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## Notes on Iowa Diatoms XII: Common Diatoms of Big Spirit Lake

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KROHN, MILBERT (Spirit Lake), M. EDWARDS and J. D. DODD (Botany and Plant Pathology, ISU, Ames, Iowa 50010). Notes on Iowa Diatoms XII: Common Diatoms of Big Spirit Lake. *Proc. Iowa Acad. Sci.* 81(3): 108-110, 1974.

A natural history of the diatoms of Spirit Lake was in preparation by the senior author prior to his death in 1973. This report is de-

rived from his notes plus some additional observations, and is published in his behalf. A table lists 139 common taxa distributed among 34 genera and notes whether these taxa occur also in Lake West Okoboji and Clear Lake.

INDEX DESCRIPTORS: Diatoms; Iowa Diatoms; Diatoms, Spirit Lake, Iowa.

Since the first publication in this series (Dodd and Stoermer, 1962), a rather large body of information concerning Iowa diatoms has accumulated. In a summary (Dodd, 1971) it was noted that many individuals have contributed important data and that the total number of diatom taxa reported from the state has approached the 1,000 mark. Of these 328 were cited as being more or less common.

A natural history of the diatoms of Big Spirit Lake was in preparation by the senior author of the present paper for many years. Last summer, in answer to a particular request, he provided a list of common diatoms from Spirit Lake, and it was our intent to persuade him to publish this as a preliminary note. However his untimely death intervened. It now seems particularly appropriate that Krohn's name become associated with the published record of Iowa diatoms and we are presenting this paper in his behalf.

## MATERIAL AND METHODS

Big Spirit Lake is the largest natural lake in Iowa, covering some 5,600 acres. It is located in Dickinson County, in the northwest sector of the state. It is a shallow, prairie lake with a rich algal flora, and was formed 10-12,000 years ago during the latest retreat of the Wisconsin glacier from the region.

Mr. Krohn's collections were made in all seasons and covered a span of three years. It was his intent to provide both a definitive diatom flora for this lake and significant ecological data for the major taxa. His techniques for collecting diatoms and preparing them for study were essentially those described by several authors including Stoermer (1966), Begres (1971) and Edwards and Christensen (1972). We checked his list carefully and added some additional common taxa, on the basis of scanning a number of slides in a similar collection of Spirit Lake diatoms prepared by one of us (Edwards). The combined list is the basis for Table 1. The

standard references used for purposes of identification were Patrick and Reimer (1966) and Hustedt (1930). No distinction is made herein between planktonic, benthic, epilithic, epipelagic, epiphytic, epizooic, etc., forms, because in broad, shallow lakes such as Spirit Lake, wind and wave action constantly sweep non-planktonic forms into the planktonic milieu. (However, an effort in this direction is part of a larger study now in progress.)

In addition, we have checked the Spirit Lake list against Stoermer's (1966) list of diatoms from Lake West Okoboji, also in Dickinson County, and Begres' (1971) list of diatoms from Clear Lake, in Cerro Gordo County. The occurrences of a few additional taxa not reported from West Okoboji by Stoermer (1966) are validated by specimens in the Diatom Herbarium maintained at the Iowa Lakeside Laboratory by Dr. Charles W. Reimer, to whom the authors, individually and collectively, owe a debt of gratitude for assistance in various diatom investigations.

In those columns of Table 1 which refer to Lake West Okoboji and Clear Lake, respectively, the symbol + refers to presence only and does not refer to relative abundance; the abbreviation *ab* refers to absence; and the use of - indicates a degree of uncertainty due to such factors as the report of a closely related minor variety rather than the one listed, a recent nomenclatural change or an unresolved problem in nomenclature. It should be clearly understood that this list is not, in itself, an adequate representation of the common diatoms of Lake West Okoboji or Clear Lake.

## RESULTS

The 139 taxa listed in Table 1 as common in Spirit Lake are distributed among 34 genera. Only eight of these are notably absent from the flora of Lake West Okoboji and a larger number (30) are absent from Clear Lake. We find the following "discrepancies" particularly interesting.

