RESULTS OF SEDIMENT CORES TAKEN FROM SISSABAGAMA LAKE, SAWYER COUNTY, SPIRIT LAKE, TAYLOR COUNTY, AND NORTH SPIRIT LAKE, PRICE COUNTY, WISCONSIN

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Aquatic organisms are good indicators of a lake's water quality because they are in direct contact with the water and are strongly affected by the chemical composition of their surroundings. Most indicator groups grow rapidly and are short lived so the community composition responds rapidly to changing environmental conditions. One of the most useful organisms for paleolimnological analysis are diatoms. These are a type of algae which possess siliceous cell walls, which enables them to be highly resistant to degradation and are usually abundant, diverse, and well-preserved in sediments. They are especially useful, as they are ecologically diverse. Diatom species have unique features as shown in Figure 1, which enable them to be readily identified. Certain taxa are usually found under nutrient poor conditions

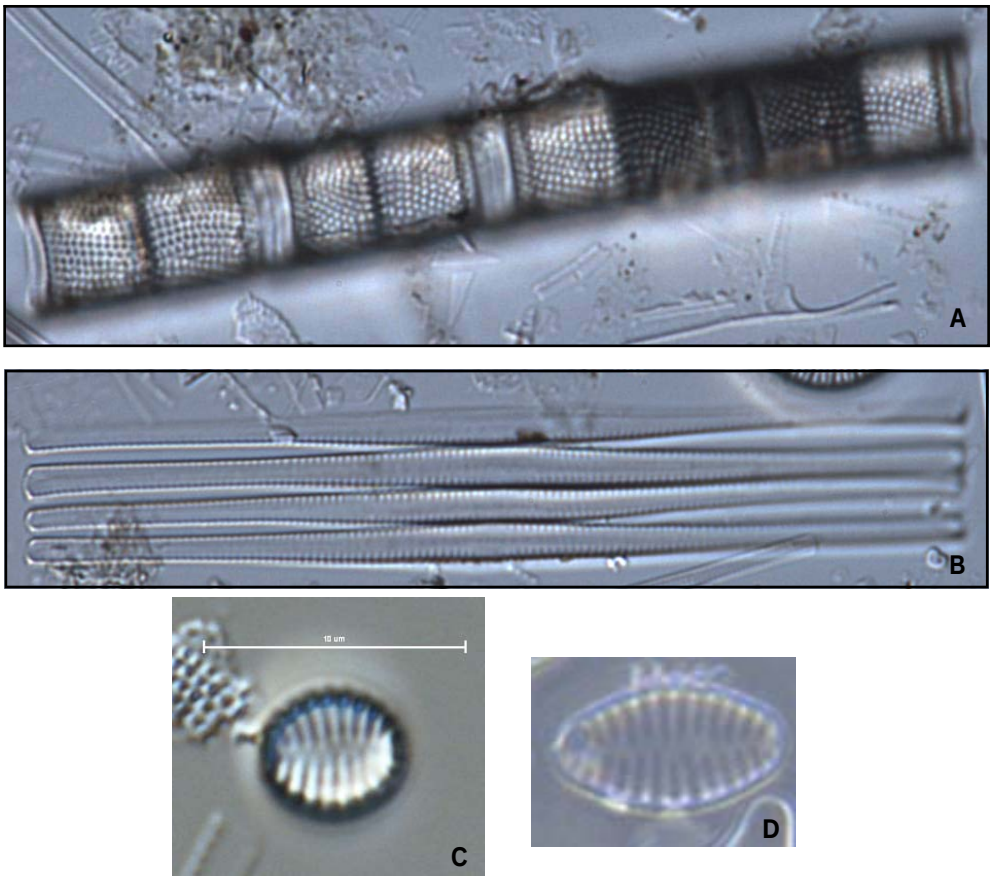

Figure 1. Photomicrographs of the diatoms commonly found in the study lakes. The top two diatoms, *Aulacoseira am*bigua (A), and *Fragilaria crotonensis* (B) are found in the open water environments while the bottom two diatoms are part of the benthic *Fragilaria* (C and D). The latter two diatoms are commonly found attached to substrates such as macrophytes. The top diatom, *A. ambigua*, was a common part of the diatom community in bottom sample in all three lakes.

while others are more common under elevated nutrient levels. Some species float in the open water areas while others grow attached to objects such as aquatic plants or the lake bottom.

By determining changes in the diatom community it is possible to determine water quality changes that have occurred in the lake. The diatom community provides information about changes in nutrient concentrations, water clarity, and pH conditions as well as alterations in the aquatic plant (macrophyte) community.

