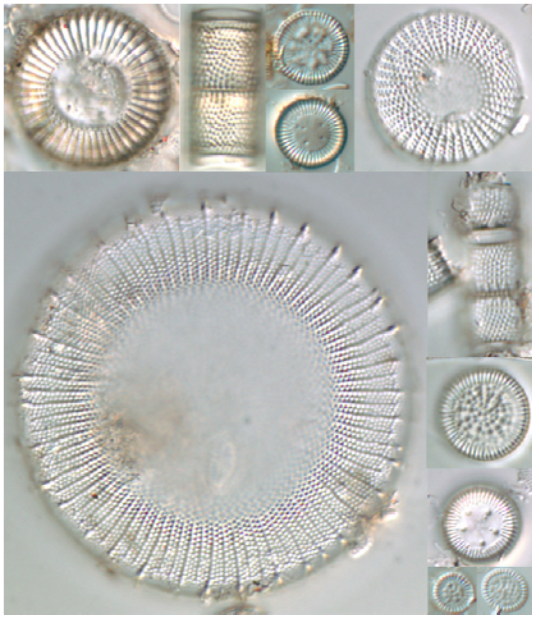
Monitoring Diatoms in Lake Bottom Sediments

Importance

Diatoms—a class of algae that have cell walls made of silica—occur throughout the water column of a lake. When they die, their remains (portions of the cell walls called *frustules*) settle onto the lake bottom, where, because of their high silica content, they are preserved in the bottom sediments like tiny bits of glass. As bottom sediments accumulate they contain a chronological record of the diatom species present in the lake through time.

Using a core of lake bottom sediments, researchers can determine the diatom species present at different times in the past. This information is important to our understanding of historic changes in water quality because particular diatom species only exist under certain conditions. Therefore, diatoms serve as water quality indicators by responding to environmental stressors with changes in community composition (presence and abundance of different species).

The Great Lakes Inventory and Monitoring Network (GLKN), working with researchers from the St. Croix Watershed Research Station, began monitoring diatoms in 2005. Researchers collected 'long cores' (1-2 m, or 3-6 ft) from 13 lakes in five Network parks and used existing cores from lakes in four other parks to analyze diatom species composition and water quality conditions dating back to pre-Euro-American settlement. The top few centimeters of bottom sediments ('surface sediments') were collected from approx. 75 lakes to track more recent changes.



Diatom frustules from NPS samples at magnification of 875-1250X. Photo by M. Edlund.

Status and Trends

The long cores showed large and consistent changes across lakes around the time of Euro-American settlement. As settlement occurred in the late 1800s, increases in agriculture and logging caused changes in water quality, which led to changes in the diatom community. In general, the cores showed increases in sedimentation rates and inorganic content, likely a result of accelerated rates of erosion due to land clearance, changes in runoff, and possible changes in lake levels.

The long cores also showed a shift in the diatom composition in the 1950s to the 2000s, with many lakes showing change in the 1970s to 1980s. These changes cannot be easily ascribed to known land use changes, but may instead be related to climate change. Climate-linked mechanisms of recent ecological change include shorter duration of ice cover, leading to earlier warming of surface water and longer growing seasons; and increased frequency or intensity of summer storms, which may increase the availability of nutrients when lake waters mix more frequently or nutrients are washed into the lakes from the surrounding landscape.

Collecting surface sediments (the top few cm) is a method used to assess recent (approx. 3-5 yrs.) changes in diatom communities. This is part of GLKN's long-term monitoring program, with each lake scheduled for sampling on a 3-5 year rotation. Thus, it will take many years before trends in diatom species, and hence water quality characteristics, will be detected.

Researchers collect a long core at Lake Harvey, Isle Royale National park. Photo by J. Elias/NPS.

Management Implications

Analysis of diatom community composition in the long cores informs park managers of historic water quality conditions, which is not possible to ascertain through other means. Understanding the natural range of variation provides the context in which to interpret more recent changes. Parks are now able to answer whether the recent changes observed in diatom communities (and hence water quality characteristics) have occurred in the past, or whether they are relatively new phenomena.