Algal Flora and Water Pollution of Samaspur Lake, Rae Bareli, U.P.

Deepak Kohli, *P. S. Pandey, H.P. Gupta & Asha Khandelwal

Birbal Sahni Institute of Palaeobotany, Lucknow 226 007, U.P.

** Feroze Gandhi Post Graduate College, Rae Bareli 229001, U.P.*

Kohli, D., Pandey, P.S., Gupta, H.P. & Khandelwal, A. 1994. Algal flora and water pollution of Samaspur Lake, Rae Bareli, U.P. *Geophytology* **24** (1):123-128.

A comprehensive study of the algal composition from a fresh water lake, Samaspur in District Rae Bareli, Uttar Pradesh has been accomplished wherein seventy one algal forms are enumerated. The memebers of Chlorophyceae dominate the assemblage. The other forms albeit in low vlaues belong to Cyanophyceae, Bacillariphyceae, Euglenophyceae and Rhodophyceae. A distinct seasonal periodicity is observed among the algal population and high frequency of pollution-indicator algae has revealed the disturbed ecology of the lake.

Key-words – Algal flora, Water pollution-indicator, Samaspur, Fresh water lake, Rae Bareli, U.P.

INTRODUCTION

SAMASPUR lake (Lat. 26°2′ N, Long. 81°28′E) is situated in Salon Development Block in District Rae Bareli. It lies about 300 m above sea level, covering an area of about 13 sq. Kms and represents lentic environment of perennial nature.

The lake abounds both in organic and inorganic compounds in dissolved as well as in suspended state. This includes dissolved gases (H_2S, NH_3 and N_2); salts (Ca, Mg, Na); minerals (clay, silt and sand); microbes, etc. Interrelationship among the different physico-chemical and biological factors have been investigated by many workers (Moor, 1979; Walker & Donnel, 1981; Walting *et al.*, 1979). In the recent past, the urban development in the vicinity of Samaspur lake has resulted a considerable increase of liquid/solid waste and garbage disposal in the lake water. Due to accumulation of sewage and other wastes in the lake, the recycling capacity has been depleted and lake's self-regulatory system under natural conditions has been almost lost. This has altogether changed the balance in chemical, physical and biological ratios leading to 'Water-pollution'.

Algal organisms being mostly ephemerals, respond quickly to even subtle environmental changes, and hence are good indicators of the quality of water in which they are found.

Although there are several reports on the distribution of algae in India including water-pollution indicating forms (Venkateswarlu, 1969, 1981; Kant & Kachroo, 1977; Kamat, 1981; Sarkar, Krishnamoorthi & Chaudhuri, 1986; Shukla & Anjum, 1991), yet several pockets still remain unexplored. Thus, the present study has been undertaken on such lakes to investigate the algal taxa with a view to evaluate the importance of algal population for monitoring the water quality.

MATERIAL AND METHOD

Algal materials were collected from five different sites (I=Hawkganj, II=Rohaniya, III=Gudwa-Hasanpur, IV=Mamni, V=Samaspur proper) with the help of a net, i.e. 22 no. bolting- silk, for two consecutive years (November, 1990 to April, 1992) at an interval of two months each. Samples were stored and preserved in one litre capacity bottles using 4 per cent formalin. Different algal taxa were counted and identified through standard methods/texts (Fritsch, 1952; Palmer, 1969; Edmondson, 1974).

RESULTS

A total of 71 algal forms belonging to Chlorophyceae (28), Bacillariophyceae (21), Cyanophyceae (18), Euglenophyceae (3) and Rhodophyceae (1) were

recorded (Plates 1 & 2). Species composition with their frequency and occurrence is given in Table 1.

Table 1. Algal Composition of Samaspur Lake as Observed from November 1990 to April, 1992.

Depending upon the relative abundance, all the species are grouped in three frequency classes: A = Abundant; C = Common; R = Rare.