On 5 and 6 October 2010 sediment cores were collected from lakes Sissabagama, Spirit, and North Spirit with a gravity corer. A sample from the top of the core and near the bottom was retained for analysis. Radiochemical analysis indicated that the cores from lakes Sissabagama and Spirit were not deep enough to reach presettlement times. Consequently another, longer core was extracted from these lakes. These cores were collected on 13 June 2011 at the same location as the previous cores. The location of the cores and water and core depth are given in Table 1.

Lake	County	GPS Coordinates	Water Depth (m)	Depth of Core (cm)	Depth of Second Core (cm)
Sissabagama	Sawyer	45.78975° 91.51013°	12.5	42	90
Spirit	Price	45.37819° 90.13422°	2.4	38	96
North Spirit	Taylor	45.38159° 90.15440°	5.8	42	NA

Results

Good cores were collected from all of the lakes and there were adequate diatoms in the samples. In none of the samples did the diatoms appear to have been unduly degraded. This means that the diatom community should accurately document water quality changes that have occurred in the lakes. The radiochemical analysis for the cores collected in October indicated that presettlement conditions were reached in the North Spirit Lake core but not in the other two cores. Since Pb-210 is a breakdown product of radium-226 if the cores are deep enough to reach background levels, there values should be similar. Since cesium-137 is a byproduct of atmospheric nuclear testing which occurred from 1954-1963 the levels should be undetectable. Since the cores from Spirit and Sissabagama were too shallow, additional , longer cores were collected in June 2011.

Table 2. Radiochemistry results from the 3 cores. Lead-210 values should be similar to Ra-226 if the cores are long enough to reach pre-settlement times. Likewise, Cs-137 should be undetectable.

Lake	County	Lead-210 (pCi g^{-1})	Radium-226 (pCi g^{-1})	Cesium-137 (pCi g^{-1})
Sissabagama	Sawyer	8.6785	1.1724	1.0356
Spirit	Price	1.7021	0.7379	<0.2812
North Spirit	Taylor	0.8977	0.6204	<0.2921

Sissabagama Lake

In Sissabagama Lake, historically the major component of the diatom community are those species that float in the open water of the lake. The major taxa of these planktonic diatoms in the bottom sample were the chain forming diatom *Aulacoseira ambigua* and small amounts of *Fragilaria crotonensis* and *Asterionella formosa* (Figure 2). These diatoms are common in lakes throughout the Upper Midwest with moderate nutrient levels. These diatoms grow in the upper part of the water column and are usually found throughout the growing season.

In the top sample the abundance of *A. ambigua* declined and was replaced by *F. crotonensis* and *A. formosa*. Both of these species are some of the first diatoms to increase as a result of nutrient enrichment following human disturbances. Recent studies have shown that these diatoms respond more to an increase in nitrogen as well as an increase in phosphorus.

The percentage of planktonic diatoms was greater in the bottom than the top samples (Figure 2). Many lakes in northern Wisconsin have experienced a decline in the abundance of planktonic diatoms in response to change in submerged aquatic vegetation (SAV). These lakes also experience an increase in species richness and an increase in species diversity as the SAV provide additional habitat for diatom growth. In Sissabagama Lake this trend occurred (Table 3) indicating a likely increase in SAV at the present time compared with presettlement conditions. Dr. Susan Borman recently conducted a study in lakes in the northwestern part of WI where she compared the SAV community in the 1930s with the present

