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Plankton Algae of the Upper Des Moines River, Iowa

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Plankton Algae of the Upper Des Moines River, Iowa¹BARBARA J. R. GUDMUNDSON²

SYNOPSIS: Sedgewick-Rafter quantitative strip counts and proportional counts of Hyrax-mounted diatom slides were made on weekly grab samples taken at one station near Boone, and every other week at four other downstream stations during 1968 and January 1969. Eleven cyanophycean taxa, six green flagellate taxa,

three taxa of other pigmented flagellates, and 42 taxa of other green algae were encountered. A total of 185 diatom taxa in 33 genera were identified, 75 of which are new to Des Moines River records. *Biddulphia* and *Thalassiosira* are diatom genera new to published records in Iowa.

The implementation of plans for development of a flood-control reservoir on the Des Moines River near Saylorville, Iowa led to the suggestion that a preimpoundment survey of algae be made on that reach of the river to be affected by the reservoir. Net plankton and bottom microflora had been sampled in 1946 and 1947 by Starrett and Patrick (1952). Drum (1964) sampled one of their stations (Fraser Dam) intensively in his three-year study of all diatom habitats of the entire river. Other diatom records from Stoermer (1964) and from Fee and Drum (1965) were available for comparison.

sampled weekly since July 1967 for the analysis of several physical and chemical variables by the Saylorville Reservoir Preimpoundment Water Quality Study (carried out by the Engineering Research Institute of Iowa State University under Contract DACW25-67-C-0064 with the U. S. Army Corps of Engineers, Rock Island District).

Preserved one-liter water samples were picked up weekly for my study by the Saylorville Study crew from January 15, 1968 to January 15, 1969.

Station 1 at Boone is approximately halfway between the river's source at Lake Yankton in Lyon County, Minnesota and its mouth at the Mississippi at Keokuk.

The mean gradient of the study reach is 0.25 m/km. Long-term mean streamflow at Station 1 is 45.7 m³/sec (48 years' records) and 61.5 m³/sec (7 years' records) at Station 5 near Saylorville. During 1968 the river was low, and the respective means were 30.8 m³/sec and 32.5 m³/sec.

Sampling and Preserving Procedures

Water from the midpoint and quarterpoints of the river was mixed thoroughly with the merthiolate-potassium iodide preservative (Weber, 1966) previously measured into a one-liter plastic plankton sample bottle. Samplers either 1) waded in to fill a bucket with river water when the water level was low enough, 2) lowered a bucket from each sampling station's nearby bridge during high levels, or 3) bored 8" holes in the ice cover if it was too thick to break away. In addition, one unpreserved sample was collected each week during the year from Station 1 and one preserved sample was collected every other week from the other four stations. Preserved samples were stored at room temperature. Unpreserved samples were refrigerated at 4° C and examined within one week to check identifications with live specimens.

Preparations

Following calibration of the counting chamber and microscope (Jackson and Williams, 1962), Sedgewick-Rafter strip counts were made, following methods established by the Federal Water Pollution Surveillance System (Weber, 1966). I also made diatom slides from a concentration of cells from each sample which was incinerated on a hotplate to remove some of the obscuring matter. These were mounted in Hyrax, using the method described in Gudmundson (1969). Slides on which voucher specimens were designated were made from empty diatom frustules prepared by Van der Werff's method (1955).

Analyses

In the first months of this study, determinations to genus (if possible) were made and recorded for all Sedgewick-Rafter counts. However, as it became apparent that the differences among the five stations on the same day were too

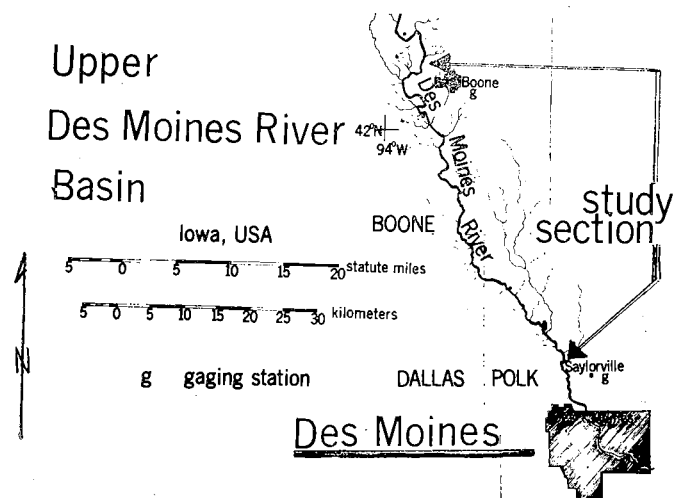


Figure 1. Upper Des Moines River basin. (Redrawn from Army Map Service-U.S.G.S. 1:250,000 topographic maps.)