Occurrence Site : I = Hawkganj; II = Rohaniya; III == Gudwa-Hasanpur; IV = Mamni; V = Samaspur proper

Sl No.	Name of Algae	Frequency Class	Occurrence Site
	CHLOROPHYCEAE		
1.	*Actinastrum* sp.	A	I, III, IV, V
2.	*Ankistrodesmum falcatus*	A	I, III, IV, V
3.	*Bulbochaete various*	R	III
4.	*Chara zeylanica*	R	III, V
5.	*Cladophora glomerata*	C	II, III, IV
6.	*Coleochaete* sp.	R	I, II
7.	*Cosmarium* sp.	C	III, IV, V
8.	*Cosmarium circulare*	A	II, III, IV, V
9.	*Eudorina* sp.	R	II, III
10.	*Hydrodictyon reticulatum*	R	I, III
11.	*Micrasterias* sp.	R	II,
12.	*Mougeotia* sp.	C	III, IV, V
13.	*Nitella* sp.	R	II, III
14.	*Oedogonium gracillimum*	R	II, IIII,
15.	*Oedogonium* sp.	R	III
16.	*Pediastrum simplex*	R	III, IV
17.	*Pediastrum* sp.	R	III, V
18.	*Pithophora* sp.	R	III
19.	*Pleodorina* sp.	R	IV
20.	*Rhizoclonium* sp.	R	IV, V
21.	*Scenedesmus quadricauda*	A	II, III, IV, V
22.	*Spirogyra* sp.	C	II, III; IV
23.	*Stigeoclonium tenue*	A	II, III, IV, V
24.	*Tetraspora* sp.	R	III
25.	*Ulothrix zonata*	C	I, II, IV
26.	*Volvox* sp.	C	II, IV, V
27.	*Zygnema tenue*	R	I, III
28.	*Zygnema* sp.	R	III
	CYANOPHYCEAE		
29.	*Anabaena* sp.	A	I, II, IV, V
30.	*Aphanothece* sp.	R	IV
31.	*Calothrix clavata*	C	I, II, IV
32.	*Chamaesiphon sideriphilus* var. *glabra.*	R	II, III
33.	*Chroococcus* sp.	C	I, II, IV
34.	*Gloeocapsa stegophila*	R	II
35.	*Gloeotrichia* sp.	C	I, III, IV
36.	*Lyngbya* sp.	A	I, II, III, IV, V
37.	*L. limnetica*	C	II, IV, V
38,.	*Merismopedia* sp.	C	I, III, V
39.	*Microchaete* sp.	C	II, III, IV
40.	*Microcystis* sp.	A	I, II, III, IV, V
41.	*Nostoc muscorum*	C	II, III, V
42	*N. carneum*	C	III, IV
43.	*Oscillatoria* sp.	A	I, II, III, V
44.	*Phormidium foveolarum*	R	III, V
45.·	*Spirulina major*	R	V
46.	*Staurastrum* sp.	R	IV
	BACILLARIOPHYCEAE		
47.	*Asterionella* sp.	A	I, II, III, IV
48.	*Caloneis* sp.	R	II
49.	*Cocconeis placentula*	R	III, IV

Plate 1

1. *Nitzschia obtusa*, x 1000.
2. *Oscillatoria* sp., x 1000.
3. *Ulothrix* sp., x 800.
4. *Rhizoclonium* sp., x 500.
5. *Spiroqyra* sp. - scalariform conjugation, x 300.
6. *Pithophora* sp. with akinete, x 300.
7. *Compsopogon* sp. showing branching, x 300.
8-9. *Cosmarium* sps. isthmus, x 1000.
10. *Actinastrum* sp. x 1000.
11. *Microcystis* sp. colony, x 1000.
12. *Calothrix* sp. with heterocyst, x 1000.
13. *Mougeotia* sp. zygote, x 500.
14. *Coleochaete scutata* complete thallus, x 500.

