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THE ECOLOGY OF DIATOMS IN HARDWATER HABITATS

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THE ECOLOGY OF DIATOMS IN HARDWATER HABITATS

by

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for the

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ABSTRACT

Most of the surface waters of Iowa fall into hardwater categories and the information in this report is excerpted from numerous detailed studies of diatoms in these waters supported by the project during a ten year period beginning in 1960. Additionally, papers concerning diatoms in Iowa written during the past twenty years under various other sponsorships were examined for records of diatom taxa. To date more than 900 diatom taxa have been recorded from Iowa and it is anticipated this number will rise to over 1000 shortly. These are distributed among 50 genera.

From this number 328 taxa were selected as being the more common diatoms of Iowa. The collection sites were grouped under the headings - Lakes, - Cores of lake sediments, - Rivers, creeks and ditches, - Ponds, marshes and bogs, - Soils, and - Special habitats. The distribution among these is given for each of the more common diatoms.

A detailed pollen analysis of a core of postglacial sediments from Lake West Okoboji, Iowa was undertaken in aid of determining chronology of the region. Diatoms from the same core were analyzed in detail for comparison purposes. Sediment age at the apparent postglacial interface is 12,700 BP$\pm$ 200 years.

This report was submitted in fulfillment of Project Number WP00221 under the sponsorship of the Environmental Protection Agency and its predecessors. The project number was changed in the terminal year to 18050DIE.

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TABLES

SECTION I

CONCLUSIONS

1. The present number of reported diatom taxa in Iowa is more than 900 and this number will shortly rise to more than 1000.

2. Of this number 328 taxa have been selected as the more common diatoms of Iowa.

3. The distribution of taxa in the latter group among various types of habitats is given and suggests that some diatoms may be ubiquitous in Iowa waters, while others appear to have some habitat preferences.

4. The restricted occurrence of some taxa to sediment cores and the absence of some taxa from the deeper cores suggests that significant changes in diatom populations have occurred as the postglacial environment changed. However, a majority of the diatom taxa found in the deeper cores still occur in the present day flora.

5. The large proportion of spruce pollen in the deepest sediment samples and its rapid proportional decrease in samples taken sequentially upwards suggest the deeper samples were approximately at the postglacial interface.

6. The large number of common taxa would seem to give the diatoms, here as elsewhere, a special value in the preparation of diversity indices for certain types of pollution studies.

SECTION II

RECOMMENDATIONS

This program was initiated primarily to fill a large regional void in the knowledge concerning a major group of living organisms, the diatoms. It is clearly evident to those involved in the project that ecological evaluations of diatom populations are almost meaningless unless some degree of taxonomic precision is achievable by the observer.

The acquisition of taxonomic skills by students does not presently appear to be a suitably "mission oriented" task worthy of EPA support. Yet, in certain areas, such as the use of diatoms in pollution evaluation studies, such training is a paramount requirement for success.

It is strongly recommended here that in the search for answers to pressing problems, the continuing need to support training of the "seekers" should not be ignored.

SECTION III

INTRODUCTION

Drift from the Wisconsin glacier covers much of central and northern Iowa. This relatively young material is rich in calcium and magnesium carbonates and water passing through it slowly into lakes and streams tends to become relatively hard. Flood waters and melting snow water running off frozen land surfaces are less affected and may cause a temporary but appreciable lowering of hardness values.

Soils in other parts of Iowa are derived from older glacial drift which has lost much of its original carbonate material and surface waters in such areas tend to have somewhat lower total hardness values. This was noted by Bachmann (1967) in a study of Iowa lakes and also by Ohl (reference 23, Table 2) in a study of farm ponds. In general, however, most of the surface waters in Iowa fall into hardwater categories.

One notable exception from the usual situation in Iowa is a Sphagnum peat bog in Hancock county known as Dead Man's Lake. Median hardness values in this habitat are approximately 30 ppm and the algal flora is quite different from our more usual hardwater habitats. Christensen (reference 31, Table 2) is engaged in a long term study of the diatoms of Dead Man's Lake.

This project was conceived more than ten years ago when it became evident that diatoms had received inadequate attention even though they comprise the major group of algae in Iowa waters. It was evident also that the ecological significance of diatoms could not be fully appreciated without a thorough knowledge of their taxonomy and attention to this basic requirement has been a major part of the total endeavor.

SECTION IV

OBJECTIVES AND ACCOMPLISHMENTS

A brief summary of stated objectives compared with accomplishments is presented in Table 1. The titles of various reports containing lists of diatoms collected in Iowa during the past two decades are assembled in Table 2. These include dissertations, published papers supported by this project, papers published here with support from other projects, papers published elsewhere, manuscripts in preparation, and unpublished special project reports.

Each of these reports was examined and the name of each diatom taxon mentioned was recorded on a separate sheet. If the data permitted at least a rough estimate an abundance rating using the following scale was assigned each record.

- a - dominant or sub-dominant
- c - widely present in collections but not dominant
- r - present with less than a 1% abundance rating; often only a single frustule in a count
- t - indicates presence only with no indication of abundance

Although this rating scale is subjective it is serving the intended use as an aid in identifying the more common diatoms in Iowa. It was anticipated ten years ago that the master list of all diatom taxa encountered in Iowa would eventually exceed 1000 entities. By March of 1971 the number had risen to 904 and work in progress will cause this number to exceed 1000 within another year. From this list approximately one third of the taxa were selected as the more common diatoms of Iowa (Table 5). The selection was based on an occurrence in at least three collections with an "r" or better rating, or occurrence in at least one collection with an "a" rating.

A further summarization of the data is presented in Table 3. The names of fifty genera of diatoms occurring in Iowa are listed and, for each genus, the number of taxa in the master list and the number in the "more common" list are presented. Most of the several hundred taxa excluded from Table V occurred in no more than one or two of our various collections and have low abundance ratings. Their existence is of interest and the master list will be made available eventually. However, it is deemed too cumbersome for the purposes of this report.

Since the papers cited in Table 2 cover a period of almost twenty years, during which the number of major reference works has increased, it seemed necessary to review the nomenclature of each taxon so that the most appropriate name might be used. This interesting but tedious task has been largely responsible for the delay in preparation of this report.

The procedure followed was to examine each reference to a given taxon in several major reference works including Hustedt, F. (1927-1966), Hustedt, F. (1930), Mills, F. W. (1933-1934), Patrick, Ruth and C. W. Reimer (1966), Schmidt, A. et al. (1874- to date), Van Heurck, H. F. (1880-1885) and Van Landingham, S. L. (1967-1969). If this cross reference procedure revealed a satisfactory state of agreement, no further literature searching was undertaken. In most cases where a given taxon was not included in a major reference work it was traced to the original publication source for verification of spellings, authority, etc. None of the very few names which, so far, have proved elusive as to source occur in Table 5. In the few instances where available information is contradictory, no judgements are offered here.

We have had a continuing interest in analyses of diatom populations from postglacial sediments in northern Iowa (Table 1, references 6, 7, 8, 9, 10, 11, 44). In order to relate the observed changes to a general postglacial chronology the estimated age of certain levels in the core was obtained by radiocarbon dating. Additionally a technique was devised which permits study of both pollen and diatoms from the same sample.

A pollen analysis by Miss Ruth M. Webster is presented in Table VI. The samples used in this analysis were portions of those used by Collins (Table 2, reference 6) and extended through 35 ft. of sediment to the postglacial interface, Little Miller's Bay, Lake West Okoboji, Iowa. An analysis and discussion of these data are in manuscript form.

The date, 12,700 $\pm$ 200 B.P., was determined by the radiocarbon dating technique for a sample taken between 34' and 35' in the sediment core of Little Miller's Bay. Since this level had the maximum spruce pollen concentration and, with minor fluctuations, the spruce pollen percentage decreased progressively in samples above this level, it is considered to be the postglacial interface.

In order to obtain more detailed information concerning the postglacial interface zone a one meter core from the depths 9.50 to 10.50 meters was obtained and divided into twenty 5 cm portions (Table II, reference 9). Both pollen and diatoms from these samples were studied in detail. At the 10.50-10.45 m. level no diatoms were encountered in 50 transects made at 1000X although an occasional diatom was seen when several slides were scanned at 430X. In the next sample (10.45-10.40 m.) 18 taxa were encountered in 50 transects at 1000X. Later these same slides were examined completely and 50 taxa were encountered with 19 of them being at the 1% level of abundance. When 50 transects were made for each of the twenty samples it was determined that at least 166 diatom taxa were present, 70 of which were at the 1% abundance level or higher.

Of the 166 taxa encountered in the bottom meter 105, or 63%, are also reported in the modern flora of West Lake Okoboji (Stoermer, Table 2, reference 3).

Some of the more interesting problems to be pursued in the future lie in a consideration of those diatoms which have disappeared from the original flora of the lake and those which have become common only since the middle of the postglacial period.

Table 1.

Objectives and Summarized Accomplishments of

Project WP00221 - Ecology of Diatoms

in Hardwater Habitats

(Reference numbers in the second column are to citations listed in Table 2.)

