RESULTS OF SEDIMENT CORE TAKEN FROM POSKIN LAKE, BARRON 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 while others are more common under elevated nutrient levels. Some species float in the

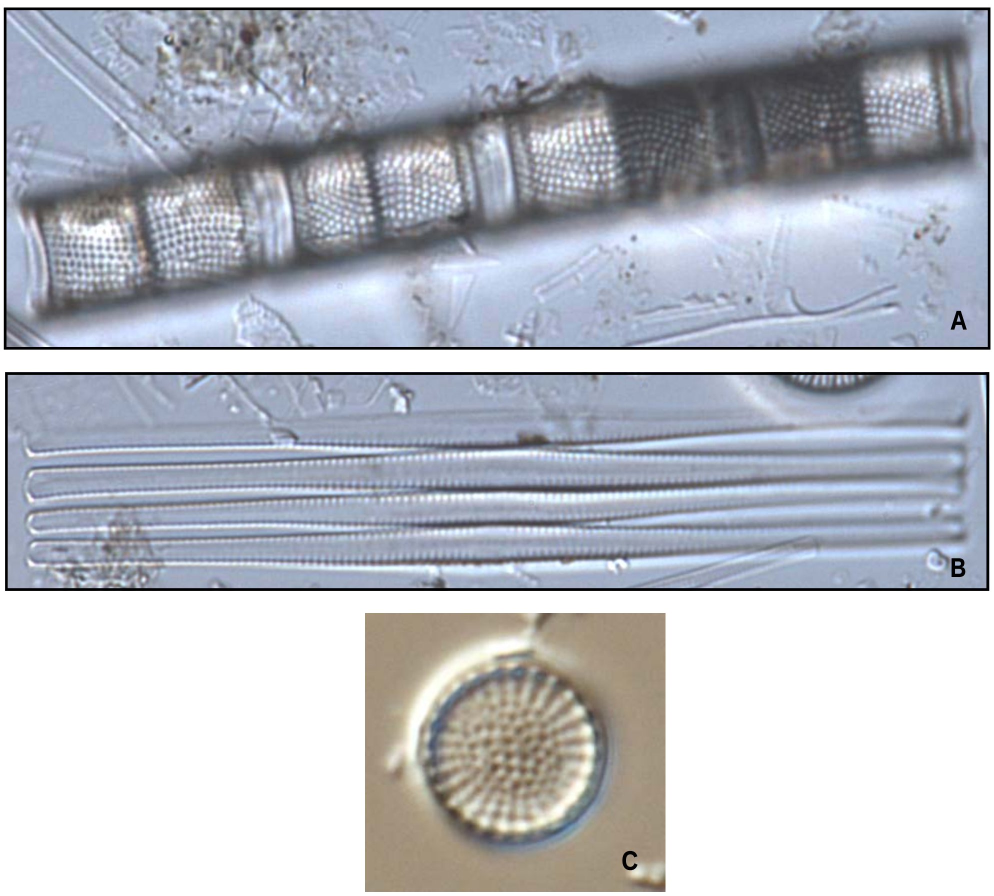

Figure 1. Photomicrographs of the diatoms *Aulacoseira am*bigua (A), and *Fragilaria crotonensis* (B), and *Stephanodiscus minutulus* (C). These were common diatoms found in the core. All of these diatoms are found in the open water of the lake and is considered a planktonic diatom. The top two diatoms indicate moderate nutrient levels while S. minutulus indicates higher nutrient levels.

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 31 August 2009 a sediment core were taken from near the deep area (N45° 25.688 W91° 58.152) of Snipe Lake in about 28 feet of water using a gravity corer. Samples from the top of the core (0-1 cm) and a section (42-44 cm) deeper in the core were kept for analysis. It is assumed that the upper sample represents present conditions while the deeper sample is indicative of water quality conditions at least 100 years ago.

Results

The total length of the sediment core was 45 cm. It was dark gray in color for the top 35 cm, which overlay a band of light gray sediment that was between 35-37 cm. The color of the rest of the sediment core was dark brown. A picture of the sediment core is shown in Figure 2.