MATERIALS AND METHODS

Sampling Sites

The section of the Des Moines River sampled for this study extends from Boone 80 km downstream to the N. W. 66th Avenue Bridge (Fisher Bridge) 8 km north of Des Moines and 3 km west of Saylorville (Figure 1). This reach has been

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TABLE 1. DES MOINES RIVER ALGAE OTHER THAN DIATOMS PRESENT IN SEDGEWICK-RAFTER COUNTS AND CONCENTRATED-CELL WET MOUNTS, WITH DATES OF FIRST AND LAST ENCOUNTER AND NUMBER OF TIMES SEEN EACH MONTH FROM 15 JAN 1968-15 JAN 1969.

Note: "Last seen" dates are not entered for those rare individuals of species or varieties due to the excessive time required for their tabulation. It may be assumed that they are less abundant than those which have "last seen" dates entered.

Taxon	First seen	J	F	M	A	M	J	J	A	S	O	N	D	J	Last seen
No. of samples taken		6	12	17	12	12	13	12	17	12	13	8	8	11	
BLUE-GREEN ALGAE															
<i>Agmenellum (Merismopedia)</i>	2/9		2	2	4	3	6	12	16	11	1	2	1	1	1/9
<i>Anabaena</i>	1/26	1	0	1	0	1	2	1	1	0	1	1	2	1	1/15/69
<i>A. spiroides</i>	5/24					3									
<i>Anacystis</i>	3/29			3	11	11	4	2	7	6	5	6	2	0	12/26
<i>Chroococcus</i>	9/12									1	1				10/2
<i>Coccochloris (Aphanothece)</i>	4/26				1	3	0	0	9	3	1	1			11/13
<i>Gomphosphaeria (Coelosphaerium)</i>	7/12						2	3	1						9/25
<i>Oscillatoria</i>	2/16		2	6	8	3	2	11	18	5	18	8	6	9	1/15/69
<i>Phormidium</i>	1/26	1		seen once											1/26
<i>Spirulina</i>	1/26	1	2	5	2	0	0	0	0	0	0	4	3	7	1/15/69
GREEN FLAGELLATES															
<i>Chlamydomonas</i>	1/15	1	6	13	8	10	7	5	7	5	3	10	8	9	1/15/69
<i>Eudorina</i>	8/29									3					8/29
<i>Euglena</i>	1/26	1	1	8	12	9	12	6	13	10	0	5	7	9	1/15/69
<i>Pandorina</i>	5/3					1	2	1	6	4	2	1			11/28
<i>Phacus</i>	8/29			seen once					1						8/29
<i>Trachelomonas</i>	1/15	1	2	5	9	10	8	2	11	13	5	4	1		12/19
OTHER PIGMENTED FLAGELLATES															
<i>Dinobryon</i>	5/24					1	4	1	0	0	0	0	2	3	1/15/69
<i>Glenodinium</i>	8/29									1	1	0	1	1	1/15/69
<i>Gymnodinium</i>	8/29			seen once						1					8/29
GREEN ALGAE (excluding flagellates)															
<i>Actinastrum</i>	3/8			4	0	11	14	6	15	12	7	8	5	5	1/15/69
<i>Ankistrodesmus</i>	1/15	9	12	18	9	12	9	10	12	10	8	7	8	7	1/15/69
<i>A. spiralis</i>	5/3					1									
<i>Botryococcus</i>	5/3					1	1	0	1	1					9/25
<i>Cerasterias</i>	9/12			seen once						1					9/12
<i>Chlorella (type)</i>	1/15	1	0	5	1	3	2	6	3	3	7	3	5	5	1/15/69
<i>Chodatella</i>	4/26				2	10	4	4	6	5	1	0	1		12/5
<i>Closteriopsis</i>	1/26	1	1	3	1	3	3								6/7
<i>C. longissima var. tropica</i>	5/10					1									
<i>Closterium</i>	5/24					2	1	2	6	2	5	1			11/13
<i>Coelastrum</i>	5/17					1	1	0	4	5					9/25
<i>Crucigenia</i>	4/26				1	0	0	3	5	4	2	1	1		12/19
<i>Gloeocystis</i>	4/12				2	0	0	2	3	2	2				10/10
<i>Golenkinia</i>	5/10					1	seen once								5/10
<i>Kirchneriella</i>	3/29			3	5	2	2	1	4	0	2	3	1		12/5
<i>Micractinium</i>	7/12							1	3	1					9/25
<i>Micrasterias</i>	5/3					4	3	1	8						8/29
<i>Oocystis</i>	3/8			2	0	0	3	1	7	1	3	0	1		12/19
<i>Pachycladon</i>	3/29			2	3	5	2								6/7
<i>Pediastrum</i>	2/16		1	6	5	11	7	5	15	12	4	1			11/28
<i>P. boryanum</i>	3/29			1											
<i>P. duplex</i>	3/15			5	7	7	5	5	1						8/29
<i>P. duplex var. convergens</i>	3/8			1											
<i>P. tetras</i>	3/15			1	1	3	1	0	1						8/29
<i>Planktosphaeria</i>	5/10					2	4	0	3	1					9/4
Scenedesmus															
<i>S. acuminatus</i>	1/15	4	5	13	10	12	13	10	16	13	13	7	5	2	1/15/69
<i>S. bijuga</i>	9/12									1					
<i>S. obliquus</i>	5/3					1									
<i>S. quadricauda</i>	2/9		3	13	11	12	13	10	16	11	10	8	3	2	1/2/69
<i>Schroederia</i>	4/12				3	3									5/10
<i>Selenastrum</i>	4/12				1	0	0	0	0	1					9/25
<i>Sphaerocystis</i>	5/3					1	seen once								5/3
<i>Staurastrum</i>	4/12				2	0	0	5	5	3	1	1			11/13
<i>Stichococcus scopulinus</i>	1/26	5	3	1	1	4	2	1	1	2	1	5	3	3	1/2/69