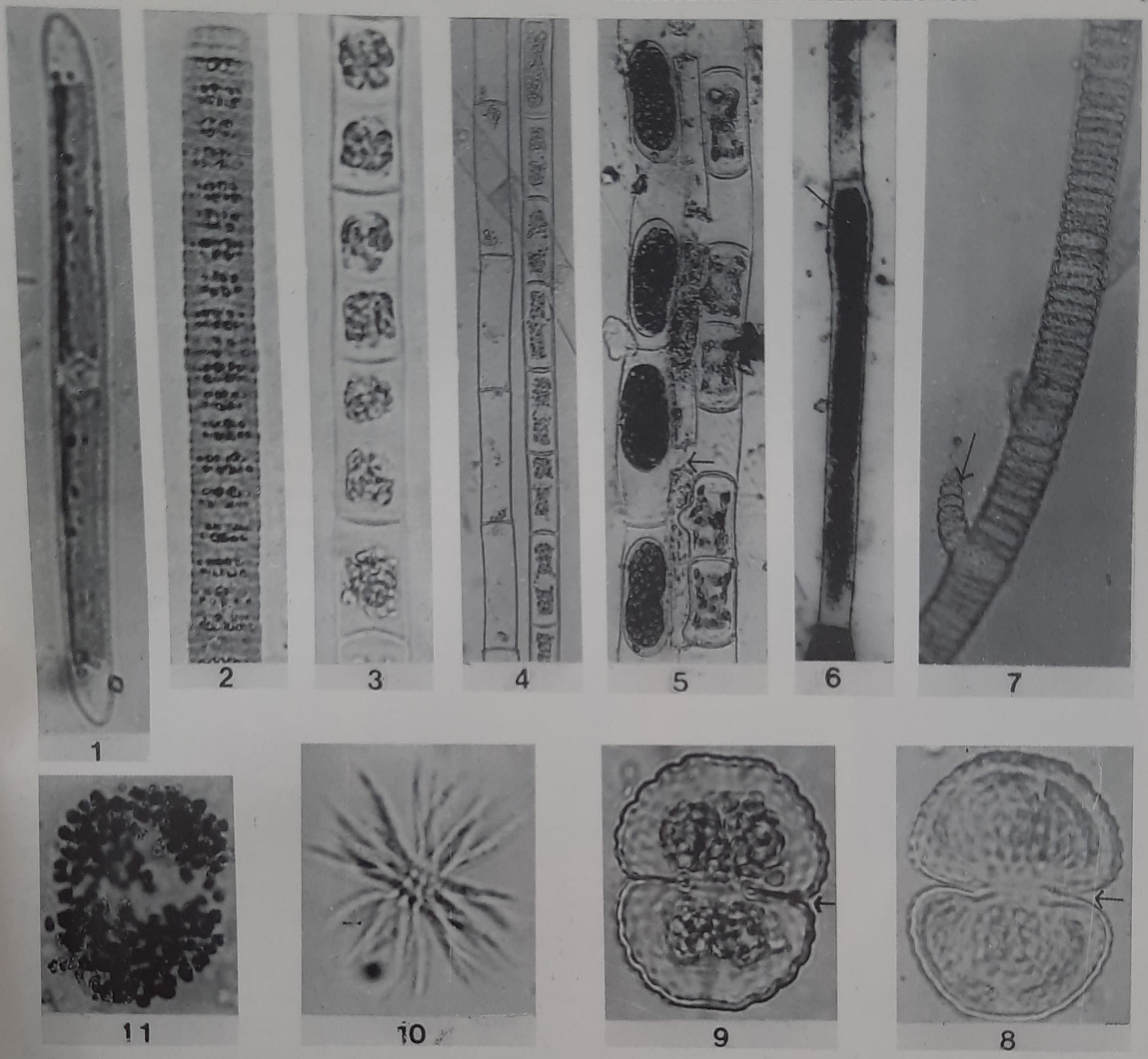

Plate 1

Sl No.	Name of Algae	Frequency Class	Occurrence Site
50.	*Cyclotella operculata*	R	II, III
51.	*Cymbella cuspidata*	R	III
52.	*Diatoma* sp.	R	II
53.	*Epithemia gibberula*	R	III, IV
54.	*Eunotia* sp.	R	IV
55.	*Fragilaria* sp.	A	I, II, III, IV
56.	*Gomphonema olivaceum*	R	II,
57.	*Grammatophora* sp.	R	II
58.	*Gyrosigma* sp.	R	III, V
59.	*Melosira granulata*	A	II, III, IV, V
60.	*Navicula crytocephala*	A	I, II, IV, V
61.	*N. anglica*	C	II, IV, V
62.	*N. capitata*	A	IV
63.	*Nitzschia acicularis*	R	III, V
64.	*N. palea*	R	I, III, IV
65.	*N. obtusa*	A	I, II, III, IV, V
66.	*Pinnularia* sp.	A	I, II, III, V
67.	*Synedra ulna*	A	I, II, IV, V
RHODOPHYCEAE			
68.	*Compsopogon* sp.	R	III
EUGLENOPHYCEAE			
69.	*Cystodinum* sp.	R	I
70.	*Euglena* sp.	C	II, III, IV
71.	*Phacus* sp.	C	I, III, IV

