ATMOSPHERIC DEPOSITION

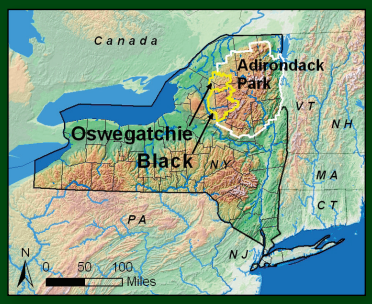
PRINCIPAL RESEARCHERS

Timothy Sullivan
E&S Environmental Chemistry, Inc
Gregory Lawrence
U.S. Geological Survey
Scott Bailey
USDA Forest Service

PARTNERS

Todd McDonnell, E&S Environmental Chemistry, Inc.

PROJECT LOCATION



Oswegatchie and Black River Basins in Adirondack Park. Source: E&S Environmental Chemistry, Inc.

CONTACT INFORMATION

For more information on this project, go to:
www.nyserda.org/programs/environment/emep/
or contact Greg Lampman at:
ggl@nyserda.org

PROJECT NUMBER 10660

KEYWORDS

- Acid deposition
- Adirondack
- Calcium
- Forests
- Sugar maple

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NYSERDA
New York State Energy Research and Development Authority

Acid Deposition Effects on Adirondack Ecosystems: Linkages Among Streams, Soils, and Sugar Maple Tree Health

PROJECT FOCUS

This project will measure the health and reproduction of sugar maple trees, an important and sensitive biological resource, in association with chemical characteristics of watershed soils in the Oswegatchie and Black River Basins in the western Adirondack Mountains. This region receives relatively high levels of atmospheric sulfur (S) and nitrogen (N) deposition that has lowered the acid-buffering capacity of soils by depleting calcium (Ca) reserves at some locations. The research team will determine where in the project area the relative abundance and/or health of sugar maple is associated with the base cation supply in soils. The goal of this project is to identify relationships between sugar maple health, soil chemistry, and stream chemistry, and to develop an integrated ecosystem assessment of acid deposition effects for this region.

CONTEXT

Acid deposition, sometimes referred to as acid rain, occurs when emissions from fossil fuel combustion and other industrial sources undergo chemical processes in the atmosphere and then fall to earth in wet or dry form, acidifying surface waters and soils. The adverse impacts of acid deposition on resources in New York State have been well-documented for Adirondack lake waters, and for stream waters in both the Catskill and Adirondack Mountains. Adverse effects on vegetation in New York have also been demonstrated, but the extent and severity of damage has not been quantified.

An example of a damaged sugar maple canopy in the western Adirondack region. Trees under stress exhibit loss of foliage and premature coloring. Source: Greg Lawrence.

This project builds upon the results of recent research conducted on sugar maple health in Pennsylvania, New England, and Quebec, as well as recent NYSERDA-sponsored research in the Adirondack Mountains on soil and stream chemistry.

Sugar maple makes a good index species for assessment of acid deposition effects on the Adirondack forest because it has a high demand for Ca, which is becoming less available in the soils due to acid deposition. Furthermore, it is a major component of northern hardwood ecosystems, and is highly valued for both commercial and esthetic reasons.