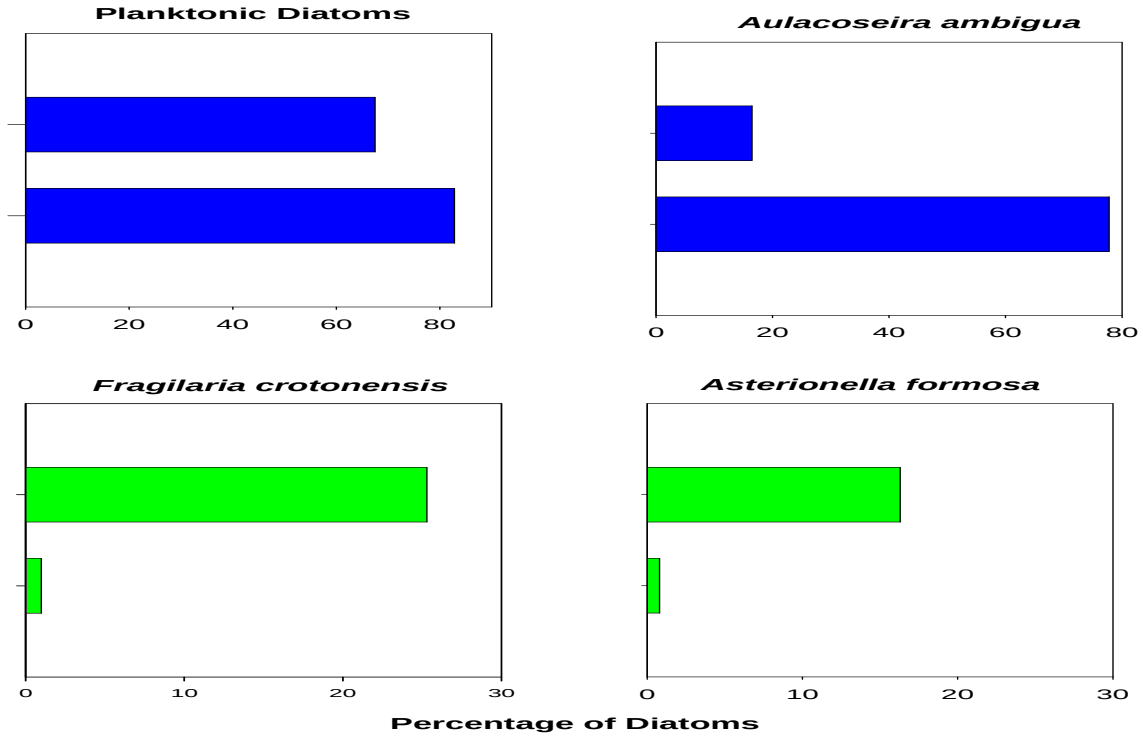

Figure 2. Changes in the abundance of important diatoms found at the top and bottom of the Sissabagama Lake sediment core. The dominant diatoms were planktonic diatoms which float in the open water. The decline in *A. ambigua* and increase in *F. crotonensis* indicates a increase in nutrients.

day community. She found that lakes with cottages have more plants and the species have shifted to those that are larger and grow closer to the lake's surface. The diatom community indicates this has happened in Sissabagama Lake.

Table 3. Number of species and diatom community diversity in the core from Sissabagama Lake.

	Number of diatom taxa	Diversity of diatom community
Top Sample	42	2.85
Bottom Sample	27	1.09

Diatom assemblages historically have been used as indicators of nutrient changes in a qualitative way. In recent years, ecologically relevant statistical methods have been developed to infer environmental conditions from diatom assemblages. These methods are based on multivariate ordination and weighted averaging regression and calibration. Ecological preferences of diatom species are determined by relating modern limnological variables to surface sediment diatom assemblages. The species-environment relationships are then used to infer environmental conditions from fossil diatom assemblages found in the sediment core.

Such a model was applied to the diatom community in the core from Sissabagama Lake. The model indicates the presettlement phosphorus concentration in the lake was around 15 µg L^{-1} while the present day concentration is 20 µg L^{-1}. This represents an increase in phosphorus levels of about 5 µg L^{-1}. I was not able to apply the model to changes in nitrogen concentrations but it is likely the change has not be more than 0.1 mg L^{-1}.

Spirit Lake

In Spirit Lake the presettlement diatom community was evenly divided between diatoms that grow attached to substrates, such as submerged aquatic vegetation (SAV) and planktonic diatoms that grow in the open water. At the present time, most of the diatoms are nonplanktonic taxa. In the top and bottom samples most of the nonplanktonic diatoms are in the group benthic *Fragilaria* (Figure 3). These diatoms grow in long filaments and are frequently found attached to SAV.

In the top sample the abundance of *A. ambigua* declines and is replaced by *A. formosa* and *F. crotonensis*. Both of these species are some of the first diatoms to increase as a result of nutrient enrichment following human disturbances. This change in diatom taxa is similar to that experienced in Sissabagama Lake but in Spirit Lake these taxa are a much smaller proportion of the diatom community.

The diatom community in the top sample has a higher number of species than the bottom sample and the diversity is higher (Table 4). This indicates that while SAV were common at

Table 4. Number of species and diatom community diversity in the core from Spirit Lake.

	Number of diatom taxa	Diversity of diatom community
Top Sample	49	2.76
Bottom Sample	35	1.99