The dominance of Chlorophycean members was observed with highest population density (81.2 per cent) in November, 90 and lowest in August, 91 (25.6 per cent), out of total algal assemblage. Cyanophyceae members were recorded highest (58.3 per cent) in August, 91 and minimum (8.2 per cent) in December, 91. Bacillariophyceae population had maximum density (40.1 per cent) in June, 91 and minimum (8.1 per cent) in November, 90. Rhodophyceae and Euglenophyceae did not show the evident seasonal periodicity.

During the course of investigation 'water-blooms' are observed in the warm and calm weather of late summer. Bloom representing forms chiefly include *Microcystis, Anabaena, Oscillatoria, Lyngbya* and *Phormidium*. These blooms impair water quality by giving it a bad taste and odour. Dense population of the blooms reduce penetration of sun light to the lake bottom reducing the photic zone. As a result, the deep waters contain less amount of dissolved oxygen, which is further reduced by decomposition of phytoplankton at the lake-bottom leading to a low fertility zone.

Thick mats of filamentous Chlorophyceae members (*Spirogyra, Oedogonium, Zygnema* and *Cladophora*) covered the large areas of lake water. Besides, certain Cyanophyceae taxa (*Gloeotrichia* and *Calothrix*) also form extensive floating masses. These invisible growths serve as breeding places for gnats and midge flies.

The high percentage of tolerant phytoplankton population in organically enriched waters is a reliable indicator of water pollution. A number of species recorded during this study are indicators of pollution in the lake, viz., *Actinastrum, Ankistrodesmus falcatus, Cosmarium, Scenedesmus quadricauda, Stigeoclonium tenue, Anabaena, Lyngbya, Microcystis, Oscillatoria, Asterionella, Fragilaria, Melosira granulata, Navicula crytocephala, Nitzschia palea, Pinnularia, Synedra ulna*, etc.

DISCUSSION AND CONCLUSION

The study reveals that the algal forms of Samaspur lake is very complex. Among different groups, the maximum number of chlorophycean forms was recorded during winter and minimum in post monsoon season. The optimal conditions for growth and reproduction of Chlorophyceae has also been recorded during February in Jammu and Kashmir (Kant & Kachroo, 1977). During the present investigation *Actinastrum, Ankistrodesmus, Cosmarium, Mougeotia, Ulothrix, Stigeoclonium* and *Volvox* were found in high frequencies. Out of the above records, presence of *Actinastrum, Ankistrodesmus, Cosmarium, Scenedesmus* and *Stigeoclonium* clearly indicate high organic pollution in the water body (Palmer, 1969; Venkateswarlu, 1969; Taylor *et al.*, 1981).

In contrast to green algae, Cyanohyceae exhibited maximum density during post monsoon season and minimum in the winter. *Microcystis* dominated over rest of the taxa of Cyanophyceae. Nevertheless, large population of *Anabaena, Lyngbya* and *Oscillatoria*, as recorded in the present study, clearly indicate their ability to tolerate high level of pollution and eutrophication (Palmer, 1957; Brook, 1965; Taylor *et al.*, 1981).

The maximum population of Bacillariophyceae was recorded during the pre-monsoon season and minimum in early winters. *Asterionella, Fragilaria, Melosira, Navicula, Nitzschia, Pinnularia* and *Synedra* were common at all study sites and are indicator of water-pollution (Kamat, 1981).

