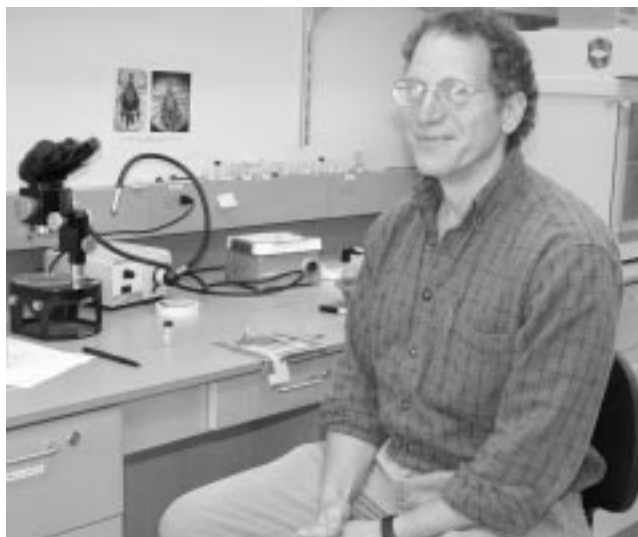


Biodiversity Buffers Lyme Disease Risk

Ecologists have long understood that fragmented landscapes can cause declines in vertebrate diversity. When faced with land development, sensitive species disappear while adaptable animals, such as crows and squirrels, persist. Researchers are now unraveling a connection between habitat fragmentation, vertebrate diversity, and disease risk. Studies performed at the Institute of Ecosystem Studies by Drs. Richard S. Ostfeld, Kathleen LoGiudice, Kenneth Schmidt and Felicia Keesing have revealed that when mammalian diversity declines, the risk of Lyme disease increases.



Rick Ostfeld in his Laboratory

Over 17,000 cases of Lyme disease are reported annually to the U.S. Centers for Disease Control and Prevention, with incidence in New York State escalating. Dutchess County, NY, has the highest number of reported cases of Lyme disease in the country, with an average of 1,300 cases annually since 1986. Understanding what regulates Lyme disease will help determine human exposure risk. With over 778 hectares (1,924 acres) of land, the Institute serves as an ideal setting for researching the biology of this bacterially caused disease.

In the northeastern U.S., black-legged ticks are responsible for spreading the bacteria (*Borrelia burgdorferi*) that causes Lyme disease. The ticks, which rely on a range of vertebrates for their blood meals, primarily acquire the bacteria when they feed on infected white-footed mice. White-footed mice, a disturbance-tolerant species that occurs in high numbers throughout fields and forest edges, are the primary carriers of the *Borrelia* bacteria in our region.

Habitat loss through destruction and fragmentation is the leading cause of biodiversity declines within North American vertebrate communities. Some species are more sensitive to habitat loss than others – white-footed mice not only persist in patchy forest environments, their populations often increase in forest patches compared to undisturbed forest. Conversely, large carnivorous species, such as lynx, disappear rapidly from fragmented habitats. Environ-

mental changes that favor disturbance-tolerant animals often result in decreased species diversity.

Through surveying local mammal and bird populations, Ostfeld, LoGiudice, Schmidt and Keesing have found that ticks that feed from hosts other than white-footed mice have a low probability of becoming infected. When ticks feed on a range of animals, there is a reduction in tick infection rates and human exposure risk. A diverse community of hosts results in a smaller proportion of ticks feeding on white-footed mice; this phenomenon is referred to as the “dilution effect.”

The roles of thirteen vertebrate species that influence tick infection rates in natural ecosystems were established through extensive live-trapping. Tick larval abundance peaks in August to September, and trapping efforts were concentrated within this four week window. For two summers, LoGiudice captured over 200 small mammals using an array of live-trapping techniques, some of which required monitoring every three hours! Trapped animals included white-footed mice, shrews, opossums, raccoon and skunks.

Captured animals were held in the lab for three days to collect the engorged ticks that dropped off them, then released at the point of capture. Ticks were then tested for *Borrelia* infection. These data provide insight on the number of ticks that feed from and become infected by each host species. Knowledge of each species’ Lyme disease infection rate allowed the creation of computer prediction models. Using these models, scientists can

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Editor's Note

Ecologists act as investigators, unraveling the relationships that govern that natural world. Recent findings by Dr. Richard S. Ostfeld and his team have shed light on the role that vertebrate populations play in transmitting Lyme disease. Their take home message, that diverse vertebrate communities decrease Lyme risk, underscores the importance of maintaining biodiversity. Future research on the host-dynamics of Lyme disease will also provide insight into food webs in terrestrial ecosystems.