PLANKTON ALGAE

3

	J	F	M	A	M	J	J	A	S	O	N	D	J	Last seen
	6	12	17	12	12	13	12	17	12	13	8	8	11	
<i>Tetraedron</i>	3/29		1	5	8	2	4	12	8	3	0	0	1	1/9/69
<i>T. caudatum</i>	5/10				1									
<i>T. regulare</i>	4/12			1										
<i>T. triappendiculatum</i>	5/3				1	seen once							5/3	
<i>Tetraspora</i>	4/12			2										4/20
<i>Treubaria</i>	5/10				7	1	0	2	1					9/25
<i>Westella</i>	5/3				1	0	0	0	4					9/25

small to justify the extra tabulation time, genus tabulations were continued on only the Station 1 and 5 counts. Counts on Station 2, 3, and 4 samples were recorded to "category". The categories used were: coccoid blue-greens, filamentous blue-greens, coccoid greens, green flagellates, filamentous greens, other pigmented flagellates, centric live diatoms and "shells" (empty frustules of dead diatoms), and live pennate diatoms and "shells".

Sedgewick-Rafter subsamples used were well-mixed non-concentrated, undiluted river water, because cell density was always favorable for counting. Non-diatom algae were counted as "units", that is, solitary cells, filament segments or coenobia were each counted as one unit.

Diatoms were counted by cells, since each cell was easily discernible and their sizes were more in the same range (Weber, 1966). Concentrated cells left over from making diatom slides were made into wet mounts which I examined at 430 X.

Proportional counts were made of diatom taxa by identifying, counting and tabulating the first 300 diatoms seen on a sample slide. Most of the diatoms encountered on these sample slides had been seen and marked beforehand on the voucher slides. If not, a specimen of each new one on a sample slide was circled and made a provisional voucher specimen until one of the identical taxon could be located on a bona fide voucher slide.

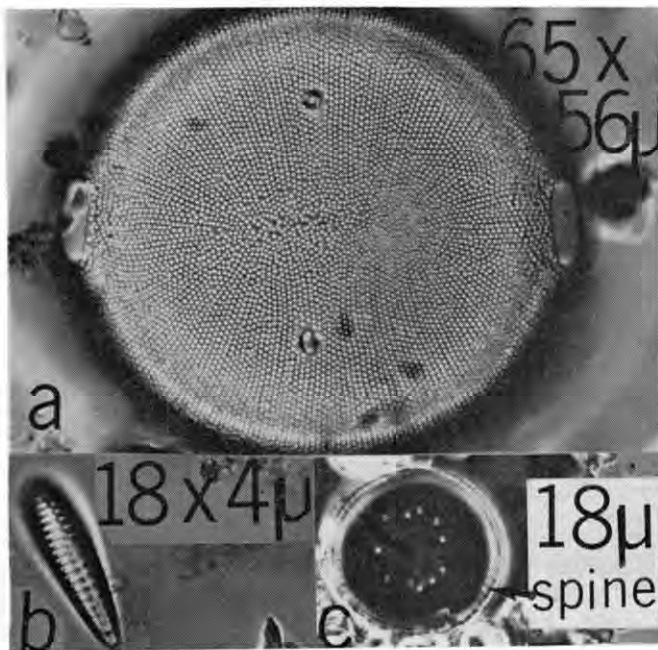


Figure 2. Rare or uncommon diatoms found in 1968 Des Moines River plankton samples.

