



Calendar

CONTINUING EDUCATION

Consider signing up for a continuing education course! Below is a sampling of class offerings, to view the complete brochure please call 845-677-9643 or visit our web site at www.ecostudies.org/cep.html.

Landscape Design

Dec. 6 (6 Mon.): **Graphics II: Illustration Drawing**

Gardening

Nov. 6 (1 Sat): **Attract Wildlife With Native Plants**

Nov. 6 (1 Sat.): **Front Lawn Alternatives**

Nov. 14 (1 Sun.): **Solving Soil Problems on Your Home**

Landscape

Dec. 4 (1 Sat.): **Native Trees & Shrubs**

Volunteer Educators Needed!

School Program Volunteer Educators get to make a difference while exploring the IES grounds, gardens and greenhouses with children. Apply inquiry-based teaching methods and help manage groups of up to 30 children. To apply or to find out more about this very rewarding opportunity, contact Susan Eberth at 677-7600 ext. 316. Training session for registered Volunteer Educators is December 6th from 9:30 to 12:00.

THE ECOLOGY SHOP

See our unique assortment of nature and gardening gifts. Many items are fair-trade, recycled, or otherwise earth-friendly, so you can feel good about your purchases. *Senior Citizens Days: 10% off on Wednesdays.*

Saturday Ecology Program November 6th, 1-3pm

Winter Tree Identification. Take a leisurely hike on the Institute's grounds and learn how to identify trees after their leaves have fallen. Free & open to the public. The program will meet at the Gifford House Visitor and Education Center, 181 Sharon Turnpike, Millbrook, NY. For more information and/or directions, call 845-677-7600 ext. 317.

IES SEMINARS

Free scientific seminars are held at 11 a.m. on Fridays in the auditorium from September until early May. Below is a selection of upcoming lectures:

Oct. 29: "**Managing ecosystem services: what do we need to know?**" *Dr. Claire Kremen, Princeton University*

Nov. 5: "**Detrital controls on soil organic matter dynamics and soil solution chemistry: an experimental approach**" *Dr. Kate Lajtha, Oregon State University*

Nov. 19: "**Prioritizing responses to invasive species threats: where does ecosystem restoration make economic sense?**" *Dr. Lisa Wainger, University of Maryland*

Dec. 3: "**Testing and building on a dispersal-assembly theory of ecological communities**" *Dr. Annette Ostling, University of California Berkeley*

Ecology Field Programs for Children & Teachers

Winter and spring at IES bring a wealth of opportunities for school children, their teachers and other groups. Explore the world of exotic plants in the greenhouse, discover the inner workings of maple sugaring, investigate watersheds, learn about the dynamic interactions of a forest ecosystem, and observe, measure, and compare the various components of pond life at the IES Cary Pond. To register for classes, call the Education Office at 845-677-7600 ext. 316. Hurry — programs fill up fast!

HOURS

Fall Hours: **October 1 - March 30**

Public attractions: Mon.-Sat., 9-4, Sun. 1-4; closed public holidays. The greenhouse closes at 3:30 daily.

The Ecology Shop: Mon.-Fri., 11-4, Sat. 9-4, Sun. 1-4. *(Please note: The shop is closed Mon.-Sat. from 1-1:30.)*

Required free permits are available at the Gifford House Visitor and Education Center until one hour before closing time.

MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the IES Newsletter, a reduced rate on courses and excursions, a 10% discount on IES Ecology Shop purchases and participation in a reciprocal admissions program. Individual membership: \$50; family membership: \$60. Interested? Call the Development Office at 845-677-7600 ext. 120.

The Institute's Aldo Leopold Society

In addition to receiving the benefits listed above, Aldo Leopold Society members are invited to special lectures, excursions and science updates. To learn more, call the Development Office at 845-677-7600 ext. 120.

GREENHOUSE

The Greenhouse is a year-round tropical plant paradise and a site for controlled environmental research. Managed using integrated pest management, plants thrive in its pesticide-free environment! Open daily until 3:30 pm with a free permit (see HOURS).