While it may be too cold for planting annuals, the season is always ripe for growing your ecological understanding. Before planning a trip to the IES Fern Glen this Spring, learn more about the unique assemblage of native plants from my interview with Judy Sullivan. Seeking a more hands-on learning experience? The IES Continuing Education Program is offering a range of unique courses this March, including: The American Kitchen Garden, Pruning Trees and Shrubs, and The Ecology of Landscaping.

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Director: Gene E. Likens
Administrator: Joseph S. Warner
Head of Education: Alan Berkowitz
Writer & Editor: Lori M. Quillen
Production Assistance: Pam 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

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The Fern Glen: An Outdoor Native Plant Classroom

Judy Sullivan has overseen the Native Plant Program at the Institute since its inception in 1994. The program utilizes an assemblage of native plants, called the Fern Glen, to educate the public about native plants, native plant communities, and invasive species. Tucked away within the interior of the Institute's property, the Fern Glen contains a botanical treasure trove of plant diversity. Recently, I sat down with Judy to discuss her involvement with the Fern Glen.

How did you find your way to the Institute?

I had been working at a landscape nursery, and a colleague suggested that I enroll in a course being offered by the Institute's Continuing Education Program. Fred McGourty, of Hillside Garden in CT, was teaching a class on winter perennials. Later, while working at the Cornell Cooperative Extension in Hudson, I responded to an IES announcement for a full-time gardener.

How did you earn your title as "Muck Maven" of the Fern Glen?

Before I left the nursery, I had formed an interest in both native flowers and ferns. I was learning to distinguish between invasive and native species and getting into fern morphology. This personal interest played a role in shaping the Fern Glen into what it is today.

The Fern Glen was initiated by the Fern Society and Dr. John Mickel of The New York Botanical Garden. When I arrived, it was essentially an exotic garden that was intended to be a hardiness testing area, as the Glen was the "Arctic of the Arboretum." My first thoughts, upon seeing the site, was "This area is gorgeous!" and "I want to do something with the native plants."

When I was assigned to the site, no discrimination had been made between ferns. Invasive plants had out-competed many native species such as climbing fern. For over ten years, I have been trying to eradicate the exotic Japanese painted fern, and it still persists in small populations in the rocky areas. The most aggressive plant invader was Japanese primrose. I had to manually dig it up and destroy it,



Judy Sullivan, Tending to the Fern Glen

which I did with particular relish! Once I had cleaned out the cobble of everything that was exotic, it was almost naked.

The task of replanting the area with native plants has been a labor of love, and it continues to be a work in progress. In 1995, we implemented a master plan that focuses on communities as opposed to simply using native plants in traditional ornamental displays. It's the communities of plants and animals that fascinate me. What grows where, with what and why? I couldn't design anything as beautiful.

Tell me how the pond has changed over time.

The pond evolved from a shallow reflecting pool with a few floating lilies and ornamentals on it. It was edged with locust tree logs cut to follow the line of the water. These had started to decay, and the pool was silting in as well. To counteract this, it was deepened to 8-10 feet and lined with rock. I began working in the area two years later.

The pool became a pond, but it needed some coaxing along. It was bare around the edges and void of typical aquatic wildlife. I began

collecting frog eggs, planting wetland edge species, relocating turtles from IES property, and encouraging a healthy insect population. The Fern Glen is a balanced environment; there is an ebb and flow to the insects. This affords me the opportunity to observe insects, rather than manipulate and repress them. I'd wager that most gardeners don't have the opportunity to actually enjoy aphids!

What are some of the unique features of the Glen?

The site had an unusually high diversity of ferns when Dr. Mickel located it, with over twelve species in a small area. It has a bowl shaped topography with a wonderful shrub swamp. In high areas it is dry, the East Branch of the Wappinger Creek runs through it, and there's a great wetland complex. It has lots of habitat complexity, and is home to a range of frogs, birds, turtles, dragonflies, newts, and salamanders. It's also simply a lovely place that is simultaneously tranquil and stimulating.

Are there any historical plantings there?

Not collections per se, but many of the orchids and the maiden haired spleenwort originated before my arrival. It is interesting to note that some of the specimens planted in the Fern Glen, although native species, were obtained from overseas collections. One has to wonder- why did they get a plant that is native to this region as a donation from Germany? They look very similar to locally grown genotypes, and I've often wondered if they originated in the U.S.

Tell me about why planting local genotypes of native species is important.

