SYSTEMATIC DESCRIPTION, DISTRIBUTION AND ECOLOGY OF CERTAIN BENTHIC LENTIC DIATOMS

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Abstract

Systematic description, distribution and ecology of 13 taxa of diatoms, belonging to eight genera, collected from four different ponds within the district Lucknow, during the course of an annual cycle has been given. Mean monthly values of 13 different physico-chemical parameters chosen for water analyses have also been provided. Most of the taxa were found to be alkaliphilous, indifferent, alkalibiontic and halobion indifferent in nature.

Introduction

From the earliest years of the study of algal ecology, the phytoplanktonic community has received the maximum attention. The benthic flora on the other hand has received comparatively little attention. Round (1964) while emphasizing the importance of benthic communities, stated that it is in this habitat that over 9/10th of all algal species grow. The benthic community can be defined as the assemblage of organisms living on the bottom of fresh-water or brackish ponds, lakes, rivers and sea-bed and the term is extended to include the epipelic, epilithic and epiphytic algae.

Patrick (1949) emphasized on the importance of the structure of aquatic community in monitoring water quality, suggesting that the total percentage of population, composed of dominant species rather than the population size of any given species, is a valuable criterion for judging the effect of pollution.

Round (1965) elaborates that diatoms are the dominant group of organisms in many natural habitats and as such are subtle indicators of environmental conditions. All that is needed for an indication of pollution is the number of species in the habitat, for, in all unbalanced systems, a single species or a few species remain and grow abundantly.

Fjerdingstad (1960) further states".. diatoms seem on the whole to be much more sensitive to poisons than the Cyanophyceae but he supported the use of diversity of diatoms as the best indicator of water quality.

Prasad and Singh (1982) concluded that benthic diatom Species Diversity Indices can not be used as a means to detect and evaluate pollution in a tropical river system like Gomati. Their study, however, lends support to the use of individual diatoms as indicators of water qualtiy.

The present investigation constitutes a part of the study carried out to assess the influence of effluents on the periodicity of diatoms and whether their distribution pattern could be used in monitoring water quality.

Material and methods

Four ponds, all varying in their degree of pollution were selected for the present study. Pond I was virtually free of any contamination. Pond II and III were observed to be highly polluted, whereas Pond IV was found to be only moderately polluted. Samples of water from these ponds were collected and analysed for 13 different physico-chemical parameters according to the standards methods (APHA-1962 and IS : 3025-1964) at an interval of approximately 30 days.

Algal samples were also collected at the same interval from all the four ponds, according to the field technique of Rao (1953). A preliminary survey of the algal flora revealed the predominance of diatoms over other groups of algae. For the estimation of the number of species of diatoms present and their periodicity, homogenised representative samples of each pond were used. Sulphuric acid-potassium dichromate method of Patrick and Reimer (1966) was used for the cleaning of frustules and counting of diatom frustules was done on these permanent mounts. Six vertical and horizontal transects of 10-12 fields each were counted within each slide. The physico-chemical characteristics of the habitats have been described elsewhere (Prasad *et al.*, 1985) but mean monthly values of the physico-chemical parameters at all the four ponds are given in Table 1. The present paper deals with the Systematic Description, distribution and ecology (pH status, Halobion status, Saprobien status and temperature status etc.) of thirteen species of diatoms which were found important in terms of their numbers during the course of investigation, which extended from November, 1979 to October, 1980.