1. The absence of *Caloneis amphisbaena*, *Diploneis elliptica*, *Gomphonema acuminatum* var. *coronata*, *Navicula disjuncta*, *Surirella brightwellii* and *Synedra radians* from both Lake West Okoboji and Clear Lake.

2. The additional absence from Clear Lake of *Campylo-discus noricus* var. *hibernicus*, *Cocconeis disculus*, *Gomphoneis erienne* var. *sensu* Stoermer (1964), *Mastogloia smithii* var. *lacustris*, *Navicula scutelloides*, *N. tripunctata* var. *schizonemoides*, *Nitzschia tryblionella* var. *levidensis*, *Stephanodiscus astraea* and *Synedra cyclosum*.

<sup>1</sup> This paper is presented in behalf of the senior author, Milbert Krohn, a science teacher in the Spirit Lake High School, who died in an airplane accident in August, 1973.

<sup>2</sup> Support for Mr. Krohn in the early phases of his research was through the NSF Program for Research Participation by high school science teachers. Portions of this work were done at Iowa Lakeside Laboratory.

SPIRIT LAKE DIATOMS

TABLE 1. COMMON DIATOMS OF BIG SPIRIT LAKE.

The symbols used in the columns headed Lake West Okoboji and Clear Lake, respectively, refer merely to presence (+) or absence (ab) of the listed forms in those lakes, and this list should not be considered a definitive checklist for either of them. The use of (-) implies an uncertainty, as explained in the text.