Objectives	Accomplishments
A. Investigation of modern diatom flora of selected Iowa lakes	Theses by Stoermer (3), Volker (4), Begres (1); papers by Stoermer (40) (41), Volker (42), Hostetter and Stoermer (5)
B. Investigation of diatoms in postglacial sediment cores	Theses by Stoermer (3) and Collins (6); papers by Dodd et al. (44), Dodd and Webster (9), Hungerford (10)
C. Investigation of diatoms in rivers, creeks and ditches	Theses by Drum (12, Shobe (18), Gudmundson (14) and Lowe (16); papers by Fee (13), Hungerford (15), Schmidt and Fee (18) and Drum (34) (35)
D. Investigation of diatoms in farm ponds, other ponds, marshes and bogs	Theses by Ohl (23), Raschke (24), and Begres (1); papers by Ohl (39), Koppen (22), and Christensen (21)
E., F., G. Investigations of diatoms in special habitats and soils.	Theses by Loescher (26); papers by Dodd and Stoermer (28), Shobe, Stoermer and Dodd (29), Stoermer (30), Drum (36), Fee and Drum (37), and Stoermer (41)
H. Comparative studies of pollen with diatoms in core samples	Papers by Dodd and Webster (9) (43) (44) (45)
I. Development of reference collections of diatoms (and, also, pollen)	In progress - at Iowa State University, Department of Botany and Plant Pathology, Room 123 Bessey Hall - (Refer also to Reimer collection of diatoms at Iowa Lakeside Laboratory).
J. Special training in diatom technology for graduate students at the Academy of Natural Science, Philadelphia	Training received by: Eugene F. Stoermer Ryan Drum Randall W. Shobe Lloyd Ohl Gary Collins Rex Lowe Forrest Begres

Table 2.

Titles of Theses, Published Papers, and Unpublished Reports Containing Records of Diatoms Collected in Iowa during the Past Two Decades.

The titles are organized under the following headings and individual titles may occur under more than one heading.

A. Diatoms of Lakes

B. Diatoms of Sediment Cores

C. Diatoms of Rivers, Creeks, and Ditches

D. Diatoms of Ponds, Marshes and Bogs

E. Diatoms of Soils

F. Diatoms of Special Habitats

G. Special Topics and/or Treatments of Taxonomic Entities

The use of the symbol * indicates either complete support or a major contribution to the support from project WP-00221 and is applied to more than half of the citations in this table. Some of the rest are the results of activities associated with but not supported by the project. Several of the papers cited are not connected in any way with this project but the information contained in them has been of inestimable value in the construction of Table 3 and Table 5.

Table 2. - continued

A. Diatoms of Lakes

1. Begres, Forrest M. (1971). Tentative title - Taxonomy and Ecology of Diatoms of Clear Lake and Ventura Marsh, Iowa. Ph.D. Thesis. Iowa State University. (Includes a year long survey of diatoms in Clear Lake).

2. Kutkukn, Joseph H. 1958. The plankton of North Twin Lake, with particular reference to the summer of 1955. Iowa State College Journal of Science 32: 419-450. (Includes a separate listing of diatom species).

*3. Stoermer, Eugene F. 1963. Post-Pleistocene diatoms from Lake West Okoboji, Iowa. Ph.D. Thesis. Iowa State University. (Includes a year long survey of modern diatom populations).

*4. Volker, Roger P. 1963. Diatoms from the plankton of Lake East Okoboji, Iowa. M.S. Thesis. Iowa State University. (Includes a year long survey of planktonic diatoms).

5. Hostetter, H. P. and E. F. Stoermer. 1968. A study of the vertical distribution of periphyton diatoms in Lake West Okoboji, Iowa. (Includes diatoms in transect collections from 15 cm to 5 meters in summer of 1964). Proc. Iowa Acad. Sci. 75: 42-47.

B. Diatoms of Sediment Cores

*6. Collins, Gary B. 1968. Implications of diatom succession in post-glacial sediments from two sites in northern Iowa. Ph.D. Thesis. Iowa State University. (Includes diatoms found in the top half of a 10 meter core extending to the post-glacial interface in Little Miller's Bay, Lake West Okoboji, Iowa).

*7. Collins, Gary B. 1968. (Includes diatoms found in bottom half of the same core.)

*8. Collins, Gary B. 1968. (Includes diatoms found in core samples from postglacial sediments in a large kettle hole near Lake Okoboji, Iowa).

*9. Dodd, John D. and Ruth M. Webster. 1970. The first postglacial millenium in northwest Iowa. (Unpublished manuscript of a paper presented in April 1970 at the annual meeting of the Iowa Academy of Science.)

(Includes diatoms in twenty 5 cm samples from the bottom meter of a core taken in the same locality as Collins (6) above.)

Table 2.- continued

*10. Hungerford, James. (1970). Diatoms from cores in some drained prairie lakes in northwest Iowa. (Manuscript in preparation.)

*11. Stoermer, Eugene F. 1963. (same reference as #3 above.) (Includes diatoms found in a 30 foot core sample from sediment in the deep hole of Lake West Okoboji, Iowa.) This core had a maximum age of approximately 4,000 years and did not extend to the postglacial interface.

C. Diatoms of Rivers, Creeks and Ditches

*12. Drum, Ryan W. 1964. Ecology of diatoms in the Des Moines River. Ph.D. Thesis. Iowa State University. (Includes diatoms collected extensively during several seasons from a wide variety of habitats in the Des Moines River).

*13. Fee, Everett J. 1967. The diatoms in a small Iowa creek. Iowa State Journal of Science 41: 393-411. (Includes diatoms collected during several seasons from Dutch Creek, a small stream in eastern Iowa).

*14. Gudmundson, Barbara. 1969. Phytoplankton fluctuations in the Des Moines River, Iowa. Ph.D. Thesis. Iowa State University. (Represents an intensive examination of phytoplankton in an area of the future Saylorville Dam impoundment and includes planktonic diatoms).

15. Hungerford, James. 1970. (Manuscript in preparation). (A list of diatoms from seven rivers in Iowa collected in the summer of 1970 by means of a plankton net.

*16. Lowe, Rex L. 1970. Taxonomic and ecological analyses of diatom communities in drainage ditches. Ph.D. Thesis. Iowa State University. (Includes diatoms found in drainage ditches in central Iowa).

*17. Schmidt, Donald J. and Everett Fee. 1967. Planktonic diatoms from the Coralville Reservoir. Proc. Iowa Acad. Sci. 74: 17-19. (Includes planktonic diatoms occurring in collections made from this reservoir in the Iowa River during a 16 month period 1965-1966.)

*18. Shobe, W. Randall. 1967. A study of diatom communities in a hardwater stream. Ph.D. Thesis. Iowa State University. (Concerns changes in diatom species composition with changes in nature of treatment plant effluent).

19. Starrett, W. C. and Ruth Patrick. 1952. Net plankton and bottom microflora of the Des Moines River. Proc. Acad. Nat. Sci. Phila. 104: 219-243. (Includes an extensive list of diatoms).

Table 2. - continued

D. Diatoms of Ponds, Marshes and Bogs

20. Begres, Forrest M. (1971 - in preparation) (same as item #1 above): (Includes a list of diatoms found in Ventura Marsh adjacent to Clear Lake, Iowa.

21. Christensen, Cameron. 1965. Collections of diatoms from an Iowa peat bog. Unpublished written report for an NSF Research participation program project. (Includes a list of diatoms from the only well known acid peat bog in Iowa.)

22. Koppen, John. 1968. Diatoms of a small Iowa pond. Unpublished written report for a special topics course. (Includes a list of diatoms from a small pond set in an old alkaline peat bed).

*23. Ohl, Lloyd. 1965. The diatoms of some Iowa farm ponds. Ph.D. Thesis. Iowa State University. (Concerns diatom populations in several farm ponds in central Iowa).

24. Raschke, Ronald. 1968. Algal periodicity, primary productivity, and waste reclamation in a tertiary sewage stabilization pond ecosystem. Ph.D. Thesis. Iowa State University. (includes a list of diatoms occurring in a pond filled with fully treated effluent water from the Ames disposal plant).

E. Diatoms from Soils

25. Hayek, J. M. W. and R. L. Hulbary. 1956. A survey of soil diatoms. Proc. Iowa Acad. Sci. 63: 327-338.

26. Loescher, Judith H. (1971 - in preparation). Soil diatoms from a native Iowa prairie. Ph.D. Thesis. Iowa State University. (Title indicates nature of collections).

27. Reimer, C. W. 1970. Some diatoms (Bacillariophyceae) from Cayler Prairie. In Diatomaceae II. Nova Hedwigia 31: 235-249. (Collections were made from soil in a northwest Iowa prairie).

F. Diatoms of Special Habitats

*28. Dodd, John D. and E. E. Stoermer. 1962. Notes on Iowa diatoms I. An interesting collection from a moss lichen habitat. Proc. Iowa Acad. Sci. 69: 83-87.

*29. Shobe, W. R., E. F. Stoermer and J. D. Dodd. 1963. Notes on Iowa diatoms IV. The diatoms in a northwest Iowa fen. Proc. Iowa Acad. Sci. 70: 71-74.

*30. Stoermer, Eugene F. 1962. Notes on Iowa Diatoms II. Species distribution in a subaerial habitat. Proc. Iowa Acad. Sci. 69: 87-95.

Table 2. - continued

G. Special Topics and/or Treatments of Taxonomic Entities

31. Christensen, C. L. 1969. Notes on Iowa diatoms IX. Variations in the genus Eunotia. Proc. Iowa Acad. Sci. 76: 62-68.

*32. _____. 1969 (and revised in 1970). Mineographed. A preliminary list of Iowa diatoms as found in the published literature.

33. _____ and C. W. Reimer. 1968. Notes on the diatom Cylindrotheca gracilis (Breb. ex. Kutz.) Grun: Its ecology and distribution. Proc. Iowa Acad. Sci. 75: 36-41.

*34. Drum, Ryan W. 1962. Notes on Iowa diatoms III. Occurrence of the genus Pleurosigma in the Des Moines River. Proc. Iowa Acad. Sci. 69: 96-98.

*35. _____. 1963. Notes on Iowa diatoms V. Epilithic diatom biomass in the Des Moines River. Proc. Iowa Acad. Sci. 70: 74-79.

*36. _____. 1964. Notes on Iowa diatoms. VI. Frustular observations in Surirella ovalis. Proc. Iowa Acad. Sci. 71: 51-55.