Table 1—Mean monthly values of physico-chemical parameters at ponds I-IV

S. No.	Parameters	Pond-I	Pond-II	Pond-III	Pond-IV
1.	Water temperature	24.60	25.57	25.31	25.41
2.	pH	8.15	8.16	7.97	7.91
3.	Carbonate	34.38	12.66	0.00	0.90
4.	Total alkalinity	183.46	462.33	505.33	174.56
5.	Bicarbonate	175.81	510.90	552.41	195.58
6.	Chloride	93.23	119.50	147.83	43.45
7.	Total hardness	126.40	301.75	462.50	118.60
8.	Calcium	19.78	57.69	70.18	25.81
9.	Magnesium	21.19	43.26	61.65	17.45
10.	Free & Saline ammonia	3.00	4.52	4.22	1.75
11.	Albuminoid ammonia	3.24	2.87	4.16	1.98
12.	Nitrate nitrogen	2.16	4.69	3.54	3.09
13.	Dissolved oxygen	9.60	2.73	3.10	4.50

All values except water temperature (°C) and pH are in mg/1.

Systematic description, distribution and ecology

The genera are arranged after Hendey (1964) while taxa under each genus have been described alphabetically.

1. *Synedra ulna* (Nitz.) Ehr. (Fig. 1)
Gandhi, H. P. 1964, p. 355, figs. 18-22

Valves linear with slight tapering at the poles. Ends rounded. Pseudoraphe linear, narrow; central area well formed, rectangular, reaching the margins. Striae coarse, 10-11 in 10 μm. Length 141-160 μm and breadth, 6.2-6.5 μm.

Habitat—Metaphytic; epipelic
Distribution—Pond II (My, Ju, O); Pond III (F, S); Pond IV (N, D, M, O)

Lowe (1974) places it in alkaliphilous, indifferent, oligosaprobic-β-mesosaprobic category, but the presence of this taxon at Ponds II and III indicates its slight preference for contaminated waters.

2. *Achnanthes hungarica* (Grun.) var. *hungarica* (Figs. 8-9) Patrick, R. and Reimer, C. W. 1966, p.259, pl. 16, figs. 27-28

Valves linear-lanceolate with obtuse apices. Valve with raphe has linear axial area. Rapheless valve with linear pseudoraphe and weak central area. Striae slightly radial, 21-22 in 10 μm. Length, 16-17 μm. Breadth, 6-6.5 μm.

Habitat—Metaphytic
Distribution—Pond II (M, Au, O); Pond III (S); Pond IV (N, J)

Lowe (1974) assigns it alkaliphilous, indifferent, β-mesosaprobic category. More frequent occurrence of this species at Ponds II and III than Pond IV reflects its preference.

3. *Navicula bacillum* Ehr. var. *bacillum* (Fig. 7)
Patrick, R. and Reimer, C. W. 1966, p. 494, pl. 47, figs. 4-5

