PROJECT UPDATE

February 2006

New York State Energy Research and Development Authority

Environmental Monitoring, Evaluation, and Protection Program

Long-Term Monitoring Program for Evaluating Changes in Water Quality in Adirondack Lakes

Principal Researcher

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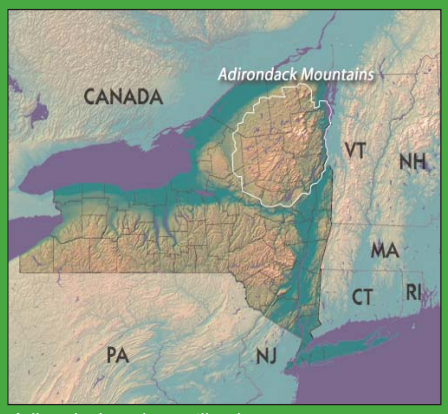
Project Location



Adirondack region outlined

Contact Information

For more information on this project see:
www.adirondacklakessurvey.org
and
www.nyserda.org/programs/environment/emep
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Keywords

- Acid deposition
- Acid neutralizing capacity (ANC)
- Episodic acidification
- pH
- Toxic aluminum

PROJECT FOCUS

The primary focus of the Adirondack Long Term Monitoring (ALTM) program of the Adirondack Lakes Survey Corporation (ALSC) program is to collect and analyze the spatial and temporal data needed for assessing seasonal and long-term patterns in the chemistry of representative Adirondack waters, and to provide data and findings for the research and policy communities. The ongoing assessment identifies changes in water chemistry over time, allowing the evaluation of future emission or deposition changes, thus providing reliable information for decisions relating to pollutant control measures. The main program objectives are to determine long-term trends and to evaluate episodic acidification for its potential impact on aquatic biota.

CONTEXT

Fossil-fuel combustion sources are major emitters of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), chemical precursors of acidic deposition (acid rain). The Adirondack mountain ecosystem of New York State, located downwind of Midwestern coalburning power plants, is one of the regions most sensitive to acidification in North America, partly owing to its geological and soil characteristics. As a result, this region is a focal point for numerous research efforts designed to identify the processes involved in acidification and its effects on aquatic resources, and to evaluate the effectiveness of emissions controls.

In 1982, researchers at Syracuse University and others began the ALTM program by conducting monthly sampling of 17 lakes in the western Adirondacks. In 1984, the ALSC was established to determine the extent and magnitude of surface water acidification in the entire Adirondack region. The ALSC found that deposition-related acidification was occurring throughout the region. In 1992, following the enactment of the 1990 Clean Air Act Amendments, which directly addressed the issue of acidic deposition, the ALSC expanded the ALTM program to 52 representative waters in the region. In 1998, funding for this program was provided by the **New York Energy $mart**SM Program. A primary goal of the project is to assess the effectiveness of the 1990 legislation, which mandated significant reductions in emissions of SO_2 and NO_x.

There are several critical chemical criteria that coincide with damage to aquatic biota. Biota are at risk from surface water acidification when surface water pH is less than 6.0, acid neutralizing capacity (ANC) is less than 50 µeq/L, or concentrations of toxic inorganic aluminum are greater than 2 µmol/L. These are called biologically relevant indicators and are the first level of data necessary for understanding and restoring aquatic ecosystem structure and function.

METHODOLOGY

Researchers collect and analyze water samples from 52 lakes (monthly) and from three streams (weekly) located in the Adirondack Park. These lakes, chosen from among 1,469 lakes surveyed in the mid-1980's, have been sampled monthly since 1992. Seventeen of these lakes have a continuous monthly data record dating from June 1982. In twelve ALTM lakes, more intensive weekly sampling is conducted during the critical spring snowmelt when acidification conditions are most severe. Lake samples are analyzed for 20 different chemical parameters using the highest quality assurance/quality control measures. Weekly sampling of three southwestern Adirondack streams is an extension of a USEPA seasonal acidification project conducted originally during 1988 to 1990. Among these is Buck Creek, which has been one of the longest study sites for documenting the persistence of acidic episodes in upland regions of the Adirondacks as well as the northeastern United States.