*37. Fee, Everett J. and R. W. Drum. 1965. Diatoms epizoic on copepods parasitizing fishes in the Des Moines River, Iowa. American midland Naturalist 74: 318-324.

38. Huntsman, Susan De Ropp. 1966. The stalk polysacchardie of the diatom, Gomphonema olivaceum. Ph.D. Thesis, Iowa State University.

*39. Ohl, Lloyd. 1964. Notes on Iowa diatoms VIII. A winter bloom of Synedra acus in a farm pond. Proc. Iowa Acad. Sci. 71: 67-71.

*40. Stoermer, Eugene F. 1963. New taxa and new United States records of the diatom genus, Neidium, from Lake West Okoboji, Iowa. Notula Naturae Acad. Nat. Sci. Phila. 358: 1-9.

*41. _____. 1964. Notes on Iowa Diatoms VII. Rare and little known diatoms from Iowa. Proc. Iowa Acad. Sci. 71: 55-66.

*42. Volker, Roger. 1962. Preliminary aspects of an ecological investigation of Lake East Okoboji, Iowa. Proc. Iowa Acad. Sci. 69: 99-107.

Table 2. - continued

*43. Webster, Ruth M. and John D. Dodd. 1965. Recent pollen deposition in Miller's Bay, Lake Okoboji, Iowa. Proc. Iowa Acad. Sci. 72: 73-83.

*44. Dodd, John D., Ruth M. Webster, Gary Collins, and Larry Wehr. 1968. A consideration of pollen, diatoms and other remains in postglacial sediments. Proc. Iowa Acad. Sci. 75: 197-209.

*45. Webster, Ruth M. and John D. Dodd. 1970. A pollen profile from northwest Iowa. (Unpublished manuscript of a paper presented in April, 1970, at the annual meeting of the Iowa Academy of Science.

Note: (The last three references primarily concern pollen studies related to the investigations of diatoms in core samples.)

Table 3. Summary of the numbers of diatom taxa per genus as listed in reports available by March 1, 1971.

Genera	Total number of taxa	Number of taxa rated common to abundant
Achnanthes	36	15
Amphicampa	1	--
Amphipleura	1	1
Amphiprora	1	1
Amphora	12	7
Anomoeoneis	5	2
Asterionella	1	1
Attheya	1	1
Bacillaria	1	--
Biddulphia	1	--
Caloneis	23	12
Campylodiscus	1	1
Cocconeis	9	6
Coscinodiscus	2	--
Cyclotella	20	9
Cylindrotheca	1	1
Cymatopleura	10	3
Cymbella	38	18
Cymbellonitzschia	1	--
Denticula	2	--
Diatoma	4	1
Diploneis	6	2
Epithemia	12	6
Eunotia	19	4
Fragilaria	23	14
Frustulia	4	1
Gomphoneis	3	1
Gomphonema	68	26
Gyrosigma	8	4
Hantzschia	5	4
Mastogloia	3	2
Melosira	13	5
Meridion	2	2
Navicula	238	76
Neidium	39	8
Nitzschia	109	36
Opephora	2	2
Peronia	1	--
Pinnularia	62	12
Pleurosigma	2	0
Rhizoselenia	1	1
Rhoicosphenia	1	1
Rhopalodia	5	3
Stauroneis	23	5
Stephanodiscus	8	6
Surirella	35	12

Table 3. (Continued)

Genera	Total number of taxa	Number of taxa rated common to abundant
Synedra	38	14
Tabellaria	1	--
Thalassiosira	1	1
Tropidoneis	1	1
Total - 50 genera	Total - 904	Total - 328

Table 4.

Total Hardness of Habitats Studied. (These are approximate median values. Actual values may vary by a factor of 40% or more.)

Site and Date Source	Total Hardness (ppm $CaCO_3$)
Iowa Lakes - (data from Bachmann, 1967)	
Lakes on Wisconsin glacial drift (average of approx. 40)	199
Lakes not on Wisconsin glacial drift (average of approx. 20)	116
Specific Examples	
Lake West Okoboji	205
Lake East Okoboji	221
Clear Lake	146
North Twin Lake	218
Coralville Reservoir (Iowa River)	178
Dead Man's Lake (acid bog)	29
Farm Ponds - (data from Ohl, ref 23, Table 1)	
Ponds on Wisconsin glacial drift (average of 7 ponds)	175
Ponds not on Wisconsin glacial drift (average of 6 ponds)	100
Des Moines River - (data from Drum, ref 12, Table 1)	410
Skunk River - (data from Shobe, ref 18, Table 1)	225
Dutch Creek - (data from Fee, ref 13, Table 1)	250
Dugout Creek (data from Christensen & Reimer ref 33, Table 1)	1000+
Drainage Ditches - (data from Lowe, ref 16, Table 1)	300
Fen in N.W. Iowa - (data from Shobe et al ref 29, Table 1)	1000+
Small pond - (data from Koppen, ref.22, Table 1)	300
Tertiary Treatment Ponds - (data from Raschke, ref 24, Table 1)	225

Table 5.

The More Common Diatoms of Iowa

(with reference to relative abundances in several types of habitats - the numbers refer to Table 2 and the letters to an abundance rating system discussed in the text.)

Achnanthes

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Achnanthes affinis Grun.	1r 3r	11r	16a			29r
A. clevei Grun.	1c, 3a	6c, 7r, 8r, 11c, 9r				
A. clevei var. rostrata Hust.	1c, 4r, 3c	6r, 7r, 11c				
A. coarctata (Bréb. in Wm.Smith) Grun.	3r					28r, 30c
A. conspicua A. Mayer	3c	6r, 9r, 11r, 10r				
A. exigua Grun.	1c, 3r	6r, 7c, 10r, 11r, 9r, 8r	12c, 18r	20r 23r		30a
A. exigua var. heterovalva Krasske	1r, 3r	6r, 11r, 8c	12c, 16r	23r		30a
A. hauckiana Grun.		6c, 9r, 7c, 10r, 8r				
A. hungarica (Grun.) Grun.	3c	11r, 8r	12a, 16r 18r	23r, 21r 20a		
A. lanceolata (Bréb.) Grun.	1C 3c, 4c	11c, 7a, 10r, 6a, 9a, 8c	12a, 18c, 14t, 13c, 16a, 15t	23c, 22t, 20a	26c, 27c	37t, 29t

Achnanthes, Amphipleura, Amphiprora, Amphora

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
A. lanceolata var. dubia Grun.	1c,3c 4c	6r, 9r, 11r, 7r, 8r	13r, 18r, 16a	20r, 23c	27r, 26c	(includes reports for var. rostrata (Østr.) Hust.)
A. lanceolata var. omissa Reimer	3c, 1r	11r	12t, 13r	23r		(includes reports for var. elliptica Cleve)
A. microcephala (Kütz.) Grun.	3c	9r, 11c, 7r				29t
A. minutissima Kütz.	3a, 1a	11r, 8c, 6c, 7r	12r, 16a, 13r	20c, 23a	25r	30r
A. minutissima var. cryptocephala Grun.	3a	11r		21t		(Patrick and Reimer 1966 include this with the nominate variety)
Amphipleura pellucida Kütz.	3c, 1d, 2r	11r, 6r	12c	23r		
Amphiprora ornata Bailey	3c, 2c, 4r, 1r	11r, 6t	12c, 14t, 15t			
Amphora montana Krasske	3r	11r	12a, 13c, 17t	23r	27r	37t
A. ovalis Kütz.	3c, 4c, 2c	11c, 7r, 6c, 10r, 8r	12c, 19r, 14t, 15t, 13r, 18r	23r, 21t		29t, 30c

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
A. ovalis var. affinis (Kütz.) V.H.		6a, 8a, 7a, 9a				
↕ Probably same taxon						
A. ovalis var. libyca (Ehr.) Cleve	3r 1C	11r	13r, 16c	23c, 20c, 21t		
A. ovalis var. pediculus (Kütz.)V.H.	3c, 1c 4c, 5t	11c, 9a, 6a, 8r, 7a	12c, 16a, 18c, 13r	20c 23r		30c
A. perpusilla Grun. in V.H.	4c		13r	23c		
A. submontana Hust.			18r, 13r, 16c	23r, 20c	26c	
A. veneta Kütz.	3c, 1c 4c	11r, 7c, 6r, 8r, 10r, 9r	12a, 13r, 18r, 16c	20c 23a		37t
Anomoeoneis sphaerophora (Ehr.) Pfitzer	3r, 4r	11r, 9r, 6r, 10r, 7r, 8r	12c, 15t, 16r	22r, 20r		
A. sphaerophora var. sculpta O. Müller	3r, 1r, 4r	11r, 10r, 6r, 8r				
Asterionella formosa Hassall	3a, 4a 2a, 1a	11a, 6r, 7r	12c, 19r, 14t, 17t	20c 23c		
Attheya zachariasi J. Brun	3c		17r			

Caloneis

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Caloneis amphisbaena (Bory) Cleve			12c, 14t 17t		26r	
C. bacillaris var. thermalis (Grun.) A. Cleve		10t	14t, 16t	20c		
C. bacillum (Grun.) Cleve	3c, 1r	11r, 9r, 6r, 8r, 7r	12c, 19r, 14t, 18r 17t, 13r	23r 20r 16c	27r	29r, 30a, 28r, 37t
C. bacillum var. fontinalis Grun. in V.H.			13r	23c	26c	
C. lewisii Patr.	3r	11r, 8r, 9r, 10r	12c, 18r, 14t, 13r 19c, 16r	23r, 20r		
C. lewisii var. inflata (Schultze) Patr.	3r	9r	13r	23r, 20r		
(Note: according to Van Landingham (1968) both C. lewisii and var. inflata should be placed in C. lamella Zakrzewski.)						
C. limosa (Kütz.) Patr.		7r, 10r, 9r 14t		(add to this all data for C. schumanniana and var. biconstricta)		
C. schumanniana (Grun.) Cleve	3r, 1r 4r	11r	19r, 16r, 13r	23r		29t
(Note: Patrick and Reimer (1966) transfer this to C. limosa, but Van Landingham (1968) maintains it here!)						

