IES Newsletter

Volume 16, Number 4
July - August 1999

From the Visitor Center ...

IES visitors will notice some changes around the Gifford House Visitor and Education Center.

- To improve visitor flow, the front pathway is being reconfigured. By next year, new perennials will fill in the space where the old pathway was, and new signs will welcome visitors.

- The brick pathway that leads through the Perennial Garden to the Carriage House, site of classrooms for both school-age and adult students, is also the way to reach the trail head for the Wappinger Creek and Cary Pines trails. But until early August, there was no clear connection between the path and the trail. Thanks to the efforts of Landmark Volunteers, a pathway linking the two has been built. You will read about the Landmark Volunteer program on page 5.

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

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Summer Science at IES: Student Field Work, International Collaboration

Each summer the Institute staff swells by some 40 people, as scientists travel to Millbrook to collaborate with IES ecologists, graduate students arrive to do their field work, and college undergraduates come to gain experience doing hands-on research. Summer 1999 has been no exception. Featured in this issue of the *IES Newsletter* is the work of some of these scientists.

Answering Ecological Questions in Wetlands

(IES Research Experiences for Undergraduates Program)

Environmental magazines, eco-tourism promotions, public broadcasting radio and television broadcasts: each has its own candidate for "Earth's most important ecosystem." Depending on the perspective of the writer or producer, and on that of the target audience, that candidate could be "rainforests" or "coral reefs" or any number of other ecosystems that are not only beautiful but also affect the quality of life well outside their borders. One of the top candidates is "wetlands", and at IES this summer two students are doing research to add to the body of knowledge about these important ecosystems. The students, participants in the Institute's Research Experiences for Undergraduates (REU) program, are studying tidal marshes in the Hudson River and doing a portion of their field work at Constitution Marsh* in Garrison, New York.

In 1837, a man named Henry Warner decided to try to make his fortune growing wild rice. To create what he hoped would be a suitable habitat, he dug a number of channels through Constitution Marsh. These channels remain today, and were the field sites for Ms. Serena Ciparis' summer research. Ms. Ciparis paired artificially created straight channels with the marsh's natural, meandering channels by matching their width and length, and compared benthic algae and invertebrate animals, submerged aquatic vegetation, water velocity, and sediment erosion. Will these biological and physical parameters differ in the straight vs. meandering courses? At press time, she was still doing her field mea-

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REU students Serena Ciparis (left) and Melissa Vernon in the IES Aquatic Laboratory.

Summer Science at IES, *continued*

surements and had not yet reached conclusions. However, her hypothesis was that in the straight channels the water will have a greater velocity, resulting in increased erosion and a negative impact on the biota. Ms. Ciparis' findings will be applicable to the restoration of many artificially straightened tidal creek ecosystems.

One of the "services" that wetlands provide for the environment is to remove pollutants from the water. Ms. Melissa Vernon tested the idea that wetland soils can lose some of their ability to become "sinks" for phosphorus, a nutrient that is essential for life but can promote eutrophication of freshwater bodies. Her hypothesis, based on some controversial findings she has read in the scientific literature, was that the ability of wetland soils to take up phosphorus decreases as the phosphorus concentration of the streams increases.

Streams carry phosphorus into wetlands and Ms. Vernon took soil cores from the mouth of streams flowing into three Hudson River tidal marshes. At Constitution Marsh her sampling site was where Indian Brook meets the marsh. Indian Brook water is low in phosphorus, and therefore the soils should have been exposed to relatively low levels as well. At the other sites, where phosphorus inputs include runoff from a sewage treatment plant, the levels of the nutrient are substantially higher, potentially diminishing the soils' ability to absorb additional phosphate. Bringing the cores back to the IES laboratory, she tested them with a standard solution of phosphorus to see how much each could absorb. Would the soils exposed to higher phosphorus concentrations reach their absorption limit, or remain able to soak up the pollutant?

Since factors other than incoming phosphorus affect the ability of a given soil to take up this nutrient, she also took separate cores from the Constitution Marsh site and added phosphorus at high, medium and low concentrations. After one week, she tested these cores using the same standard phosphorus solution she used to test the cores from the different sites. Although her project was not completed at press time, data collected using the cores from different sites seemed to support her hypothesis. However, she was still waiting to see whether or not her other data would be consistent with what she had seen so far. ●

** Constitution Marsh, on the east shore of the Hudson River, has a long-standing relationship with the Institute. Since 1986, well over 100 adult students in the IES Continuing Education Program have paddled canoes through the marsh, learning wetland ecology from a National Audubon Society guide. This fall the program is offering a new look at the area, "Sunrise Adventure at Constitution Marsh", on Saturday, 18 September. See the Calendar on page 6 for registration information.*

New Work on the Ecology of Lyme Disease

(IES Research Experiences for Undergraduates Program)

The animal most often associated with the black-legged tick, vector of the bacterium that causes Lyme disease (and other diseases), is the white-footed mouse. The eastern chipmunk is another significant host for the tick. Last summer, as part of ongoing studies of the ecology of Lyme disease, chipmunks were removed from experimental plots on the Mary Flagler Cary Arboretum and relocated to neighboring plots. This summer, REU student Ms. Cherie Gregoire worked on those same experimental plots to learn how black-legged ticks have been affected by the absence of one of their principal hosts.

