

Study links ecosystem changes in temperate lakes to climate warming

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Unparalleled warming over the last few decades has triggered widespread ecosystem changes in many temperate North American and Western European lakes, say researchers at Queen's University and the Ontario Ministry of the Environment.

The team reports that striking changes are now occurring in many temperate lakes similar to those previously observed in the rapidly warming Arctic, although typically many decades later. The Arctic has long been considered a "bellwether" of what will eventually happen with warmer conditions farther south.

"Our findings suggest that ecologically important changes are already under way in temperate lakes," says Queen's Biology research scientist, Dr. Kathleen Ruhland, from the university's Paleoecological Environmental Assessment and Research Lab (PEARL) and lead author of the study.

The research was recently published in the international journal *Global Change Biology*. Also on the team are Biology professor John Smol, Canada Research Chair in Environmental Change, and Andrew Paterson, a research scientist at the Ontario Ministry of the Environment and an adjunct professor at Queen's.

One of the biggest challenges with environmental studies is the lack of long-term monitoring data, Dr. Ruhland notes. "We have almost no data on how lakes have responded to climate change over the last few

decades, and certainly no data on longer term time scales," she says. "However, lake sediments archive an important record of past ecosystem changes by the fossils preserved in mud profiles."

The scientists studied changes over the last few decades in the species composition of small, microscopic algae preserved in sediments from more than 200 lake systems in the northern hemisphere. These algae dominate the plankton that float at or near the surface of lakes, and serve as food for other larger organisms.

Striking ecosystem changes were recorded from a large suite of lakes from Arctic, alpine and temperate ecozones in North America and western Europe. Aquatic ecosystem changes across the circumpolar Arctic were found to occur in the late-19th and early 20th centuries. These were similar to shifts in algal communities, indicating decreased ice cover and related changes, over the last few decades in the temperate lakes.

"As expected, these changes occurred earlier – by about 100 years – in highly sensitive Arctic lakes, compared with temperate regions," says Dr. Smol, recipient of the 2004 Herzberg Gold Medal as Canada's top scientist.

In a detailed study from Whitefish Bay, Lake of the Woods, located in northwestern Ontario, strong relationships were found between changes in the lake algae and long-term changes in air temperature and ice-out records. The authors believe that, although the study was focused on algae preserved in lake sediments, changes to other parts of the aquatic ecosystem are also likely (for example algal blooms and deep-water oxygen levels).

"The widespread occurrence of these trends is particularly troubling as they suggest that climatically-induced ecological thresholds have already

been crossed, even with temperature increases that are below projected future warming scenarios for these regions," adds Dr. Paterson. The authors warn that if the rate and magnitude of temperature increases continue, it is likely that new ecological thresholds will be surpassed, many of which may be unexpected.

"We are entering uncharted territory, the effects of which can cascade throughout the entire ecosystem," concludes Dr. Smol.

Source: Queen's University

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