- Biddulphia laevis* Ehr. 65 μ x 56 μ , 17 striae/10 μ , 16 puncta/10 μ ; on voucher slide 11/13/68-1A.
- Peronia fibula* (Bréb. ex Kütz.) Ross. 18 μ x 4 μ , 12 striae/10 μ . Note partially developed raphe on pointed end. On voucher slide 6/14/68-1J.
- Thalassiosira fluviatilis* Hust. 18 μ diam., 13 striae/10 μ . On voucher slide 6/14/68-1L. (Phase contrast)

RESULTS

The detailed counts are omitted here but are available elsewhere (Gudmundson, 1969). A complete listing of algal taxa identified at 210 X in the Sedgewick-Rafter counting chamber, and in wet mounts at 430 X is given in Table 1. Identification of diatoms to species was usually impossible in these preparations. Table 2 lists diatom taxa for which there are voucher slides, and most of which were seen on sample slides also.

Biddulphia laevis Ehr. reported here for the first time in Iowa is shown with *Peronia fibula* (Bréb. ex Kütz.) Ross and *Thalassiosira fluviatilis* Hust. in Figure 2. This report is the first in Iowa of *Peronia fibula*, although *Peronia intermedium* (H. L. Smith) Patr. was reported in 1898 as *Meridion intermedium* H. L. Smith by Myers. Although this is the first published record of *Thalassiosira fluviatilis*, this taxon is listed by Drum (1964), Shobe (1967), and Hungerford (1971, manuscript in preparation).

Non-diatom taxa identified during Sedgewick-Rafter counts and scans of cell-concentrate wet mounts totalled 62. There were 42 taxa of non-flagellated and six taxa of flagellated green algae. I saw three genera of other pigmented flagellates, as well as six taxa of filamentous and five taxa of coccoid blue-green algae.

The 185 diatom taxa reported here are distributed among 33 genera and 75 of the taxa are new to both published and unpublished records for the Des Moines River.