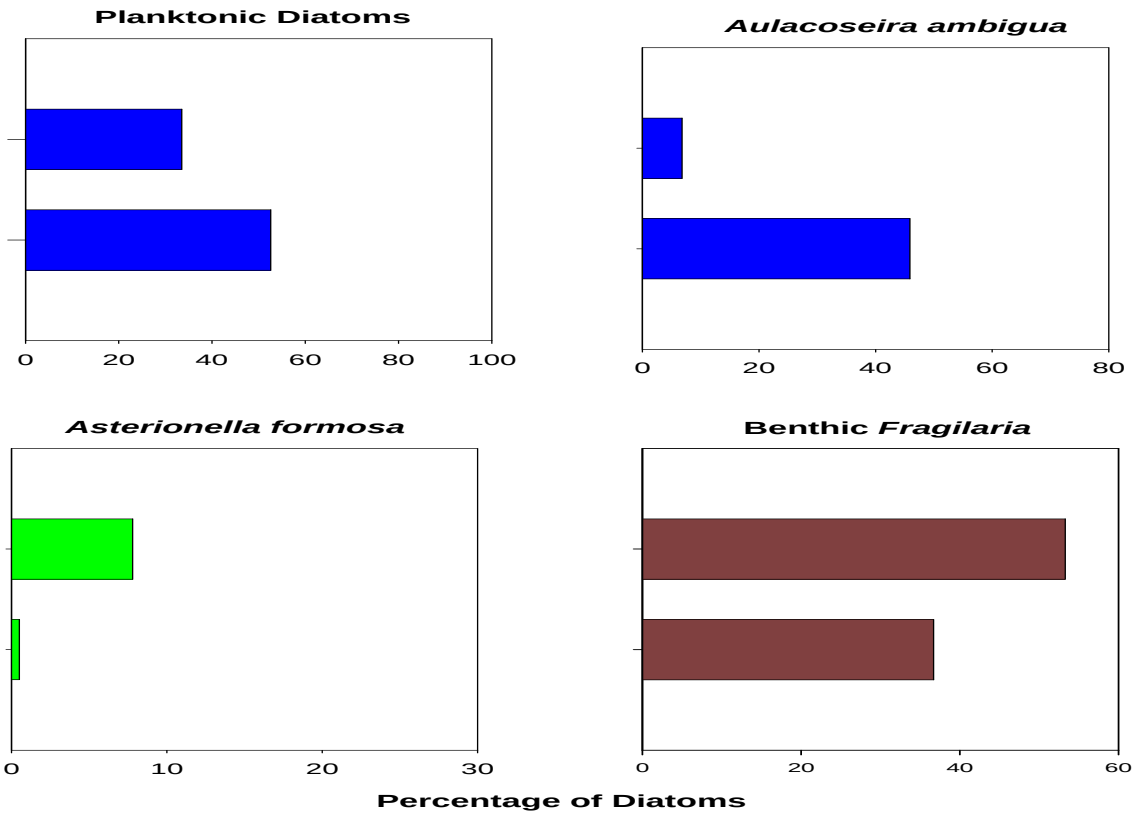

Figure 3. Changes in the abundance of important diatoms found at the top and bottom of the Spirit Lake sediment core. The dominant diatoms at the bottom of the core were planktonic but they shifted to nonplanktonic diatoms at the top of the core. This indicates an increase in growth of submerged aquatic vegetation.

the time the bottom sample was deposited there likely has been an increase in the macrophyte community in recent times.

The model that was applied to the diatom community in Spirit Lake estimated that the presettlement phosphorus concentration was about 44 µg L^{-1}. The model estimated the present day concentration was 117 µg L^{-1} which is similar to the measured values of the last 5 years. The model indicates a substantial increase of phosphorus since presettlement times.

North Spirit Lake

In North Spirit Lake the diatom community was historically dominated by planktonic diatoms. As with Sissabagama Lake, the dominant species was *A. ambigua* (Figure 4). Like the other two lakes, the diatom community changed significantly in the top sample. The planktonic diatom, *A. ambigua* was replaced by *Stephanodiscus hantzschii* which is typically found in higher phosphorus concentrations. There has been a decline in the abundance of planktonic diatoms and they have been replaced by benthic *Fragilaria,* especially *Fragilaria capucina*.

Spirit and North Spirit lakes are adjacent and connected, and historically the diatom communities were somewhat similar. There were more nonplanktonic diatoms in Spirit Lake but the dominant taxa were similar. At the present time the communities are much more similar,

although planktonic diatoms are more common in North Spirit Lake. Benthic *Fragilaria* are common in the top samples of both lakes. In North Spirit Lake there has been in an increase in species richness and diversity (Table 5) which is an indication of increased SAV growth in recent years.

The modeling effort for North Spirit Lake indicates that phosphorus concentrations have increased significantly between the bottom and top sample. The average summer phosphorus concentration measured in the lake during the period 2005-10 was 77 µg L^{-1} while the estimated present day concentration is 94 µg L^{-1}. The model estimates that the historical phosphorus concentration was about 52 µg L^{-1} which is much lower than the present day levels.

