RESEARCH ARTICLE

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# Studies on Phytoplankton Density of Water at the Wetland Area of Keoladeo National Park

**C.K. Mishra and J.K. Singh**
Department of Zoology, Agra College, Agra
E-mail: drckmishra11@gmail.com

## ABSTRACT

*Present investigation was carried out to study of phytoplankton density at selected two sites- Sapanmori and Hans Sarover blocks at Keoladeo National Park, Bharatpur. The concentration of water was determined with the help of plankton net then it preserved in 10 % formaldehyde in a plastic tube. One drop of water was taken with the help of ordinary dropper on Sedgwick after (graduated) and plankton counting was done with the help of microscope in high power. It was concluded that the total phytoplankton population fluctuated between (64,562 /litre and 67,375 /litre) in August to (2,34,875 /litre and 2,33,625 /litre) in May during 2000 and 2001, respectively. Seasonally, the density was maximum (1,99,170 /litre and 2,08,093 /litre) in summer followed by winter and autumn; while minimum (75,427 /litre and 90,781 /litre) was observed in monsoon season during both the years. Regarding the sites, the density was maximum at site A (2,34,875 /litre) followed by site B (2,19,500 /litre). Chlorophyceae population ranged from (22,562 /litre, 30,000/ litre) in August to (94,250 /litre and 95,625 /litre) in May during 2000 and 2001. Bacillariophyceae population fluctuated between (21,125 /litre and 28,750 /litre) in August to (56,000 /litre) in May during both the years. Myxophyceae population varied from (16,250 /litre and 18,250 /litre) in August to (76,860 /litre and 86,125 /litre) in June during 2000 and 2001, respectively.*

***Key Words:*** *Phytoplankton Density, Keoladeo National Park*

## INTRODUCTION:

Keoladeo National Park (locally known as Ghana Bird Sanctuary) considered as a paradise for avian biologists in India. Ajan Bandh is the main source of water to maintain water supply resource for this park. It is a centre for attraction due to some migratory birds especially Siberia, Heron etc (Anon 1981, Ali and Ripley 1983). In spite of micro invertebrates (worms, insects, molluscs etc) some vertebrates (fishes, birds, reptiles and some mammalian species) were also found in this park (Bhupathy 1991 and Gwynfryn 2001). All living beings depend on water to carry out complex biochemical processes which aid in the sustenance of life on earth (Reza, *et al.,* 2009 and Goncharuk 2012). Some biotic and abiotic factors (phytoplankton, zooplankton, temperature, phosphates, total solids, turbidity, acidity etc) influencing this wetland ecosystem (Holffmann 1977). So the present research work was laid out to study the density of phytoplankton in the water at selected sites; Sapanmori and Hans Sarover at the wetland area of Keoladeo National Park.

## MATERIALS AND METHODS:

The present investigation was laid out for two experimental years; from January 2000 to December 2001. For this study, the phytoplankton density was determined by sieving 50 liters of the lake surface water from two selected sites, through a plankton net. This net is made up of nylon bolting silk of 25 standard grades or 77 meshes/cm. It is truncated cone shaped with upper part of 20 cm and lower with 3 cm and a specimen tube; fixed at the tail end. The concentration of water sieved through net in tube was preserved in 10% formaldehyde in a plastic tube. Phytoplankton was

identified after shaking thoroughly the plastic tube in the laboratory. One drop of water was taken with the help of ordinary dropper on Sedgwick after (graduated) and plankton counting was done with the help of microscope in high power. The formula (Welch, 1948) applied for counting of plankton is -

$$N = (a\ 1000)\ c / l$$

Where,
n = Numebr of plankton/ litre of original.
a = Mean number of plankton all count in counting cell.
c = Volume of concentrated plankton in ml.
i = Volume of original water filtered in it.
In the present case, the counting cell of one cubic cm capacity was used, hence the formula change to:

$$n = a\ x\ c / l$$

The obtained result after analyzing is present in Table-1, 2, 3 and 4 and Graph.- I, II, III and IV.

