



Project Impacts

NSRC-FUNDED RESEARCH FINAL REPORT

Stream Fishes Sensitive to Acid-Aluminum Levels in Northern Forest Ecosystems



PROJECT AWARD YEAR AND TITLE:

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Stream Fishes as Sentinels for Acid-Aluminum Impacts in New England Forested Ecosystems

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Aluminum is a common element in soils, and trace amounts are present in surface waters. Low pH, resulting from acid rain, promotes formation of inorganic aluminum. Even minute amounts and short-term exposure to inorganic aluminum affects fish, damaging gills and impairing *osmoregulation* (maintenance of water balance within the body) and respiration. NSRC researchers developed techniques to measure acid-aluminum impacts on northeastern stream ecosystems and conducted a region-wide assessment of acid-aluminum impacts on stream fishes.

Researchers monitored pH and inorganic aluminum and ion concentrations at 66 stream sites in Vermont, New Hampshire, and Maine from April 2007 to November 2008. They collected water samples in April, June, September, and December and evaluated the potential for “Diffusive Gradient in Thin Film” (DGT) samplers to record inorganic aluminum levels integrated over time. At a subset of monitoring sites, researchers measured gill aluminum in Atlantic salmon and brook trout and determined fish population and diversity levels.

DGT sampling appears to be an effective measurement of integrated levels of inorganic aluminum for time intervals of 2-4 weeks. Levels of pH and inorganic aluminum varied widely across sample sites, often reaching levels that impact the physiology of resident fishes. The most severe conditions occurred in spring, coincident with Atlantic salmon smolt transformation (life stage that migrates to sea), when the fish are most sensitive to acid-aluminum. Sites with the lowest pH and highest aluminum had fish with elevated gill aluminum and low fish diversity. Gill samples from smolts migrating from the Merrimack watershed in New Hampshire showed high levels of aluminum and impaired osmoregulatory capacity.