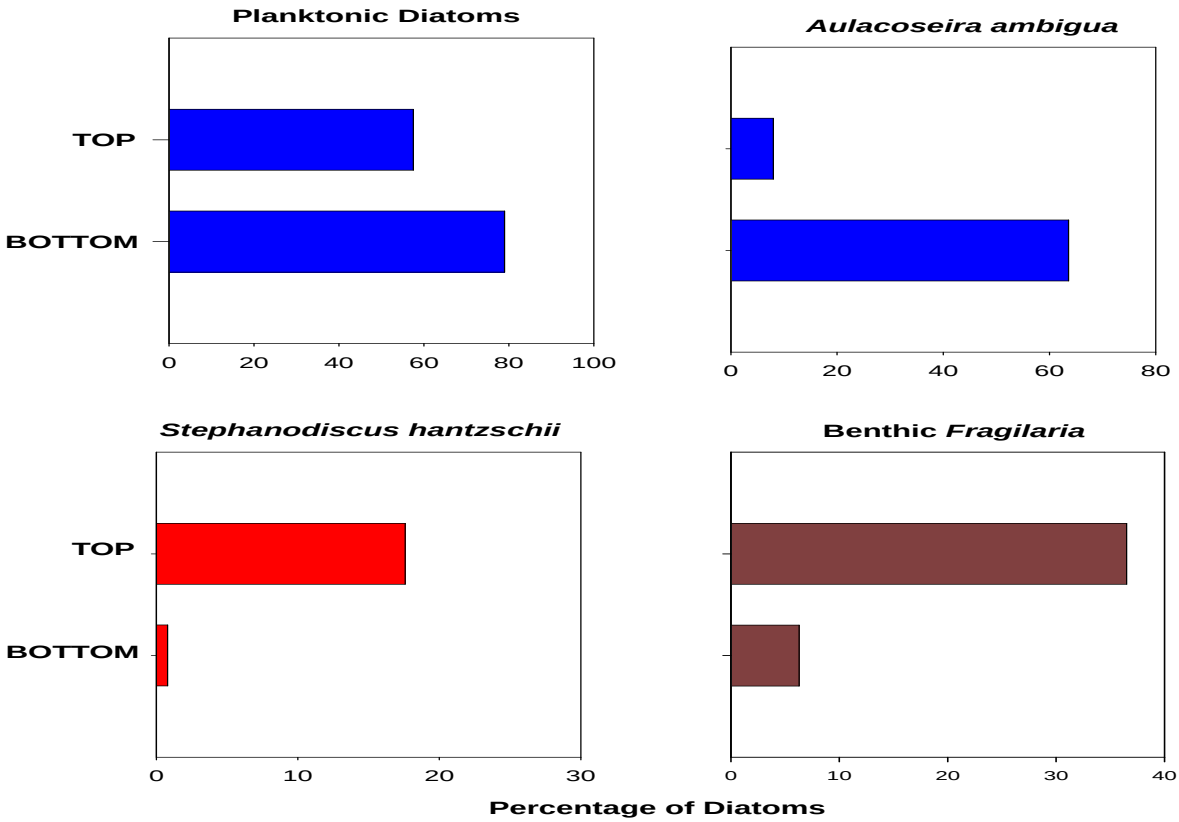

Figure 4. Changes in the abundance of important diatoms found at the top and bottom of the North Spirit Lake sediment core. There was a significant shift of diatom community with planktonic diatoms becoming less important in the top sample. This indicates an increase in growth of the SAV community. The replacement of A. ambigua with S. hantzschii signals and increase in phosphorus.

Table 5. Number of species and diatom community diversity in the core from North Spirit Lake.

	Number of diatom taxa	Diversity of diatom community
Top Sample	36	2.49
Bottom Sample	24	1.55

Summary

The diatom communities indicate that phosphorus concentrations in all the lakes is higher now than they were historically (Table 6). The phosphorus concentrations in Lake Sissabagama are about 5 µg L^{-1} higher now compared with presettlement levels. Phosphorus levels have increased much more in Spirit and North Spirit lakes. Historically both of these lakes had phosphorus levels in the eutrophic range but they are much higher now.

The extent of the SAV community has increased in all three lakes. This is common in lakes that have experienced cottage development. It is likely this is reflected the growth of plant species that are more architecturally diverse and grow higher in the water column.

Table 6. Mean summer phosphorus concentrations in the study lakes (µg L^{-1}). The observed value represents the last 5 years. The concentration for the top and bottom samples were estimated from the diatom community.

	Observed P	Top	Bottom
Sissabagama	23	20	15
Spirit	120	117	44
North Spirit	77	94	52