TO CONTACT IES ...

... **for research, graduate opportunities, library and administration:**

Institute of Ecosystem Studies
Box AB, Millbrook NY 12545-0129
Tel: 845-677-5343 • Fax: 845-677-5976

Street address: Plant Science Building,
65 Sharon Tpke. (Rte. 44A), Millbrook, NY 12545

... **for education, general information and The Ecology Shop:**

Institute of Ecosystem Studies
Education Program
Box R, Millbrook NY 12545-0178
Tel: 845-677-5359 • Fax: 845-677-6455

The Ecology Shop: 845-677-7600 ext. 309

Street address: Gifford House Visitor and Education Center, 181 Sharon Tpke. (Rte. 44A), Millbrook, NY 12545



Volume 21, Number 5 September - October 2004

Editor's Note

Both articles in this issue deal with the consequences of human-induced environmental change. Acidic streams in the White Mountains of New Hampshire share a common origin with zebra mussels blanketing the Hudson River— human activity. With globalization, invasive species transmission and acid precipitation will likely increase in coming years. Maintaining healthy ecosystems will depend on wise management and restoration practices arising from strong science-based policies.

Making informed decisions is integral to protecting the Earth's resources, from using energy efficiently to supporting policies that minimize human impacts. Interested in expanding your ecological understanding? Consider attending one of the Institute's free Scientific Seminars, held on Fridays at 11am in the IES auditorium. Upcoming topics include managing ecosystem services (Oct. 29) and restoring degraded ecosystems (Nov. 19).

The *IES Newsletter* is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York.

President and Director: Gene E. Likens
Administrator: Joseph S. Warner
Head of Education: Alan R. Berkowitz
Writer & Editor: Lori M. Quillen
Production Assistance: Pamela Freeman

Address newsletter correspondence to:
Public Information Office
Institute of Ecosystem Studies
Education Program, Box R
Millbrook, NY 12545-0178
e-mail: QuillenL@ecostudies.org

Printing: Spectrum Graphics, Poughkeepsie, NY

A Treatment, Not a Cure: Calcium Silicate Neutralizes an Acidic Stream

As a result of fossil fuel emissions, many freshwater bodies in eastern North America have become acidified. When burned, fossil fuels release sulfur dioxide and nitrogen oxide, the precursors to acid precipitation, into the atmosphere. Persistent exposure to these pollutants, which return to Earth in rain, snow, sleet, hail and fog, can compromise the health of aquatic ecosystems.

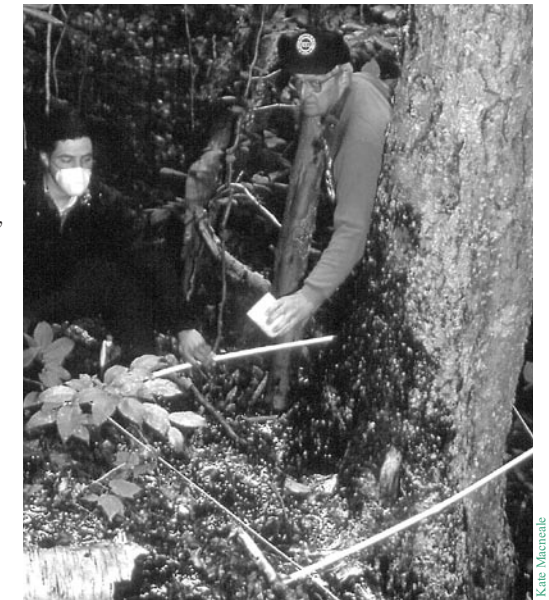
In a recent *Restoration Ecology* paper, Institute of Ecosystem Studies President and Director Dr. Gene E. Likens, with colleagues, explores a new approach to restoring acidified streams, the addition of calcium silicate. The paper is the first to document the neutralizing effects of Wollastonite, a calcium silicate mineral, on an acidic stream.