TABLE 2. DIATOM TAXA FOUND IN THE UPPER DES MOINES RIVER PLANKTON, 1968-1969

Taxon	Voucher slide	Ident. source	Also reported from Des Moines River by..... ^b				
<i>Achnanthes lanceolata</i> var. <i>dubia</i> Grun.	6/14/68-1H	PR 66	D	<i>Diatoma tenue</i> Var. <i>elongatum</i> Lyngbye	4/26/68-1A	PR 66	
<i>Amphiprora ornata</i> Bailey	1/15/68-1EE	Hu 30	B	<i>D. vulgare</i> Bory	3/8/68-1B	PR 66	AB
<i>Amphora delicatissima</i> Krasske	3/8/68-1C	Hu 30		<i>D. vulgare</i> var. <i>breve</i> Grun.	1/15/68-1JJ	PR 66	
<i>A. normani</i> Rabh.	10/16/68-1A	Hu 30		<i>Diploneis</i> sp.	10/6/68-1A		
<i>A. ovalis</i> Kütz.	10/6/68-1B	Hu 30	AB	<i>Epithemia sorex</i> Kütz.	1/15/68-1E	Hu 30	B
<i>Asterionella formosa</i> Hass.	5/10/68-1	PR 66	AB	<i>E. turgida</i> (Ehr.) Kütz.	1/15/68-1BB	Hu 30	AB
<i>Biddulphia laevis</i> Ehr.	11/14/68-1A	VH 80		<i>E. turgida</i> var. <i>granulata</i> (Ehr.) Brun.	10/16/68-1F	Hu 30	E
<i>Caloneis amphisbaena</i> (Bory) Cl.	1/15/68-1F	PR 66	BE	<i>E. zebra</i> var. <i>saxonica</i> (Kütz.) Grun.	11/13/68-1B	Hu 30	B
<i>C. bacillaris</i> var. <i>thermalis</i> (Grun.) A.Cl.	1/15/68-1UU	PR 66		<i>Fragilaria brevistriata</i> var. <i>capitata</i> Hérib.	3/8/68-1K	PR 66	
<i>C. bacillum</i> (Grun.) Cl.	3/8/68-1DD	PR 66	BD	<i>F. capucina</i> var. <i>mesolepta</i> Rabh.	8/16/68-5A	PR 66	B
<i>C. lewisii</i> Patr.	4/20/68-1I	PR 66	ABC	<i>F. crotonensis</i> Kitton	7/12/68-1B	PR 66	B
<i>C. limosa</i> (Kütz.) Patr.	10/16/68-1G	PR 66	B	<i>F. leptostauron</i> var. <i>dubia</i> (Grun.) Hust.	1/15/68-1RR	PR 66	B
<i>C. ventricosa</i> var. <i>alpina</i> (Cl.) Patr.	11/13/68-1E	PR 66		<i>F. vaucheriae</i> (Kütz.) Peters	3/8/68-1J	PR 66	B
<i>Caloneis ventricosa</i> var. <i>minuta</i> (Grun.) Patr.	5/17/68-1G	PR 66		<i>Frustulia vulgaris</i> (Thwaites) Det.	3/8/68-1S	PR 66	AB
<i>Caloneis ventricosa</i> var. <i>truncatula</i> (Grun.) Meist.	5/17/68-1C	PR 66	B	<i>F. weinholdii</i> Hust.	5/10/68-2	PR 66	
<i>Cocconeis placentula</i> var. <i>lineata</i> (Ehr.) V. H.	1/15/68-1V	PR 66	E	<i>Gomphonema angustatum</i> (Kütz.) Rabh.	10/16/68-1E	Hu 30	
<i>C. rugosa</i> Sov.	1/15/68-1C	PR 66		<i>G. angustatum</i> var. <i>producta</i> Grun.	3/8/68-1P	Hu 30	
<i>Cyclotella atomus</i> Hust.	4/20/68-1M	US 66	BD	<i>G. constrictum</i> Ehr.	6/14/68-1A	Hu 30	B
<i>C. comta</i> (Ehr.) Kütz.	2/9/68-1D	Hu 30		<i>G. lanceolatum</i> Ehr.	7/12/68-1M	Hu 30	B
<i>C. kützingiana</i> var. <i>planetophora</i> Fricke	7/18/68-1B	Hu 30		<i>G. longiceps</i> var. <i>subclavata</i> fo. <i>gracilis</i> Hust.	11/13/68-1G	Hu 30	B
<i>C. meneghiniana</i> Kütz.	1/15/68-1D	Hu 30	AB	<i>G. olivaceum</i> (Lyngbye) Kütz.	5/17/68-1R	Hu 30	AB
<i>C. meneghiniana</i> var. <i>laevissima</i> (van Goor) Hust.	1/15/68-1R	Hu 30		<i>G. parvulum</i> var. <i>lagenula</i> (Kütz. ? Grun.) Hust.	9/18/68-1F	Hu 30	
<i>C. michiganiana</i> Skvortzow	4/20/68-1A	US 66		<i>G. parvulum</i> var. <i>micropus</i> (Kütz.) Cleve	10/16/68-1E	Hu 30	AB
<i>C. ocellata</i> Pant.	3/8/68-2	Hu 30		<i>Gyrosigma acuminatum</i> (Kütz.) Rabh.	1/15/68-1G	PR 66	AB
<i>C. pseudostelligera</i> Hust.	3/29/68-2	US 66	B	<i>G. scalproides</i> (Rabh.) Cl.	4/20/68-1I	PR 66	ABD
<i>Cymatopleura elliptica</i> var. <i>constricta</i> Grun.	11/13/68-1H	Hu 30		<i>G. spencerii</i> (Quek.) Griff. and Henfr.	4/20/68-1F	PR 66	
<i>C. elliptica</i> var. <i>hibernica</i> (W.Sm.) V. H.	10/16/68-1C	Hu 30		<i>G. spencerii</i> var. <i>curvula</i> (Grun.) Reim.	1/15/68-1NN	PR 66	
<i>C. solea</i> (Bréb.) W. Smith	2/9/68-1B	Hu 30	AB	<i>Hantzschia amphioxys</i> (Ehr.) Grun.	5/17/68-1J	Hu 30	ABE
<i>C. solea</i> var. <i>regula</i> (Ehr.) Grun.	1/15/68-1X	Hu 30	E	<i>H. amphioxys</i> fo. <i>capitata</i> O.Müll.	12/19/68-1A	Hu 30	
<i>Cymbella aequalis</i> W. Smith	11/13/68-1C	Hu 30		<i>H. virgata</i> (Roper) Grun.	3/29/68-5	Hu 30	
<i>C. aspera</i> (Ehr.) Hérib.	1/15/68-1AA	Hu 30	E	<i>Melosira ambigua</i> (Grun.) O. Müll.	5/17/68-1K	Hu 30	AB
<i>C. sinuata</i> Gregory	9/18/68-1H	Hu 30	B	<i>M. binderana</i> Kütz.	5/10/68-4	Hu 30	
<i>C. tumida</i> (Bréb.) V. H.	4/20/68-1K	Hu 30	BD	<i>M. granulata</i> (Ehr.) Ralfs	4/20/68-1J	Hu 30	ABD
<i>C. turgida</i> (Gregory) Cleve	3/8/68-1G	Hu 30		<i>M. granulata</i> var. <i>angustissima</i> Müll.	1/15/68-1Y	Hu 30	ABD
<i>C. ventricosa</i> Kütz.	4/20/68-1E	Hu 30	BDE	<i>M. granulata</i> var. <i>muzzanensis</i> (Meister) Bethge	5/10/68-2B	Hu 30	B
				<i>M. italica</i> (Ehr.) Kütz.	4/20/68-1D	Hu 30	E
				<i>M. italica</i> var. <i>tenuissima</i> (Grun.) O. Müll.	8/23/68-1	Hu 30	B