Caloneis, Campylodiscus, Cocconeis

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
C. schumanniana var. biconstricta (Grun.) Reichelt	3r	11r	12c, 16r 13c	23r, 21t		
(Note: Patrick and Reimer also include this in C. limosa but Van Landingham maintains it here.)						
C. silicula (Ehr.) Cleve	3c, 1c 2r	11r, 7r, 6r, 8c	13r	23r		
(Note: Patrick and Reimer (1966) transfer this to C. ventricosa (Ehr.) Meist.)						
C. ventricosa (Ehr.) Meist.		6r, 8c, 7r	14t, 15t, 19t			
(Note: this may include many varieties of C. silicula.)						
C. ventricosa var. truncatula (Grun.) Meist.	3r, 1r	11r, 9r	12r, 18r, 14t, 13r, 16r	23r	27c	
Campylodiscus noricus var. hibernicus (Ehr.) Grun.	3r, 4r	11r, 9r	15t	(Also known to occur in Big Spirit Lake, J.D.D.)		
Cocconeis diminuta Pant.	3c	11c, 9r		23r		
C. disculus (Schum.) Cleve	3c, 4r	11r, 6r, 7r, 9r				

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
C. pediculus Ehr.	3c, 1c, 4c, 5t	11c, 6r	12a, 18r, 19c, 13c, 17t, 16a	23c		
C. placentula Ehr.	3a, 5t, 4a 1a	11c, 10c	12c	20a		29t
C. placentula var. euglypta (Ehr.) Cleve	3c, 4c	11c	12t, 13c, 18c, 16a	23c,		
C. placentula var. lineata (Ehr.)V.H.	3c, 1c	6a, 9a, 11c, 7a, 8c	14t, 16r, 15t	23a, 22t, 21t 20c		
Cyclotella atomus Hust.			12a, 17t, 14a, 18a			37t
C. bodanica Eulenstein	3r, 1c	11c, 7r, 6c, 9r				
C. comta (Ehr.) Kütz.	2c, 1c	9r	14t			
C. kützingiana Thwaites		7c	12a		25t	37t
C. meneghiniana Kütz.	3c, 2c, 4c 1c	11c, 9r, 6r, 10r, 7r	12a, 19c, 13r, 14c, 15t, 17t, 18c, 16a	23a, 20a		
C. pseudostelligera Hust.			12t, 14t, 18a	23a		

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
C. stelligera (Cleve and Grun.) V.H.	3r, 1r	11r	12c, 18r	23c		
C. striata (Kütz.) Grun.		7r, 8r	12a			
C. striata var. bipunctata Fricke		10r	12a			37t
Cylindrotheca gracilis (Bréb.) Grun.			12r, 13r, 16r			33c
Cyamtopleura cochlea J. Brun.	3r, 1c, 4c, 1r	11r, 10r	12c, 18r, 13r	20r, 23r		
C. elliptica (Bréb.) Wm. Smith	3c, 2c, 4c	11r, 9r, 6r	12c, 15t	23r		
C. solea (Bréb.) Wm. Smith	3c, 2c, 4c, 1r	11r, 9r, 6r, 10r, 7r	12a, 18c, 14t, 13r, 17t, 15t, 19c, 16r	23r, 20c, 22t		
Cymbella affinis Kütz.	3c, 1a	11r, 10r, 9c	12a	23r, 22t		
C. aspera (Ehr.) Héribaud	3r, 1r	11r, 9r, 7r, 10r	14t, 16r, 13r	23r, 21t		
C. cistula (Ehr. in Hempr. and Ehr.) Kirchn. in Cohn	4r, 1c 3c,	11r, 9c, 6a, 10c, 7c	12c , 16r	23r		
C. cistula var. maculata (Kütz.)V.H.		6c, 8r, 7r		23r		29t

(Note: this should probably include most of our reports of C. parva.)

Cymbella cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
C. cuspidata Kütz.	3c, 1r	11r, 9r, 6r, 10c, 7r	16r			
C. hustedtii Krasske	3c, 1r	11r, 9r				
C. inaequalis (Ehr.) Rabh.	3c, 1c, 4r, 2c	11r, 9r, 6r, 10r, 7r				(Our records for C. ehrenbergii Kütz. included here)
C. mexicana (Ehr.) Cleve	3c, 4r	11r, 9r, 6r, 10r, 7r	12c, 19c, 16r			
C. microcephala Grun.	3c, 1a	11r, 10r, 6r, 7r	16r	23c		29t
C. muelleri Hust.	3c, 1a	11r, 10r, 6r, 8r, 7r		20r		
C. norvegica Grun.	3r	11r	12r	23r		29t
C. prostrata (Berk.) Cleve	3c, 1c, 4r, 5r	11r	12a, 17t			
C. ruttneri Hust.	3r	11r, 6c				
C. sinuata Greg.	3r, 1r	11r	12c, 15t, 14t, 13r			

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
C. triangulum (Ehr.) Cleve (includes C. rhomboidea Boyer)	3c, 1r, 4r	7r, 10r, 9r	12c, 15t, 19c, 13r, 17t, 16r	23c	26r	37t
C. tumida (Bréb.) V.H.	3c, 2c, 4c	11r	12a, 15t, 14t, 13r, 17t			
C. turgida Greg. sensu Hust. 1930	1c	9r, 10c	14t	23r, 21t	? See var. pseudogracilis Choln. discussed in Begun thesis	
C. ventricosa Kütz. sensu Hust. 1930	3c, 4r	11r, 10c, 6r, 9c, 7r,	12a, 19c, 14t, 18r, 13r, 16c	23c, 21t	26r	
Diatoma vulgare Bory	3a, 1r, 4c	11c	12c, 19c, 14t, 13r, 17t	20r		
Diploneis oculata (Bréb.) Cleve	3r, 1r	11r, 6r				30t
Diploneis ovalis (Hilse) Cleve	3r, 1r	11r		20r		29t, 30c
Epithemia argus (Ehr.) Kütz.	4r, 2r	9r	18r			29t
E. sorex Kütz.	3c, 1r, 4r	11r, 9r, 6r, 7r	12r, 14t	23r		
E. turgida (Ehr.) Kütz.	1r 3c, 5t	11r, 9a, 6 c, 8c, 7c, 10a	12r, 15t, 14t, 16r, 19r	23a, 20a		

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
E. turgida var. granulata (Ehr.) Brun.		9r, 10r	14t, 16t	20c		
E. zebra var. porcellus (Kütz.) Grun.	3c	11r, 9c, 6a, 8r, 7c, 10c	16r	23c		
E. zebra var. saxonica (Kütz.) Grun.	1c 3r, 4r	11r, 8c, 6r, 7r	12r, 16r, 14t	20c		
Eunotia curvata (Kütz.) Lagerst.	1r 4r, 2r	10r, 8c, 7r	17t, 12r, 16c	22t, 21t, 20c, 23r	27c	29t, 31a
E. formica Ehr.	1r	10r	12r, 16r	30r, 21c		
E. pectinalis var. minor (Kütz.) Rabh.	2r, 1r	6r, 8r, 9r		21t		31c
E. valida Hust.		7r, 8r, 10r	12r			31c
Fragilaria brevistriata Grun.	3a, 1a	11a, 9a, 6a, 10a, 7a, 8a	18r			
F. brevistriata var. inflata (Pant.) Hust.	3c	11c		22t		
F. capucina Desmazieres	3a, 1a, 2c	11c, 6c	12c	20c 23r		

Fragilaria cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
F. capucina var. mesolepta Rabh.	3a, 1a, 4a	11c, 9r, 6c, 10c, 7a, 84	12c, 14t	20a 23a		
F. construens (Ehr.) Grun.	3c, 1a, 2r	11c, 9a, 6c, 7a, 8a	12c, 15t, 18r	20r	26a	
F. construens var. binodis (Ehr.) Grun.	3c	11c, 10r 6r				
F. construens var. venter (Ehr.) Grun.	1c	9t, 10t		23r, 22t	26t	
F. crotonensis Kitton	3a, 1a, 2a	11a, 10r, 6c, 7r, 8r	12a, 14t	20c 23r	27	
F. crotonensis var. oregona Sov.	3r,	11r, 6r, 7r				
F. lapponica Grun.		11r, 9a, 6r, 10r, 7c, 8r	12r			
E. pinnata Ehr.	3c	11c, 9r, 6a, 10r, 7c, 8a	12r			
F. pinnata var. lancettula (Schum.) Hust.	3r, 1a	11r, 6r, 7r				
F. vaucheriae (Kütz.) Peters.	3c, 1a, 4c, 5t	11c, 9c, 6a, 8c, 7a, 10r	12a, 13c, 14t, 16a, 18r	20a 30r		37t

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
F. virescens Ralfs	2r	9r, 8a	16r	20c	26r, 27a	
Frustulia vulgaris (Thwaites)DeToni	3r, 4r	11r	12c, 18r, 14t, 13c, 19r, 16c	23r	26r	30c
Gomphoneis eriense Grun.	3r, 4r	11r, 10r, 6r, 7r	Note: see discussion by Stoermer (41).			
Gomphonema acuminatum Ehr.	3r	11r, 8c, 6r, 7r	12c	23r, 20c		
G. acuminatum var. brébissonii (Kütz.) Grun.	3r, 1r	11r, 8a, 9r	12r, 16r	20r		
G. acuminatum var. coronata (Ehr.) Wm. Smith		9c, 8r, 10r	12r, 16c			
G. affine Kütz.	3r	11r	12r	23c	27c	
Gomphonema angustatum (Kütz.) Rabh.	1r 3c, 4c	11r, 10c	14t, 13c, 18r, 16a	23c, 20a, 21t	26c, 27r	29t
G. angustatum var. producta Grun.	3r	11r	14t, 13r, 15t, 18c	23r, 21t		
G. angustatum var. sarcophagus (Greg.) Grun.	1r	6r, 7r, 8a	13r, 16r	20r 23r, 21t	26c, 27r	