The research was done at the Hubbard Brook Experimental Forest, located in the White Mountains of New Hampshire. Likens, who with colleagues discovered acid rain at Hubbard Brook in the 1960s, has been investigating human-accelerated environmental change there for over four decades. A network of researchers and agencies, including over 70 scientists, has made the 3,160-hectare forest one of the most intensively studied watersheds in the world.

"Years of monitoring have documented that Hubbard Brook receives high levels of acid precipitation from emissions largely originating at Midwestern utility plants; as a result many streams on the site are acidic," Likens comments. Adding that, "The only way to successfully combat stream acidity is through improved air quality. Until that happens, we are exploring short-term methods of restoring water quality at sensitive sites."

Symptoms of acidified streams include a drop in pH, calcium, and dissolved inorganic carbon and an increase in metals like aluminum. When pH levels decline, a stream is said to have lost its acid neutralizing capacity. Aquatic and semi-aquatic animals, such as fish and salamanders, are more prone to stress and disease when exposed to acidity and heavy metals.

As a remedy for acid stomach, people reach for Tums, or a similar calcium-based acid reducer. When attempting to increase pH levels in acidic streams, scientists have historically used various forms of limestone, a natural source of calcium carbonate. Its



(L-R) Jason Demers holding a grid while Dr. Gene E. Likens applies Wollastonite pellets to the study stream.

neutralizing effects are short-lived, however, and it can generate extreme fluctuations in water chemistry. Recognizing the limitations of limestone, Likens and colleagues looked to another material to neutralize an acidified stream at Hubbard Brook— Wollastonite.

Over one hundred and thirty pounds (61kg) of this naturally occurring calcium silicate mineral, mined from the Adirondack Mountains and manufactured into a pellet form, was manually applied to the study stream. Pellets were added to 50-meters of the 910-meter stream, including the stream channel and adjacent stream bank. Researchers took extensive measurements of water attributes, such as pH and acid neutralizing capacity, before, during and after the application.

Despite the small treatment area, the buffering effects of the Wollastonite were long lasting. By adding the pellets to 5.5% of the entire stream, acidity was suppressed for over four months. It is likely that a larger addition would have resulted in a longer neutralizing effect. Wollastonite degraded slowly in the system; as a result water chemistry fluctuations were smaller than during limestone additions.

While the study's findings are useful to land managers looking for new methods of temporarily neutralizing acid streams, Likens is quick to comment that, "Manually adding

Muscling Their Way Into the Food Chain: Zebra Mussels Alter Fish Populations

Exotic invasive species can profoundly alter the environments they invade, resulting in ecological and economic losses. Invaders with high reproductive rates, few predators and voracious appetites can upset fragile food webs. With lives that take place under water, away from the watchful eyes of humans, it's hard to observe the changes brought about by invasive aquatic animals.

Take the case of zebra mussels, which were introduced into the Hudson River in 1991. Over the past thirteen years, the prolific bivalves have rapidly colonized hospitable river habitats, becoming the most abundant animals in the river's freshwater reaches.

The most obvious consequences of the zebra mussel invasion have been clogged pipes and increased water clarity. Adult animals need to anchor themselves to hard surfaces; to the lament of municipal water managers, many mussels make their homes on water intake pipes. Voracious filter feeders, they increase water clarity when they feed on microscopic plants and animals (phytoplankton and zooplankton) living in the water column. The first problem is mainly economic, but what does foraging competition and increased water clarity mean to other animals living in the river?