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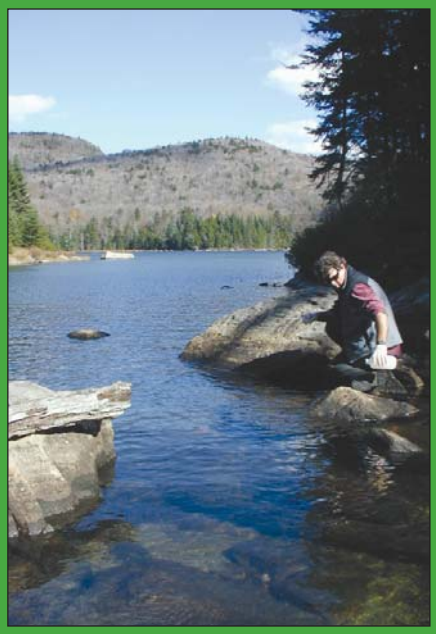


Researcher collects water samples

Project Status

- Initiated 1999
- Project ongoing

New York Energy Smart℠ 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, and 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.

FINDINGS

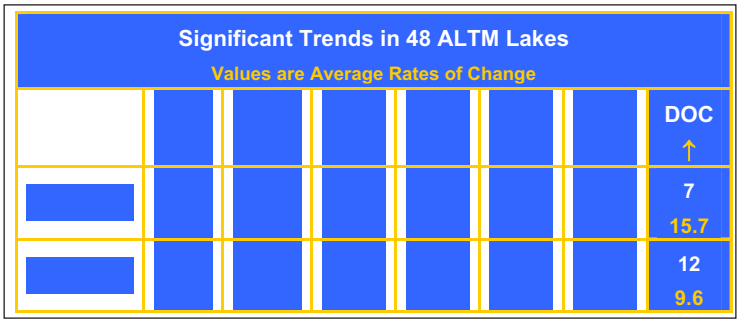
LAKE TREND RESULTS:

The first trend analysis (1982-1991) conducted on the original 17 ALTM lakes found sulfate decreasing in many lakes, with patterns of increasing nitrate in over half of the waters. No improvements in acid neutralizing capacity (ANC) or pH were observed. The first analysis of the expanded 52-lake survey (1992-2000) showed new indications of change. During this time, rainfall chemistry was improving, with most of the pH increases occurring from 1991 to 1995. The following key trends were observed in ALTM lakes:

- **SO_4:** Nearly all lakes showed improvement (decreases). Over the longer record lakes, sulfate levels were decreasing in all of the 16 lakes at a uniform rate, suggesting that decreases in SO_2 emissions and atmospheric sulfate deposition were responsible for the change.
- **NO_3:** Unlike sulfates, nitrate levels are varied. Patterns of nitrate cannot be attributed to changes in nitrate deposition or explained by nitrogen saturation models.
- **ANC:** Improvement detected in 29 out of 48 lakes. The rates of change are small and slow, suggesting it will take decades at current deposition rates to reach 50 µeq/L, a level suitable for aquatic biota. Overall lake ANC levels remain a concern in 2000 with 34 lakes showing average ANC values of less than 50 µeq/L, including 10 lakes with ANC levels below zero.
- **pH:** Improvement (increased pH) observed in 18 lakes with two lakes declining. Overall averages still critical to aquatic biota with 23 lakes showing an annual mean pH of less than 5.5.
- **Aluminum:** Decreases in toxic forms of aluminum detected in 28 lakes. While a shift was observed from toxic inorganic forms toward less toxic organic forms, toxic levels remain at levels above those known to be toxic to juvenile forms of native Adirondack fish.

RECENT FINDINGS:

More recently in 2005, another time-series analysis was conducted with four years of additional data (1992-2004). These results show that while a greater number of lakes are exhibiting positive trends, the slopes or the rates of those trends have slowed. This further indicates that full chemical recovery for these lakes will be in the order of decades. Critically high levels of toxic aluminum and other chemical indicators continue to occur particularly during spring snowmelt. The patterns and mechanisms for these changes are being further analyzed across lake types.



PROJECT IMPLICATIONS

Findings of this project indicate that when declines in emissions result in declines in acidic deposition, these improvements can translate into changes in water chemistry. Time-series analysis of water chemistry conducted from 1982-2000 data and more recently through 2004 show improvements have occurred in a number of lakes, albeit slightly, as a result of changes in atmospheric deposition. It is important to note, however, that these data do not indicate that lake recovery is complete, only that it is beginning. Acidic deposition still impacts sensitive ecosystems in the Adirondacks. At current rates, it will take decades to alleviate acidification stress to biota in these waters. For example, in many of the studied lakes, inorganic aluminum levels remain above toxic levels for fish, especially during spring snowmelt. ANC and pH values also remain too low for healthy biota in many waters. The results indicate that further reductions in NO_x and SO_2 emissions would contribute to the recovery process of these lakes.