SISSABAGAMA LAKE		
Sawyer County		
Top (0-1 cm)		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthidium minutissimum (Kützing) Czarnecki	13	0.033
Asterionella formosa Hassal	65	0.163
Aulacoseira ambigua (Grunow) Simonsen	62	0.155
Aulacoseira ambigua (Grunow) Simonsen narrow morph	4	0.010
Aulacoseira granulata (Ehrenberg) Simonsen	10	0.025
Aulacoseira granulata var. angustissima (Müller) Simonsen	1	0.003
Cocconeis neothumensis Krammer	1	0.003
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	4	0.010
Cyclotella bodanica var. lemanica Müller	1	0.003
Cymbella naviculiformis Auerswald ex Héribaud	2	0.005
Discostella stelligera (Hustedt) Houk et Klee	11	0.028
Discostella stelligeroides (Hustedt) Houk et Klee	4	0.010
Encyonopsis microcephala (Grunow) Krammer	3	0.008
Eunotia incisa Smith ex Gregory	3	0.008
Eunotia spp.	1	0.003
Fragilaria capucina Desmazières	1	0.003
Fragilaria capucina var. mesolepta Rabenhorst	15	0.038
Fragilaria capucina var. rumpens (Kützing) Lange-Bertalot	1	0.003
Fragilaria crotonensis Kitton	81	0.203
Fragilaria crotonensis var. oregona Sovereign	21	0.053
Fragilaria sepes Ehrenberg	7	0.018
Fragilaria tenera (Smith) Lange-Bertalot	2	0.005
Geissleria acceptata (Hustedt) Lange-Bertalot et Metzeltin	1	0.003
Gomphonema cf. angusticephalum Reichardt	2	0.005
Gomphonema gracile Ehrenberg emend Van Heurck	3	0.008
Gomphonema pumilum (Grunow) Reichardt et Lange-Bertalot	2	0.005
Karayevia clevei (Grunow) Bukhtiyarova	1	0.003
Navicula cryptocephala Kützing	2	0.005
Navicula minima Grunow	1	0.003
Navicula rhynchocephala Kützing	2	0.005
Navicula tantula Hustedt	4	0.010
Nitzschia lacuum Lange-Bertalot	2	0.005
Nitzschia linearis var. subtilis Hustedt	1	0.003
Nitzschia perminuta (Grunow) Peragallo	1	0.003
Nitzschia spp.	1	0.003
Opephora olsenii Møller	1	0.003
Platessa conspicua (Mayer) Lange-Bertalot	4	0.010
Pseudostaurosira trainorii Morales	3	0.008
Rhizosolenia longiseta Zacharias	1	0.003
Sellaphora seminulum (Grunow) Mann	4	0.010
Sellaphora spp.	1	0.003
Staurosira construens var. venter morph 1	4	0.010
Staurosirella pinnata (Ehrenberg) Williams et Round	4	0.010
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	2	0.005
Synedra biceps Kützing	1	0.003
Synedra delicatissima var. angustissima Grunow	6	0.015
Tabellaria flocculosa (strain III) sensu Koppen	2	0.005
Tabellaria flocculosa (strain IIIp) sensu Koppen	24	0.060
Tabellaria flocculosa var. linearis Koppen	7	0.018
TOTAL	400	1.000

SISSABAGAMA LAKE		
Sawyer County		
Bottom (86-88 cm)		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthes spp.	5	0.013
Achnanthes oblongella Østrup	2	0.005
Achnanthidium minutissimum (Kützing) Czarnecki	1	0.003
Asterionella formosa Hassal	3	0.008
Aulacoseira ambigua (Grunow) Simonsen	311	0.778
Aulacoseira lirata (Ehrenberg) Ross	1	0.003
Aulacoseira spp.	9	0.023
Cyclotella bodanica var. lemanica Müller	1	0.003
Cymbella spp.	2	0.005
Encyonema minutum (Hilse) Mann	2	0.005
Eunotia formica Ehrenberg	1	0.003
Eunotia incisa Smith ex Gregory	2	0.005
Fragilaria capucina var. gracilis (Østrup) Hustedt	3	0.008
Fragilaria crotonensis Kitton	4	0.010
Fragilaria vaucheriae (Kützing) Petersen	1	0.003
Gomphonema gracile Ehrenberg emend Van Heurck	1	0.003
Hantzschia amphioxys (Ehrenberg) Grunow	1	0.003
Navicula spp.	4	0.010
Pseudostaurosira brevistriata (Grunow) Williams et Round	6	0.015
Pseudostaurosira parasitica (Smith) Morales	2	0.005
Pseudostaurosira trainorii Morales	13	0.033
Puncticulata bodanica (Grunow in Schneider) Håkansson	2	0.005
Staurosira construens var. subsalina (Hustedt) Andresen, Stoermer et	1	0.003
Staurosira construens var. venter (Ehrenberg) Hamilton	5	0.013
Staurosirella pinnata (Ehrenberg) Williams et Round	5	0.013
Synedra rumpens var. familiaris (Kützing) Hustedt	1	0.003
Tabellaria flocculosa (strain III) sensu Koppen	1	0.003
Tabellaria spp.	3	0.008
unknown pennate	7	0.018
TOTAL	400	1.000

