The Adirondack Effects Assessment Program

Program Update & New Research Directions

Charles W. Boylen
James W. Sutherland
Jay A. Bloomfield &
Sandra A. Nierzwicki-Bauer

Darrin Fresh Water Institute, Rensselaer Polytechnic Institute &
Bureau of Watershed Assessment and Management, NYS DEC
Presentation Outline

• AEAP Background
• Current Data
• Brooktrout Lake Biotic Trends
• Fish Restoration Project
The Adirondack Effects Assessment Program

Since 1994 a study of water quality trends in acidified lakes and ponds in the Adirondack Mountain Region of New York State with a concomitant effect on biota funded by the US EPA
AEAP Scientific Collaborations representing state, federal and university investigators

- Darrin Fresh Water Institute, RPI
- State University of NY at Oswego & Syracuse
- NYS DEC
- Academy of Natural Sciences in Philadelphia
- Marist College
- NYS Museum
- US Geological Survey
- University of Maryland
Lawrence Eichler, James Harrison, Sascha Percent, David Winkler
Darrin Fresh Water Institute
Robert Bombard
NYS Department of Environmental Conservation
Gregory Lawrence
U.S. Geological Survey
Robert Daniels
NYS Museum
William Shaw
Marist College
Don Charles and Frank Acker
Academy of Natural Sciences
Bahram Momen
University of Maryland
Myron J. Mitchell
SUNY-ESF
Alfred Stamm
SUNY Oswego
Study Sites

- Southwest quadrant of Adirondack Park
- 30 lakes and ponds initially selected
- Sites are different hydrologic types
- A subset of ALTM Program waters
Sampling Strategy

• Mid-summer during thermal stratification
  • most stable part of growing season
  • ability to detect temporal changes in chemistry and biota
• Vertical profiles – temp, DO, light
• 20 chemical analytes including pH, ANC, NO$_3$, SO$_4$, TP, PO$_4$, Al
Net Trend in pH since 1994

The blue bar is the mean 1994 pH for each lake; the maroon bar is the net increase in pH through the 2004 sampling season.
Net Trend in NO$_3$ since 1994

The blue bar is the mean 1994 NO$_3$ concentration for each lake; the maroon bar is the net increase (above x-axis) or decrease (below x-axis) in NO$_3$ through the 2004 sampling season.
Net Trend in SO$_4$ since 1994

The blue bar is the mean 1994 SO$_4$ concentration for each lake; the maroon bar is the net increase (above x-axis) or decrease (below x-axis) in SO$_4$ through the 2004 sampling season.
Phytoplankton Species vs pH

$y = 13.818x - 38.362$

$R^2 = 0.508$
5 Year Average Number of Zooplankton Species vs. pH

TZ = -5.3 + (3.68 * pH), r^2 = 0.627, p < 0.001
Aquatic Plant Species vs pH

\[ y = 7.7844x - 31.346 \]

\[ R^2 = 0.6107 \]
Summary of Biotic Trends of the 30 Study Lakes

As pH and ANC gradually increase in some of the study lakes, documented shifts are beginning to occur in the major trophic levels of these lakes towards more circum-neutral species with the disappearance of strictly acid tolerant species.
Case Study: Brooktrout Lake
Brooktrout Lake

- Watershed Area: 176.9 ha
- Lake Volume: $2.41 \times 10^6$ m$^3$
- Lake Area: 28.7 ha
- $T_{\text{hyd}}$: 1.4 yr
- Annual Runoff: 89 cm
- Mean Depth: 8.4 m
Brooktrout Lake pH & ANC Trends

\[ y = 1.3944x - 8.2007 \quad R^2 = 0.7827 \]

\[ y = 0.0502x + 5.2853 \quad R^2 = 0.3034 \]
Brooktrout Lake SO$_4$ Trend

$y = -1.6591x + 65.964$

$R^2 = 0.4298$
Brooktrout Lake NO$_3$ Trend

\[ y = -0.947x + 11.626 \]

\[ R^2 = 0.3935 \]
Brooktrout Light Extinction Profiles

\[ Zsd = -0.0016t + 64.82 \quad \text{R}^2 = 0.61 \]

\[ Ke = -8 \times 10^{-5}t + 2.5764 \quad \text{R}^2 = 0.56 \]
Brooktrout Lake Phytoplankton Trends
Crustacean & Rotifer Community Composition

Brooktrout Lake - Crustacean Community Composition - 1994-2003

Proportion of total density

Total Cyclopoids
Total Calanoids
Total Cladocerans

Brooktrout Lake - Rotifer Community Composition - 1994-2003

% of total community

K. taurocephala
P. vulgaris
All others
Avg mid-summer column pH
Brooktrout Lake Conclusions

• As SO$_4$ deposition has declined, starting around 1996, BTL has experienced an increase in pH from around 5.00 to 6.00. Transparency, Al species, NO$_3$ and reactive Si have also declined. Chl a and Total P have also increased.

• Although 13 other AEAP lakes have shown slight declines in NO$_3$ during the same time period (confirmed by the more-detailed ALSC LTM dataset), only BTL has shown a substantial NO$_3$ decline during the summer months, coincident with increases in trophic state parameters.

• Preliminary evidence from the 2003 BTL macrophyte survey also indicates an increase in macrophyte densities.

• Both phytoplankton & zooplankton community composition have also changed.

• Although piscivorous birds (for example, loons) have been observed at BTL in recent years, no evidence of fish has been noted.
Fish Restoration Project

Collaborating Institutions

• Darrin Fresh Water Institute
• NYS Department of Environmental Conservation
• NYS Museum
• Cornell University
Project Description

In November 2005 the DEC will stock Horn Lake strain brook trout:


Consideration given to stocking 20-40 older fish of different age classes this fall depending on Region 6 staff netting success from Horn Lake

Fish will be stocked by aircraft and fin clipped

Chemistry, phytoplankton, zooplankton & macroinvertebrates (both water column & benthic) sampled through growing season
BioSonics Advanced Digital Hydroacoustics Technology
Use of Hydroacoustic Technology
Hydroacoustics will be used to provide:

- Lake bathymetry
- Habitat zones
- Diurnal Chaoborus gradients
- Fish movements within the lake once they are introduced
Night Hydroacoustic Profiling

Jeremy Farrell & James Harrison on Brooktrout Lake - DFWI
Night Chaoborus Gradient
Anticipated Project Results

• Use of hydroacoustic will be first ‘state-of-the-art’ investigation of fish population recovery in the Adirondack Park

• Documentation of the population of the population dynamics of the introduced species

• Allow evaluation of survival following introduction and the in-lake reproduction by the older introduced individuals

• Demonstrate the effect of the introduced fish on the Chaoborus population as well as other water column macroinvertebrates

• Observe the interaction between the introduced fish and the resident loons on the lake