^a Identification source symbols: DS 62 = Dodd and Stoermer, 1962; Hu 30 = Hustedt, 1930; Hu 49 = Hustedt, 1949; PR 66 = Patrick and Reimer, 1966; Sc 77 = Schmidt's Atlas, 1877-1944; St 64 = Stoermer, 1964; US 66 = U.S. Department of the Interior. FWPCA, 1966; V H 80 = Van Heurck, 1880-1881.

^b Symbols for "Also reported from Des Moines River": A = Starratt and Patrick, 1952; B = Drum dissertation, 1964; C = Stoermer, 1964; D = Fee and Drum, 1965; E = Ehrenberg, 1856.

^c Sample slides have no letters following the date and station number.

PLANKTON ALGAE

Taxon	Voucher slide	ident. source	Also reported from Des Moi. R. by				
<i>Meridion circulare</i> var. <i>constrictum</i> (Ralfs) V. H.	3/8/68-10	PR 66		<i>N. apiculata</i> (Greg.) Grun.	3/8/68-1N	Hu 30	ABDE
<i>Navicula arvensis</i> Hust.	3/15/68-1	PR 66		<i>N. capitellata</i> Hust.	1/15/68-1SS	Hu 30	
<i>N. canalis</i> Patr.	5/17/68-1L	PR 66	B	<i>N. closterium</i> var. V.H.	9/18/68-1A	VH 80	A
<i>N. capitata</i> Ehr.	3/8/68-1Z	PR 66	B	<i>N. commutata</i> Grun.	3/8/68-1AA	Hu 30	B
<i>N. capitata</i> var. <i>hungarica</i> (Grun.) Ross	1/15/68-1Q	PR 66	B	<i>N. dissipata</i> (Kütz.) Grun.	1/15/68-1M	Hu 30	ABD
<i>N. cincta</i> (Ehr.) Ralfs	3/8/68-1F	Hu 30	B	<i>N. epiphytica</i> O. Müll.	10/6/68-1G	Hu 49	
<i>N. circumtexta</i> Meist. ex Hust.	4/26/68-4	PR 66	BC	<i>N. filiformis</i> (W. Sm.) Schutt	3/8/68-1V	Hu 30	B
<i>N. cryptocephala</i> var. <i>veneta</i> (Kütz.) Rabh.	6/14/68-1B	PR 66	B	<i>N. fonticola</i> Grun.	7/12/68-1L	Hu 30	B
<i>N. cuspidata</i> (Kütz.) Kütz.	10/6/68-1D	PR 66	ABE	<i>N. gracilis</i> Hantzsch	1/15/68-1DD	Hu 30	B
<i>N. cuspidata</i> var. <i>major</i> Meist.	10/2/68-1	PR 66		<i>N. hantzschiana</i> Rabh.	9/18/68-1G	Hu 30	
<i>N. decussis</i> Østr.	3/8/68-1M	PR 66	BC	<i>N. holsatica</i> Hust.	2/9/68-3	Hu 30	
<i>N. elginensis</i> (Greg.) Ralfs	8/16/68-1D	PR 66		<i>N. hungarica</i> Grun.	1/15/68-1CC	Sc 77	AB
<i>N. exigua</i> var. <i>capitata</i> Patr.	5/17/68-1E	PR 66	AC	<i>N. ignorata</i> Krasske	3/8/68-1X	Hu 30	B
<i>N. gibbula</i> Cleve	3/8/68-1D	Hu 30		<i>N. intermedia</i> Hantzsch	3/8/68-1EE	Hu 49	
<i>N. gottlandica</i> Grun.	4/20/68-1B	PR 66		<i>N. intermissa</i> Hust.	2/9/68-1A	Hu 49	
<i>N. heufleri</i> var. <i>leptocephala</i> (Bréb. ex Grun.) Patr.	3/8/68-1T	PR 66		<i>N. linearis</i> (Agardh) W. Smith	4/20/68-1Q	Hu 30	ABD
<i>N. lanceolata</i> var. <i>cymbula</i> (Donk.) Cleve	9/18/68-1E	St 64	C	<i>N. obtusa</i> W. Smith	1/15/68-1PP	Hu 30	
<i>N. minima</i> Grun.	3/8/68-1BB	Hu 30	B	<i>N. palea</i> (Kütz.) W. Smith	1/15/68-1O	Hu 30	ABD
<i>N. mournei</i> Patr.	1/15/68-1A	PR 66		<i>N. palea</i> var. <i>tropica</i> Hust.	8/16/68-1A	Hu 49	
<i>N. mutica</i> Kütz.	5/17/68-1D	DS 62		<i>N. recta</i> Hantzsch	1/15/68-1K	Hu 30	BD
<i>N. pupula</i> Kütz.	6/14/68-1M	PR 66	AB	<i>N. robusta</i> Hust.	8/16/68-1C	Hu 49	
<i>N. pupula</i> var. <i>elliptica</i> Hust.	3/8/68-1J	PR 66		<i>N. sigma</i> (Kütz.) W. Smith	1/15/68-1S	Hu 30	AB
