PROJECT UPDATE

August 2005

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Assessment of Chemistry and Benthic Communities in Streams of the Oswegatchie-Black River Basins of the Adirondack Region

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Project Location

Adirondack Mountain Region outlined.

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Keywords

- Acidic deposition
- Benthic communities
- Macroinvertebrates
- Periphytic diatoms
- Stream chemistry
- Stream reaches

PROJECT FOCUS

The U.S. Geological Survey (USGS), in collaboration with several other organizations, is conducting a survey of streams in the Black River and Oswegatchie River watersheds of the western Adirondack region of New York State (NYS) to assess the impacts of acidic deposition. These watersheds are representative of the region likely to be most affected by acidic deposition in New York and possibly in the United States.

The project team is using a new approach for quantifying the length of stream reaches that are affected by chronic and episodic acidification. The research involves:

- Sampling stream water at approximately 200 semi-randomly chosen locations for analysis of water chemistry;
- Sampling soils of fifteen watersheds to infer calcium status of soils (from information on stream chemistry under different flow conditions);
- Resampling sites that have been previously assessed (1980-1985) and sites currently being sampled in other projects, in order to allow historical and other comparisons; and
- Collecting macroinvertebrates and periphytic diatoms at locations that represent a range of chemical and physical conditions, in order to analyze trends in species composition in relation to acidification factors.

CONTEXT

Fossil-fuel combustion sources are major emitters of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), which through complex reactions in the atmosphere form nitric and sulfuric acids. The deposition of these compounds contributes to the acidification of soils and waters. New York's Adirondack Mountains, located downwind of midwestern coal-burning power plants, are one of the regions most sensitive to acidification in North America, partly owing to their geological and soil characteristics. However, neither the proportion of affected streams nor the spatial extent of soil acidification has been determined.

Two important measurements for categorizing acidification are pH and acid-neutralizing capacity (ANC), measured in microequivalents per liter (µeq/L). Bodies of water exhibit a wide range of pH and ANC values under natural conditions that can be lowered by acidic deposition. Naturally acidic surface waters, however, do not contain measurable amounts of inorganic monomeric Aluminum (Al), which make this measure a definitive indicator of acidic deposition effects. In general, ANC values less than 50, pH values less than 5.5, and inorganic monomeric Al concentrations greater than 2.0 micromoles per liter are considered detrimental to aquatic ecosystems.

Credit: Greg Lawrence, USGS
Bear Brook, near Raquette Lake.

In addition to water chemistry parameters, biota found in benthic communities (the groups of organisms living in or on the sediment in a body of water) are important indicators of river water quality. Since each species has a certain tolerance for water chemistry and other environmental factors, species composition can be used as an index of general water quality. Benthic communities in Adirondack streams contain a wide variety of periphytic diatoms, single-celled microalgae that grow on all moist or submerged surfaces (e.g., rocks, sediment, or plants). Freshwater macroinvertebrates, larger-than-microscopic invertebrates including aquatic insects, worms, clams, snails, and crustaceans, are widely used in biomonitoring programs for assessing water quality because of their abundance and their sensitivity to environmental impacts.

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Credit: Greg Lawrence, USGS

Examples of macroinvertebrates collected for the study.

Project Status

- Initiated 2003
- Project ongoing

New York Energy $mart℠ PUB

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 NYSERDA'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. NYSERDA administers the SBC program under an agreement with the Public Service Commission.

METHODOLOGY

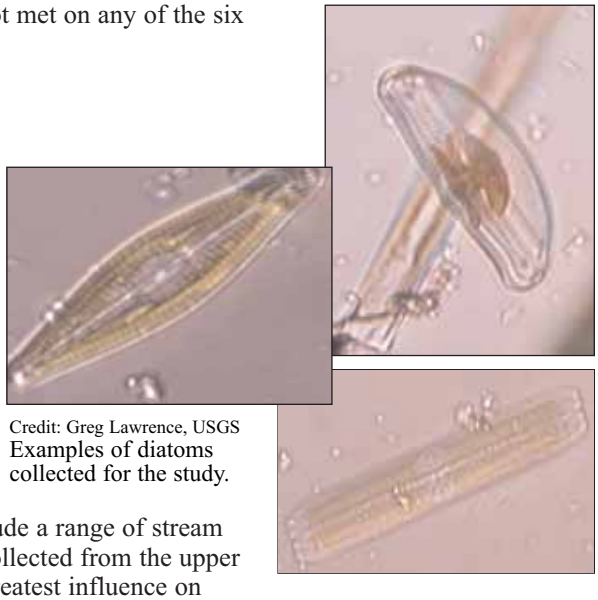
This survey involves a new approach for quantifying the length of stream reaches affected by chronic and episodic stream chemistry. Previous research suggests that the acidity of stream water in upland regions increases or remains the same in the upstream direction. This tendency is being used to estimate the total length of acidic stream reaches in the study region and in the following components of the project's sampling efforts:

Water Chemistry

- Collection of stream water for chemical analysis from approximately 200 streams. Sampling will take place during high and low flows in the early spring, late summer, and late fall of August 2003 through April 2005. The sites were randomly selected from a population of all accessible stream sampling locations that are not greatly influenced by upstream lakes and ponds.
- Collection of stream water for chemical analysis from 13 sites sampled in 1980–1985. Chemical concentrations determined on different dates shall be compared for each site to determine seasonal variations that can be used to infer acidification status. With this approach, the sites will be considered chronically acidic if ANC is less than 10 µeq/L, pH is less than 5.5, and inorganic monomeric aluminum (Al) concentrations are greater than 2.0 µmol/L on all six sampling dates. Sites will be considered episodically acidic if these criteria are met on 1–5 sampling dates, and nonacidic if not met on any of the six sampling dates.

Benthic Communities

- Collection of periphytic diatoms at the same 200 stream sampling locations to determine species composition.
- Collection of macroinvertebrates in 40 selected streams that vary chemically. Some of these streams were similarly sampled in 1980 -1985. Species occurrence, richness, and relative abundance will be measured.



Credit: Greg Lawrence, USGS

Examples of diatoms collected for the study.

Soil Chemistry

- Collection of soil samples for chemical analysis in 15 watersheds. The watersheds will be selected to include a range of stream acidification levels. Samples will be collected from the upper part of the soil profile, which has the greatest influence on stream chemistry during high flows. Streams that are chronically acidic, as well as those that become acidic during high flows will be expected to have low amounts of calcium in the soil. Calcium is an important nutrient for tree growth and aquatic ecosystems, as well as being the primary component for neutralizing acidic deposition.

PROJECT STATUS

All sampling has been conducted and chemical analyses are complete. Data analysis is underway.

PROJECT IMPLICATIONS

While the acidity of deposition has declined in New York over the past 20 years, insufficient data exist for determining whether the acidity of streams has decreased in response to these developments. More adequate baseline data will also be needed for identifying and evaluating future trends in the acidity of soils and streams. In the absence of sufficient information, policy efforts at restoring and protecting these natural resources will have to be made with a considerable degree of uncertainty.

This project addresses these needs by better characterizing the current status of streams and soils in the western Adirondack region, an area that is highly sensitive to acidic deposition. The project's innovative method for quantifying stream reaches will be evaluated for possible use in assessing acidic deposition impacts in other regions of the Adirondack Mountains and New York State.