	Occurrence in			
	Lake West Okoboji	Clear Lake		
<i>Achnanthes exigua</i> var. <i>heterovalva</i> Krasske	+	+	<i>G. angustatum</i> (Kütz.) Rabh. var. <i>angustatum</i>	+ +
<i>A. lanceolata</i> (Bréb.) Grun. var. <i>lanceolata</i>	+	+	<i>G. constrictum</i> Ehr. var. <i>constrictum</i>	+ +
<i>A. lanceolata</i> var. <i>dubia</i> Grun.	+	+	<i>G. gracile</i> var. <i>naviculoides</i> (Wm. Smith) Grun.	- +
<i>A. lanceolata</i> var. <i>omissa</i> Reim.	-	+	<i>G. intricatum</i> var. <i>pumila</i> Grun.	+ +
<i>Amphipleura pellucida</i> (Ehr.) Kütz. var. <i>pellucida</i>	+	+	<i>G. olivaceum</i> (Lyngbye) Kütz. var. <i>olivaceum</i>	+ +
<i>Amphiprora ornata</i> Bailey var. <i>ornata</i>	+	+	<i>G. parvulum</i> (Kütz.) Grun. var. <i>parvulum</i>	+ +
<i>Amphora ovalis</i> Kütz. var. <i>ovalis</i>	+	-	<i>Gyrosigma attenuatum</i> (Kütz.) Rabh. var. <i>attenuatum</i>	+ +
<i>A. ovalis</i> var. <i>affinis</i> (Kütz.) V.H.	+	+	<i>G. sciotense</i> (Sulliv. and Wormley) Cl. var. <i>sciotense</i>	+ -
<i>A. ovalis</i> var. <i>pediculus</i> (Kütz.) V.H.	+	+	<i>Hantzschia amphioxys</i> (Ehr.) Grun. var. <i>amphioxys</i>	+ -
<i>A. veneta</i> Kütz. var. <i>veneta</i>	+	+	<i>Mastogloia grevillei</i> Wm. Smith var. <i>grevillei</i>	+ +
<i>Anomooneis sphaerophora</i> (Ehr.) Pfitzer var. <i>sphaerophora</i>	+	-	<i>M. smithii</i> var. <i>lacustris</i> Grun.	+ ab
<i>Asterionella formosa</i> Hassall var. <i>formosa</i>	+	+	<i>Melosira granulata</i> (Ehr.) Ralfs. var. <i>granulata</i>	+ +
<i>Caloneis amphisbaena</i> (Bory) Cl. var. <i>amphisbaena</i>	ab	ab	<i>M. granulata</i> var. <i>angustissima</i> O. Müll.	+ +
<i>C. bacillum</i> (Grun.) Cl. var. <i>bacillum</i>	+	+	<i>M. italica</i> (Ehr.) Kütz. var. <i>italica</i>	+ -
<i>C. clevei</i> var. <i>uruguayensis</i> Freng.	ab	ab	<i>M. varians</i> Agardh var. <i>variens</i>	+ +
<i>C. lewisii</i> Patr. var. <i>lewisii</i>	+	ab	<i>Meridion circumare</i> (Grev.) Agardh var. <i>circulare</i>	+ +
<i>C. lewisii</i> var. <i>inflata</i> (Schultze) Patr.	+	ab	<i>Navicula accomoda</i> Hust. var. <i>accomoda</i>	+ ab
<i>C. limosa</i> (Kütz.) Patr. var. <i>limosa</i>	-	-	<i>N. capitata</i> Ehr. var. <i>capitata</i>	- +
<i>C. silicula</i> (Ehr.) Cl. var. <i>silicula</i>	+	+	<i>N. capitata</i> var. <i>hungarica</i> (Grun.) Ross	+ +
<i>Campylodiscus noricus</i> var. <i>hibernicus</i> (Ehr.) Grun.	+	ab	<i>N. cryptocephala</i> Kütz. var. <i>cryptocephala</i>	+ +
<i>Cocconeis disculus</i> (Schum.) Cl. var. <i>disculus</i>	+	ab	<i>N. cryptocephala</i> var. <i>veneta</i> (Kütz.) Rabh.	+ +
<i>C. pediculus</i> Ehr. var. <i>pediculus</i>	+	+	<i>N. cuspidata</i> (Kütz.) Kütz. var. <i>cuspidata</i>	+ +
<i>C. placentula</i> var. <i>euglypta</i> (Ehr.) Cl.	+	ab	<i>N. decussis</i> østr. var. <i>decussis</i>	+ +
<i>C. placentula</i> var. <i>lineata</i> (Ehr.) V.H.	+	+	<i>N. disjuncta</i> Hust. var. <i>disjuncta</i>	ab ab
<i>Cyclotella meneghiniana</i> Kütz. var. <i>meneghiniana</i>	+	+	<i>N. exigua</i> Greg. ex Grun. var. <i>exigua</i>	- -
<i>Cymatopleura cochlea</i> J. Brun. var. <i>cochlea</i>	+	+	<i>N. exigua</i> var. <i>capitata</i> Patr.	+ -
<i>C. elliptica</i> (Bréb.) Wm. Smith var. <i>elliptica</i>	+	ab	<i>N. gastrum</i> (Ehr.) Kütz. var. <i>gastrum</i>	- ab
<i>C. solea</i> (Bréb.) Wm. Smith var. <i>solea</i>	+	+	<i>N. heufleri</i> Grun. var. <i>heufleri</i>	+ +
<i>Cymbella affinis</i> Kütz. var. <i>affinis</i>	+	+	<i>N. laevisissima</i> Kütz. var. <i>laevisissima</i>	- -
<i>C. aspera</i> (Ehr.) Hérib. var. <i>aspera</i>	+	+	<i>N. lanceolata</i> (Agardh) Kütz. var. <i>lanceolata</i>	+ +