Historically, most of the diatom community was composed of those species that are planktonic, i.e. float in the open water (Figure 2). Of these planktonic species, the most common

Figure 2. Photograph of the Poskin Lake sediment core with Dave Blumer and Denny Landro who helped with core collection.

were *Stephanodiscus minutulus* and *Aulacoseira* spp. The *Aulacoseira* species were *A. ambigua* (pictured in Figure 1A) and *A. italica*. These taxa are common in mesotrophic lakes. The other important diatom, *S. minutulus* is typically found in eutrophic waters. At the top of the core the importance of *S. minutulus* had increased. The high amount of *S. minutulus* at the indicates that phosphorus levels historically were in the eutrophic range. The increase in *Stephanodiscus* and decline in *Aulacoseira* indicate that phosphorus levels at the present time are somewhat higher. There is an increase in Fragilaria crotonensis which probably indicates that nitrogen levels are higher at the present time compared with 100 years ago.

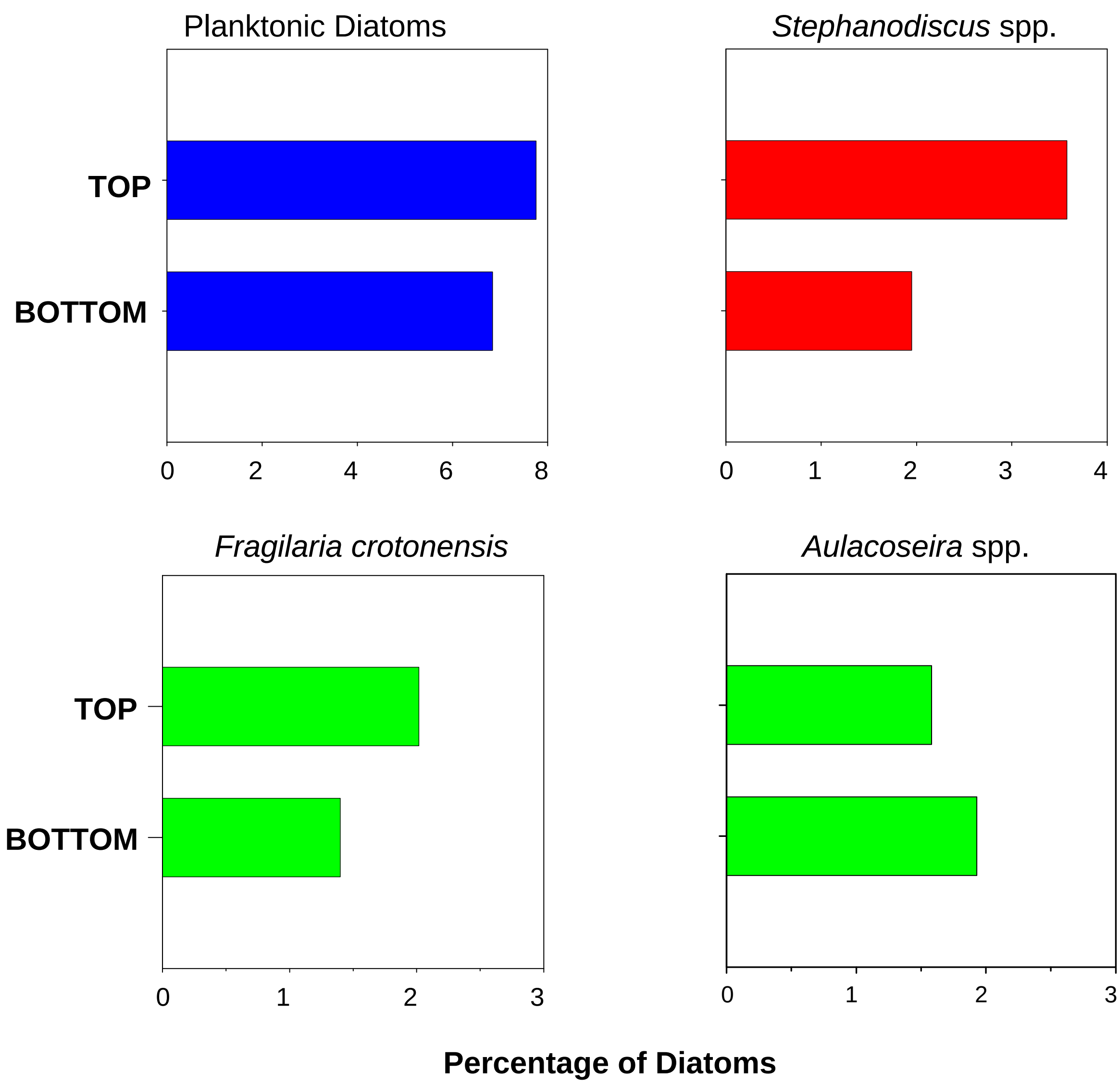

Figure 3. Changes in the abundance of important diatoms found at the top and bottom of the Poskin Lake sediment core. The dominant diatoms were planktonic diatoms which float in the open water. The most common species was *Stephanodiscus minutulus* which is found under eutrophic conditions. *F. crotonensis* and *Aulacoseira* spp. are indicative of mesotrophic waters.