Gomphonema cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
G. augur Ehr.	3r, 1c	11r, 10r, 9r				
G. brasiliense Grun.			12r, 13c, 18r	23r		
G. constrictum Ehr.	1r 3r, 4r	11r, 9c, 6r, 10r, 7r, 8c	12c, 13r, 14t, 16c	23r, 20r, 21t		
G. constrictum var. capitatum (Ehr.) Grun.	3r	11r, 10r, 6r	13r, 16r	23r, 21t, 20r		
G. gracile Ehr.	3c	6c, 9r, 11r, 8r, 7r	12t, 13r, 18r, 16r	23c, 22t, 21t		
G. gracile var. aurita (A. Braun) Cl.	1r, 5c			20r		
G. gracile var. lanceolata (Kütz.) Cl.	1c		13r, 16r	20c		
G. insigne Greg.			12C 13r, 16a	23r, 20c		includes former G. lanceolatum var. insignis (Greg.) Cl
G. intricatum Kütz.		6a, 8a, 7c, 10r, 9r	16r	20r 23c	27t	29t, 37t
G. intricatum var. dichotoma Grun.			13c	23r		

Gomphonema cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
G. intricatum var. pumila Grun.	1c, 3c	11c, 8r, 6a, 9a, 7a	12c, 13r 18r, 16r	20r	27c	37t
G. lanceolatum Ehr.		9r, 10c	12c, 18r 14t, 15t	23r		
G. longiceps var. subclavata fo. gracilis Hust.		9r	12c, 14t			37t
G. montanum var. subclavatum Grun. in V.H.	1c		16c	20c		
G. olivaceum (Lyngb.) Kütz.	3a, 5t 4c, 1a	11c, 9r, 6c, 7r	12c, 19r 13c, 14t 15t, 16r 17t, 18r	23r, 20r 21t		
G. parvulum (Kütz.) Grun.	1c, 3c 4c	11r, 9r, 6r, 10r, 7r, 8c	12a, 17t 19r, 18a 15t, 13c, 16a	23a, 22t 24t, 20a	27a	30r, 37t
G. parvulum var. micropus (Kütz.) Cl	1r		12c, 19r 14t, 17t	20a		
G. sphaerophorum Ehr.	3r, 1c	11r, 9r, 6r, 8r, 7r, 10r	(Stoermer found it in several other lakes) 12t	20r, 23r		36t, 41t
G. subclavatum Grun. (Sensu Fricke)	3r	11r	13r	1r		29t
G. subclavatum var. mexicanum (Grun.) Patr. in Hohn	3r, 4a	11r, 8r, 6r, 7r	16r	23c, 20c	(Formerly G. mexicanum Grun.)	

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Gyrosigma acuminatum (Kütz.) Rabh.			12c, 19r, 14t, 18r, 15t			
G. attenuatum (Kütz.) Rabh.	3c, 1c 2c, 5r	11c, 9c, 6c, 7r	12t, 19r	20r	26r	
G. scalproides (Rabh.) Cl.	3r(?)		12c, 13c, 19c, 16r, 14t	23r		37t
G. spencerii (Quek.) Griff. and Henfr.	3c, 1r, 4r	11r, 6c, 7r	14t, 13c, 17t			
Hantzschia amphioxys (Ehr.) Grun.	1r 3c, 4c	11r, 10r, 6r, 8r, 7r	12c, 13r, 14t, 16c, 19r	23c, 20c	25a, 26a, 27a	28t
H. amphioxys var. capitata (O. Muller) Hust.	3c	11r, 9c, 6r, 10r, 7c, 8a	14t, 13r 16r	23r, 21t	26a	29t
H. amphioxys var. major Grun.	3r	11r, 10r	16r	20r	27t	28t, 30t
H. amphioxys var. vivax Grun.	3r	11r	16r	23r, 20r	27t	
Mastogloia grevillei Wm. Smith	3c, 1r	11c, 7r, 6r, 9c, 10r		23r		29t
Mastogloia smithii var. lacustris Grun.	3c	11c, 7c, 6r, 9a, 10r				

Melosira, Navicula , Meridion

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Melosira ambigua (Grun.) O. Müller	3a, 2a, 4a, 1a	11a, 8r, 7r	12t, 14t, 19c	20c,		
M. granulata (Ehr.) Ralfs	3a, 1a, 4a, 2a	11a, 9a, 6a, 10r, 7a, 8a	12r, 15a, 14t, 19a	20c, 23a, 14r		37t
M. granulata var. angustissima O. Müller	3a, 2a, 4a, 1c	11a	12a, 19a, 14t, 17t	20a 23a		37t
M. italica (Ehr.) Kütz.	3r, 4c	11r	14t	20c		
M. varians Agardh	3c, 1r	11r	12a, 18r 19c, 13c, 16a	23r		
Meridion circulare (Grev.) Agardh	3r, 4c	11r, 9r, 6r, 10r, 7r	12c, 16a, 15t, 13c	20c	26c, 27t	
Meridion circulare var. constricta (Ralfs.) V.H.	3r	11r	14t		27c	
Navicula abiskoensis Hust.	3r, 1r	11r	16r	20r 23r	27t	30c
(Stoermer says it is widely distributed.)						
N. accomoda Hust.			12t, 13r, 17t, 16c, 18c	23c, 20r, 24t		

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. americana Ehr.		6r, 8c, 9r			26r	
N. amphibola Cl.	3r	11r, 9r, 8r	16r	20r		
N. anglica Ralfs	3c, 1r, 4r	11r, 6r, 10r, 7r, 8r	19r, 13r			37t
N. aurora Sov.	1r, 3r	7r, 11r, 9r				
N. bacillum Ehr.	3c, 1r, 4r	11r, 8r, 6r			27c	
N. biconica Patr.		6r, 7r	12r, 16r 18r	20r		
N. bryophila J. B. Petersen	3c, 1c	11r		20r		30c
N. capitata Ehr. (was a variety of N. hungarica)	1r	6r, 10r, 7r, 9r	18r, 16r 12t, 14t 19r, 13r	20c		
N. capitata var. hungarica (Grun.) Ross	3r, 4c	6c, 10r, 7c, 11r, 9c	13r, 14t 16a, 15t 12a, 18c 19r	20c, 23c		
N. cincta (Ehr.) Ralfs	3c	11r, 6c, 8c	12c, 14t	23r		

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. cincta var. rostrata Reim.	1r		12t, 18c	20c		29t
N. citrus Krasske	3r	11r	12a, 13r, 18r	23r		37t
N. cocconeiformis Greg. ex Grev.	1r	6r, 9r	12c			
N. confervacea (Kütz.) Grun.	3c	11r, 8c, 7r	12t	23r, 20r		
N. contenta var. biceps (Arn.) V.H.			12t, 13r	23r	26c	28t, 30a
N. cryptocephala Kütz.	1c 3r, 2t	11r, 10r	16r 12a, 18r, 13c	23a, 20a		37t
N. cryptocephala var. veneta (Kütz.) Rabh.	3c, 4a, 1c	8r, 11r, 6c	12c, 15t, 14t, 18r 16c 19t, 13c	23r		
N. cuspidata (Kütz.) Kütz.	3c, 2c, 4r, 1r	11c, 9r, 6c, 10c, 7r, 8c	12c, 17t, 16c, 14t, 18c, 15t, 13r	23c, 22t, 20c, 21t, 9t,	26c, 27r	
N. cuspidata var. ambigua (Ehr.) Cl.	3c, 4r	11r	12a, 16r 19a, 13r	23c, 21t 24t	26r	37t
N. cuspidata var. heribaudi Perag. in Herib.	1r	6r, 8r	12c, 16r		26c	
N. decussis Østr.	3c, 1c	11r	12c, 13c, 14t, 16c 18a	23r		

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. elginensis (Greg.) Ralfs		6r, 10r, 7r, 8a, 9r	12t, 16c, 14t,13r	23r	25t	30c
N. exigua var. capitata Patr.	3r	11r, 6r, 7r, 9r	14t, 19r, 16r			
N. explanata Hust.	3r, 1r	11r, 8r, 6r, 9r	12c			
N. graciloides A. Mayer	3c, 1r	6a, 9c, 11r, 7a, 8r			30r	
N. heufleri Grun.	3c 1r	11r, 10r, 6c, 8r, 7c	19c, 13r, 16c	20c 23r	27r	
N. heufleri var. leptocephala (Bréb. ex Grun.) Patr.	3r	7a	13c, 18r 14t			
N. laevissima Kütz.		6c, 10r, 7c, 8a				
N. lanceolata (Agardh) Kütz.	3c, 1c	11r, 9r, 4a	12c, 18a, 19a, 13c, 15c, 16c	23c, 20c, 21t, 24t		
N. luzonensis Hust.	3c 1r	11r	18a, 16c	23r, 20c		
N. menisculus Schum.	3c	11c	12c, 18r, 19r, 13c, 17t, 16r	23c		