**RESULT**:
In the entire period of investigation the total phytoplankton density varied from a minimum of (64,562 unit/litre) in the month of August 2000 to a maximum of (2,34,875 unit/litre) May 2000. Almost similar conditions were found in the year 2001, but having highest number of phytoplankton (2,33,625 unit/litre) in May, end a minimum of (56,812 unit/litre) in the month of September 2001 was recorded (Table 1 and Graph I).
Seasonally, the phytoplankton density was found to be highest in summer (2,01,228 unit/litre) followed by winter (1,40,667 unit/litre) and autumn (1,27,296 unit/litre) but a least number of (79,229 unit/litre) were recorded in the monsoon of 2000. The same season was recorded in the next investigation year 2001. The maximum of (2,08,094 unit/litre) was noted in the summer, followed by winter (1,57,375 unit/litre) and autumn (1,39,687 unit/litre). The minimum production was noted in monsoon (75,437 unit/litre) (Table 2 & 4 and Graph II & IV).
Considering both of the selected sites, the maximum production was at site A (2,34,875 unit/litre) followed by site B (2,19,500 unit/litre). The minimum phytoplankton was noted at site A (64,562 unit/litre) followed by site B (72,310 unit/litre) in 2000. During next year 2001 the highest density was at site A (2,33,625 unit/litre) followed by site B (2,09,620 unit/litre). The minimum phytoplankton was noted at site A (56,812 unit/litre) followed by site B (73,393 unit/litre) (Table 2 & 4 and Graph II & IV).

**Chlorophyceae**:
The density of chlorophyceae varied from a minimum of (22,562 unit/litre) in the month of August 2000 to a maximum of (94,250 unit/litre) in the month of May 2000. Similar condition was observed in the next investigation period of 2001. The highest productivity (95,625 unit/litre) was noted in the month of May and lowest (30,000 unit/litre) in the month of August. During both the years second peak were recorded in the month of February.
Seasonal fluctuation were recorded as a minimum of (32,960 unit/litre) in monsoon season of 2000 and a maximum of (65,625 unit/litre) in the summer season followed by winter (38,160 unit/litre) and autumn (36,092 unit/litre) season of 2000. In year 2001, highest was recorded (73,000 unit/litre) in the summer season followed by winter (38,791 unit/litre) and a lowest (33,955 unit/litre) productivity was noted in the monsoon season.
The density of green algae at both the sites varied from a minimum of (22,562 unit/litre) was noted at site A in August. To a maximum (94,250 unit/litre) at site A in the month of May 2000. In year 2001, high green algae was noted a site A (95,625 unit/litre) in the month of May. The lowest production was noted at site B (24,866 unit/litre) in the month of September.

**Bacillariophyceae**:
Throughout the investigation year 2000, Diatoms were found to vary from a minimum of (21,125 unit/litre) in the month of September, to a maximum of (61,875 unit/litre) in the month of May. During next investigation year 2001, Bacillariophyceae showed the maximum production of (67,000 unit/litre) in the month of May to a least production of (10,687 unit/litre) in the month of September.
Seasonally, highest production of diatoms was recorded in summer (54,150 unit/litre) period of 2000 followed by winter (32,960 unit/litre) and autumn (28,304 unit/litre). The least density of diatoms was found (21,916 unit/litre) in the monsoon of 2000. In the year 2001 similar conditions were observed, having maximum diatoms (59,687 unit/litre) in the summer followed by winter (45,292 unit/litre) and autumn (39,125 unit/litre). The minimum diatoms (19,270 unit/litre) were recorded in monsoon.
Considering the sitewise distribution during the entire investigation period, a maximum of (61,875 unit/litre) was observed at site A in the month of May 2000; while, in year 2001 the maximum was found (67,000 unit/litre) at the same site A in May.

**Myxophyceae**:
This group was found throughout the year in the lake varying from a minimum of (18,250 unit/litre) in the month of August to a maximum of (99,062 unit/litre) in the month of March 2000. In the next investigation year 2001, a maximum density of (81,875 unit/litre) was noted in the month of June and minimum (16,250 unit/litre) in the month of August.
Considering all the four seasons the summer was found to be highly productive for Myxophyceae (83,890 unit/litre) and the monsoon as least productive (25,906 unit/litre). While, the winter and autumn were fairly productive in the year 2000. In the year 2001, a maximum production of (75,406 unit/litre) was recorded in the summer season followed winter (73,292 unit/litre) and autumn (62,500 unit/litre). A maximum of (11,750 unit/litre) was observed in the monsoon.
Considering the sitewise distribution of blue green algae showed the maximum density (99,062 unit/litre) at site A, in the month of March 2000. In year 2001, maximum of (81,875 unit/litre) was noted at site A in the month of June.