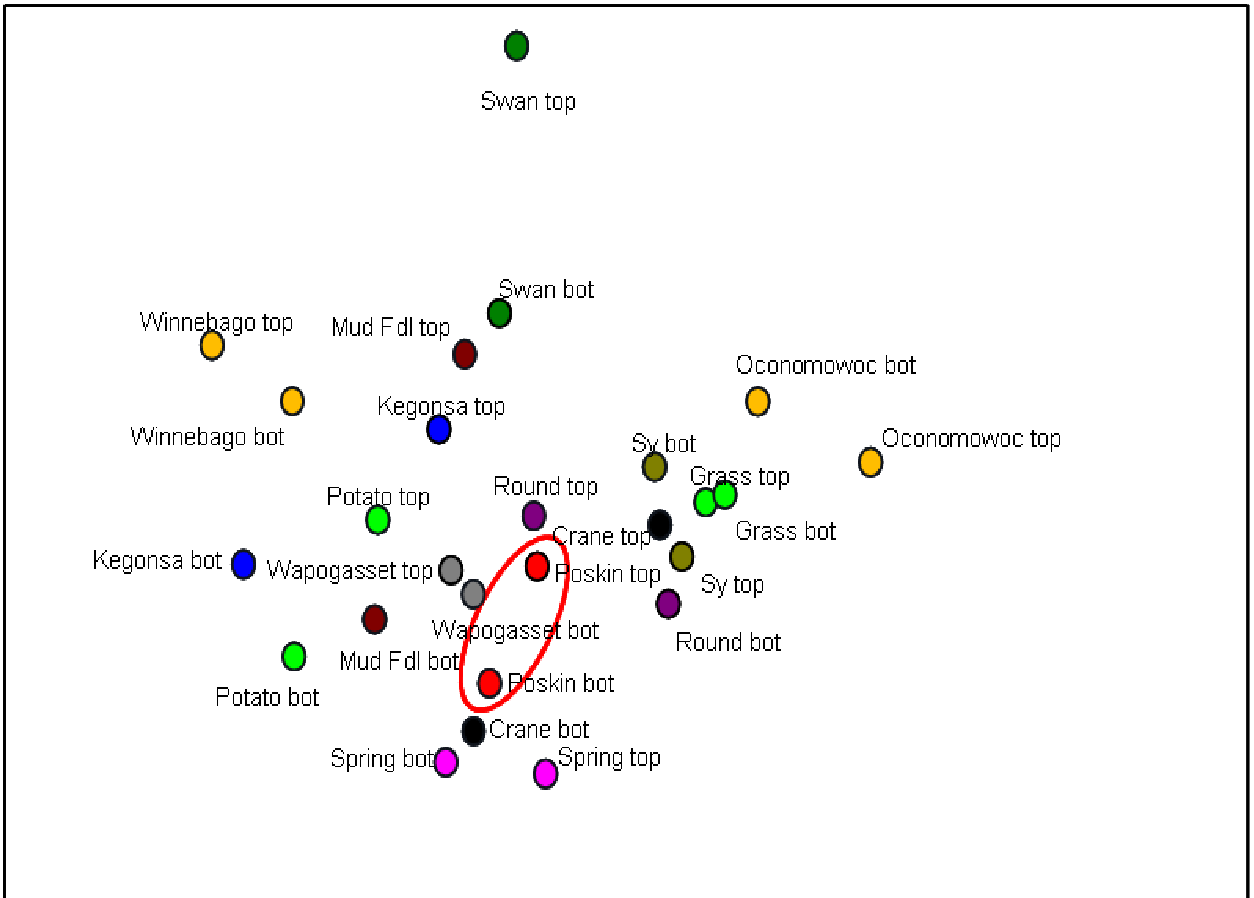

Figure 4. A DCA analysis of top/bottom cores in lakes similar to Poskin Lake. This analysis is based upon the diatom community. The closer the samples are, the less change that has occurred in the diatom community. Examples of lakes that show little change are Grass and Wapogasset. The diatom communities of other lakes exhibit greater differences between the top and bottom of the core. Examples of these lakes are Swan and Kegonsa. Poskin Lake is intermediate but this analysis indicates that the ecology of Poskin Lake has changed during the last 100 years.

A comparison was made of the diatom communities at the top and bottom of cores from lakes similar to Poskin Lake. This comparison was made using detrended correspondence analysis (DCA). This is a multivariate statistical analysis that determines relative differences in the diatom community between different samples. The farther apart the top/bottom samples plot on the graph, the greater the differences in the diatom communities. This analysis is shown in Figure 4. Some lakes show little difference in the diatom communities between the top and bottom of the cores, e.g. Grass, Wapogasset, while others exhibit larger differences, e.g. Swan, Kegonsa. The differences in Poskin Lake are intermediate but demonstrate that the diatom community has changed during the last 100 years. This analysis does not determine what environmental conditions have changed. Judging from the direction of change in other cores it is likely that the direction of change from the bottom to the top of the core (upward) indicates increased phosphorus at the top of the core. Because the top and bottom samples are relatively close together, the change has not been large.

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 Poskin Lake. The model indicates there has been a small increase in phosphorus. The model indicates that phosphorus concentrations are higher at the top of the core compared with the bottom of the core. The model does indicate that phosphorus levels at the bottom of the core were in the eutrophic range.

