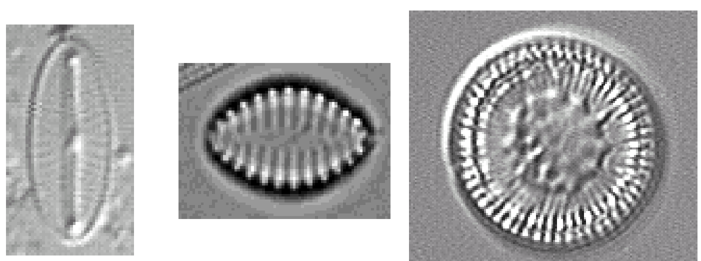
RESULTS OF SEDIMENT CORE TAKEN FROM BLUE LAKE, ONEIDA COUNTY, WISCONSIN

Paul Garrison, Wisconsin Department of Natural Resources
November 2003

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 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 and pH conditions as well as alterations in the aquatic plant community.



A B C

Figure 1. Micrographs of diatoms similar to those found in the Blue Lake sediment core. The diatoms on the left, *Navicula atomus* var. *permitis* and *Staurosira construens* var. *venter* are typically found growing attached to plants or on the sediments. The diatom on the right, *Cyclotella comensis* is found floating in the open water. This diatom was not found in the core but is somewhat similar to *C. glomerata* which was common.

I have examined the diatoms from the cores taken on 10 July 2003 near the deep area of Blue Lake. The sediment core was collected from a water depth of 17 meters with a gravity corer. I examined sediment from the top of the core and a section deeper in the core. 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.

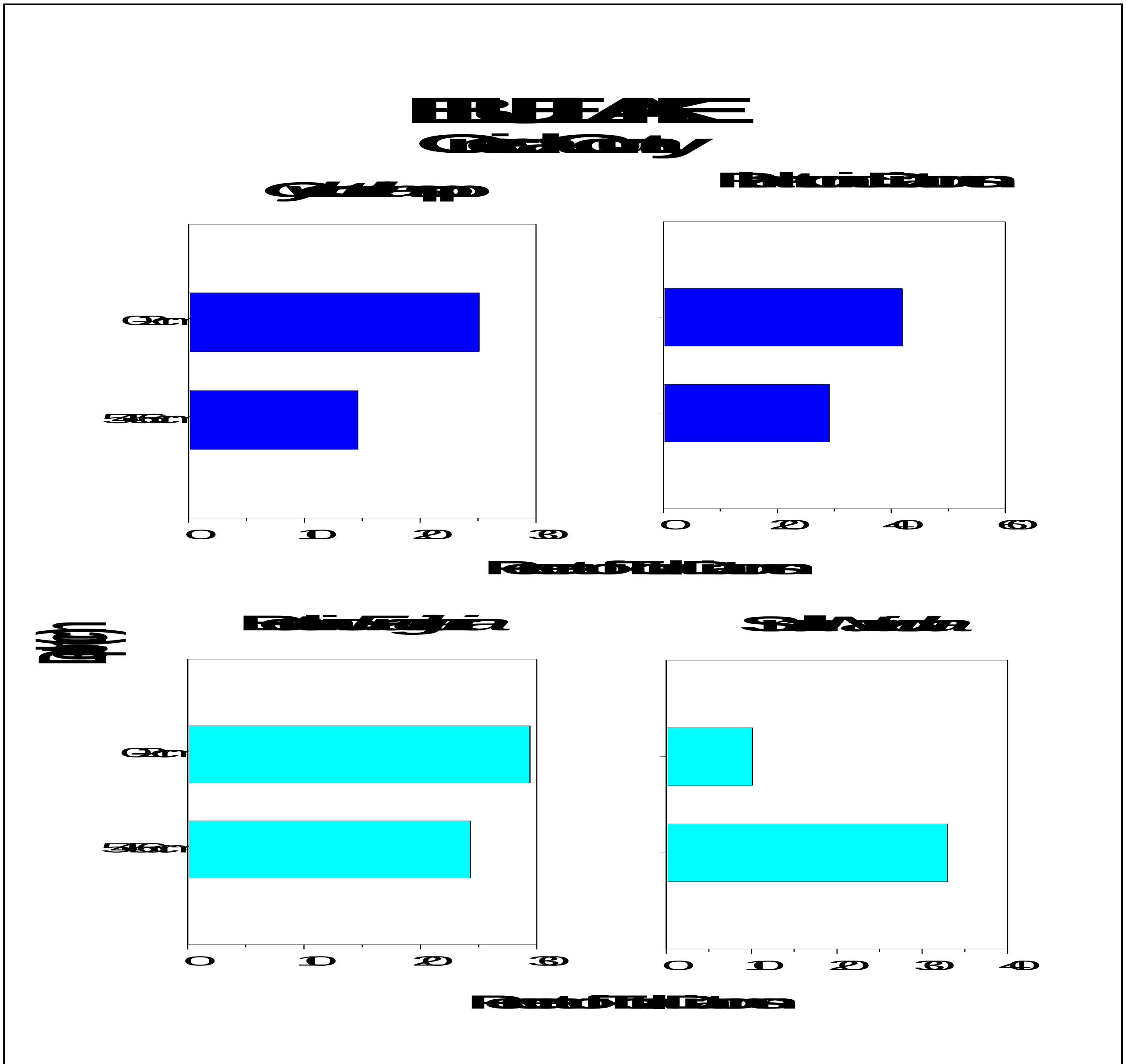


Figure 2. Changes in the abundance of important diatoms found at the top and bottom of the Blue Lake sediment core. An increase in planktonic diatoms indicates that phosphorus levels have increased during the last 100 years. The dominant diatom in the planktonic community is *Cyclotella glomerata*, which indicates the phosphorus concentration is low even though it has increased. The decline of small *Navicula* and increase of benthic *Fragilaria* also indicates an increase in phosphorus during the last 100 years.