<i>C. cistula</i> (Ehr. in Hempr. and Ehr.) Kütz. in Cohn var. <i>cistula</i>	+	+	<i>N. menisculus</i> var. <i>upsaliensis</i> (Grun.) Grun.	- +
<i>C. microcephala</i> Grun. var. <i>microcephala</i>	+	+	<i>N. minima</i> Grun. var. <i>minima</i> (Compare <i>N. nigrii</i> De Notaris)	+ +
<i>C. prostrata</i> (Berk.) Cl. var. <i>prostrata</i>	+	+	<i>N. mutica</i> Kütz. var. <i>mutica</i>	+ +
<i>C. sinuata</i> Greg. var. <i>sinuata</i>	+	+	<i>N. pelliculosa</i> (Bréb., ex Kütz.) Hilse var. <i>pelliculosa</i>	ab ab
<i>C. tumida</i> (Bréb.) V.H. var. <i>tumida</i>	+	ab	<i>N. pseudoreinhardtii</i> Patr. var. <i>pseudoreinhardtii</i>	+ -
<i>C. turgida</i> var. <i>pseudogracilis</i> Chohn.	+	+	<i>N. pupula</i> Kütz. var. <i>pupula</i>	+ +
<i>C. ventricosa</i> (Kütz.) sensu Hust. 1930 var. <i>ventricosa</i>	+	ab	<i>N. pupula</i> var. <i>rectangularis</i> (Greg.) Grun.	+ +
<i>Diatoma vulgare</i> Bory var. <i>vulgare</i>	+	+	<i>N. radiosa</i> var. <i>tenella</i> (Bréb. ex Kütz.) Grun.	+ +
<i>Diploneis elliptica</i> (Kütz.) Cl. var. <i>elliptica</i>	ab	ab	<i>N. reinhardtii</i> (Grun.) Grun. var. <i>reinhardtii</i>	+ +
<i>Epithemia sorex</i> Kütz. var. <i>sorex</i>	+	+	<i>N. salinarum</i> var. <i>intermedia</i> (Grun.) Cl.	+ +
<i>E. turgida</i> (Ehr.) Kütz. var. <i>turgida</i>	+	+	<i>N. scutelloides</i> Wm. Smith ex Greg. var. <i>scutelloides</i>	+ ab
<i>E. zebra</i> var. <i>porcellus</i> (Kütz.) Grun.	+	ab	<i>N. tripunctata</i> var. <i>schizonemoides</i> (V.H.) Patr.	+ ab
<i>Fragilaria brevistriata</i> Grun. var. <i>brevistriata</i>	+	+	<i>N. tuscula</i> Ehr. var. <i>tuscula</i>	+ +
<i>F. capucina</i> Desm. var. <i>capucina</i>	+	+	<i>N. variostrata</i> Krasske var. <i>variostrata</i>	- -
<i>F. capustrina</i> var. <i>mesolepta</i> Rabh.	+	+	<i>N. viridula</i> var. <i>rostellata</i> (Kütz.?) Cl.	- -
<i>F. construens</i> (Ehr.) Grun. var. <i>construens</i>	+	+	<i>N. vulpina</i> Kütz. var. <i>vulpina</i>	+ +
<i>F. crotonensis</i> Kitton var. <i>crotonensis</i>	+	+	<i>Neidium affine</i> (Ehr.) Pfitz. var. <i>affine</i>	+ +
<i>F. leptostauron</i> var. <i>dubia</i> (Grun.) Hust.	-	-	<i>N. dubium</i> (Ehr.) Cl. var. <i>dubium</i>	+ +
<i>F. vaucheriae</i> (Kütz.) Peters. var. <i>vaucheriae</i>	+	+	<i>Nitzschia acicularis</i> (Kütz.) Wm. Smith var. <i>acicularis</i>	+ +
<i>F. vaucheriae</i> var. <i>capitellata</i> (Grun.) Patr.	-	+	<i>N. amphibia</i> Grun. var. <i>amphibia</i>	+ +
<i>Gomphonensia eriense</i> var. --- sensu Stoermer 1964	+	ab	<i>N. angustata</i> (Wm. Smith) Grun. var. <i>angustata</i>	+ +
<i>Gomphonema acuminatum</i> Ehr. var. <i>acuminatum</i>	+	-	<i>N. apiculata</i> (Greg.) Grun. var. <i>apiculata</i>	+ ab
<i>G. acuminatum</i> var. <i>coronata</i> (Ehr.) Wm. Smith	ab	ab	<i>N. dissipata</i> (Kütz.) Grun. var. <i>dissipata</i>	+ +
			<i>N. fonticola</i> Grun. in V.H. var. <i>fonticola</i>	+ +
			<i>N. frustulum</i> (Kütz.) Rabh. var. <i>frustulum</i>	+ +
			<i>N. hungarica</i> Grun. var. <i>hungarica</i>	+ ab
			<i>N. linearis</i> (Agardh) Wm. Smith var. <i>linearis</i>	+ +
			<i>N. palea</i> (Kütz.) Wm. Smith var. <i>palea</i>	+ +
			<i>N. sigmoidea</i> (Nitz.) Wm. Smith var. <i>sigmoidea</i>	+ +
			<i>N. tryblionella</i> var. <i>levidensis</i> (Wm. Smith) Grun.	+ ab
			<i>Opephora martyi</i> Hérib. var. <i>martyi</i>	+ +
			<i>Pinnularia brebissonii</i> (Kütz.) Rabh. var. <i>brebissonii</i>	+ +
			<i>P. viridis</i> (Nitz.) Ehr. var. <i>viridis</i>	+ +
			<i>Rhoicosphenia curvata</i> (Kütz.) Grun. ex Rabh. var. <i>curvata</i>	+ +