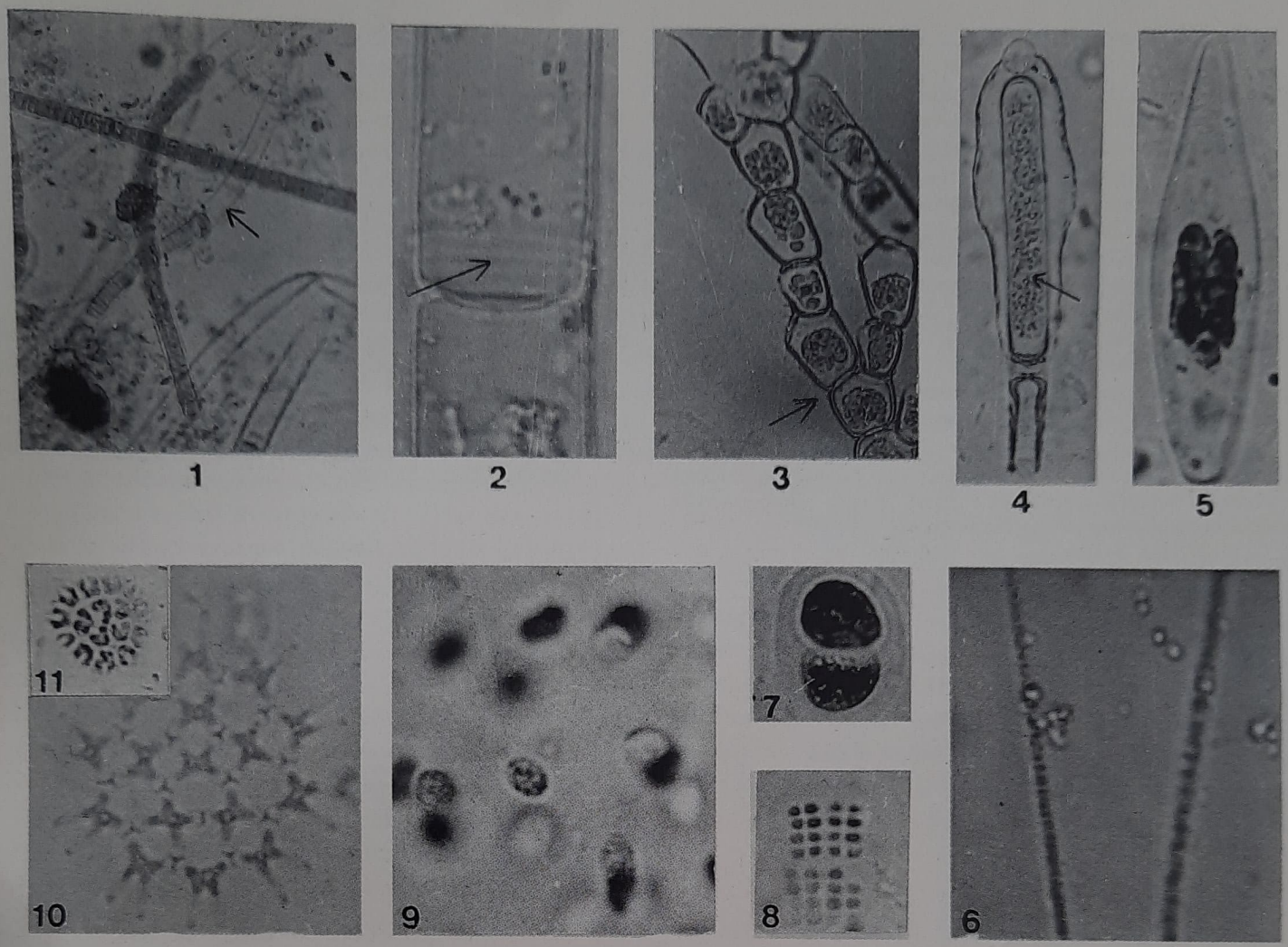

Plate 2

1. *Lyngbya* sp. with projecting mucilagenous sheath, 500.
2. *Oedogonium* sp. with cap cells, x 1000.
3. *Bulbochaete* sp. showing branching, x 300.
4. *Gloeotrichia* sp. with akinete, x 300.
5. *Gomphonema* sp., x, 1000.
6. *Phormidium* sp., x 300.
7. *Chroococcus* sp., x 1000.
8. *Merismopedia* sp. colony, x 500.
9. *Aphanothece* sp., x 500.
10. *Pediastrum* sp., x 500
11. *P. tetras*, x 300.