SPIRIT LAKE		
Taylor County		
Top (0-1 cm)		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthidium minutissimum (Kützing) Czarnecki	6	0.015
Amphora copulata (Kützing) Schoeman et Archibald	1	0.003
Asterionella formosa Hassal	31	0.078
Aulacoseira ambigua (Grunow) Simonsen	20	0.050
Aulacoseira ambigua (Grunow) Simonsen curved morph	7	0.018
Aulacoseira granulata (Ehrenberg) Simonsen	14	0.035
Aulacoseira granulata var. angustissima (Müller) Simonsen	10	0.025
Aulacoseira subarctica (Müller) Haworth	7	0.018
Aulacoseira tenella (Nygaard) Simonsen	6	0.015
Chamepinnularia sp. 1?	1	0.003
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	1	0.003
Ctenophora pulchella (Ralfs ex Kützing) Williams et Round	1	0.003
Cyclostephanos invisitatus (Hohn et Hellerman) Theriot, Stoermer et Håkansson	5	0.013
Cyclostephanos tholiformis Stoermer, Håkansson et Theriot	5	0.013
Discostella pseudostelligera (Hustedt) Houk et Klee	1	0.003
Discostella stelligera (Hustedt) Houk et Klee	1	0.003
Discostella woltereckii (Hustedt) Houk et Klee	7	0.018
Eunotia formica Ehrenberg	1	0.003
Eunotia soleirolii (Kützing) Rabenhorst	1	0.003
Fragilaria capucina Desmazières	1	0.003
Fragilaria capucina var. mesolepta Rabenhorst	7	0.018
Fragilaria capucina var. rumpens (Kützing) Lange-Bertalot	1	0.003
Fragilaria crotonensis Kitton	18	0.045
Fragilaria crotonensis var. oregona Sovereign	2	0.005
Geissleria acceptata (Hustedt) Lange-Bertalot et Metzeltin	2	0.005
Gomphonema spp.	2	0.005
Hantzschia amphioxys (Ehrenberg) Grunow	1	0.003
Lemnicola hungarica (Grunow) Round et Basson	2	0.005
Navicula cryptocephala Kützing	4	0.010
Navicula glomus Carter et Bailey-Watts	1	0.003
Navicula minima Grunow	4	0.010
Navicula tantula Hustedt	3	0.008
Nitzschia archibaldii Lange-Bertalot	4	0.010
Nitzschia frustulum (Kützing) Grunow	1	0.003
Nupela sp. 1	1	0.003
Planothidium biporomum (Hohn et Hellerman) Lange-Bertalot	1	0.003
Planothidium lanceolatum (Brébisson ex Kützing) Lange-Bertalot	1	0.003
Pseudostaurosira brevistriata (Grunow) Williams et Round	3	0.008
Pseudostaurosira trainorii Morales	90	0.225
Sellaphora pupula (Kützing) Mereschkowsky	1	0.003
Sellaphora seminulum (Grunow) Mann	4	0.010
Staurosira construens Ehrenberg	18	0.045
Staurosira construens var. venter (Ehrenberg) Hamilton	94	0.235
Stephanodiscus niagarae Ehrenberg	2	0.005
Stephanodiscus parvus Stoermer et Håkansson	2	0.005
Surirella angusta Kützing	1	0.003
Synedra acus Kützing	1	0.003
Synedra delicatissima var. angustissima Grunow	1	0.003
Tabellaria flocculosa (strain IV) sensu Koppen	1	0.003
TOTAL	400	1.000

SPIRIT LAKE		
Taylor County		
Bottom (92-94 cm)		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthes spp.	4	0.010
Achnanthidium minutissimum (Kützing) Czarnecki	2	0.005
Asterionella formosa Hassal	2	0.005
Aulacoseira ambigua (Grunow) Simonsen	184	0.459
Aulacoseira italica (Ehrenberg) Simonsen	10	0.025
Aulacoseira subarctica (Müller) Haworth	12	0.030
Cymbella spp.	1	0.002
Discotella pseudostelligera (Hustedt) Houk et Klee	3	0.007
Discotella stelligera (Hustedt) Houk et Klee	3	0.007
Eolimna minima (Grunow) Lange-Bertalot	3	0.007
Eunotia incisa Smith ex Gregory	1	0.002
Fragilaria capucina var. gracilis (Østrup) Hustedt	6	0.015
Fragilaria capucina var. mesolepta Rabenhorst	1	0.002
Fragilaria crotonensis Kitton	2	0.005
Fragilaria sepes Ehrenberg	1	0.002
Gomphonema spp.	1	0.002
Navicula subrotundata Hustedt	2	0.005
Neidium iridis (Ehrenberg) Cleve	1	0.002
Nitzschia palea (Kützing) Smith	1	0.002
Nitzschia spp.	1	0.002
Pseudostaurosira brevistriata (Grunow) Williams et Round	6	0.015
Pseudostaurosira trainorii Morales	92	0.229
Rhizosolenia longiseta Zacharias	1	0.002
Sellaphora pupula (Kützing) Meresckowsky	1	0.002
Sellaphora sp.	1	0.002
Staurosirella pinnata (Ehrenberg) Williams et Round	17	0.042
Staurosirella pinnata var. lancettula (Schumann) Siver et Hamilton	32	0.080
Synedra rumpens Kützing	1	0.002
Synedra rumpens var. familiaris (Kützing) Hustedt	5	0.012
Synedra ulna (Nitzsch) Ehrenberg	1	0.002
Tabellaria spp.	2	0.005
unknown pennate	1	0.002
TOTAL	401	1.000

