A Paleolimnological Study in the Comfort Lake-Forest Lake Watershed District

MOODY LAKE

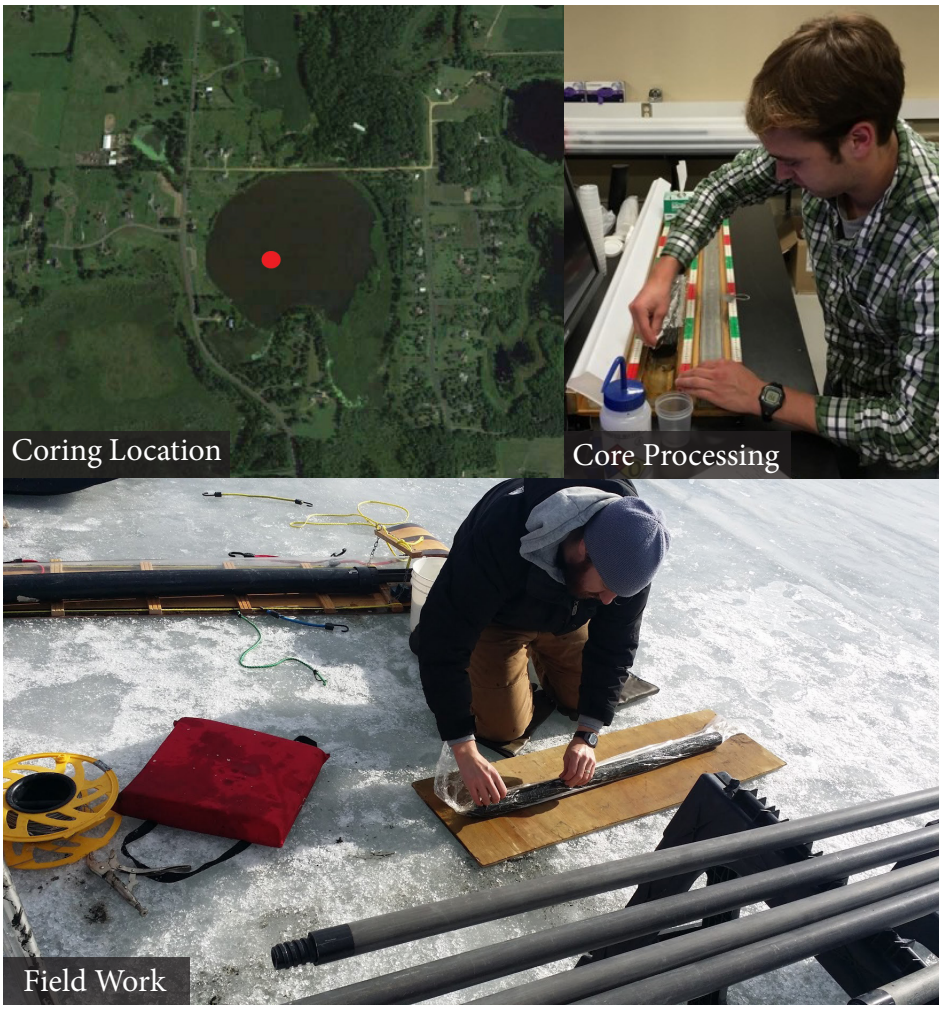
THE PROBLEM:

Moody Lake (pictured left) is impaired due to high nutrient levels. This study used sediments from the lake bottom to tell us about the historical condition of the lake, and when it changed, to help inform lake management decisions.

ANALYSIS:

Lake sediments provide a record of physical, chemical, and biological clues for determining how and when a lake has changed. Scientists (paleolimnologists) work from an anchored boat or the surface of the ice to recover sediment cores. A piston corer uses a clear tube that is lowered to the lake bottom using alloy rods that thread together. The tube is fitted with a piston held in place with a cable; as the tube is pushed into the mud, the piston helps "pull" the sediment into the tube.