**Table 1:** Monthly variations in total phytoplankton (unit/lit.) at site A in wetland area of Keoladeo National Park during both experimental year 2000-2001.

| Months | Chlorophyceae | | Bacllariophyceae | | Myxophyceae | | Total Phytoplankton | |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| Jan. | 38,125 | 37,000 | 31,250 | 36,000 | 70,150 | 83,250 | 1,39,525 | 1,56,250 |
| Feb | 39,625 | 41,250 | 36,000 | 37,375 | 69,000 | 65,625 | 1,44,625 | 1,44,250 |
| Mar. | 58,625 | 69,000 | 51,600 | 62,125 | 99,062 | 70,375 | 2,09,287 | 2,01,500 |
| Apr. | 58,750 | 64,875 | 52,500 | 59,125 | 71,625 | 78,375 | 1,82,875 | 2,02,375 |
| May | 94,250 | 95,625 | 61,875 | 67,000 | 78,750 | 71,000 | 2,34,875 | 2,33,625 |
| Jun. | 50,875 | 62,500 | 40,875 | 50,500 | 86,125 | 81,875 | 1,77,875 | 1,94,875 |
| Jul. | 48,750 | 48,000 | 20,875 | 26,000 | 27,500 | 28,125 | 97,125 | 1,02,125 |
| Aug. | 22,562 | 30,000 | 23,750 | 21,125 | 18,250 | 16,250 | 64,562 | 67,375 |
| Sep. | 28,000 | 24,875 | 21,125 | 10,687 | 26,875 | 21,250 | 76,000 | 56,812 |
| Oct. | 33,350 | 36,000 | 25,625 | 19,750 | 59,500 | 60,375 | 1,18,475 | 1,16,125 |
| Nov. | 34,875 | 39,500 | 25,000 | 58,500 | 63,500 | 65,250 | 1,23,375 | 1,63,250 |
| Dec. | 36,250 | 38,125 | 26,625 | 62,500 | 68,750 | 71,000 | 1,31,825 | 1,71,625 |

**Graph I:** Monthly variations in total phytoplankton (unit/lit.) at site A in wetland area of Keoladeo National Park during both experimental year 2000-2001

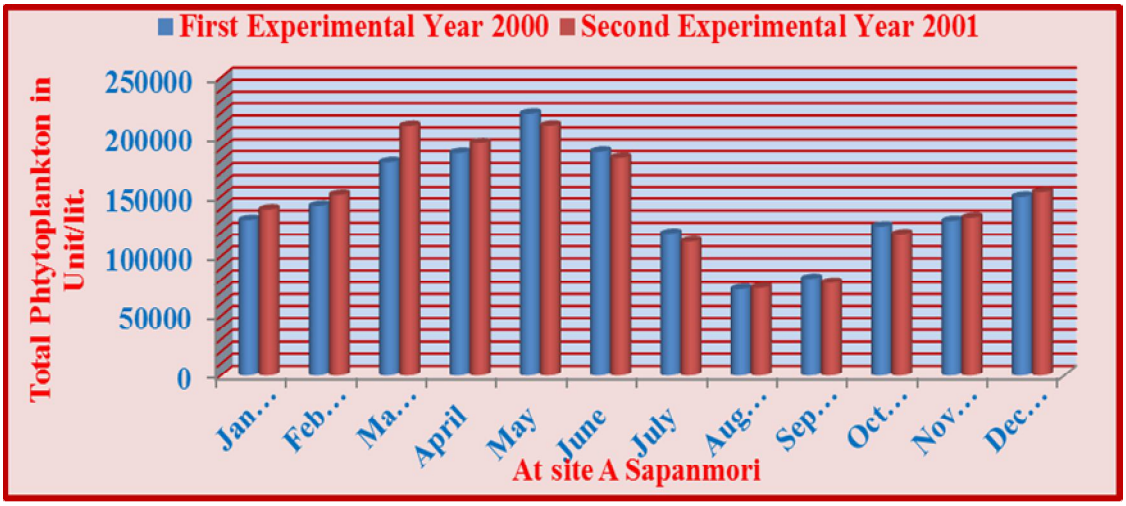



**Table 2:** Seasonal variations in total Phytoplankton (unit/litre) at site A in wetland area of Keoladeo National Park

| Season / Years | Chlorophyceae | | Bacilariophyceae | | Myxophyceae | | Total Phytoplankton | |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| Summer | 66,625 | 73,000 | 51,7125 | 59,687.5 | 83890.5 | 75406.25 | 201228 | 208093.75 |
| Monsoon | 33104 | 34291.66 | 21916.66 | 19270.66 | 24208.33 | 21875 | 79228.99 | 75437.32 |
| Autumn | 341125 | 37750 | 25312.5 | 39125 | 61500 | 62812.5 | 120925 | 139687.5 |
| Winter | 38000 | 38791.66 | 31291.66 | 45291.66 | 69300 | 73291.66 | 138591.66 | 157374.98 |