One of the focuses of the Native Plant Program is finding ethical sources of bio-regional native plant populations. When I first started buying natives, I ordered turtlehead plants from a western nursery that did not engage in live collection. It was the correct species, but it did not resemble the turtleheads grown in this region. It was taller with slender leaves, adaptations that may

Ecology Day Camp: Engaging Students in Ecological Exploration!

The registration period for Spring Ecology Camp is now open! Geared toward students in grades 1-3, the camp will take place on April 14-17, from 9am to 3pm. For a small additional fee, 8am early drop-off and 4pm late pick-up options are available. At the 2003 session students will be given the opportunity to perform experiments, meet scientists, create art projects, and engage in games that stimulate scientific thinking. To register, contact Susan Eberth at 845-677-7600 ext. 316 or eberths@ecostudies.org. Also, it is never too early to register for the 2003 Summer Ecology Camp sessions, as registrations are taken on a first-come, first-served basis.

Building Ecological Foundations



Jorahan Walsh

Taught by IES Scientists, the Fundamentals of Ecosystem Ecology Course is an intensive two-week program that introduces students to ecosystem ecology concepts. This year Dr. David Strayer coordinated 14 lectures from IES Scientists. Seventeen students attended the course, several of whom were international students from the Swedish Agricultural University, the Swiss Federal Institute of Technology, and the National Institute of Oceanography in India. *Front, L-R: Michelle Slaney, Dr. David Strayer, Lorne Byrne, Sandra Cooke, Ivan Diaz, Dr. Lynn Christianson, Wally Fulweiler, Kit Sheehan, Julia Butzler, Jude Maul; Back, L-R: Karen Moore, Isabelle Providoli, Patrick Herron, Ben Koch, Pradeep Ram, Ken Belt, Bob Smith, Ishi Buffam.*

Fern Glen, *continued from page 2*

have helped its survival in a western climate. This got me thinking about the importance of local genotypes. These plants are adapted to grow in our area, and for demonstration purposes they are more representative of local wild plants.

What role does the Glen play at IES?

The Glen is a physical part of the Native Plant Program. Used as a teaching tool, its purpose is to demonstrate selected habitats within a 100-mile radius of the Institute. As a living classroom, the primary focus of the site is to educate the public about native plant communities. It is currently used by visitors, the Continuing Education Program, and the IES Ecology Camp, and it serves as a demonstration model for arboreta interested in native plant exhibition.

What are your thoughts for the future?

I'm especially excited about the continued work in the wetland areas. Where the Japanese primrose once stampeded the native plants, we're creating a demonstration comparing rich and poor fens. We also plan to renovate the pond to enhance its habitat potential for both plant and animal life. The frogs, newts, turtles and insects are magnets for the child, or the child at heart.

The Glen is an area that is rich in biological diversity and teeming with educational opportunities. In the future we're looking forward to increasing visitor interpretation, expanding information about the program on the IES website, and developing curricula for children and adults. We've begun by introducing a weekly "From the Fern Glen" entry to the website. It is available at: <http://www.ecostudies.org/welcome/ThisWeek.html> ●

Lyme, *continued from page 1*

manipulate the size of vertebrate communities and assess how the transmission of Lyme disease is impacted by biodiversity change.

"Community disassembly rules" is the term used to describe the order in which vertebrate species disappear when animals are subjected to habitat loss. Interactions between habitat disturbance and vertebrate survivorship are complex, and community disassembly rules are poorly understood. In an attempt to comprehend this phenomenon, Ostfeld, LoGiudice, and Keesing developed a computer simulation model that deconstructed vertebrate communities using five different sets of disassembly rules. In all but one of the modeling exercises, decreased biodiversity resulted in increased risk of Lyme disease.

These findings highlight the importance of learning which vertebrate species are most sensitive to habitat destruction and fragmentation. Land managers and planners could use information on susceptible species to inform development decisions. In addition to preserving the integrity of ecological systems, maintaining vertebrate diversity may also help to protect human health.

Ostfeld began looking at host diversity and Lyme disease risk in 1995, while collaborating with Dr. Joshua Van Buskirk, a Cary Post-doctoral Fellow. Using a computer model that simulated Lyme infection rates in mice and chipmunks, they found that communities with both species had a lower Lyme infection rate. Future work on the dilution effect will shed light on other infectious diseases, such as West Nile Virus. As in the Lyme disease scenario, disturbance-tolerant species such as house sparrows and starlings are the most competent carriers of West Nile Virus. Ostfeld believes that further studies on the West Nile Virus will show that infection rates are lower in areas with healthy populations of native passerines, such as warblers and vireos.