Physical, chemical, and biological indicators preserved in the sediment are analyzed to reconstruct the ecological history of the lake. For example, naturally occurring radioisotopes, which decay at a known rate, allow scientists to establish a age-depth relationship for the core; and fossil diatoms (algae that were preserved due to their biologically produced glass cell walls) tell us about historical water quality and ecology.



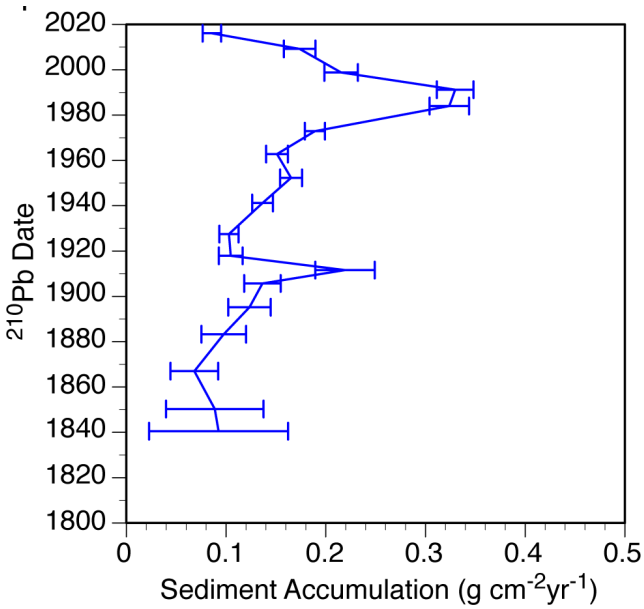
THE LAKE:

Moody Lake has a surface area of 34 acres and a maximum depth of 14.3 m (47 feet). The Moody Lake 2,315-acre watershed is primarily agricultural and rural; there is a carry-in only public boat launch, and the lake is used for watering livestock, and some fishing and non-motorized boating. Average summer total phosphorus (TP) in 2016 was 104 µg/l, and the Comfort Lake – Forest Lake Watershed District notes that TP levels have been improving. In February of 2016, a sediment core was collected through the ice to determine the lake's ecological history.

THE CORE:

The image to the right represents a portion of the sediment core recovered from Moody Lake. The top of the image shows sediments that were deposited in recent years, and sediments get older downcore. Naturally-occurring radioisotopes (lead-210) were used to establish a date-depth relationship for the core. Sediments were sectioned into 2-cm increments for analysis.

THE RESULTS:



The sedimentation rate (how fast sediment is accumulating) has changed over time in Moody Lake. The sedimentation rate began a slow rise in the late 1800s and peaked in the early 1900s and again in the 1990s (where it was over three times higher than it had been in the 1800s). The rate has decreased in recent decades and the rate at the core top (2016) was comparable to the rate in the 1800s.

- There was a **rise in the relative proportion of organic matter in the 1850s**, this may have been due to initial settlement and land clearance in the area. There were no drastic changes in sediment composition in the core in the 1900s or 2000s.

- The diatom community assemblage had one **significant shift between 1905 and 1917**; prior to this time diatoms which are often associated with shallow lakes, and a few that are associated with aquatic plants, were present in significant abundance. This suggested that the lake may have been shallower with more macrophytes prior to the early 1900s.

- Diatom results indicated that the **nutrient levels in Moody Lake increased in the 1960s, shifting the lake into the eutrophic (nutrient-rich) category**. The phosphorus measured in the sediments also showed an increase in the flux of phosphorus to the core site at this time.

- The phosphorus (P) measured in the core showed a sharp spike at the core top (2016), with the majority of the P in readily exchangeable forms (the P is not tightly bound within the sediments). This means that **internal loading of P could be an issue in Moody Lake**; the P continues to cycle back into the water column where it is available to algae, instead of being lost to burial in the sediments.

- Algal pigment analysis showed that types of blue-green algae (cyanobacteria) that have the potential to form toxic blooms have been present since the 1940s.

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