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IES REU Program — 1999

The National Science Foundation (NSF) developed the Research Experiences for Undergraduates program in the mid-1980s as a way to improve science education in the U.S. and to help assure an adequate supply of top-notch scientists, mathematicians and engineers for the future. Many institutions across the country compete for NSF funds to support REU students, and consistently the Institute of Ecosystem Studies has been among the recipients.

Funding from NSF since 1988 and the Andrew W. Mellon Foundation since 1994 allows students to do ecological research at the Institute for three months in summer. The students collaborate with a mentor — in most cases from the IES resident or visiting scientific staff — to design their own studies, do field and/or laboratory work and analyze results. Finally, they present their findings at a public symposium, held on August 19 this year. Final reports are published by the Institute as an IES Occasional Publication. One hundred fourteen college undergraduates have participated in the IES REU program to date. The 1999 students were:

- Serena Ciparis (Virginia Polytechnic Institute and State Univ.): *Channel morphology of tidal creeks in Hudson River freshwater tidal marshes.* Mentor: Dr. Stuart Findlay.
- Jessica DiCicco (Drew Univ.): *The relationship between denitrification potential and nitrification potential across a nitrification gradient in the Catskills, N.Y. and the White Mountains, N.H.* Mentors: Drs. Louis Verchot and Peter Groffman.
- Heather Fuller (Huntingdon College): *Controls over isoprene emissions from trees.* Mentors: Drs. Clive Jones and Manuel Lerdau (IES and SUNY Stony Brook).
- Cherie Gregoire (Siena College): *Effect of the removal of a highly competent host* (Tamias striatus) *on Lyme disease risk.* Mentors: Drs. Felicia Keesing (IES and Siena College) and Richard Ostfeld.
- Gerod Hall (Howard Univ.): *Abundance of black-legged ticks* (Ixodes scapularis) *on native and non-native shrub species.* Mentors: Drs. Felicia Keesing (IES and Siena College) and Richard Ostfeld.
- Lis Castillo Nelis (Michigan State Univ.): *The effect of barberry* (Berberis thunbergii) *on the predation of veery* (Catharus fuscenscens) *nests.* Mentors: Drs. Kenneth Schmidt and Richard Ostfeld.
- K. Allison Smith (Duke Univ.): *Life on a mussel: an analysis of epizoic algae and the freshwater mussel* (Elliptio complanata). Mentor: Dr. David Strayer.
- Kristen Strassner (Cornell Univ.): *Fungal and bacterial response to earthworms in a northern hardwood forest.* Mentors: Drs. Melany Fisk (at Cornell Univ.) and Peter Groffman.
- Melissa Vernon (Tulane Univ.): *The effects of anthropogenic phosphate loading on the phosphorus retention capacity of wetland soils.* Mentor: Dr. Stuart Findlay.

Tick dragging: Wearing white jumpsuits, REU students Gerod Hall and Cherie Gregoire collect ticks from a square of white corduroy they have just dragged through a forest plot.

"Tick dragging" is how Ms. Gregoire collected the tiny arthropods. Dressed in protective clothing, she towed a meter-square (approximately a square yard) of white corduroy behind her as she walked a 30 meter (close to 100 feet) transect across each of three experimental plots and three control plots, from which chipmunks had not been removed. She collected the ticks, plainly visible on the white cloth, to bring them back to the IES laboratory where she stained the mid-gut contents with a dye that makes bacteria glow green under a special microscope. Using 400x magnification, she could identify and count the spirochete bacteria that cause Lyme disease, and in that way could determine the percentage of infected ticks from each plot. Although her results were not final at press time, she reported that approximately 30-60% of nymphs* were infected, and that while there was a lower rate of infection on two of the three experimental plots, the difference was not statistically significant.

Ms. Gregoire's findings suggest that other hosts also must be significant. Experimentation by other IES scientists studying the ecology of Lyme disease is suggesting that shrews, which may host hundreds of ticks, may also have a major role in the ecological dynamics of Lyme disease. Ms. Gregoire has been doing some mathematical modeling, and her preliminary results confirm these observations.

When ticks select a shrub from which to quest for hosts, do they show a preference for native shrubs or for exotic ones? Mr. Gerod Hall's hypothesis was that there would be more ticks associated with the non-native species, whose branch structure and denser foliage may provide better protection. Knowing that ticks are drawn to warm-blooded animals when they sense exhaled carbon dioxide, he tested his hypothesis by placing carbon dioxide traps under native shrubs, under exotic shrubs, and in a shrub-free grassy area. The traps were insulated boxes approximately 0.5 meters (18 inches) on a side, containing dry ice, with holes toward the bottom to let the gas escape, and double-sided tape at the base. Ticks, attracted to the carbon dioxide gas, were stopped dead in their tracks by the tape, enabling Mr. Hall to count them. Early data suggest that numbers of nymphs in barberry, an exotic, were slightly higher than in the native mapleleaf viburnum, and that there were more nymphs associated with shrubs of either kind than with shrub-free areas.

