RESULTS OF SEDIMENT CORES TAKEN FROM LONG AND BASS LAKES, LINCOLN 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 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.

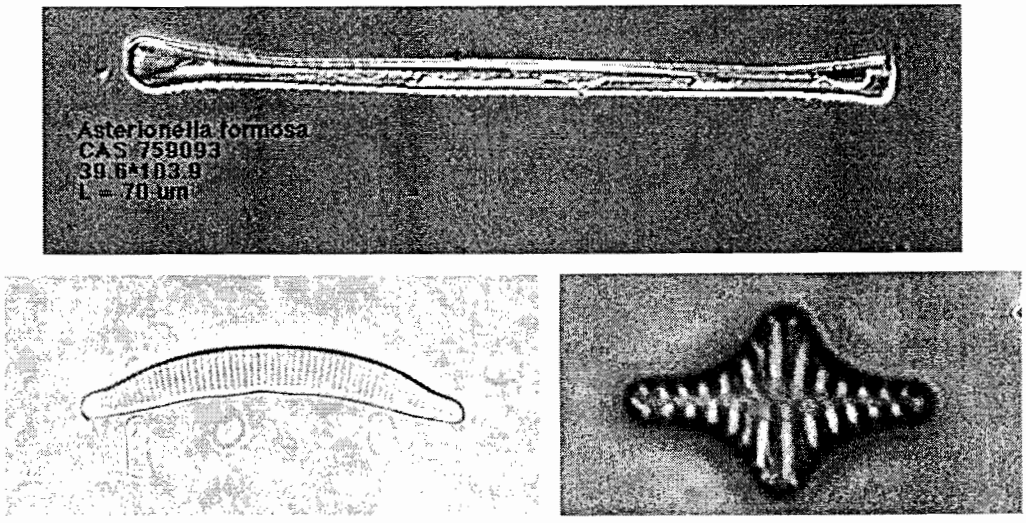

Figure 1. Micrographs of diatoms *Asterionella* (top), *Eunotia* (left), and a representative of benthic *Fragilaria* (right). The diatom at the top is often found floating in the open water and the diatoms on the bottom are found attached to substrates such as aquatic plant or on the sediment surface.

I have examined the diatoms from the cores taken on 4 September 2001 from near the deep areas of Long and Bass lakes. 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.