Scientists have long speculated that zebra mussels may compete with fish over food resources. Several species of young fish feed on the very microscopic animals that mussels are so adept at removing from the water column. Until recently, there was little scientific evidence to substantiate that mussels were impacting fish. In the August issue of *The*

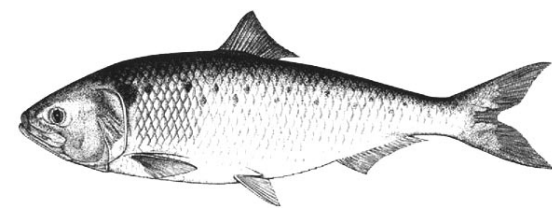
Canadian Journal of Fisheries and Aquatic Sciences, Institute scientist Dr. David L. Strayer, with New York State Department of Environmental Conservation scientists Dr. Kathryn A. Hattala and Dr. Andrew W. Kahnle, reveals that open-water fish species, like the commercially important American shad, are declining in response to the exotic invaders.

Invasive species research often is limited by a lack of ecological data on pre-invasion conditions.

Strayer and colleagues were fortunate to have extensive data on river fish populations before and after the zebra mussel introduction. As a condition of withdrawing cooling water from the river, utility companies on the Hudson River have gathered long-term data on juvenile fish since the 1970s. Institute scientists have been collecting data on the Hudson River food web since the 1980s. A window into pre-invasion conditions, this information was used to assess how fish have responded to the zebra mussel spread.

Careful analysis of fish population trends revealed that, depending on where they foraged, fish species responded quite differently. Open-water fish, such as American shad and striped bass, have decreased in growth and abundance since the zebra mussel invasion. Conversely, species like sunfish, which prefer vegetated shoreline habitat, have increased significantly. Changes were not modest; the median decrease in abundance of open-water species was 28%, while the median increase in abundance of shoreline species was 97%.

Why are open-water fish and vegetated shoreline fish being impacted so differently? The answer is in how the river responds to the prodigious appetites of zebra mussels. As mentioned earlier, adult zebra mussels feed by grazing on food particles suspended in the water column. There are so many zebra mussels in the Hudson River that they filter all of the water in the river every 1-4 days, stripping it of the microscopic plants and animals that make up their diet. In the past decade, fish species that rely on the same food resources have seen their aquatic pantry shelves increasingly bare.



Top: Small in size but significant in aggregate- individual adult zebra mussels are about the size of a penny. Bottom: An American shad, a fish species that is declining in the Hudson River as a result of the zebra mussel invasion.

Top: Lori M. Quillen, Bottom: National Oceanic and Atmospheric Association

"Zebra mussels have significantly reduced populations of zooplankton and other animals that are a dietary staple of open-water larval and juvenile fish," Strayer comments. Past research has shown that open-water zooplankton populations have declined by over 70% since the introduction of zebra mussels. When food is scarce, juvenile and larval fish are less likely to forage successfully and thus mature into adult fish.

When mussels remove food particles from the water, a byproduct is increased light penetration. In shallow light-limited areas, increased sunlight stimulates the growth of aquatic plants and the invertebrates associated with them, creating more fish food. Thus, when zebra mussels abound, open-water food resources decline and shoreline food resources increase. This shift explains the population trends observed by Strayer and colleagues, with open-water species moving downriver, away from the invasion, and shoreline species moving upriver.

Many of the population declines of open-water fish were large and involved species of commercial or recreational importance, such as American shad and black bass. Strayer notes, "The changes we observed may lead to fewer adults of species such as American shad, and more adults of species such as redbreasted sunfish in the Hudson. Maintaining a sustainable fishery for species like American shad, in the face of sharp population reductions, will be challenging. When a river's ability to support young fish changes, it becomes more difficult to develop and evaluate sound management strategies." ●

Fish Population Changes in Response to the Zebra Mussel Invasion

Open-water population declines:

American shad
White perch

Shoreline population increases:

Sunfish
Banded killifish
Bluegill
Red breast sunfish
Small mouth bass
Tessellated darter

Environmental Leadership: IES Receives the Russel Wright Award

The Institute has been honored as a recipient of the Russel Wright Award in Environmentalism, presented by the Russel Wright Design Center. The award recognizes the Institute's contributions to understanding the ecosystems that support life, both locally and globally. Mr. Andrew W. Capitman, Co-President of the Russel Wright Design Center, comments, "Institute Director Dr. Gene E. Likens has built an environmental resource not only for our valley but for the entire world."