At this point it is assumed that the bottom of the core represents a time period prior to the arrival of European settlers, around the middle of the nineteenth century. A radiochemical analysis is underway to verify this.

In summary, the sediment core indicates that Poskin Lake was historically an eutrophic lake. Although phosphorus levels at the present time are in the range of 50 $\mu g\ L^{-1}$, they were likely not much lower prior to the arrival of European settlers 150 years ago.

POSKIN LAKE		
Barron County		
Top		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthes cf. bahusiensis (Grunow) Lange-Bertalot	1	0.002
Asterionella formosa Hassal	16	0.039
Aulacoseira ambigua (Grunow) Simonsen	22	0.054
Aulacoseira granulata (Ehrenberg) Simonsen	4	0.010
Aulacoseira italica (Ehrenberg) Simonsen	27	0.066
Aulacoseira subarctica (Müller) Haworth	12	0.029
Cocconeis placentula (RV)	2	0.005
Cyclostephanos dubius (Frick) Round	2	0.005
Cyclostephanos tholiformis Stoermer, Håkansson et Theriot	2	0.005
Cymbella spp.	1	0.002
Eolimna subminuscula Manguin	2	0.005
Fragilaria capucina var. mesolepta Rabenhorst	57	0.139
Fragilaria crotonensis Kitton	2	0.005
Fragilaria crotonensis var. oregona Sovereign	81	0.197
Fragilaria vaucheriae (Kützing) Petersen	2	0.005
Gomphonema angustum Agardh	3	0.007
Luticola mutica (Kützing) Mann	1	0.002
Navicula cryptocephala Kützing	2	0.005
Navicula spp.	1	0.002
Nitzschia acicularis (Kützing) Smith	3	0.007
Nitzschia palea (Kützing) Smith	3	0.007
Nitzschia spp.	3	0.007
Pinnularia spp.	1	0.002
Platessa conspicua (Mayer) Lange-Bertalot	1	0.002
Staurosirella pinnata (Ehrenberg) Williams et Round	1	0.002
Stephanodiscus hantzschii Grunow	2	0.005
Stephanodiscus minutulus (Kützing) Cleve et Möller	97	0.236
Stephanodiscus minutulus morph 2 (Kützing) Cleve et Möller	50	0.122
Stephanodiscus niagarae Ehrenberg	5	0.012
Synedra delicatissima Smith	1	0.002
Synedra sp.	1	0.002
unknown pennate	3	0.007
TOTAL	411	1.000
Planktonic diatoms		0.776
Nonplanktonic diatoms		0.224
Chrysophyte scale	1	
Chrysophyte cyst	6	
Phytolith	1	