**Graph II:** Seasonal variations in total phytoplankton (unit/lit.) in two sites in the lakes of Keoladeo National Park

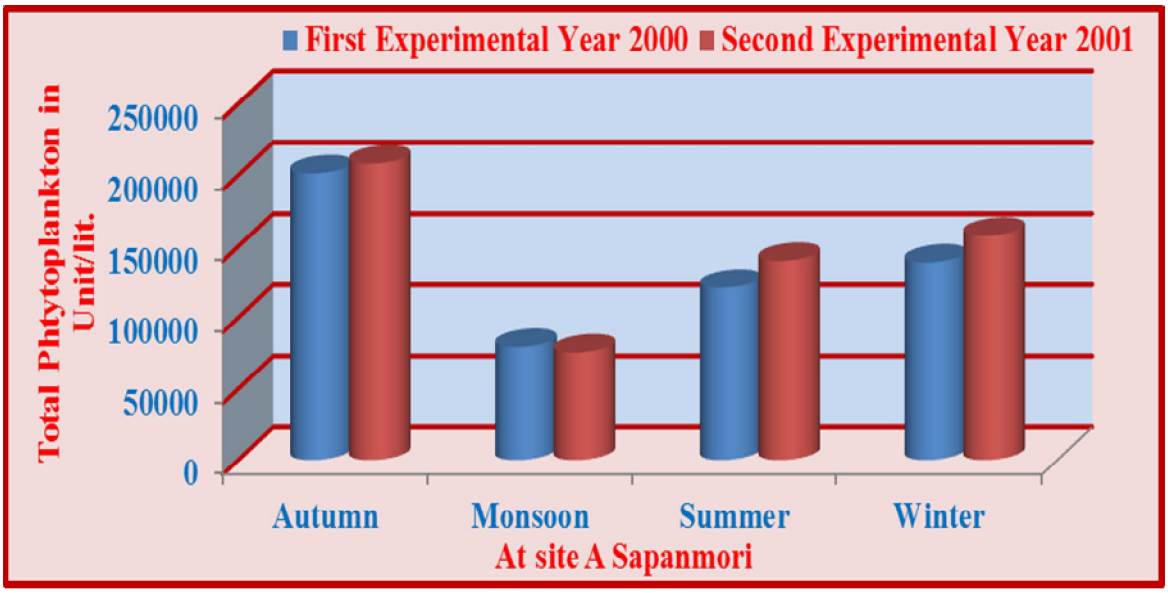


**Table 3:** Monthly variations in total phytoplankton (unit/lit.) at site B in wetland area of Keoladeo National Park during both experimental year 2000-2001

| Months | Chlorophyceae | | Bacllariophyceae | | Myxophyceae | | Total Phytoplankton | |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| Jan. | 40,120 | 38,000 | 30,260 | 38,000 | 60,000 | 63,060 | 1,30,380 | 1,39,060 |
| Feb | 36,000 | 44,200 | 38,000 | 38,360 | 68,000 | 68,620 | 1,42,000 | 1,51,180 |
| Mar. | 56,030 | 68,000 | 42,800 | 60,120 | 80,062 | 81,300 | 1,78,892 | 2,09,420 |
| Apr. | 56,500 | 68,600 | 58,400 | 58,120 | 71,725 | 68,460 | 1,86,525 | 1,95,180 |
| May | 86,050 | 86,620 | 60,600 | 56,000 | 72,850 | 67,000 | 2,19,500 | 2,09,620 |
| Jun. | 52,604 | 60,600 | 54,800 | 45,000 | 80,120 | 76,860 | 1,87,524 | 1,82,460 |
| Jul. | 49,500 | 46,000 | 40,875 | 36,000 | 28,600 | 30,220 | 1,18,975 | 1,12,220 |
| Aug. | 23,300 | 29,000 | 28,750 | 26,125 | 20,260 | 18,268 | 72,310 | 73,393 |
| Sep. | 26,080 | 26,866 | 26,120 | 26,600 | 28,858 | 24,280 | 81,058 | 77,746 |
| Oct. | 35,580 | 38,000 | 28,608 | 20,050 | 60,800 | 60,400 | 1,24,988 | 1,18,450 |
| Nov. | 36,604 | 38,600 | 28,000 | 25,600 | 65,000 | 68,200 | 1,29,604 | 1,32,400 |
| Dec. | 38,360 | 40,120 | 30,620 | 32,400 | 80,640 | 81,080 | 1,49,620 | 1,53,600 |