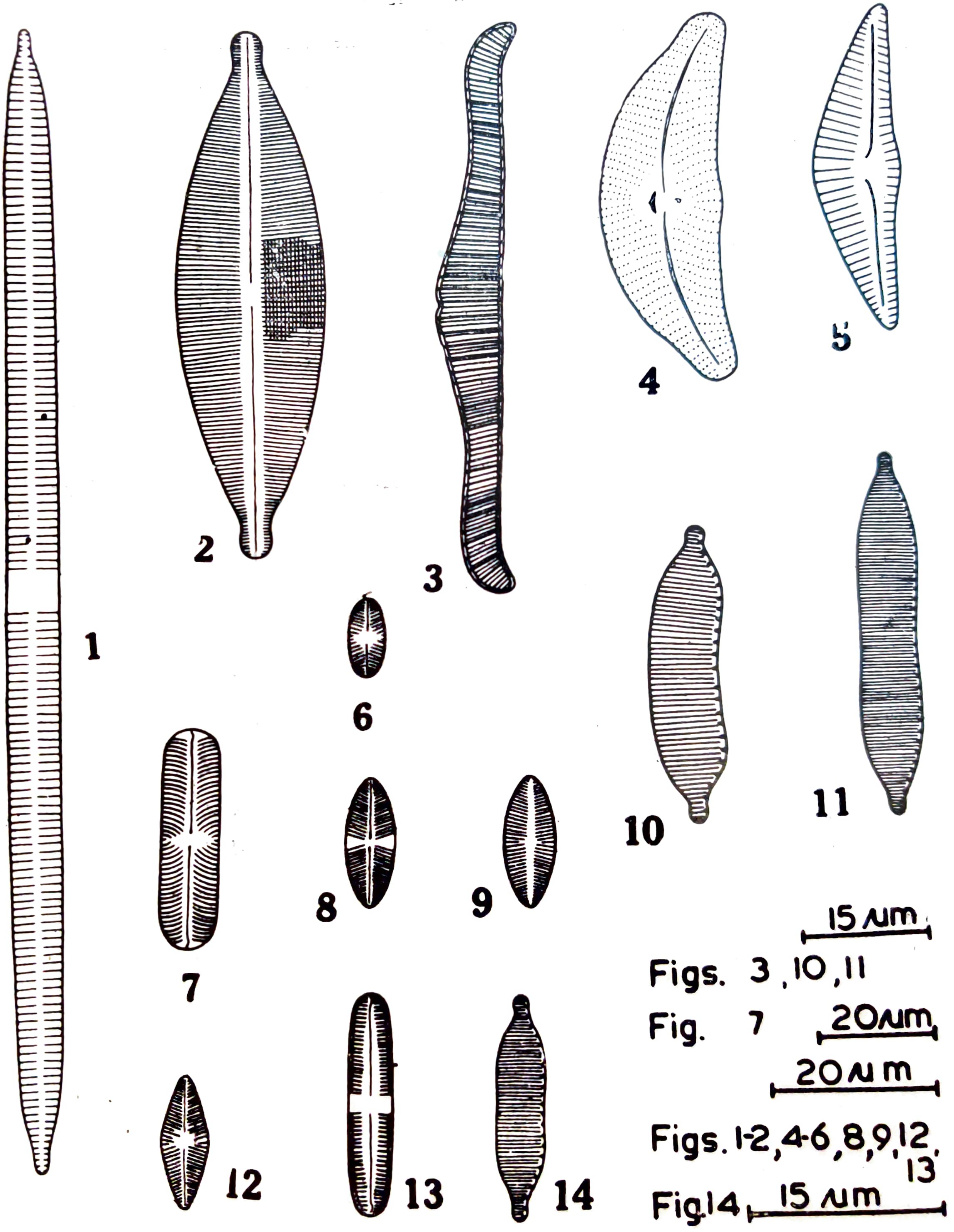
Valves linear with rounded ends. Raphe thin, straight with conspicuous central pores and curved terminal fissures. Axial area narrow; central area distinct, elliptical in outline. Striae radial, somewhat curved throughout the valve, 16-18 in 10 μm. Length 33-35 μm. Breadth 9.5-10 μm.

Habitat—Periphytic.
Distribution—Pond III (Au, O).

According to Lowe (1974) this taxon belongs to alkaliphilous-indifferent, saproxenous category, but its presence, though, only twice in Pond III indicates its ability to withstand polluted waters.

Abbreviation used:

J	—	January	My	—	May	S	—	September
F	—	February	Ju	—	June	O	—	October
M	—	March	Jy	—	July	N	—	November
A	—	April	Au	—	August	D	—	December



Text-figs. 1-14.—1. *Synedra ulna*, 2. *Navicula cuspidata* var. *ambigua*, 3. *Rhopalodia gibba*, 4. *Cymbella tumida*, 5. *Cymbella turgida*, 6. *Navicula minima* var. *minima*, 7. *Navicula bacillum* var. *bacillum*, 8-9. *Achnanathes hungarcia* var. *hungarica*, 10. *Hantzschia amphioxys*, 11. *Nitzschia stagnorum*, 12. *Navicula cocconeiformis*, 13. *Caloneis bacillum*, 14. *Nitzschia microcephala*.

4. *Navicula cocconeiformis* Greg. (Fig. 12)
Gandhi, H. P. 1958b, p. 256, fig. 10

Valves rhombic-lanceolate with obtuse, rounded ends. Striae radial, punctate, alternate short and long in the middle, 25-28 in 10 μm. Length 14-16 μm. Breadth 6-6.2 μm.

