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NWT Environmental Research Bulletin (NERB)

NWT Cumulative Impact Monitoring Program (NWT CIMP)

A source of environmental monitoring and research in the NWT. The program coordinates, conducts and funds the collection, analysis and reporting of information related to environmental conditions in the NWT.

NWT Environmental Research Bulletin (NERB)

A series of brief plain language summaries of various environmental research findings in the Northwest Territories. If you're conducting environmental research in the NWT, consider sharing your information with northern residents in a bulletin. These research summaries are also of use to northern resource decision-makers.

Changing Lake Ecosystems in Response to Warming Temperatures

Climate warming occurring in Canada's northern regions can lead to increased forest fires. The impacts from fires and other disturbances on the environment can continue for years as ecosystems recover. Small lakes and ponds are important features of the northern landscape. This project shows that primary production, the conversion of sunlight and carbon dioxide into organic matter, is increasing in all lakes but more so in shallow ones. Results show a decrease in diatom (microscopic algae) size and diversity and a change in species composition.

Why is this research important?

Small lakes and ponds are important ecological and cultural features of the northern landscape. This study provides a long-term record of lake and pond ecosystems and their resiliency to change. It provides a better understanding of the cumulative impacts of warming temperatures and forest fires.

What did we do?

We collected "mud" (sediment) from the bottom of six lakes in burned and unburned watersheds and analyzed sedimentary **chlorophyll a** and **diatoms** to determine how lake ecosystems are responding to warming temperatures and fires. Sediment cores were dated using radiometric dating techniques, providing records from the 1600s to the present.

What did we find?

- Although primary production began to increase in lakes and ponds in the early to mid-20th century, rapid change in boreal lakes near Yellowknife only began in the late-20th century. In all sampled lakes, contemporary values are higher than the previous 200-300 years.

Figure 1: This is a map showing the location of the study lakes. The upper picture shows one of the sediment cores. The lower picture shows how to sample the sediment cores on site. (Credit: Wilfrid Laurier University)

- Diatom analysis of shallow (~1m depth), unburned lakes suggest that diatom communities are responding to warming temperatures, beginning in the mid-20th century. The response is characterized by a decrease in diatom size and diversity and a change in diatom species composition. Such changes are important because species composition and size influence food web structure.
- Results suggest that although fire may play a role in causing recent increased primary production, the main driver is warming temperatures.
- Together, these results show that changing climate is leading to ecosystem change that can affect aquatic food webs and the movement of carbon through the environment, called biogeochemical cycling.

What does this mean?

These lakes remained relatively unchanged until human activities caused global climate warming beginning in the late 19th and early 20th century. The lakes are now undergoing unprecedented change in the context of the last 300-400 years. Although fire may play a role in causing recent increased primary production, the main driver is warming temperatures. The cumulative effects of fire and climate warming are driving changes to water quality in small lake and pond ecosystems.

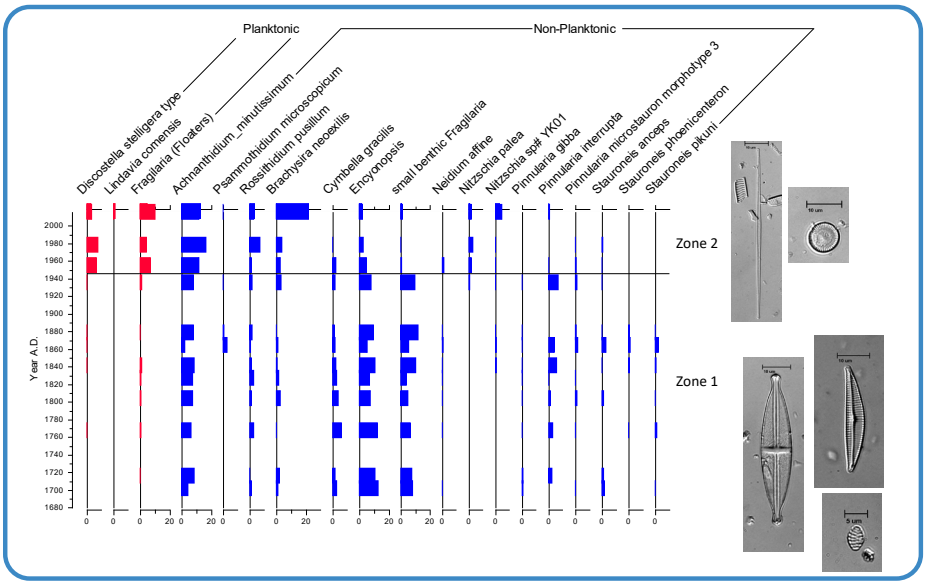

Figure 2: This shows the diatom community composition change in one of the study lakes beginning ~1940 (the horizontal black line indicates the main change in diatom community composition). The y-axis (vertical axis) shows the age of the sediment sample. Each column represents a diatom species or taxon. Planktonic diatom taxa are floaters living in the open water; whereas non-planktonic taxa spend at least part of their lives living in the shallow water, typically attached to sediments, rocks or aquatic plants.

What are diatoms?

Diatoms are microscopic algae that are composed of *opaline silica*, a resistant material very similar to glass. Diatom cell walls are well-preserved in lake and pond sediments.

What is sedimentary chlorophyll *a*?

Algae and aquatic plants are primary producers (i.e., they create their own energy from the sun). Chlorophyll *a* is a pigment needed for photosynthesis that all algae and aquatic plants contain. It is a sign of the amount of algae and aquatic plants in water.

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