 9   | 9   | 13  | 6   | 7   | 5   | 5   |

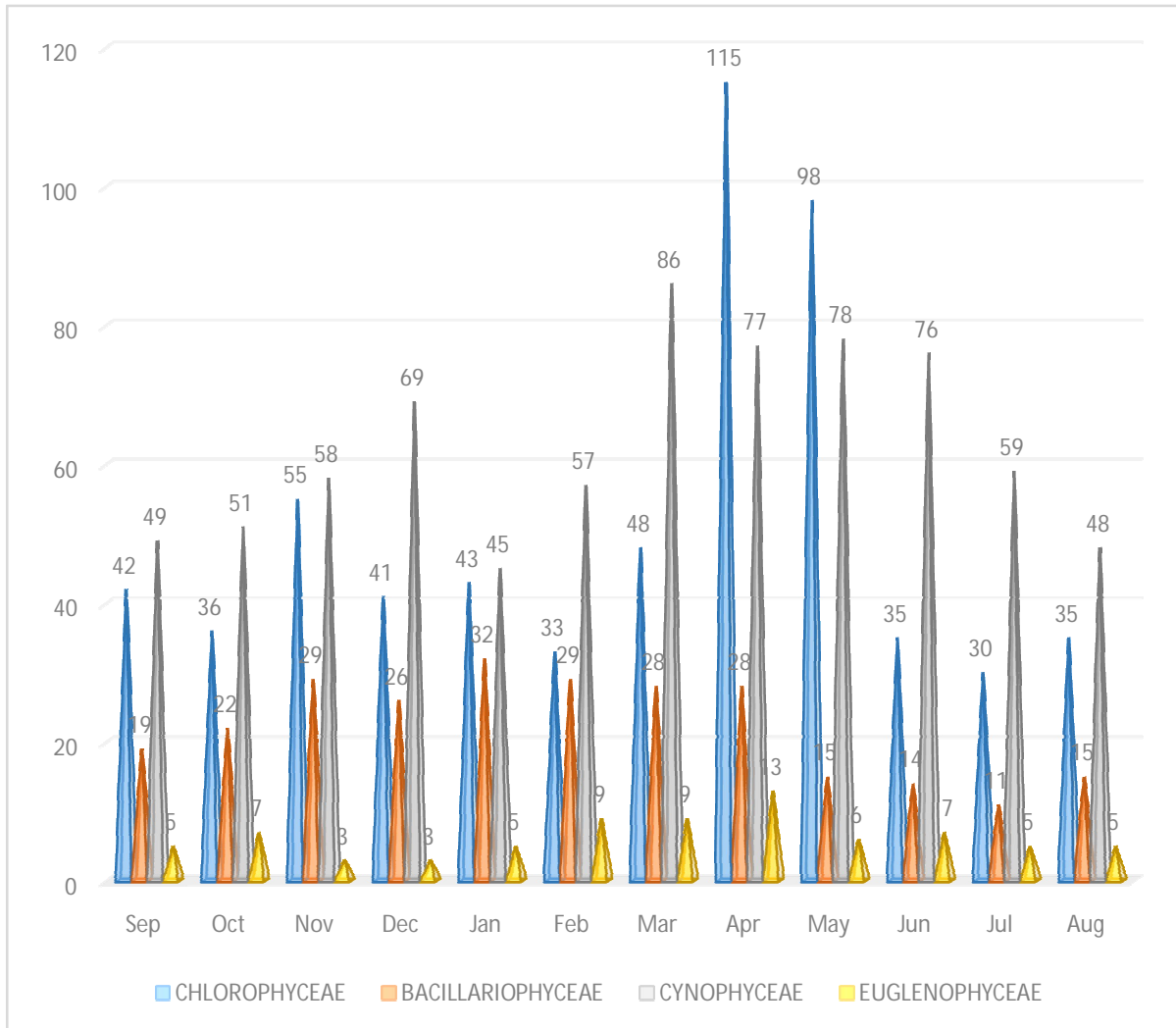
**Graphs No.2: Graph showing monthly variations of different class of Phytoplankton.**



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## IV. CONCLUSION

In the present study, the growth of algae was during summer season which favourable condition for the growth of algae in terms of nutrients and minerals. The abundance of phytoplankton was lowered during the pre-monsoon because of less water in the lake. The lake shows the dominance of Cyanophyceae over Chlorophyceae, Bacillariophyceae and Euglenophyceae. The present basic information of the phytoplankton distribution and abundance would form a useful tool for further ecological assessment and monitoring of the Bibi lake ecosystem.

## V. ACKNOWLEDGEMENT

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