Habitat—Epipelic.
Distribution—Pond IV (A, S, O).

Gandhi (1962b) places it in halophobus, indifferent category. This taxon was recorded from Pond IV only, suggesting that it can withstand in mildly polluted waters.

5. *Navicula cuspidata* Kuetz. var. *ambigua* (Ehr.) Cl. (Fig. 2)
Gandhi, H. P. 1858a, p. 496, fig. 37; Patrick, R. and Reimer, C. W. 1966, p. 464, pl. 43, figs. 9-10.

Valves lanceolate with constricted, produced, capitate ends. Raphe thin and straight with conspicuous central pores. Axial area narrow, linear; central area not differentiated. Striae transverse, 17-18 in 10 μm, longitudinal striae very fine, virtually indistinct, 22-24 in 10 μm. Length 67-72 μm. Breadth 19-20 μm.

Patrick and Reimer (1966) have merged the taxon *Navicula cuspidata* Kuetz. var. *ambigua* into *Navicula cuspidata* (Kuetz.) Kuetz. var. *cuspidata*.

Habitat—Metaphytic.
Distribution—Pond III (A, Ju).

Lowe (1974) categorises it in alkaliphilous, indifferent, β-mesosaprobic category. The presence of this diatom in Pond III only which is highly polluted, indicates that this species can thrive in highly polluted waters.

6. *Navicula minima* Grun. var. *minima* (Fig. 6)
Patrick, R. and Reimer, C. W. 1966, p. 468, pl. 46, figs. 17-18

Valves linear-elliptical with rounded ends. Central area formed by almost equal shortening of the central striae. Striae radial except in the centre where they are parallel, 22-24 in 10 μm. Length 11-13 μm. Breadth 4.5-5.0 μm.

Habitat—Metaphytic.
Distribution—Pond II (S).

This taxon was isolated only once in Pond II, therefore, it is difficult to ascertain its affinities. Lowe (1974) places it in alkaliphilous, indifferent, oligosaprobic category.

7. *Caloneis bacillum* (Grun.) Meresch. (Fig. 13)
Gandhi, H. P. 1964, p. 358, fig. 35

Valves linear with almost parallel sides and rounded ends. Raphe thin and straight, central pores somewhat approximate, terminal fissures weakly curved. Axial area linear-lanceolate; central area rectangular reaching the sides. Striae distinct, radial, 22-24 in 10 μm. Length 25-27 μm. Breadth 5,4-6,0 μm.

Habitat—Metaphytic.
Distribution—Pond IV (F, S).

This species was recorded in February and September from Pond IV which is mildly polluted pond, suggesting that it can grow in mildly polluted waters. Lowe (1974), however, places it in alkaliphilous, indifferent, saproxenous category.

8. *Cymbella tumida* (Breb.) V. H. (Fig. 4)
Gandhi, H. P. 1964, p. 370, figs. 66-67

Valves ventricose, highly convex dorsal side, ventral margins concave, inflated in the middle with produced, rostrate, truncate apices. Raphe arcuate, surrounded by a broad hyaline zone, very considerably inflated round the central nodule, dilated portion showing isolated stigma. Striae punctate, radial in the middle, convergent at the ends, 9-10 in 10 μm. Length 48-50 μm. Breadth 15-16 μm.

Habitat—Epipelic.
Distribution—Pond III (F, O); Pond IV (Ju).

The present specimen is slightly smaller in dimensions than the type.

This diatom was observed in Pond III which is higly polluted as well as in Pond IV which is mildly polluted, indicating thereby its rather indifferent nature. Lowe (1974) places it in alkaliphilous-alkalibiontic, indifferent-halophobous, oligosaprobic-saproxenous category.