<i>Navicula pupula</i> var. <i>rectangularis</i> (Greg.) Grun.	10/16/68-1C	PR 66		<i>N. sigmoidea</i> (Nitz.) W. Smith	4/20/68-1R	Hu 30	AB
<i>N. pygmaea</i> Kütz.	5/17/68-1H	PR 66	AB	<i>N. spiculoides</i> Hust.	2/23/68-1	Hu 49	B
<i>N. rhynchocephala</i> var. <i>amphiceros</i> (Kütz.) Grun.	2/9/68-1C	PR 66		<i>N. sublinearis</i> Hust.	1/15/68-1I	Hu 30	
<i>N. rhynchocephala</i> var. <i>germainii</i> (Wallace) Patr.	1/15/68-1J	PR 66	B	<i>N. tarda</i> Hust.	7/12/68-1A	Hu 49	B
<i>N. salinarum</i> Grun.	1/15/68-1A	PR 66		<i>N. thermalis</i> (Ehr.) Auers.	4/20/68-1G	Hu 30	B
<i>N. salinarum</i> var. <i>intermedia</i> (Grun.) Cleve	3/8/68-1U	PR 66		<i>N. tropica</i> Hust.	3/8/68-1A	Hu 49	
<i>N. secreta</i> var. <i>apiculata</i> Patr.	4/26/68-1	PR 66		<i>N. tryblionella</i> var. <i>debilis</i> (Arnott) A. Mayer	10/16/68-1C	Hu 30	BD
<i>N. tripunctata</i> (O. F. Müll.) Bory	6/14/68-1E	PR 66	BD	<i>N. tryblionella</i> var. <i>levidensis</i> (W. Sm.) Grun.	8/16/68-1B	Hu 30	B
<i>N. tripunctata</i> var. <i>schizonemoides</i> (V. H.) Patr.	1/15/68-1VV	PR 66	B	<i>Peronia fibula</i> (Bréb. ex Kütz.) Ross	6/14/68-1J	PR 66	
<i>N. viridula</i> var. <i>avenacea</i> (Bréb. ex Grun.) V. H.	1/15/68-1QQ	PR 66		<i>Pinnularia abaujensis</i> var. <i>linearis</i> (Hust.) Patr.	11/13/68-1I	PR 66	
<i>N. viridula</i> var. <i>rostellata</i> (Kütz. ?) Cl.	10/16/68-1D	PR 66		<i>P. borealis</i> Ehr.	11/7/68-1	PR 66	B
<i>Neidium affine</i> var. <i>amphirhynchus</i> (Ehr.) Cl.	5/17/68-1I	PR 66	A	<i>P. brébissonii</i> (Kütz.) Rabh.	1/15/68-1II	PR 66	A
<i>N. affine</i> var. <i>hankense</i> (Skv.) Reim.	10/6/68-1E	PR 66		<i>P. microstauron</i> (Ehr.) Cleve	3/8/68-1Q	PR 66	B
<i>N. dubium</i> (Ehr.) Cl.	6/14/68-1M	PR 66	AB	<i>P. rupestris</i> Hantz.	10/16/68-1A	PR 66	
<i>N. iridis</i> (Ehr.) Cl.	5/17/68-1F	PR 66	AB	<i>Pleurosigma salinarum</i> Grun.	9/18/68-1D	PR 66	
<i>N. ladogensis</i> var. <i>densestriatum</i> (Østr.) Foged	6/14/68-1I	PR 66		<i>Rhoicosphenia curvata</i> (Kütz.) Grun. ex Rabh.	6/14/68-1C	PR 66	
<i>Nitzschia accomodata</i> Hust.	3/8/68-1R	Hu 49	B	<i>Rhopalodia gibba</i> (Ehr.) O. Müll.	3/8/68-3	Hu 30	AB
<i>N. acicularis</i> (Kütz.) W. Sm.	1/26/68-1A	Hu 30	BD	<i>R. gibberula</i> var. <i>vanheurckii</i> O. Müll.	6/14/68-1G	Hu 30	B
<i>N. amphibia</i> Grun.	3/8/68-1I	Hu 30	ABD	<i>Stauroneis anceps</i> Ehr.	5/17/68-1Q	PR 66	BE
<i>N. angustata</i> (W. Sm.) Grun.	1/15/68-1N	Hu 30		<i>S. smithii</i> Grun.	10/6/68-1F	PR 66	AB
				<i>Stephanodiscus astraea</i> (Ehr.) Grun.	1/15/68-1GG	Hu 30	ABD
				<i>S. astraea</i> var. <i>intermedia</i> Fricke	1/15/68-1Z	Hu 30	
				<i>S. astraea</i> var. <i>minutula</i> (Kütz.) Grun.	1/15/68-1B	Hu 30	ABD
				<i>S. dubius</i> (Fricke) Hust.	10/16/68-1F	Hu 30	B
				<i>S. hantzschii</i> Grun.	1/15/68-1U	Hu 30	BD
				<i>S. invisitatus</i> Hohn and Hellerman	1/15/68-1AA	US 66	
				<i>S. niagarae</i> Ehr.	4/20/68-1O	US 66	ABCD