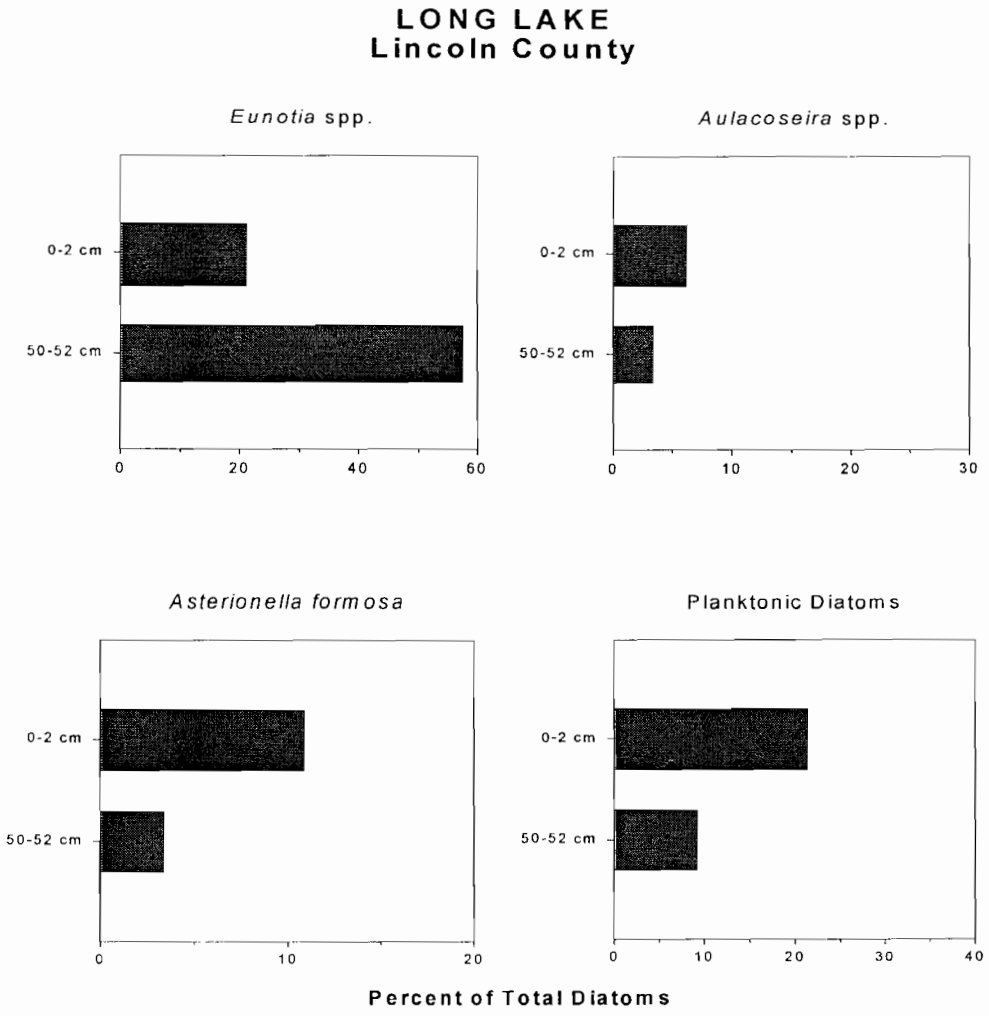

Figure 2. Changes in abundance of important diatoms found at present and presettlement times. *Eunotia* grows attached to substrates such as aquatic moss and other plants. *Aulacoseira* and *Asterionella formosa* are planktonic diatoms and are found floating in the open water.

Long Lake

The core in Long Lake was extracted from a water depth of 36 feet. The top 2 cm and the deep section in the core (50-52 cm) were analyzed. The sediment was flocculent with both the top and bottom sections containing aquatic moss fragments. In Long Lake, at the present time and historically, the major component of the diatom

community were those species that grow on the lake bottom or are associated with aquatic plants, e.g. aquatic mosses.

Planktonic diatoms (those that float in the open water area of the lake) comprise 9% of the community at the bottom of the core but increase to 21% at the top of the core. The major species of the planktonic diatoms is *Asterionella formosa* (Figure 1, top). The relatively low percentage of planktonic species is indicative of the relatively shallow depth in the lake as well as very good water clarity. If the lake experienced large and frequent algal blooms there would not be enough light reaching the lake bottom to allow the growth of benthic diatoms.

The diatom community does indicate that there has been a decrease in water clarity from the time period of the bottom of the core and the present time. This most likely is the result of an increase in nutrients. This is indicated by an increase in the planktonic diatoms, especially *A. formosa*. Planktonic diatoms in general, and especially *A. formosa* do better under increased levels of nutrients. The decline in *Eunotia*, (Figure 1, left) which grow attached to substrates such as aquatic mosses, is also an indication in the decline in water clarity. As the amount of light which can reach the lake bottom decreases, the diatoms growing attached to plants also decline. It appears that the total phosphorus levels have increased about 2-4 $\mu g\ L^{-1}$ from presettlement to the present time. There does not appear to have been a significant increase in macrophytes (aquatic plants) in Long Lake during this time.

Bass Lake

The core in Bass Lake was extracted from a water depth of 32 feet. The top 2 cm and the deep section in the core (54-56 cm) were analyzed. The sediment in Bass Lake was firmer than the sediment in Long Lake. Some aquatic moss fragments were present in the deep core section but none in the surface section.

In Bass Lake, at the present time and historically, the major component of the diatom community were those species that grow on the lake bottom or are associated with aquatic plants, e.g. aquatic moss. Planktonic diatoms comprise 4% of the community at the bottom of the core but increase to 34% at the top of the core. The major type of the planktonic diatom is *Aulacoseira* (Figure 1, top). If the lake experienced large and frequent algal blooms there would not be enough light reaching the lake bottom to allow for the growth of benthic diatoms. The relatively low percentage of planktonic species is indicative of the relatively shallow depth in the lake as well as very good water clarity.

The dominant benthic diatoms in the deep section of the core were benthic *Fragilaria* (Figure 1, right). Unlike Long Lake, *Eunotia* were not as important historically in Bass Lake. This indicates that aquatic moss was not as common in Bass Lake.

Like Long Lake, the water clarity of Bass Lake at the present time is not as good as it was historically. A sharp decline in benthic diatoms such as benthic *Fragilaria* and *Eunotia* and an increase in planktonic diatoms indicate this, e.g. *Aulacoseira* (Figure 3). These changes are greater in Bass Lake than Long Lake indicating it is likely that nutrient levels have increased more in Bass Lake. The increase has been on the order of 4-6 $\mu g\ L^{-1}$.

As with Long Lake, in Bass Lake there does not appear to have been a significant increase in macrophytes (aquatic plants) during this time.

