Researchers link crayfish decline in Algonquin Park lakes to lack of calcium

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Researchers from Queen's University, working with colleagues from the Ontario Ministry of the Environment and Climate Change, have linked the localized near-extinction of a native crayfish species in four lakes in Algonquin Park to declining calcium levels, a long-term legacy of acid rain on forest soils and aquatic ecosystems.

"Crayfish are an integral component of aquatic food webs, because they function at multiple trophic levels and are a key element in the diets of popular recreational and economically important fish species," says Kris Hadley, the lead author of the study and a PhD student at Queen's University at the time the study was conducted.

Crayfish shed their protective carapace - the upper exoskeleton that is primarily composed of calcium carbonate - several times during their life cycle and, as a result, have high calcium requirements. The researchers found that lack of calcium in the lakes has contributed to a decline in crayfish populations.

Acid rain "mobilizes" calcium found in the soil and bedrock. Once mobilized, calcium levels in the water increase, before declining as calcium stores are used up. In areas such as Kingston, where much of the bedrock is comprised of limestone, the effect is mitigated by the high volume of calcium found in the bedrock. The lakes analyzed by the research team are farther north on Canadian Shield bedrock, which has a much lower concentration of calcium. The lakes selected allowed for a much clearer analysis of the effects of calcium decline on larger

organisms.

Because long-term data records of lake water pH and calcium levels are typically not available, researchers analysed fossilized microscopic organisms (i.e., algal remains) to reconstruct past lake water pH levels and fossils of water fleas to track past changes in lake water calcium concentrations. Using this technique, the team was able to examine environmental trends in the four lakes over the past 150 years.

The research team found evidence that acid rain had impacted some of the lakes over time, but they also inferred marked declines in lake water calcium levels - a known legacy of acid rain. Dr. Hadley says the team's findings suggest calcium concentrations began declining in these lakes as early as the 1960s, and may now have fallen below the threshold required for the survival of some aquatic organisms.

"Although lake water pH has been recovering in many waterways with controls on acid emissions, there has been no such recovery in calcium levels, and thus aquatic organisms are beginning to show the negative effects of what we are colloquially calling 'aquatic osteoporosis,'" says John Smol (Biology), the Canada Research Chair in Environmental Change.

"Aquatic osteoporosis" has only recently been identified as an environmental stressor for many soft-water lakes in North America and elsewhere, with potentially serious ecological consequences, such as the "jellification" of lakes. This is the third major study published by Dr. Smol and his team on the effects of declining calcium levels on the ecosystems of soft-water lakes.

The study was published in the international journal Freshwater Science.

More information: Kristopher R. Hadley et al. Altered pH and

reduced calcium levels drive near extirpation of native crayfish, , in Algonquin Park, Ontario, Canada , *Freshwater Science* (2015). DOI: 10.1086/681910

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