**Graph III:** Monthly variations in total phytoplankton (unit/lit.) at site A in wetland area of Keoladeo National Park during both experimental year 2000-2001

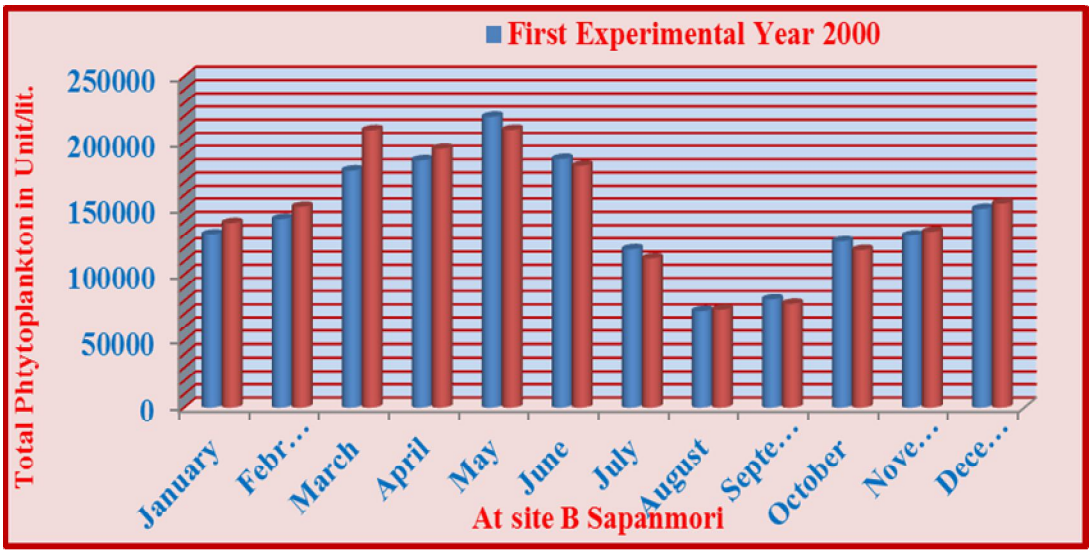
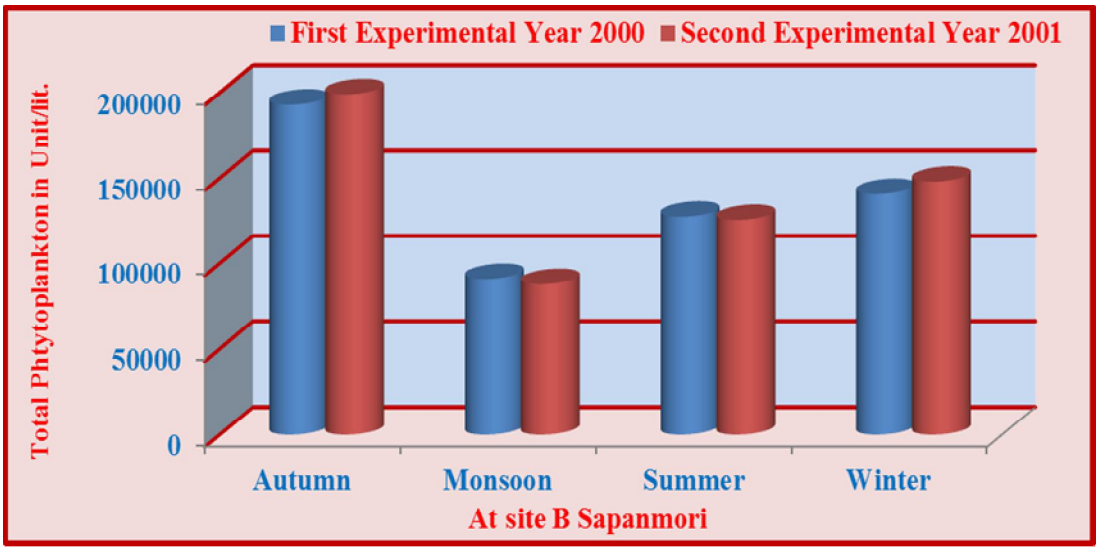