PROJECT IMPLICATIONS

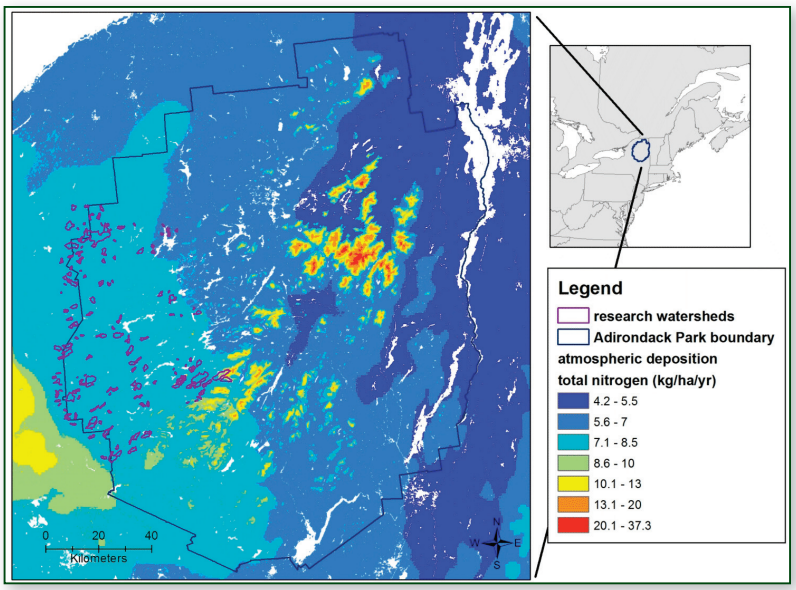
This research will provide a foundation for determining the extent to which sugar maple trees and their watershed soils in the western Adirondack Mountains have been impacted by acid deposition, and will help in estimating the degree to which impacted forests can recover, both chemically (soils) and biologically (vegetation), following reductions in acid deposition. This information will help policymakers better understand and evaluate the impact of current and future efforts to reduce acid deposition in New York State.

PROJECT STATUS
Ongoing

A large sugar maple tree in the western Adirondack region being measured by project scientist Greg Lawrence of the USGS. Source: Greg Lawrence.

METHODOLOGY

This research uses the sampling design and data collected from the Western Adirondack Stream Survey (WASS). The WASS provided an assessment of stream acidification for small watersheds through the sampling of 200 streams randomly selected from the population of 565 streams. In the new project, a subset of WASS watersheds has been randomly selected for soil and vegetation sampling. Low-order stream watersheds are used as the integrating unit. This provides the foundation for statistically based regional extrapolation of research findings and includes the possibility of using seasonal streamwater chemistry as an integrator of aspects of forest soil chemistry that are associated with adverse impacts on sugar maple.



Map showing watersheds in the western Adirondack Mountains that were included in the WASS, which forms the basis for this project. Also shown is the estimated level of total N deposition at the locations of the study watersheds. Source: Greg Lawrence and Kathleen Weathers.

To select the 50 study plots for this project, the 200 WASS watersheds were ranked by the stream water base cation surplus value, and divided into 20 groups that maintain their ranking. One watershed was randomly selected for sampling (one to three plots per watershed) from each group. Landscape characteristics are being evaluated through the use of GIS databases, aerial photography and field reconnaissance to select locations that are generally representative of the watershed and include sugar maple trees. In these locations, sugar maple seedlings are being counted, identified, and measured, and wood cores are being collected for dendrochronological analysis. In each plot, all standing living and dead trees of greater than 10 cm diameter at breast height (dbh) will be evaluated by species, dbh, and crown class (dominant, codominant, intermediate, suppressed). Crown vigor index, percent branch dieback, and percent crown transparency will be estimated for each tree. Percent dead sugar maple basal area, mean sugar maple crown vigor, and mean percent sugar maple dieback will be determined for each stand. Assessments in the selected watershed locations will also include soil profile sampling and soil chemical analyses.

The objectives of this research are to:

- Assess the visible health of dominant and codominant sugar maple trees through systematic evaluation of canopy condition;
- Analyze historical growth trends through dendrochronology;
- Assess seedling and sapling density;
- Identify relationships among sugar maple health, soil chemistry, and stream chemistry;
- Evaluate the extent to which poor soil base cation status and vegetative health can be inferred from streamwater chemistry; and
- Develop an integrated ecosystem assessment of soil, stream water, and sugar maple conditions that can be applied to the regional population of 565 watersheds.

FINDINGS

Field sampling for this project was completed in July 2009. Analysis of samples, data interpretation and report writing will proceed through 2010.

New York Energy Smart
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