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. menisculus var. upsaliensis (Grun.) Grun.	1r,	10r	18c, 13c, 16r	23a, 20r		
N. minima Grun. { See Begres' discussion of N. nigrii De Notaris }	1C 3r, 4r	11r, 8r, 7r	12c, 13r, 14t, 18c	23c 20a	25t	
N. mournei Patr.		7r, 10r, 9c, 8r	14t			
N. mutica Kütz.	1r	6r, 10r, 7r, 8r, 9c	14t, 16r 18r, 13c	23c, 20r, 21t	25t, 27a 28t	
N. mutica var. cohnii (Hilse) Grun.		6r, 7r, 8r	16r 12t, 13r	23r		28t
N. mutica fo. intermedia Hust.					26c, 27c	
N. mutica var. tropica Hust.			12a, 13r	23r		
N. notha Wallace			18r, 13c	23c, 22t		41t
N. mutica var. undulata (Hilse) Grun.		6r	16r	20r	26r,27t	
N. nyassensis fo. minor O. Müller	3c, 1r	11r		20r		
N. oblonga (Kütz.) Kütz.	3c, 1r	11r, 9c, 6c, 10c, 7r, 8r				30t

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. oppugnata Hust.	3r	11r, 6r, 7r	13r			29t
N. paludosa Hust.			12r	20r	27a	(Compare Stoermer's (30) use of N. lagerstedtii)
N. pelliculosa (Bréb.) Hilse			12a, 16a, 18r, 13r	23r, 20r		37t
N. placentula (Ehr.) Kütz.	3c, 1r	11r, 9r, 6r, 7r				
N. platycephala O. Müller	3r, 1r	11r, 6r				
N. pseudoventralis Hust.	3c	11r, 10r, 6r, 8a, 7r				
N. pupula Kütz.	3c, 4c	11r, 8c, 10r	12a, 15t, 14t, 17t, 19c, 18a, 13c, 16c	23c, 20c		
N. pupula var. capitata Skv. and Meyer	3r, 4r	11r	12c, 13r, 19r, 15r	23r		29t
N. pupula var. mutata (Krasske)Hust.	4c 1r	6r, 7r, 9c		15r		
N. pupula var. rectangularis (Greg.) Grun.		6c, 10r, 7r, 8r, 9c	14t, 16r	22t, 20c, 21t	27r	29t

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. pygmaea Kütz.	3r, 7r	6r	12c, 19c, 14t, 15t, 17t, 13r	18r		
N. radiosa Kütz.	3c, 1c, 4r	11r, 9r, 6c, 10c, 7r, 8r	15c, 18r, 16r	23r		
N. radiosa var. tenella (Bréb. ex Kütz.) Grun.	3c, 1a	11c, 6r, 7r	12c, 13r	23r, 20a		29r
N. reinhardtii (Grun.) Grun.	3c, 2c, 4c, 1r	11r, 9c, 6r, 7c	12r, 15t	20r		
N. rhyncocephala Kütz.	3r	11r, 6r	12a, 13r, 19r, 17t			
N. rhyncocephala var. germainii Patr. (Formerly N. germainii Wallace)			12c, 13a, 14t	23r		
N. salinarum var. intermedia (Grun.) Cl.	1a	7r	14t, 18r, 16r	20c		
N. scutelloides Wm. Smith ex Greg.	3c, 4r, 5t	11c, 9c, 6c, 10r, 7r	12r			
N. seminuloides Hust.		6r, 10r, 7r, 8a		23r		
N. seminulum Grun.	1r	8r	18r, 13c, 16r	23c, 20c	25c	29t

Navicula cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. stroesei A. Cleve	3c, 1r	11r, 8c, 9r		(Stoermer adds Lake East Okoboji and Des Moines River in (41).		
N. symmetrica Patr.	3c	11r	12a, 18r, 13c	23r		37t
N. tantula Hust.	3r, 1r	11r, 7r	17t, 13c, 18r, 16r	23c, 20c	26c, 27c	
N. tenelloides Hust.			13r, 16r	20r		30a
N. tripunctata (O. F. Müll.) Bory formerly was N. gracilis Ehr.	3c, 1r	11r, 7r	12a, 13c, 14t, 16c, 19r	23r		37t
N. tripunctata var. schizonemoides (V.H.) Patr.	3r	11r, 9r	12a, 18c, 14t, 19r	23c		
N. tuscula Ehr.	1r 3c	11r, 10r, 6r, 9c	12r, 16r	23c		
N. vellita Krasske			13c	23c.	(compare N. luzonensis)	
N. viridula var. argunensis Skv.	1c		13r, 16r	23c, 20c	26r	
N. viridula var. rostellata (Kütz?)	1.		14t, 16r, 18a			

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. vulpina Kütz.	3r, 1r	11r, 9r		23r		
N. wittrockii (Lagst.) A. Cleve-Euler	1r 3r	11r, 10r, 9?	13r, 16r	23r, 21r, 20r		(Compare N. laevissima)
Neidium affine (Ehr.) Pfitz.	3r	11r, 10r, 6r, 8r, 7r	12c, 19r, 16r	23r		
N. affine var. amphirhynchus (Ehr.) Cl.	3r, 4r	11r, 9r	14t, 16r, 19r, 13r	23r	26r	
N. affine var. tenuirostris A. Mayer	3r, 4r	11r	13r	20r		40 t
N. affine var. undulatum (Grun.) Cl.	3r	11r, 10r, 8r	17t, 13r	20r		
N. bisulcatum var. baicalense (Skv. and Meyer) Reimer	3r	11r, 9r		20r		30r
N. distincte-punctatum Hust.	3r, 1r	11r, 10r	12r			
N. dubium (Ehr.) Cl.	3c, 1r, 2r	11r, 6r	12c, 14t, 19r			
Neidium iridis (Ehr.) Cl.	3c, 1r, 4r	11r, 9r, 6c, 10r, 8r	14t, 19r, 16r	20r		
N. kozlowi Meresch.	3r	11r, 9r, 6t	12t			40t, 41t

Nitzschia

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Nitzschia accomodata Hust.			14t, 16a, 12t, 18c	24t	27t	
N. acicularis (Kütz.) Wm. Smith	1r 3r, 2c	11r	12a, 13c, 14c, 16c, 18a	23r, 20c		37t
N. amphibia Grun.	3a, 1a, 4a	11c, 9a, 6a, 10a, 7a, 8a	12c, 15c, 14t, 18a, 13c, 19r, 16a	20a 23a, 24t	26c, 27a	29t
N. angustata (Wm. Smith) Grun.	1c 3c	11r, 10r, 6r, 7r	14t, 15t	20r		
N. apiculata (Greg.) Grun.	3r	11r	12a, 17t 14t, 18c 19c, 13r, 16c			
N. bacata Hust.	3r	11r	12t, 18r	23r		
N. capitellata Hust.	1r 3r	11r	14t, 18a, 15t, 13c, 17t	20c 23r	27r	
N. communis Rabh.	3r	11r	17t, 16c, 18r, 13r	23r, 24t		
N. commutata Grun.		7r, 8r	12c, 14t, 13r	20r	27r	
N. denticula Grun.		6r, 9r	12c, 16c	23r	26r	29t

Nitzschia cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. dissipata (Kütz.) Grun.	3c, 1c, 4a	11r	12r, 17t, 14t, 18c, 19c, 13a, 16c	20r, 23c		30t, 37t
N. filiformis (Wm. Smith) Schutt	3r	11r	12c, 14t			
N. fonticola Grun. in V.H.	3c, 1c, 4a	11r	12t, 13c, 14t, 16c, 18c	20r, 23c, 24t		
N. fonticola var. pelagica Hust.	3c	11c	(associated with (Microcystis aeruginosa)			
N. frustulum (Kütz.) Rabh.	4r	6c, 8r, 7r, 9c	12a, 16r, 18a, 13r	23c, 20c	27a	
N. frustulum var. perminuta Grun.		6r, 7r	12t, 13r	23r		
N. gracilis Hantz.	1r	6r, 7r	12t, 14t	23c		
N. holsatica Hust.	1c		14c	20a	(I'm sure it is much more common than this!)	
N. hungarica Grun.	3r, 4r	11r, 10r	12a, 18c, 14t, 13r, 17t, 19c, 15t	20r		
N. intermedia Hantz. in Cleve and Grunow	3r	11r	14t, 13r, 17t	23r		

Nitzschia cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. invisitata Hust.	3r	11r	12c, 13c, 17t, 18a	20c 23c	27t	
N. linearis (Agardh)Wm. Smith	1c		12r, 15t, 14t, 18c, 19c, 13c, 17t, 16a	23c, 22t		
N. palea (Kütz.) Wm. Smith	1c 3c, 4a	11r, 6r	12r, 19c, 14c, 13c, 17t, 16a, 18a	23a, 22t, 20a, 24t	27t	
N. parvula var. terricola Lund				20r	27a, 26c	
N. recta Hantz. in Rabh.	1r 3r, 4c	11r	14t, 12a, 13r	23r		37t
N. romana Grun.	3c, 4c	11r	12t, 13r	23c		
N. sigma (Kütz.) Wm. Smith	3c, 2c	11r	12a, 13r, 14t, 19r	23r		
N. sigmoidea (Nitzsch) Wm. Smith	3c, 2c	11r, 10r, 6r, 9c	12a, 15t, 14t, 13r, 19t	23c, 22r		
N. sinuata var. tabellaria Grun.	3r, 4r	11r	13r	23r		
N. subcapitellata Hust.			12a, 16c, 17t, 18c			37t