In Blue Lake, historically the major component of the diatom community are those species that grow attached to plants or on the lake bottom (benthic *Fragilaria* and small *Navicula*)(Figure 2). The principal benthic *Fragilaria* was *Staurosira construens* var. *venter* and the most common small *Navicula* was *N. atomus* var. *permitis* (Figure 1). Historically planktonic diatoms (diatoms that float in the open water) made up about 30% of the diatom community. The principal component of this community was *Cyclotella glomerata* (Figure 1). In recent sediments, planktonic diatoms have increased in importance and are nearly 50% of the diatom community. Also small *Navicula* have declined while benthic *Fragilaria* have increased. These changes indicate that there has been a small increase in phosphorus in the lake water. Many other studies have found that planktonic diatoms increase as a percentage of the total diatom community in response to increased phosphorus. Other studies have also found that small *Navicula* decline with increasing phosphorus levels and are replaced, in part by benthic *Fragilaria*, e.g., *S. construens* var. *venter*.

Many other sediment core studies in Wisconsin have found a significant increase in aquatic plants as a result of shoreline development. This does not appear to be the case in Blue Lake. Increases in the plant community appear to be localized and not on the scale of other northern Wisconsin lakes.

In summary, the diatom community indicates Blue Lake that nutrient levels in Blue Lake have increased during the last 100 years. The increase, while significant, is small, probably on the order of 2-4 μg L^{-1}. While water clarity is still very good in Blue Lake it likely is not as good as historical levels. The increased nutrient levels are an indication that steps should be taken to reduce nutrient input from the watershed before algal blooms become a problem. It is much more difficult to restore a lake to good water quality than to prevent its degradation.

Table 1. Diatom Counts from the Blue Lake Sediment Core.

BLUE LAKE
Oneida County

Core Top (0-2 cm)

TAXA	Number	Prop
Achnanthidium levanderi	3	0.014
Achnanthidium minutissima	1	0.005
Achnanthidium sp.	6	0.029
Asterionella formosa	14	0.067
Aulacoseira ambigua	2	0.010
Cyclotella bodanica var. lemanica	5	0.024
Cyclotella glomerata	42	0.202
Cyclotella stelligera	5	0.024
Fragilaria crotonensis	2	0.010
Fragilaria crotonensis var. oregona	6	0.029
Navicula atomus var. permitis	17	0.082
Navicula pseudoventralis	2	0.010
Navicula minima	1	0.005
Navicula seminuloides	3	0.014
Navicula subtilissima	1	0.005
Navicula (GV)	1	0.005
Navicula sp.	1	0.005
Nitzschia palea	1	0.005
Nitzschia fonticola	1	0.005
Nitzschia gandersheimiensis	1	0.005
Nitzschia gracilis	1	0.005
Nitzschia sp.	8.5	0.041
Pinnularia biceps	3	0.014
Pinnularia sp.	1	0.005
Sellaphora pupula	2	0.010
Sellaphora bacillum	4	0.019
Staurosira construens	1	0.005
Staurosira construens var. venter	56	0.270
Staurosira elliptica	3	0.014
Tabellaria flocculosa str. IIIp	7	0.034
Tabellaria floccolosa (central area)	2	0.010
Tabellaria flocculosa str. III	1	0.005
Tabellaria flocculosa var. linearis	1	0.005
Unknown	2	0.010
TOTAL	207.5	1.000
Chrysophyte scales	4	
Chrysophyte cysts	35	
Pediastrum coenubia	1	
Planktonic taxa		0.419
Nonplanktonic taxa		0.571

BLUE LAKE
Oneida County

Core Bottom (60-62 cm)

TAXA	Number	Prop
Achnanthidium levanderi	2	0.010
Achnanthidium sp.	2	0.010
Asterionella formosa	12	0.058
Aulacoseira ambigua	3	0.015
Cyclotella glomerata	20	0.097
Cyclotella pseudostelligera	1	0.005
Cyclotella stelligera	9	0.044
Navicula atomus var. permitis	47	0.228
Navicula lanceolata	1	0.005
Navicula perparva	7	0.034
Navicula minima	1	0.005
Navicula seminuloides	8	0.039
Navicula subtilissima	3	0.015
Navicula sp. (short)	5	0.024
Navicula sp.	6	0.029
Nitzschia palea	3.5	0.017
Nitzschia sp.	0.5	0.002
Pinnularia abaujensis	1	0.005
Psammothidium subatomoides	1	0.005
Pseudostaurosira brevistrata	6	0.029
Sellaphora rectangularis	1	0.005
Stauroneis anceps f. gracilis	3	0.015
Stauroneis phoenicenteron f. gracilis	1	0.005
Staurosira construens var. venter	41	0.199
Staurosira elliptica	1	0.005
Staurosirella pinnata	2	0.010
Synedra radians	2	0.010
Tabellaria flocculosa str. IIIp	12	0.058
Tabellaria flocculosa (central area)	1	0.005
Unknown (raphid)	3	0.015
TOTAL	206	1.000
Chrysophyte scales		
Chrysophyte cysts	20	
Pediastrum coenubia	2	
Scenedesmus coenubia	4	
Tetraedron coenubia	1	
Planktonic taxa		0.291
Nonplanktonic taxa		0.694