

Liming to Accelerate Recovery from Acid Rain Effects

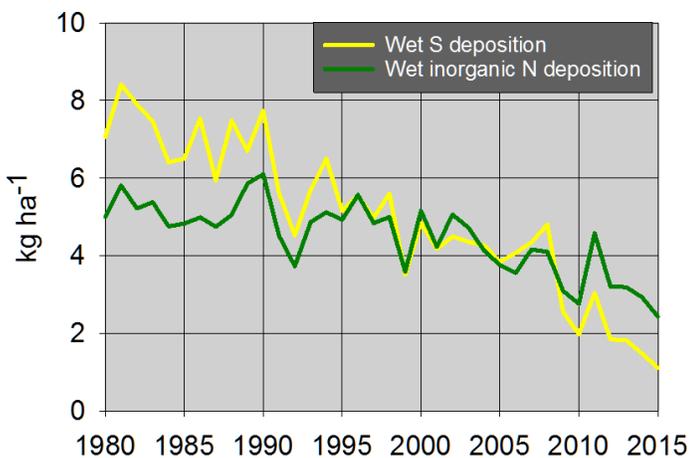
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Helicopter liming of an Adirondack watershed

Background

Acid rain caused by fossil fuel burning has degraded aquatic and terrestrial ecosystems in eastern North America. Despite decades of decreasing deposition levels, recovery of soils and streams proceeds slowly.



Policies have been effective in reducing the emissions of sulfur (S) and nitrogen (N), the air pollutants that form acid rain.

Objective

Liming is no longer needed to prevent further damage, but liming might help accelerate recovery in ecosystems where progress has lagged. This management option is being investigated with an experiment that involves adding lime either directly to streams or to an entire watershed to replace the leached calcium from soils. Calcium both buffers acid rain and supplies an important nutrient.

Setting

The liming experiment is being done in the Honnedaga Lake drainage basin in the southwestern Adirondack region of New York State. Thin, calcium-poor soils overlying little or no glacial till—a feature common across the Adirondack landscape—produces inadequate acid buffering. As a result, acid rain has caused severe acidification within the basin.



- Thin soil and a bedrock stream channel create conditions that provide minimal acid buffering.
- The image on the right (b) is the same stream channel in the image on the left (a) during high-flow when stream water becomes extremely acidic.

Experimental Design

Two streams (T6, T8) were treated with limestone to improve water chemistry and fish reproduction.

An entire watershed (T16) was aerially limed to treat both terrestrial and aquatic ecosystems.

Treatment effects are being monitored by measuring flow and chemistry of streams and soils along with assessments of fish and aquatic macroinvertebrates, measurements of tree growth, and assessments of soil fauna, including snails and salamanders.

A joint study of liming effects on mercury mobility and biocycling is being led by Syracuse University.



- The image on the left (a) is of a V-notch weir used to measure stream flow.
- The image on the right (b) is of a researcher checking monitoring equipment.

Key Questions to be Addressed

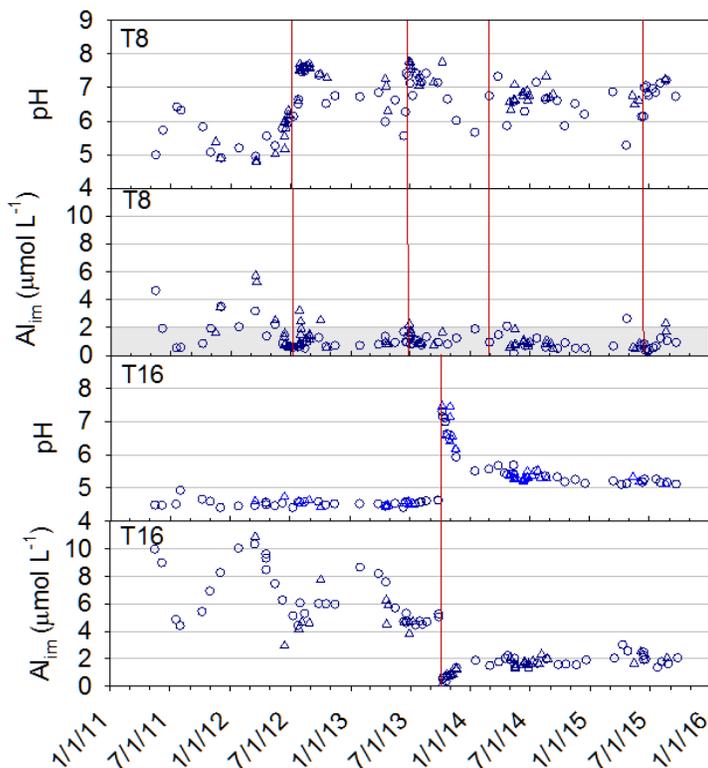
1. Can direct stream liming accelerate recovery of aquatic ecosystems?
2. Does whole-watershed liming promote recovery of acid-intolerant terrestrial plant and animal species?
3. Can whole-watershed liming accelerate recovery of both terrestrial and aquatic ecosystems?

Preliminary Results—Stream Chemistry



Direct stream liming was done three times in the summer and once just prior to spring snowmelt.

Direct stream liming increased pH and decreased toxic aluminum (Al_{im}) in stream T8. Watershed liming also increased pH and decreased Al_{im} in the more acidic stream of T16 but to a lesser degree.



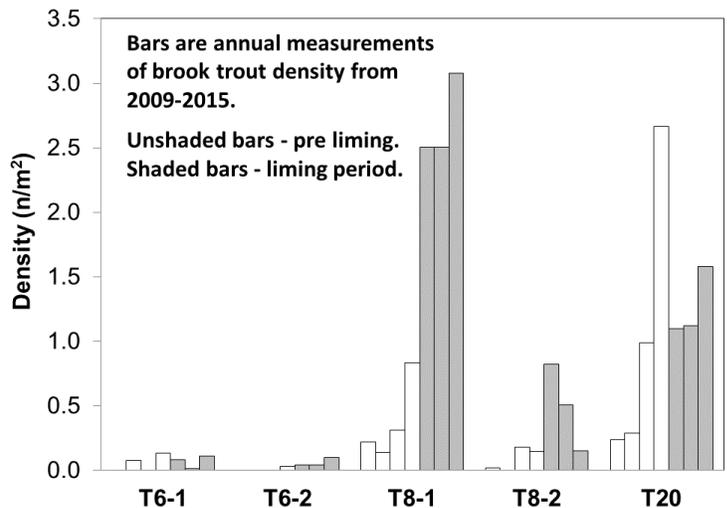
Values of pH and aluminum (Al_{im}) in streams of T8 (direct liming) and T16 (watershed liming). Red lines indicate dates of liming application.

Preliminary Results—Fisheries



The brook trout population in the lake is recovering as water chemistry improves, but acidified tributary streams continue to limit reproduction.

Stream liming had no effect on numbers of fish in T6 but resulted in distinct increases in T8, which suggests that individual watershed characteristics play a role in the effectiveness of liming for improving brook trout habitat. T20, a well-buffered, untreated reference stream, showed large year-to-year variations in the absence of treatment.



Fish densities in two treated stream reaches in T6 and T8 as well as in untreated T9. Bars are in chronological order, left to right for 2009–2015. Unshaded bars indicate pre-treatment; shaded bars indicate treatment years.

This project is a joint collaboration of the U.S. Geological Survey (USGS), Cornell University, SUNY College of Environmental Science and Forestry, Syracuse University, and Colgate University.

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