LITERATURE CITED

Taxon	Voucher slide	ident. source	Also reported from Des Moines River by
<i>Surirella angusta</i> Kütz.	1/15/68-1KK	Hu 30	ABD
<i>S. brightwellii</i> W. Sm.	10/6/68-1C	US 66	B
<i>S. gracilis</i> (W. Sm.) Grun.	3/8/68-1CC	Hu 30	B
<i>S. ovata</i> Kütz.	1/15/68-1L	Hu 30	AB
<i>S. robusta</i> var. <i>splendida</i> (Ehr.) V. H.	10/16/68-1B	Hu 30	ABE
<i>S. tenera</i> Gregory	8/16/68-1G	Hu 30	A
<i>Synedra acus</i> Kütz.	1/15/68-1TT	PR 66	ABD
<i>S. amphicephala</i> Kütz.	1/15/68-1WW	PR 66	B
<i>S. amphicephala</i> var. <i>austriaca</i> (Grun.) Hust.	3/8/68-1H	PR 66	
<i>S. delicatissima</i> W. Sm.	5/17/68-1M	PR 66	
<i>S. gaillonii</i> (Bory) Ehr.	8/16/68-5B	PR 66	B
<i>S. radians</i> Kütz.	1/15/68-1MM	PR 66	A
<i>S. rumpens</i> Kütz.	1/15/68-1W	PR 66	B
<i>S. socia</i> Wallace	3/8/68-1L	PR 66	
<i>S. ulna</i> (Nitz.) Ehr.	1/15/68-1A	PR 66	ABDE
<i>S. ulna</i> var. <i>chaseana</i> Thomas	11/13/68-1D	PR 66	
<i>S. ulna</i> var. <i>longissima</i> (W. Sm.) Brun.	7/12/68-1I	PR 66	
<i>S. ulna</i> var. <i>obtusa</i> V. H.	1/15/68-1A	PR 66	
<i>S. ulna</i> var. <i>oxyrhynchus</i> (Kütz.) V. H.	1/15/68-1LL	Hu 30	
<i>S. ulna</i> var. <i>spatulifera</i> (Grun.) V. H.	5/17/68-1B	PR 66	
<i>S. ulna</i> var. <i>subaequalis</i> (Grun.) V. H.	6/14/68-1F	PR 66	
<i>Thalassiosira fluviatilis</i> Hust.	6/14/68-1L	Hu 30	B

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