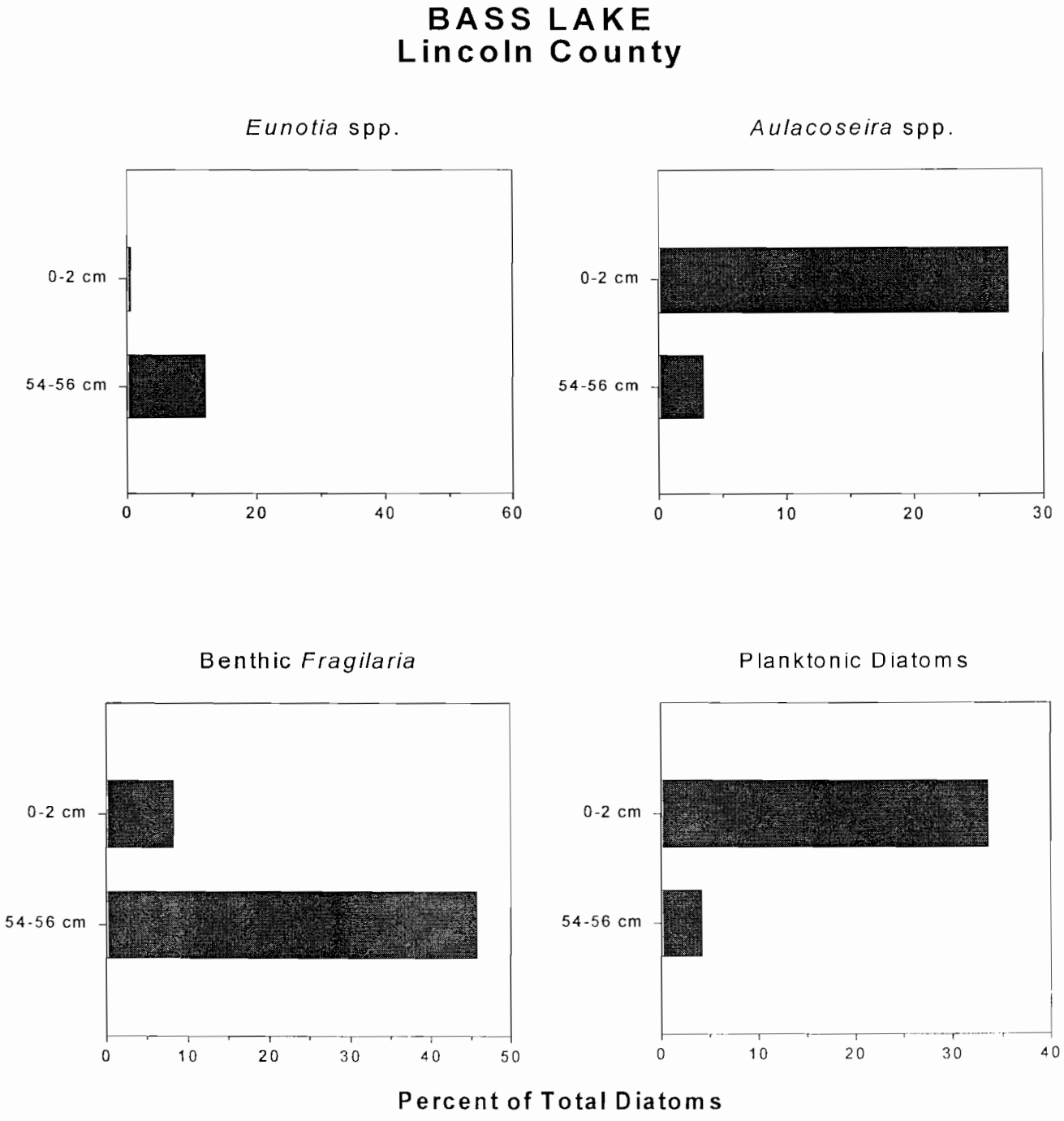

Figure 3. Changes in abundance of important diatoms in Bass Lake. *Eunotia* and benthic *Fragilaria* grow attached to substrates such as moss and on the sediment surface. *Aulacoseira* is usually found floating in the open water. Planktonic diatoms typically increase as a result of higher nutrient levels.

Summary

The diatom community indicates that there has been a small decrease in water clarity in both of the lakes over the last 100 years. The decline has been greater in Bass Lake. This likely is the result of small increases in phosphorus levels. At the present time there is a good growth of aquatic moss in the deeper waters of Long Lake. This is not uncommon in softwater lakes with good water clarity. Bass Lake does not have much moss growth at the present time nor did it historically. Neither lake appears to have experienced a significant increased growth of macrophytes (aquatic plants) since the onset of shoreline development. In many other lakes with shoreline development, there often has been an increase in macrophyte growth in the last 20 to 30 years. Both Long and Bass lakes are sensitive to acid rain because of their dilute water chemistry. The pH of both of these lakes is nearly identical at the present time compared with presettlement levels, indicating they have not been adversely affected by acid rain.