**Table 4:** Seasonal variations in total Phytoplankton (unit/litre) at site B in wetland area of Keoladeo National Park

| Season / Years | Chlorophyceae | | Bacilariophyceae | | Myxophyceae | | Total Phytoplankton | |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| Summer | 62,796 | 70,955 | 54,150 | 54,810 | 76,164 | 73,405 | 1,93,110 | 1,99,170 |
| Monsoon | 32,960 | 33,955 | 31,915 | 29,575 | 25,906 | 24,256 | 90,781 | 87,786 |
| Autumn | 36,092 | 38,300 | 28,304 | 22,825 | 62,900 | 64,300 | 1,27,296 | 1,25,425 |
| Winter | 38,160 | 40,773 | 32,960 | 36,253 | 69,547 | 70,920 | 1,40,667 | 1,47,946 |

**Graph IV:** Seasonal variations in total phytoplankton (unit/lit.) in two sites at site B in the lakes of Keoladeo National Park




**DISCUSSION:**

The fish yield is directly or indirectly governed by the plankton dominance, which is dependent upon various physico-chemical characteristics of water. But, as pointed out by Rana, (1991), no relationship can be obtained between the chemical conditions and plankton population at any particular period on the other hand, he pointed out that a number of physico-chemical and biological condition acting simultaneously, must be taken into considering, to observe population dynamics of plankton (Rana, 1997). The phytoplankton in the present study showed three peaks- first (highest) in the month of May, second in the month of February and the third (lowest) during August 2000 and 2001.

In the present investigation, summer season is more productive in comparison to the other seasons. Most probably due to high water temperature, long photoperiods and highest carbonate and low bicarbonate alkalinity, high pH responsible for the high production of phytoplankton (Wetzel, 1957; Galton and Meyer, 1985). Cabecadas and Brigueria (1987) observed the lowest value during monsoon due to the influx of large volume of rain water, much of it is lost in the draw- down (Govind, 1969; Ramakrishnaiah and Sarkar, 1982) and fairly high phytoplankton population were observed during winter and autumn season. Michael (1964) and Hussainly (1967) have also reported the maximum number in colder seasons. While, Bais *et al.* (1995) noted its maximum density during summer season.

The high population of plankton in this lake is due to high eutrophication, during the investigation period of 2000 and 2001, the chlorophyceae showed the most abundant group of the phytoplankton, being in showing the maximum abundance in summers when the water temperature was high (Rana, 1997, Yadav and Rana, 2001).

Seasonally, chlorophyceae showed the maximum peak during summer, fairly high during winter and lowest population was obtained during monsoon, due to disturbance by rain water. During summers it was high due to high water temperature responsible for the production of green algae (Verma and Datta Munshi, 1987). Fairly high population of green algae was due to high dissolved oxygen (Gonjalves and Joshi, 1946).

In this period phosphate show the direct relationship with green algae. It was maximum during summers, fairly high during winter and autumn season and lowest in monsoon (Govind, 1963). Considering the two sites, the green algae was increasing simultaneously in each site. It was slightly high at site A, due to eutrophication. Bacillariophyceae is the

second most dominant group of phytoplankton. Maximum population of diatoms was observed in the month of February. Mazhar and Kapoor (1992) recorded its peak in January and minimum was recorded in the month of August due the influx of large volume of rain water.

Seasonally, the maximum diatoms density was obtained during winter, fairly high during summer and autumn. Dutta *et al.* (1954) Roy (1955) and George (1966) have also recorded its maximum density during winters; most probably due to low water temperature, which allows the nitrate to accumulate in water; thus stimulate the abundant growth of diatoms in water supported by Venkateswarlu (1969) and Manikya Reddy (1984).