The Center presents several awards annually to celebrate organizations and individuals that build on the legacy of interior designer and environmentalist Russel Wright. Award areas include design, architecture, landscape and the environment. "Located in the heart of the Hudson Valley, the Institute was selected on the strength of its intellectual leadership in ecology, which helps inform environmental preservation," Mr. Capitman notes.

A furnishing designer, Russel Wright developed an appreciation of nature when he moved his studio from Manhattan to Garrison, N.Y. in 1942. He spent three decades restoring his 75-acre property, once the site of extensive logging, using native plants. The grounds are open to the public. To learn more about the Russel Wright Design Center, visit <http://www.russelwrightcenter.org>



(L-R) Dr. Michael L. Pace, Assistant Director of the Institute of Ecosystem Studies and Mr. Andrew W. Capitman, Co-President of Manitoga/The Russel Wright Design Center.

Denise E. White

A Treatment, continued from page 1

buffering agents to acidic streams will never solve the acid rain problem. At most, it is a way to buy time until the real solution emerges—a reduction in air pollution."

He goes on to warn that, "Viewing calcium applications as a prescriptive cure for acid rain is like a runner viewing steroids as a cure for a bad knee. At the end of the race, when the steroids have worn off, the runner is left limping. Calcium additions, which are cost and labor-intensive, temporarily mask symptoms. They don't alleviate underlying causes, they are not feasible on a landscape scale and they will not protect our nation's freshwater resources." ●



The Wollastonite stream application was part of a larger watershed-level project. To learn more about how the calcium silicate addition impacted forests and wetlands, visit an overview on the Hubbard Brook website: www.hubbardbrook.org/yale/watersheds/w1/

The following collaborators were integral in conducting the Wollastonite addition research and preparing and co-authoring the *Restoration Ecology* paper. Several were IES graduate students when they participated in the project (*).

Donald Buso, Institute of Ecosystem Studies
Brian K. Dresser
*Emily S. Bernhardt, University of Maryland
Robert O. Hall, Jr., University of Wyoming
*Kate H. Macneale, Northwest Fisheries Science Center
Scott W. Bailey, USDA Forest Service

Plant Display Wins 4 Blue Ribbons!



Thousands of fair attendees visited the Institute's exhibit on environmentally friendly gardening and landscaping.

Richard Weisenthal

Garden design students in the Institute's Continuing Education Program (CEP) won four blue ribbons at this year's Dutchess County Fair. In response to the competition theme, "This Land is Your Land," students created a display focusing on environmentally friendly gardening and landscaping techniques.

An excerpt from the exhibit's text reads, "We are all stewards of the land. For most of us, our land is our yard. What we do on our land affects two of our most precious resources, soil and water." Exhibit content included landscaping with native plants, integrated pest management, and lawn care.

Students Carol Anderson, Ilma Dietz, Denise Dyko, Kathy Martin, John Muller and Andy Papp volunteered hundreds of hours of time to represent the Institute at the fair. CEP Program Leader Richard Weisenthal coordinated the effort, with assistance from instructor Michelle Keeley and IES Native Plant Gardener Judy Sullivan. Awards were won for Best Plant Design, Best Design, Best in Show for Education and 1st Place in Horticultural Education.



(L-R) Jack Eberth, Jim Eyring and IES Horticultural Assistant Margaret Eyring get tomato growing tips from Ray Bawol, a local Dutchess Country farmer.

Lori M. Quillen

Supporting Local Agriculture

This August, Institute scientist Dr. Valerie T. Eviner co-hosted a tomato tasting at IES with the Cornell Cooperative Extension and the Culinary Institute of America. Attendees rated 14 tomatoes grown by local farmers. Lemon Boy, Navidad and Sonoma varieties received top ratings. In addition to being bred for taste and nutrition, locally grown produce encourages open space and minimizes the fuel costs associated with long-distance shipping.