9. *Cymbella turgida* (Greg.) Cl. (Fig. 5)
Venkataraman, G. 1939, p. 343, fig. 125

Valves lunate with highly convex dorsal side, ventral margins gibbous with acute ends. Raphe straight, terminal ends not clear. Axial area somewhat broad. Striae radial on the dorsal side and in middle, slightly convergent at the ends on the ventral side, 10-11 in 10 μm. Length 40-42 μm. Breadth 10-11 μm.

Habitat—Metaphytic.
Distribution—Pond II (Au, O); Pond III (A, Ju); Pond IV (F, S).

Lowe (1974) places it in alkaliphilous, indifferent, oligosaprobic category. The presence of this species in Ponds II and III which are higly polluted as well as in Pond IV, the one which is rather mildly polluted suggests that this taxon is possibly indifferent to pollution.

10. *Rhopalodia gibba* (Ehr.) O. Mueller (Fig. 3)
Gandhi, H. P. 1958a, p.503, fig. 47

Valves with a little bulged dorsal side, ventral side straight with a little depression at the ends which are acutely rounded. Costae strongly radial towards the ends, 7-8 in 10 μm, alternates with 2-3 rows of alveoli, rows of alveoli 11-12 in 10 μm.

Habitat—Epiphytic.
Distribution—Pond II (M, My); Pond III (Ju, S, O); Pond IV (D, My).

Lowe (1974) places it in alkaliphilous-alkalibiontic, indifferent, α-mesosaprobic-oligosaprobic category. This taxon was observed more frequently in polluted (Pond II & III) water, indicating thereby its ability to withstand stress conditions.

11. *Nitzschia microcephala* Grun. (Fig. 14)
Gandhi, H. P. 1962a, p.486, fig. 46

Valves linear, slightly concave in the middle withnarrowed, constricted, capitate, produced ends. Keel punctae small, rounded, evenly placed, 13-14 in 10 μm. Striae fine, 35-37 in 10 μm. Length 17.5-19.0 μm. Breadth 4-4.2 μm.

The present specimen is slightly small in length than the one described by Gandhi (1962a).

Habitat—Epipelic.
Distribution—Pond III (S, O); Pond IV (My).

The occurrence of this taxon in Pond III and IV points towards its preferences. Lowe (1974) places it in alkaliphilous, halophilous, indifferent, eurythermal category.

12. *Nitzschia stagnorum* Rabh. (Fig. 11)
Gandhi, H. P. 1962a, p. 477, fig. 33

Valves linear, side walls concave with narrowly cuneate, constricted, acutely produced, rounded ends. Keel excentric, keel punctae small, two of the middle punctae distantly placed, 9-10 in 10 μm, striae fine, 25-27 in 10 μm. Length 44-48 μm. Breadth 7-7.2 (in the middle portion), 8.0 μm at the broadest.

Habitat—Metaphytic.
Distrbution—Pond II (Au, O); Pond III (J, M) Pond IV (My, Jy).

Lowe (1974) places it in indifferent-alkaliphilous, indifferent, β-mesosaprobic category. The distribution of this diatom indicates its preference for polluted water.

M. K. Job no. 310, page no. 111 to 115.

13. *Hantzschia amphioxys* (Ehr.) Grun. (Fig. 10)
Gandhi, H. P. 1962a, p. 472, figs. 18, 22

Valves linear, slightly arcuate, dorsal side convex, ventral side concave with depression in the middle, ends constricted, produced and weakly capitate, Keel very excentric. Keel punctae 7 in 10 μm, two of the middle ones, wide. Striae distinct, 17-18 in 10 μm. Length 34-40 μm. Breadth 8-9 μm.

Habitat —Metaphytic.
Distribution—Pond II (D, M, Au); Pond III (My); Pond IV IV (A).

This taxon was most frequently observed in Pond II than Pond III or Pond IV. This suggests that the species can thrive in polluted water. Lowe (1974), however, has placed it in alkaliphilous, indifferent, mesosaprobic, eurythermal-oligothermal category.

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