In the present study temperature itself is not responsible for the seasonal variations in diatoms as their primary peak was observed during this period, when the temperature ranged between 13.0 ºC and 36.0 ºC whereas, during the secondary peak the temperature was between 14.5 ºC and 35.5 ºC. Kant and Raina (1989) also reported that diatoms density tolerate a temperature range of 0 ºC-35 ºC. The important nutrients, which effect the growth of diatoms in general; are silicates, nitrates, nitrite, phosphate and dissolved oxygen. Roy (1955), Chakrabarty *et al.* (1959), and Sampath Kumar (1977) stressed the importance of phosphates in the periodicity of diatoms. In the present case, direct relationship was observed between the concentration of phosphate and the diatoms population.

In the investigation a direct relationship was noted between phosphates and diatoms population (Roy, 1955; Bais *et al.* 1995) during monsoon season. Vankateswarlu (1969) have also recorded a direct relationship between dissolved oxygen and diatom density. In the case of Keoladeo National Park, the diatom population was maximum during winter and minimum during monsoon. Similarly, the dissolved oxygen was fluctuating. Considering the selected sites, diatoms are more or less equal. However, fairly high concentration was recorded at site A due to high organic matter at this site.

Myxophyceae showed the maximum population in the month of June and (Vyas and Kumar, 1967) and minimum the month of August as the flood water entered in the lake; after that sudden increase was noted till December. Many workers, while disagreeing with the periodicity of blue green algae, with rains, have laid much stress on the water temperature (West and West, 1912; William, 1962).

In seasonal observations, the myxophyceae showed the maximum density during summers (Vyas and Kumar, loc. cit) due to high organic matter and high pH value and water temperature Sengar *et al.* (1985). Rao and Duve (1992), Nayak and Khare (1993) also reported the high organic matter responsible for its development. Kant and Sinha (1999) observed the rich organic matter responsible for the growth of blue green algae. pH, phosphate, nitrite, hardness, chloride show the direct correlationship with myxophyceae. Hegde (1990), Rana (1997) observed the positive relation between myxophyceae and chlorides. Seenayya and Zafar (1979) noted the inverse relationship between nitrite, phosphate and blue green algae. The high myxophyceae population observed at selected sites was due to the eutrophic nature of water. Rana (1991) started that blue green algal bloom in a lake show the eutrophication.

**CONCLUSION**:

The microbial assessment of the water in two lakes of the park was done as two types of the planktons which was ascertained and identified by simple drop method under various magnifications in Sedgewick Rafter microscopic in accordance to Welch (1948). Phytoplanktons were represented by three major group- Chlorophyceae, Bacillariophyceae and Myxophyceae. The various forms belonging to these group, were arranged into four categories according to their occurrence as Dominant, abundance, frequent and Rare.

The total phytoplankton population fluctuated between (64,562 /litre and 67,375 /litre) in August to (2,34,875 /litre and 2,33,625 /litre) in May during 2000 and 2001,

respectively. Seasonally, the density was maximum (1,99,170 /litre and 2,08,093 /litre) in summer followed by winter and autumn; while minimum (75,427 /litre and 90,781 /litre) was observed in monsoon season during both the years. Regarding the sites, the density was maximum at site A (2,34,875 /litre) followed by site B (2,19,500 /litre).

**Chlorophyceae:**
Its population ranged from (22,562 /litre, 30,000/ litre) in August to (94,250 /litre and 95,625 /litre) in May during 2000 and 2001. Concerning the seasons, the density was maximum (65,625 /litre and 73,000 /litre) in summer, followed by winter and minimum (32,960 /litre and 33,955 /litre) in monsoon season. Regarding the sites, the highest population was observed at site A (95,625 /litre) followed by site B (86,620 /litre).

**Bacillariophyceae**:
Its population fluctuated between (21,125 /litre and 28,750 /litre) in August to (56,000 /litre) in May during both the years. Seasonally, diatoms were maximum (59,687.5 /litre and 83,890.5 /litre) in summer, followed by winter and minimum (19,270.66 /litre and 21,916 /litre) in monsoon. As far as the sites are concerned the highest density of diatoms was noted at site A (67,000 /litre) followed by site B (60,600 /litre).

**Myxophyceae**:
Its population varied from (16,250 /litre and 18,250 /litre) in August to (76,860 /litre and 86,125 /litre) in June during 2000 and 2001, respectively. On seasonal basis, the density was maximum (76,164 /litre and 83,890.0 /litre) in summer followed by winter and autumn; while minimum (21,875 /litre and 24,208.33 /litre during monsoon season. Concerning the sites, blue green algae were most dominant at site A (86,125 /litre) followed by site B (80,120 /litre).

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