Ostfeld, LoGiudice, Schmidt and Keesing have recently published their findings in the *Proceedings of the National Academy of Science* and *Conservation Biology*. Through a grant from the National Institutes of Health, Ostfeld and his team will spend the next four years continuing to unravel the link between biodiversity and infectious disease. ●

Strayer and Weathers Honored as AAAS Fellows

Election as a Fellow of the American Association for the Advancement of Science is an honor bestowed upon members by their peers. Awarded to 291 members this year, individuals are nominated based on their efforts to advance science or foster applications that are deemed scientifically or socially distinguished. Founded in 1848, the AAAS is the largest federation of scientists working to advance society through public programs and publications such as the journal *Science*.



Newsletter

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CONTINUING EDUCATION

The Continuing Education Program is still accepting winter registrations. For information, or to request a brochure, call 845-677-9643 or visit www.ecostudies.org/education/continuing.html. Winter semester programs include:

Gardening

February 15 (1 Sat.): **House Plant Clinic**
March 16 (1 Sun.): **From Seed to Side Dish: Getting an Early Start on a Vegetable Garden**
March 17(4 Mon.,1 Sat.): **Fundamentals of Gardening**

Natural Science Illustration

March 21(1 Sat.,1 Sun.) **Colored Pencil Techniques for Bugs and Beasts.**

Landscape Design

March 15 (1 Sat.) **Lighting in Landscapes**

Workshop

March 28 (1 Fri.) **The ABC's and XYZ's for Earth Moving Success**

SATURDAY ECOLOGY PROGRAMS

Come to **free public programs**. Children age 6 and up are welcome with an accompanying adult. Pre-registration isn't necessary. If you have questions, call 845-677-7600 ext. 317 for information on upcoming programs: Programs are from 1 - 3 p.m. and begin at the Gifford House Visitor and Education Center. [Dress according to the weather for the outdoor programs.]

March 8: The Magic of Maple Sugaring. Join IES ecology educators to tap trees, make syrup and learn how other organisms benefit from the delicious sap of the sugar maple just like people do. There will definitely be some tasting involved!

GREENHOUSE

The Greenhouse is a year-round tropical plant paradise and a site for controlled environmental research. The green house is open daily until 3:30 p.m. with a free permit (see HOURS).

Calendar

IES SEMINARS

Free scientific seminars are held at 11 a.m. on Fridays in the auditorium from September until early May.

Feb. 14: **Ecosystem engineering and biodiversity:** How species create habitat for others. Dr. Clive Jones. Institute of Ecosystem Studies.

Feb. 21: **Why fish need trees: Anthropogenic impacts on Lake Tanganyika, East Africa.** Dr. Catherine O'Reilly, Vassar Environmental Science Program.

Feb. 28: TBA

March 7: **Ecological effects of El Nino in terrestrial ecosystems of Western South America.** Dr. Fabian Jaksic, Catholic University of Chile.

March 14: **Local and landscape-scale controls on the distribution and abundance of a headwater stream salamander.** Dr. Winsor Lowe, Dartmouth College.

March 21: **Evolutionary games in animals and plants: Competition as a tug-of-war.** Dr. N. Tom Hobbs, Colorado State University.

March 28: **Chronic wasting disease in mule deer populations: understanding dynamics at multiple scales.** Dr. N. Tom Hobbs, Colorado State University.
April 4: **Tropical forest dynamics.** Dr. Richard Condit. Smithsonian Tropical Research Institute, Panama.

THE ECOLOGY SHOP

New items in the shop. Browse our ever-changing selection of birding items: birdhouse and feeder kits, suet cages, bird whistles, wood and gourd birdhouses handcrafted in New York State, and more.
Senior Citizens Days: 10% off on Wednesdays.

HOURS

Winter Hours: October 1 - March 30

Internal roadways and trails closed during deer hunting season, and when snow covered.

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.)
Free permits are required and 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, member's rate for courses and excursions, a 10% discount on IES Ecology Shop purchases, and participation in a reciprocal admissions program. Individual membership: \$40; family membership: \$50. Call the Development Office at 845-677-7600 ext. 120.

The Institute's Aldo Leopold Society

In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call the Development Office at 845-677-7600 ext. 120.

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, N.Y.

... 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, N.Y.

... **IES website:** www.ecostudies.org

SAVE THE DATE!

The IES Spring Plant Sale will be held
Friday - Saturday, May 16 - 17, 2003 from 10 am to 4 pm, and Sunday, May 18, 2003 from 11 am to 4 pm.