<i>Rhopalodia gibba</i> (Ehr.) O. Müll. var. <i>gibba</i>	+	+
<i>R. gibberula</i> (Ehr.) O. Müll. var. <i>gibberula</i>	+	ab
<i>Stauroneis acuta</i> Wm. Smith var. <i>acuta</i>	+	+
<i>S. anceps</i> Ehr. var. <i>anceps</i>	+	ab
<i>S. phoenicenteron</i> (Nitz.) Ehr. var. <i>phoenicenteron</i>		
<i>Stephanodiscus astraea</i> (Ehr.) Grun. var. <i>astraea</i>	+	ab
<i>S. astraea</i> var. <i>minutula</i> (Kütz.) Grun.	+	+
<i>S. hantzschii</i> Grun. var. <i>hantzschii</i>	+	-
<i>S. niagarae</i> Ehr. var. <i>niagarae</i>	+	+
<i>Surirella angusta</i> Kütz. var. <i>angusta</i>	+	+
<i>S. biseriata</i> f. <i>punctata</i> Meister	+	+
<i>S. brightwellii</i> Wm. Smith var. <i>brightwellii</i>	ab	ab
<i>S. linearis</i> Wm. Smith var. <i>linearis</i>	+	-
<i>S. ovata</i> Kütz. var. <i>ovata</i>	+	ab
<i>S. ovata</i> var. <i>pinnata</i> (Wm. Smith) Hust.	+	+
<i>S. tenera</i> Greg. var. <i>tenera</i>	+	-
<i>Synedra acus</i> Kütz. var. <i>acus</i>	+	+
<i>S. cyclopus</i> Brutschy var. <i>cyclopus</i>	+	ab
<i>S. parasitica</i> var. <i>subconstricta</i> (Grun.) Hust.	-	-
<i>S. radians</i> Kütz. var. <i>radians</i>	ab	ab
<i>S. ulna</i> (Nitz.) Ehr. var. <i>ulna</i>	+	+
<i>S. ulna</i> var. <i>contracta</i> Østr.	-	-

## DISCUSSION

It is from observations such as these that suggestions for significant ecological investigations on the distribution of diatom taxa may arise. For instance, the absence of *Navicula scutelloides* and *Gomphoneis eriense* var. —, from Clear Lake, in contrast with their relative abundance in the north-west Iowa lakes, suggests the possibility that an identifiable ecological factor may limit the distributions of these taxa.

Some of the forms found in lakes may well be stream forms carried into the lake. This is possibly true for *Caloneis*

*amphisbaena*, *Navicula accomoda*, *N. disjuncta*, *N. pelliculosa* and *Nitzschia tryblionella* var. *levidensis*, since the data summarized by Dodd (1971) show these forms are common in streams rather than lakes.

It is anticipated that a complete analysis of the Krohn and Edwards collections will add perhaps 200 additional "uncommon" taxa to the list of Spirit Lake diatoms. When that list is complete it will be possible to make the obverse comparisons between the common diatoms of Lake West Okoboji and Clear Lake and those present in Spirit Lake.

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