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## The power of the past: using lake sediments to study long-term environmental changes in lake ecosystems

One of the greatest challenges faced by ecologists and environmental scientists is using appropriate time scales. When managing aquatic ecosystems, important questions include: Is water quality or quantity changing? If so, why is it changing and by how much? What is the timing and the causes of these changes? What were natural or pre-disturbance conditions like (and therefore what are reasonable mitigation targets)? Each of these questions has a temporal component associated with it. However, due to the general lack of reliable long-term monitoring data, it is often difficult to determine the nature and timing of ecosystem changes. In lieu of direct monitoring data, paleolimnologists have developed a variety of physical, chemical, and biological approaches to track past changes in aquatic ecosystems using proxy data archived in lake and river sediments.

This presentation summarizes a few recent ecological examples of paleoenvironmental research that have examined the effects of multiple stressors on lake ecosystems. One example of a newly described, mutiple-stressor affecting softwater lakes in Canada is the decline in lakewater calcium levels (or “aquatic osteoporosis”), which can be linked to human activities such as logging and acid precipitation. In many cases, the onset of lakewater Ca decline predates direct observation, and so documenting the effects on freshwater ecosystems can be complex. By combining lab, field and paleolimnological approaches, it is now evident that keystone taxa have been severely affected by these calcium declines. In addition, recent climatic warming (or the “big threat multiplier”) is affecting a wide range of lake ecosystems across vast geographical regions in diverse and often complex ways. Meta-analyses of paleolimnological profiles can now be used to help disentangle the effects of climate warming from other environmental variables to determine how various components of lake ecosystems are responding to these multiple stressors. Some ecosystems, such as shallow ponds in the High Arctic, which paleolimnological data have shown were permanent water bodies for millennia, have now evaporated totally over the last few years.

Paleolimnological studies do not only identify our environmental failures, but lake sediments can also record our successes. For example, many lake systems in Sudbury, Wawa, Muskoka-Haliburton, and elsewhere are recording remarkable recoveries from acidification, eutrophication, and other stressors, once appropriate remedial action had been taken. The economic costs of not taking appropriate environmental action will also be highlighted.

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