NORTH SPIRIT LAKE		
Price County		
Top (0-1 cm)		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthidium minutissimum (Kützing) Czarnecki	2	0.005
Adlafia minuscula (Grunow) Lange-Bertalot	2	0.005
Asterionella formosa Hassal	66	0.165
Aulacoseira ambigua (Grunow) Simonsen	32	0.080
Aulacoseira granulata (Ehrenberg) Simonsen	2	0.005
Cyclostephanos tholiformis Stoermer, Håkansson et Theriot	1	0.003
Discostella woltereckii (Hustedt) Houk et Klee	3	0.008
Fragilaria capucina Desmazières	7	0.018
Fragilaria capucina var. mesolepta Rabenhorst	80	0.200
Fragilaria capucina var. rumpens (Kützing) Lange-Bertalot	1	0.003
Fragilaria crotonensis Kitton	28	0.070
Fragilaria crotonensis var. oregona Sovereign	9	0.023
Fragilaria vaucheriae (Kützing) Petersen	1	0.003
Geissleria decussis (Hustedt) Lange-Bertalot et Metzeltin	1	0.003
Geissleria similis (Krasske) Lange-Bertalot et Metzeltin	1	0.003
Gomphonema minutum (Agardh) Agardh	1	0.003
Gomphonema pumilum (Grunow) Reichardt et Lange-Bertalot	1	0.003
Karayevia clevei (Grunow) Bukhtiyarova	1	0.003
Navicula cf. minima Grunow	1	0.003
Navicula cryptocephala Kützing	1	0.003
Navicula minima Grunow	2	0.005
Nitzschia amphibia Grunow	1	0.003
Nitzschia archibaldii Lange-Bertalot	2	0.005
Nitzschia dissipata (Kützing) Grunow	2	0.005
Opephora olsenii Møller	1	0.003
Pinnularia abaujensis (Pantocsek) Ross	2	0.005
Pseudostaurosira trainorii Morales	9	0.023
Sellaphora laevissima (Kützing) Mann	1	0.003
Sellaphora pupula (Kützing) Meresckowsky	1	0.003
Staurosira construens var. venter (Ehrenberg) Hamilton	45	0.113
Staurosirella pinnata (Ehrenberg) Williams et Round	4	0.010
Stephanodiscus hantzschii fo. tenuis (Hustedt) Håkansson et Stoermer	5	0.013
Stephanodiscus hantzschii Grunow	65	0.163
Stephanodiscus niagarae Ehrenberg	16	0.040
Stephanodiscus parvus Stoermer et Håkansson	2	0.005
Synedra cyclopum Brutschy	1	0.003
TOTAL	400	1.000

NORTH SPIRIT LAKE		
Price County		
Bottom (38-40 cm)		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthidium minutissimum (Kützing) Czarnecki	3	0.008
Asterionella formosa Hassal	24	0.060
Aulacoseira ambigua (Grunow) Simonsen	251	0.628
Aulacoseira ambigua (Grunow) Simonsen narrow morph	3	0.008
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	2	0.005
Cyclostephanos tholiformis Stoermer, Håkansson et Theriot	1	0.003
Discostella stelligeroides (Hustedt) Houk et Klee	3	0.008
Discostella woltereckii (Hustedt) Houk et Klee	5	0.013
Eunotia bilunaris (Ehrenberg) Mills	1	0.003
Eunotia incisa Smith ex Gregory	2	0.005
Fragilaria capucina var. mesolepta Rabenhorst	7	0.018
Fragilaria capucina var. rumpens (Kützing) Lange-Bertalot	17	0.043
Fragilaria crotonensis Kitton	47	0.118
Fragilaria sepes Ehrenberg	3	0.008
Gomphonema gracile Ehrenberg emend Van Heurck	2	0.005
Gomphonema minutum (Agardh) Agardh	1	0.003
Navicula minima Grunow	2	0.005
Navicula subrotundata Hustedt	2	0.005
Pseudostaurosira trainorii Morales	12	0.030
Rossithidium linearis (Smith) Round et Bukhtiyarova	1	0.003
Sellaphora pupula (Kützing) Meresckowsky	1	0.003
Sellaphora seminulum (Grunow) Mann	1	0.003
Staurosira construens var. venter (Ehrenberg) Hamilton	6	0.015
Stephanodiscus hantzschii Grunow	3	0.008
TOTAL	400	1.000