POSKIN LAKE		
Barron County		
Bottom		
	COUNT TOTAL	
	Number	Prop.
TAXA		
Achnanthes spp.	2	0.005
Achnanthes oblongella Østrup	3	0.007
Achnanthidium minutissimum var. jackii (Rabhenhorst) Lange-Bertalot et Ruppel	1	0.002
Asterionella formosa Hassal	24	0.059
Aulacoseira ambigua (Grunow) Simonsen	31	0.077
Aulacoseira islandica (Müller) Simonsen	2	0.005
Aulacoseira italica (Ehrenberg) Simonsen	41	0.101
Aulacoseira muzzanensis (Meister) Krammer	1	0.002
Aulacoseira subarctica (Müller) Haworth	3	0.007
Caloneis sp.	3	0.007
Cocconeis placentula var. lineata (Ehrenberg) Van Heurck	1	0.002
Cyclostephanos dubius (Frick) Round	4	0.010
Cyclostephanos tholiformis Stoermer, Håkansson et Theriot	1	0.002
Cymbella spp.	1	0.002
Eolimna minima (Grunow) Lange-Bertalot	10	0.025
Eolimna subminuscula Manguin	4	0.010
Eunotia spp.	1	0.002
Fragilaria capucina var. gracilis (Østrup) Hustedt	3	0.007
Fragilaria capucina var. mesolepta Rabenhorst	36	0.089
Fragilaria crotonensis Kitton	52	0.128
Fragilaria crotonensis var. oregona Sovereign	5	0.012
Fragilaria vaucheriae (Kützing) Petersen	16	0.040
Gomphonema parvulum (Kützing) Kützing	1	0.002
Gomphonema spp.	2	0.005
Navicula cf. menisculus Schumann	1	0.002
Navicula medioconvexa Hustedt	2	0.005
Navicula spp.	2	0.005
Nitzschia amphibia Grunow	2	0.005
Nitzschia dissipata (Kützing) Grunow	1	0.002
Nitzschia palea (Kützing) Smith	1	0.002
Planothidium dubium (Grunow) Round et Bukhtiyarova	**2**	0.005
Planothidium lanceolatum (Brébisson ex Kützing) Lange-Bertalot	1	0.002
Staurosira construens var. binodis (Ehrenberg) Hamilton	10	0.025
Staurosira elliptica (Schumann) Williams et Round	1	0.002
Staurosirella leptostauron var. dubia (Grunow) Edlund	1	0.002
Staurosirella pinnata (Ehrenberg) Williams et Round	14	0.035
Stephanodiscus hantzschii Grunow	18	0.044
Stephanodiscus minutulus (Kützing) Cleve et Möller	39	0.096
Stephanodiscus minutulus morph 2 (Kützing) Cleve et Möller	40	0.099
Stephanodiscus niagarae Ehrenberg	13	0.032
Synedra radians Kützing	1	0.002
Tabellaria flocculosa (strain III) sensu Koppen	1	0.002
Tabellaria flocculosa (strain IIIp) sensu Koppen	2	0.005
Tabellaria spp.	2	0.005
unknown pennate	3	0.007
TOTAL	405	1.000
Planktonic diatoms		0.684
Nonplanktonic diatoms		0.316
Chrysophyte scale	1	
Chrysophyte cyst	6	
Phytolith	1	