

ASSESSMENT OF NITROGEN AND ACIDIC DEPOSITION IMPACTS TO TERRESTRIAL AND AQUATIC ECOSYSTEMS OF TUG HILL

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Project Location

Tug Hill Region



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Keywords

- Acidic deposition
- Foliar chemistry
- Forest canopy
- Soil chemistry
- Surface water quality

PROJECT FOCUS

This project will assess the extent to which aquatic and terrestrial ecosystems in the Tug Hill region of New York are affected by excess nitrogen (N) and acidic deposition. The two-year study will provide much-needed baseline data for a region of New York State (NYS) that is susceptible to the effects of acidic deposition but where little is known about the extent and magnitude of these effects. The present study includes:

- ◆ Synoptic surveys of surface water quality at 40 sites across the Tug Hill region;
- ◆ Testing of soil chemistry, forest vegetation composition, and plant tissue chemistry at locations adjacent to the surface water samples; and
- ◆ Synthesis of data for site-level assessments of the effects of acidification on soils, including base cation nutrient depletion and potential for N saturation.

CONTEXT

Fossil-fuel combustion sources are major emitters of sulfur dioxide (SO₂) and nitrogen oxides (NO_x). These pollutants undergo complex reactions in the atmosphere to form nitric and sulfuric acids, which, through atmospheric deposition in forests and bodies of water, affect ecosystems in complex ways and contribute to the acidification of soils, lakes, and streams. Over the past 20 years, federal policies such as the Clean Air Act Amendments of 1990 (CAAAAs) have resulted in decreased atmospheric emissions and deposition of sulfur in NYS. In the same period, atmospheric emissions of nitrogen, which were not capped by the CAAAs, have not changed significantly.

Tug Hill, the third largest intact, forested region in New York, is subject to especially high levels of nitrogen and acidic deposition for the eastern United States. Given the significance of the region for plant and wildlife habitats, forest products, fisheries, and drinking water, it is critical to understand the extent to which the region's aquatic and terrestrial ecosystems are affected by excess nitrogen and acidic deposition.

In comparison with other regions of New York, such as the Adirondacks, Catskills, and the Allegheny Plateau, Tug Hill has the highest long-term (1980-2002) average annual deposition rates for ammonium (NH₄⁺), nitrate (NO₃⁻), total inorganic N, sulfate (SO₄²⁻), and hydrogen (i.e., H⁺, affecting pH). For example, Tug Hill is subject to inputs of N and H⁺ that are, respectively, 1.9 and 1.5 times greater than in the central Adirondacks. In addition, because the Tug Hill forests

are similar to those of the Adirondacks and northern New England, and much of the region has strongly acidic soils, it is likely that Tug Hill is affected by N saturation and acidification. Despite these considerations, there has been no regional assessment of the effects of atmospheric deposition on Tug Hill's forests and streams.



Greg McGee and Laura Hartley (field assistant) mapping out a study site.

Credit: Greg McGee

PROJECT UPDATE

December 2005



Credit: Greg McGee
Pat Crast canoeing on Tug Hill.

Project Status

- Initiated January 2005
- Project ongoing



Since 1975, the New York State Energy Research and Development Authority (NYSERDA) has developed and implemented innovative products and processes to enhance the State's energy efficiency, economic growth, and environmental protection. One of NYSEDA's key efforts, the Environmental Monitoring, Evaluation Protection (EMEP) Program, supports energy-related environmental research. The EMEP Program is funded by a System Benefits Charge (SBC) collected by the State's investor-owned utilities. NYSEDA administers the SBC program under an agreement with the Public Service Commission.

METHODOLOGY

A broad sampling plan, encompassing various media, will be performed over a two-year period (2005-2007). The project team will survey **surface water quality** at 40 representative sites in the Tug Hill region during snowmelt (March-April) and baseflow (July-August) conditions. Samples will be analyzed for pH, acid-neutralizing capacity, organic and inorganic N, dissolved organic carbon, base and acid cations, and anions. While baseflow measurements will be helpful in evaluating ground water contributions across the region, snowmelt measurements will indicate which parts of the region are most susceptible to acidification and NO_3^- export during acidification events.

At two plots adjacent to the above sites, soil chemistry, forest vegetative composition, and live plant foliar chemistry will be sampled in order to determine the extent to which regional forests and their respective watersheds display symptoms of excess acidic and N deposition. One plot will be established at lower topographic positions near the stream and the other at the highest position on the streamside hill slope.

- ◆ **Soil Chemistry:** Soils will be sampled once in the middle of each growing season in 2005 and 2006. Forest-floor and mineral soil chemistry will be analyzed at each location.
- ◆ **Forest Composition:** Forest tree composition and structure will be assessed on each sample plot.
- ◆ **Plant Foliar Chemistry:** Forest canopy plant tissue will be sampled once in the middle of each growing season in 2005 and 2006. The analysis will measure levels of carbon, N, lignin, aluminum, and nutrient base cations (Ca^{2+} , K^+ , Mg^{2+}).

Accumulated data from the monitoring sites will be synthesized in order to gauge the effects of acidification on soils in the region, including the depletion of base cations and potential for N saturation. The evaluation will allow for the:

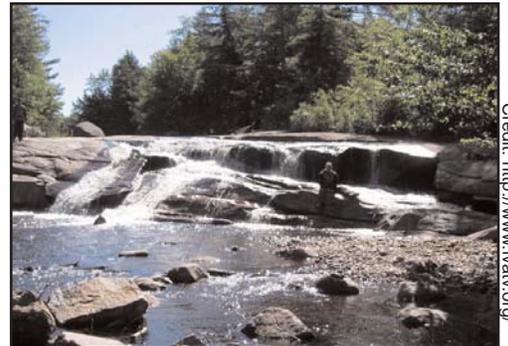
- ◆ Assessment of the potential impacts of acidic and N deposition on the Tug Hill region as a whole, including a comparison of the range of surface water, soil, and plant tissue indicator values with studies from other regions of New York where the effects of acidification and excess N deposition have been well documented.
- ◆ Analysis of the variation among the Tug Hill sites with regard to acidification and N status, relating differences to site conditions such as soil, forest species composition, and stand development stage.

PROJECT IMPLICATIONS

The Tug Hill region contains approximately 6,400 km of streams that contain world-class fisheries and serve as the source of drinking water for several municipalities. The region's forests support an \$80 million wood products and paper manufacturing industry that is comprised of 70 wood-using businesses on or near Tug Hill. This economically important region of New York has not been subject to adequate monitoring efforts, despite its susceptibility to the impacts of acidic deposition. This project's analysis of current conditions in the region will seek to fill this information gap, significantly expanding our knowledge of the effects of atmospheric deposition on aquatic ecosystems and forests in the Northeast. The data accumulated will benefit the development of sound policies for the management and protection of New York's forest resources.



Aerial view of Tug Hill Plateau



Waterfalls on Tug Hill Plateau

Credit: <http://www.epa.gov/>

Credit: <http://www.natv.org/>