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
N. tarda Hust.	3c	11r	12t, 14t, 18r, 13r			
N. thermalis (Ehr.) Auers.	4a	10r	12c, 18a, 14t, 13r, 15t	23r, 24t	(OK in Rabh Mill's index and in 1864.)	
N. tropica Hust.	1a		12t	23c, 20a		
N. tryblionella Hantz. in Rabh.	3r	11r, 10r	12c			
N. tryblionella var. debilis (Arn.) Grun.			12t, 14t	23r		30r, 37t
N. tryblionella var. levidensis (Wm. Smith) Grun.	3r	11r	12t, 18t, 14t, 15t	23r		
N. vermicularis (Kütz.) Hantz. in Rabh.	3r	11r, 6r	12t, 16c, 15t, 13r	23r		
Opephora ansata Hohn and Hellerman		6a, 7a, 8a				
O. martyi Héribaud	3r, 1c	11r, 9a, 6c, 7c	12r			
Pinnularia acrosphaeria Wm. Smith			12r, 17t, 16r	23r, 20r, 21t	(See P & R's discussion)	
P. appendiculata (Agardh) Cl.	3r	11r, 9r, 6r, 8r, 7r				

Pinnularia cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
P. biceps Greg.		10r	17t, 19r, 12r	23r, 21t		
P. borealis Ehr.	3r, 1r	11r, 9r, 10r, 7r, 8r	12r, 16r, 14r, 13r	23c, 21t	26a	
P. brebissonii (Kütz.) Rabh.	3r, 1r, 4c	11r, 9r, 6c, 8c, 7c	14t, 13r, 19r, 16c, 17t	23c, 20r	26c, 25t	
P. intermedia (Lagerst.) Cl.	3r, 4r	11r, 8r, 6r, 7r	13r			
P. major (Kütz.) Rabh.	3r, 2c	11r, 6r, 9r	15t, 13r	23c		
P. microstauron (Ehr.) Cl.	3r	9r, 11r, 10r	12a, 14t		27r	30c
P. obscura Krasske		7r	12r, 13r	23r	26c	
P. stomatophora (Grun.) Cl.	3r	11r, 6r, 8r		21t	29t	
P. streptoraphe Cl.		8c, 10r	16r	21t		
P. viridis (Nitz.) Ehr.	3c, 1r, 4r	11r, 10r, 9r, 8c	12r, 16r, 19r, 13r	20T 23c, 21t	27c	29t

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Rhizoselenia eriense H. L. Smith	2c, 1c	(Probably more widespread than this!)				
Rhoicosphenia curvata (Kütz.) Grun. ex Rabh.	3c, 4a, 5t, 1r	11c, 9r, 6a, 7a	12c, 18r, 14t, 13c, 15t, 16a	23c, 22t, 20c		29t
Rhopalodia gibba (Ehr.) O. Muller	3c, 1c, 4r, 2r	11r, 9c, 6c, 10r, 7c, 8r	12c, 18r, 14t, 13r, 19c, 16r	20 c, 23c, 22t		29t
R. gibba var. ventricosa (Kütz.) Grun.	3r	11r, 9r	12t		27t	
R. gibberula (Ehr.) O. Müller	3r	11r, 8r, 6r, 7r	12c, 15t			29t
Stauroneis acuta Wm. Smith	3r, 2r, 1r	11r, 10r, 7r, 8r, 9r		20r	25t	
S. anceps Ehr.	3r, 4r	11r, 8r	12r, 16r, 14t, 13r	20r	25t, 26r, 27r	29t
S. phoenicenteron (Nitz.) Ehr.	1r, 3c, 4r	11r, 10r, 6r, 9c, 8c	12r, 16r, 13r	23r, 21t		
S. phoenicenteron fo. gracilis (Ehr.) Hust.	3r, 1r	11r, 10r	16r	22t	28t	
S. smithii Grun.		6r	12c, 13r, 14t, 16c, 19r	23r		30a

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
Stephanodiscus astraea (Ehr.) Grun.	4a, 2c	6c, 10a, 7r, 9c	12a, 18a, 14t, 19a			37t
S. astraea var. minutula (Kütz.)Grun	3a, 1c, 4a	11a, 9c, 6a, 7a	12a, 17t, 14t, 15c, 19c	20a 23c		37t
S. hantzschii Grun.	3r	11r, 6t, 9r	12c, 14a, 17t	23a		37t
S. invisitatus Hohn and Hellerman	1c	6a, 8c, 7a, 9r	14t, 17t	20c 23c		
S. niagarae Ehr.	3r, 5t, 2a, 1a	11c, 9c, 6c, 7c	12c, 17t, 14t, 15t, 19a	20r 23r		37t
S. niagarae var. magnifica Fricke	3a, 4a	11c, 6a, 9?	~~12t, 17t,~~			41t
Surirella angusta Kütz.	3c, 1r, 4c	11r, 10r	14t, 15t, 18c, 19c, ~~13c, 16c~~	20c 25c	37t	
S. biseriata Bréb.	3r, 2c	11r	12c			
S. biseriata var. bifrons (Ehr.) Hust.	4r, 2c	6r, 10r, 7r, 9r		23r		
S. brightwellii Wm. Smith		10r	12a, 14t, 18r			

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
S. höfleri (or hoefleri) Hust.	4c		17t, 13r	23r		
S. linearis Wm. Smith	3r	11r, 10r	19r	23r, 22t		
S. ovalis Bréb.	4r	9r	12a, 19r	23r		
S. ovata Kütz.	3r		12c, 15t, 14t, 18c, 17t, 13a, 19c, 16a	20r 23c	25t, 26r	
S. ovata var. pinnata (Wm.Smith)Hust.	3c, 4c	11r, 10r	12c, 13c, 17t, 16c, 15t	20r 23c, 20c		30r
S. robusta var. splendida (Ehr.)V.H.	3r, 4r	11r	12c, 14t, 19r			
S. tenera Greg.	3r, 4r	11r	14t, 16r, 19r, 18r	22c		
S. tenera var. nervosa A. Schmidt	3r, 1r, 4r	11r	12r, 13r, 19r	23c		
Synedra acus Kütz.	3c, 2a, 4c, 1a, 5t	11r, 10r	14t, 18c, 19c, 16a, 17t	20a 23c		37t
S. amphicephala Kütz.		10r	12a, 14t			

Synedra cont.

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
S. capitata Ehr.	3r	~~11r, 9r~~ 6r, 10r, 7r				
S. cyclopum Brutschy	3c	11c	(undoubtedly more common			than this!)
S. delicatissima Wm. Smith		6r, 10r	14c			
S. parasitica (Wm. Smith) Hust.	4r,1r 3c	~~11c, 9r,~~ 6c, 12r, 7r, 10r				
S. radians Kütz.	4r		14t, 19r, 17t	23a		
S. rumpens Kütz.		10r	14t, 15t, 13r	23r		
S. rumpens var. familiaris (Kütz.) Grun.	3c	11r	12r	20r 23c, 21t		
S. rumpens var. fragilariodes Grun.	3c, 1r	11r, 6c, 7r	16r	20r		
S. tenera Wm. Smith	3c	11r	17t	23r		
S. ulna (Nitz.) Ehr.	3a, 2a 4r	~~11c, 9t,~~ 6r, 8r, 7c	~~12c, 17t,~~ 15t, 14t, 18r, 19r ~~13r, 16a~~	23c, 21t, 22t, 20c		37t

Taxa	Lakes	Sediment Cores	Rivers Creeks & Ditches	Ponds Marshes & Bogs	Soils	Special Topics and/or Special Habitats
S. ulna var. danica (Kütz.) Grun.	3a	11c	12a, 16r	23c		
S. ulna var. obtusa V.H.	3c	11r	12c, 14t			
Tabellaria fenestrata (Lyngb.)Kütz.	1r	11r, 9r, 10r, 8r				
Thalassiosira fluviatilis Hust.			14t, 12t, 15t, 18c			
Tropidoneis lepidoptera var. proboscidea Cl.	3c, 1r	11r				

Table 6.

Proportional pollen counts
in a 35' core of sediment from
Little Miller's Bay, Lake West
Okoboji, Iowa.
Prepared by Ruth M. Webster.

PROPORTIONAL DISTRIBUTION OF POLLEN IN SEDIMENTS OF LAKE WEST OKOBOJII, IOWA
(Expressed in percentages)