The foregoing account in the algal distribution in the Samaspur lake envisages that besides other controlling factors, pollution input has exercised considerable influence over the occurrence and distribution pattern of different algal species in Samaspur lake. In other words algae are of paramount importance and potent enough to reveal the extent of water pollution. Furthermore, the regular monitoring of algal components in relation to their seasonality and frequency, shall provide better understanding to evaluate the nature and degree of water-pollution in an aquatic milieu.

ACKNOWLEDGEMENTS

We sincerely acknowledge our thanks to the Ministry of Environment, Forest and Wild Life, New Delhi for financial assistance. We also record our thanks to the Chief Warden, Wild Life, U.P. Forest Department for his permission to carry out the investigations in the protected Samaspur Bird Sanctuary, Salon, District Rae Bareli.

REFERENCES

Brooke, A.J. 1965. Planktonic algae as indicators of lake types, with special reference to Desmidiaceae. *Limnology and Oceanography* **10**:401-411.

Edmondson, W.T. 1974. A simplified method for counting phytoplankton. *In* : Richard, E.V. (Ed.)-*A manual on methods for measuring primary production in aquatic environment* : 14-16. Black Well Science Publication, Oxford.

Fritsch, F.E. 1952. *The Structure and Reproduction of the Algae*. University Press, Cambridge.

Kamat, M.D. 1981. Diatoms and diatom populations indicating water quality and pollution. *WHO workshop on biological indicators and*

indices of environmental pollution, Central Board of Prevention and Control of Water Pollution, Osmania University, Hyderabad:

Kant, S.& Kachroo, P. 1977. Limnological studies in Kashmir lake, I. Hydrobiological features, composition and periodicity of phytoplankton in the Dal and Nagin lakes. *Phykos* **15** (1-2): 77-97.

Moor, J.W., 1979. Factors influencing the diversity, species composition and abundance of phytoplankton in twenty one arctic and subarctic lakes. *Int. Rev.Gesantem. Hydrobiologia* **64**:485-499.

Palmer, C.M. 1957. Algae as biological indicators of pollution. *Proceedings of the Seminar on Biological Problems in Water Pollution, 1956, U.S. Deptt. of Health Education and Welfare*: 60-69

Palmer, C.M. 1969. Algal records for three Indian Sewage stabilization ponds. *Proc. Ind. Acad. Sci.* **78**: 139- 145.

Sarkar, R., Krishnamoorthi, K.P. & Chadhuri, P.R. 1986. Ecological responses of fresh water periphyton community for water quality evaluation. *IAWPC Technical Annual*(13): 110- 119.

Shukla, A.C. & Anjum 1991. Biological aspects of Ganga river ecosystem. *In:* Gopal, B. & Asthana, V. (eds.)- *Aquatic Sciences in India. Indian Assoc. for Limnology Oceanography* : 93-109.

Taylor, W.D., Williams, L.R. & Horn, S.L. 1981. Phytoplankton water quality relationships in U.S. lakes, Part VIII. Algae associated with or responsible for water quality problems. *Research and Development EPA-600/53*: 80-100.

Venkateswarlu, V. 1969. An ecological study of the algae of the river Moosi, Hyderabad (India) with special reference to water pollution. I. Physico-chemical complexes. *Hydrobiologia* **33**(1):117-143.

Venkateswarlu, V. 1981. Algae as indicators, river water quality and pollution. *WHO Workshop on biological indicators and indices of environmental pollution, Central Board for Prevention and Control of Water Pollution, Osmania University, Hyderabad* : 93-100.

Walker, T.A. & Donnel, G.C. 1981. Observation on nitrate, phosphate and silicate in Cleveland Bay. *Aust. J. Mar. Fresh Water Res.* **33**:877-887.

Watling, L., Follom, D., Perbroke, A. & Maurer, D. 1979. Seasonal variation in Delaware Bay phytoplankton community structure. *Mar. Biol.* **52** (3) : 207-215.