DEPTH LEVEL IN SEDIMENT	ABIES	PICEA	PINUS I	PINUS II	TSUGA	ALNUS	BETULA	QUERCUS	CARYA	JUGLANS	ULMUS	ACER	FRAXINUS	OSTRYA-CARPINUS	TILIA	CORYLUS	SALIX	GRAMINEAE	AMBROSIA	ARTEMISIA	OTHER COMPOSITAE
surface to 1'		0.3	0.6	2.4		0.3	0.3	19.7	0.4	1.0	3.0	1.4			0.6		0.6	4.7	48.0	1.0	6.0
3'			13.3	19.0			1.5	16.0	1.5	0.5	1.5			1.0	2.3	0.2		11.5	22.0		5.4
4'			5.0	16.0		1.2	1.7	17.3	1.2	1.7	2.0	0.3	0.3	1.2	1.5		0.5	7.3	21.3	5.8	8.3
5'			6.4	18.0		0.3	2.0	16.0	0.7	1.3	0.7	1.0	0.3		1.0		1.0	11.4	21.7	3.7	4.0
6'			2.7	13.4		1.0	2.0	26.0	2.4	1.4	2.0	0.6	0.3	0.6	1.4		0.6	9.7	23.7	4.0	1.7
7'		0.3	3.3	16.4		0.6	4.4	29.4	2.0	2.7	2.0	0.6		0.3	1.7		0.3	9.4	16.4	5.0	0.3
8'		1.3	3.0	16.7			1.7	18.7			4.0	1.3		0.6	2.7		2.0	11.7	28.0	1.7	1.3
9'		0.3	4.7	12.7		0.6	1.0	16.0	2.0	0.7	2.7	1.0	0.3	1.0	2.0	0.3	0.6	11.7	27.4	5.0	2.7
10'			5.4	6.0		0.3	0.6	14.0	0.6	1.4	2.0		1.0		0.6	0.6	1.0	16.0	31.7	3.4	11.4
11'			6.0	6.0		0.3	0.6	16.4	1.4	2.7	4.4		1.4				0.6	12.7	29.0	4.0	7.0
12'		0.3	9.0	6.0		0.3	0.3	17.0	0.3		1.7				0.3	0.3	0.3	9.7	43.0	2.0	6.0
13'		0.3	10.0	7.0				11.0	1.4	1.4	1.0						0.6	11.7	36.0	4.0	8.7
14'			8.0	11.0		0.3	1.0	7.0			1.0	0.3	0.3	0.3			1.6	18.4	16.7	4.0	10.7
15'		0.3	9.0	7.0		1.6	1.6	11.7	0.3		1.4			1.0			1.3	24.0	24.0	4.4	3.4
16'			2.0	6.4		1.0	0.3	11.4	0.3		1.0			0.3			2.7	13.0	28.0	4.7	12.7
17'			1.6	4.0		0.3	0.6	3.4			1.0						5.7	14.0	35.4	3.0	7.7
18'			2.6	6.4				8.0			0.6						0.6	21.0	27.7	3.6	5.4
19'			2.8	3.8				5.2		0.5	2.0	0.3					7.5	14.0	41.2	5.0	3.8
20'			1.7	2.3				4.3			0.7						10.7	23.4	27.4	6.6	4.6
21'		0.6	9.0	13.4			0.6	5.0			1.7						2.0	20.0	33.0	0.6	2.4
22'			1.6	5.4		0.3	0.3	4.6	0.3		1.4			0.3			2.7	35.0	31.7	0.3	3.4
23'			1.3	2.0				2.4	0.3		1.7						3.0	37.7	36.4		1.0
24'		0.3	6.0	5.7		0.3	1.7	5.7	0.3	0.3	5.4		0.4	0.3			7.0	17.0	33.4	2.4	3.4
25'		0.3	3.0	4.4		1.0	1.0	9.0	0.3	1.0	3.0			0.6	0.3		2.7	19.7	30.0	1.7	2.0
26'		0.6	1.3	4.4		0.6	0.3	5.4	1.0		4.7			0.3	0.3		2.4	13.4	48.4	3.6	0.6
27'	0.2	0.4	5.4	5.8		0.4	1.6	6.4	0.8	0.2	8.0			0.6	0.2	0.8	2.0	21.0	20.4	1.2	2.4
28'	0.6	1.0	2.4	5.0			2.4	11.7	0.3	0.6	5.0			0.3	0.3	0.6	6.7	21.0	21.7	1.0	3.4
29'	0.3	2.7	2.0	3.7		0.6	0.3	11.0	1.0	0.6	8.4	0.6		1.0	0.3		4.0	19.0	25.7	1.7	2.4
30'	0.3	3.3	3.6	6.6		0.5	3.3	13.2	2.3	0.5	14.3	0.5	1.3	1.2	1.2	0.3	1.8	11.2	20.3	2.2	2.0
31'	0.4	0.6	1.0	3.2		1.0	3.0	17.8	2.0	0.8	21.0	1.0	1.2	3.2	1.2	0.4	0.2	14.0	15.8	2.2	0.6
32'		0.5	0.6	1.8	0.3	0.3	1.4	20.2	4.5	0.5	43.9	1.0	1.8	4.5	2.5	0.6	0.2	4.9	5.0	1.0	0.3
33'	1.0	1.0	1.3	4.3		2.8	10.2	21.3	2.9	1.8	32.6	1.5	4.7	2.5	0.3	2.0	1.0	2.1	3.0	1.3	0.3
34'	4.8	27.0	5.0	0.4	0.2	18.0	21.6	4.4			6.2	0.8	1.6	1.2		1.6	1.0	1.6	0.6	1.6	0.4
35'	3.6	62.7	13.2	0.6		1.4	1.6	1.6	0.2	0.2	1.3		1.6			0.9	0.9	2.3	3.8	1.3	0.6

DEPTH LEVEL IN SEDIMENT	CHENOPODIACEAE-AMARANTHACEAE	PLANTAGO	UMBELLIFERAE	ALISMA	CRUCIFERAE	CYPERACEAE	POLYGONACEAE	SPARGANIUM	TYPHA	MYRIOPHYLLUM	POTAMOGETON	RANUNCULACEAE	FILICALES (SPORES)	UNKNOWNS	UNIDENTIFIABLE	TOTAL COUNT OF POLLEN
surface to 1'	6.0					0.7		0.3	0.3	2.4				1.6	2.3	300
3'	0.4					1.3			0.3	2.3				.5	4.0	400
4'	2.7	0.5				1.7			0.3	1.7		0.5		1.5	3.5	400
5'	2.0					1.6			4.7	1.6	0.6			3.0	6.3	300
6'	1.7	0.6	0.3			1.3		0.3	2.0	0.3				.3	6.3	300
7'	2.4					0.6			1.3	0.6				1.0	4.6	300
8'	2.7		0.6						1.7	0.3			.6	2.3	11.0	300
9'	0.3	2.7	0.3			1.7		0.3	1.7	0.3			1.3	3.0	7.3	300
10'	2.0						0.7	0.3	0.7	0.3			.3	3.3	6.6	300
11'	4.4					1.0			0.7	1.4			.3	2.3	8.3	300
12'	2.7								0.4	0.4				1.3	4.6	300
13'	4.0					2.0	0.3		0.3	0.3			.6	1.0	2.3	300
14'	5.6					3.6	1.6		6.6			2.0	2.0	2.3	5.6	300
15'	3.4					3.4			1.3	0.3	0.3	0.3		1.0	3.0	300
16'	6.0				0.6	3.7	1.3		3.7	0.6		0.3	1.0	3.3	12.3	300
17'	10.7		0.3			3.0	0.6		6.0	2.7				2.0	5.6	300
18'	9.0					4.4			3.7	6.7		0.3	.2	1.2	5.0	500
19'	6.2		0.3		1.2	3.0			1.5	1.7			.2	1.5	8.0	400
20'	7.0		0.3			6.4			1.6	2.0		1.0		5.6	18.0	300
21'	8.7					1.4			0.7	0.6	0.3		.3	7.6	4.0	300
22'	8.0					2.4			1.3	0.6	0.3	0.3	.3	6.0	5.9	300
23'	7.0	0.3				4.3	0.3		2.0		0.3		.6	2.6	5.3	300
24'	5.0					2.7			2.4				.3	6.0	[illegible]	300
25'	8.0				1.0	2.4			4.0	2.7			1.0	4.3	4.3	300
26'	6.7					2.4			2.0			0.6	.3	9.0	5.3	300
27'	7.6	0.2			0.6	5.2	0.2		6.8	0.8	0.6	0.2	1.8	8.8	4.6	500
28'	6.7				1.0	4.0			2.0	2.0		0.3	.6	8.0	3.6	300
29'	8.0	0.3				3.4			0.7		0.3	2.0	.6	3.3	2.0	300
30'	2.6					4.3	0.2		1.5	0.3	1.2		.6	3.3	4.8	600
31'	3.2					5.2			1.0				.8	3.6	2.2	500
32'	2.0			0.2		1.5			0.5				1.6	.5	4.5	600
33'	0.2					1.1			0.5	0.3			2.0	2.6	4.6	600
34'	0.8			0.6		0.2			0.4	0.2			1.2	.6	3.8	500
35'	0.6					1.0			0.6				3.3	1.6	6.5	1000

SECTION V

ACKNOWLEDGEMENTS

Project WP-00221 was initiated in 1960 with support from the Division of Water Supply and Pollution Control, Public Health Service, U. S. Department of Health, Education and Welfare. It was renewed in 1965 and, at some time thereafter, the supporting agency became the Federal Water Pollution Control Administration of the U. S. Department of the Interior. The project prematurely terminated in 1968 when available funds were diverted to the solution of more pressing problems. During the period of report preparation the supporting group became part of the Environmental Protection Agency and Mr. Charles Walbridge became the project officer.

Salary support for the principal investigator has been provided in its entirety by Iowa State University. The names of graduate students supported by the project are appropriately indicated in Table 2.

During this grant period seven doctoral dissertations and one master's thesis were completed and more than twenty papers were published. The present report is intended to compare project objectives with results and summarize selected portions of the accumulated data.

Most of the students associated with the project have had the privilege of working for an extended period in the laboratory of Dr. Ruth Patrick at the Academy of Natural Sciences, Philadelphia. Through associations with Dr. Patrick and Dr. Charles W. Reimer as well as access to major diatom collections housed at that institution, it has been possible for them to achieve a relatively high level of competency in matters of diatom identification. Their interaction as a group here, and the availability of major reference works from the Iowa State University library have added immeasurably to their proficiency. At one time or another all of us have been stimulated by an opportunity to undertake intensive study and/or research at the Iowa Lakeside Laboratory. This has been especially true in the summers when Dr. Charles Reimer has served as "diatomist in residence".

Much of our work has been supported by funds allocated to this project but a considerable portion of the total activity of the research group involved has received support from other agencies. In addition, a number of papers written elsewhere have dealt with diatom populations in Iowa and these have provided us with much important data.

The radiocarbon date cited in the text was determined by Isotopes, Inc., Westwood, New Jersey.

Various graduate students have been responsible for most of the actual work done on the project and their names appear in appropriate places in the report.

Because of her untimely death before her research was completed the name of Mrs. Jane Moore does not appear in the list of publications. It seems fitting to comment here that her presence brightened the lives of all of us during the brief time we were permitted to know her.

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27 Abstract

Detailed studies of diatoms from several hardwater habitats in Iowa are summarized. Of the more than 900 taxa encountered, 328 are selected as the more common diatoms of Iowa and their distributions in several types of habitats are tabulated. A pollen analysis and a radiocarbon date of 12,700 BP ± 200 years for postglacial sediments of Lake West Okoboji are given and permit a comparative chronology with diatoms in these sediments.

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