During the second phase of his study, Mr. Hall tested the survival of black-legged tick nymphs in different habitats. After collecting the animals by dragging, he put them in mesh bags and then buried the bags in leaf litter, some in the open and others under barberry shrubs. The expectation was that the nymphs would have a higher survival rate in the shaded environment of the shrubs.

** There are three stages in the tick's two-year life cycle: larva, nymph and adult. Nymphal ticks are the ones most likely to transmit the Lyme disease bacterium to humans because their questing season, June and July, corresponds with peak human outdoor activity. Larvae also have peak activity levels in the summer, but they hatch free of the bacterium because it is not passed transovarially (mother to eggs). Larvae contract the bacterium only if they take their one blood meal from an infected mammal. It is not possible to get Lyme disease from a larval tick.*

Do Trees Provide for Their Own?

When a tree dies in the forest, the gap created by its absence opens a whole new world for saplings on the forest floor. The sudden bounty of sunlight speeds their growth and eventually the more successful competitors reach maturity. But do the progeny of the now-dead tree have any advantage over other young tree species? Could the parent tree somehow have altered the chemistry of the soil to make the environment more conducive to survival of its own kind?

Mr. Feike Dijkstra is investigating whether trees have an impact on the availability of calcium, an element affecting soil acidity. A graduate student at Wageningen Agricultural University in The Netherlands, Mr. Dijkstra is doing his third summer of field work at the Great Mountain Forest in northwestern Connecticut. His research is part of an IES study in which he collaborates with his advisor, Prof. Nico van Breemen (Wageningen Agricultural University); IES director Dr. Gene Likens, his co-advisor; and Drs. Charles Canham, Gary Lovett and Seth Bigelow. ("Investigating the Forces of Forest Change", the *IES Newsletter* cover story, March-April 1999, described research by Dr. Bigelow, an IES post-doctoral associate. Dr. Bigelow's work takes the opposite tack from Mr. Dijkstra's: how do soil properties affect tree growth?)

All plants need calcium to grow. Calcium is present in rocks and minerals in soil but cannot be used by plants until it has been weathered. Weathering of calcium minerals in the soil, through the effects of

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Summer Science at IES, *continued*

rain, sun and temperature, produces "available calcium". Part of Mr. Dijkstra's graduate research is aimed at learning whether trees' root systems, with their associated mycorrhizzal fungi, produce organic acids that break down soil minerals and thereby increase the weathering of calcium.

Because calcium is made available to the ecosystem not only through weathering but also through atmospheric deposition, Mr. Dijkstra must separate the two inputs if he is to determine precisely any role the tree may play in calcium weathering. He does this by comparing the ratios of two isotopes of the element strontium, ratios which differ depending on whether the isotopes come from the atmosphere or from soil.

At his 36 research sites — where either hemlock, sugar maple, red maple, white ash, red oak or American beech predominate on six plots each — Mr. Dijkstra collects samples of rain water, soil and wood, the latter by coring into the trunks of the site's dominant tree species. Back in Amsterdam he analyzes the samples with a mass spectrometer, and by determining isotope ratios can calculate how much strontium in the wood came from the atmosphere and how much from soil. Since strontium behaves in a way similar to calcium, he then can relate the percentage of calcium in the wood to that which originates in soil.

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Left: *Mr. Feike Dijkstra collects soil cores to learn more about the effects of trees on the weathering of calcium.*

Mr. Dijkstra has found that each study plot has a different amount of mineral calcium in the soil, and that increased weathering occurs at sites where the levels of mineral calcium are higher. He also has discovered that there is essentially no difference in the amount of calcium in the wood of the six different tree species except in direct proportion to the amount of total calcium in the soil in which they grow. It therefore appears that trees do not have a distinct weathering effect on calcium and do not, at least in this way, have an impact on the soil in which their seedlings sprout.

International Collaboration on Edge Ecology

Forest edges, where open space meets woodland, have physical and biological characteristics that distinguish them from the adjacent ecosystems. In their studies of these edges, IES ecologists have learned a great deal about the ways in which structure, or architecture, relates to function. Now they are applying that knowledge to a different type of edge.

In South Africa's Kruger National Park, an international team of ecologists — including Drs. Steward Pickett and Mary Cadenasso from IES — is studying the boundaries between savanna and riparian* ecosystems to learn how these edges function, how they shift through time, and how this information can be used to understand and manage the land. The eight scientists on the team are looking at different aspects of the edges, with the South African group focusing on tree population dynamics and the movement of nutrients. Dr. Steve Higgins, a post-doctoral associate at the University of Witwatersrand in Johannesburg, is at the Institute this summer, working with his IES colleagues, analyzing his data on the spatial patterns of trees, and doing some preliminary computer modeling.

Dr. Higgins' research sites are the alternately patchy and distinct boundaries in the arid land along the Shingwedzi River and its tributaries. Across a gradient of moist riparian to dry savanna, he is looking at different environmental factors — herbivory, fire, moisture, stress and competition — and studying their impact on the movement of nutrients and on the growth patterns of trees and woody shrubs. He measures "nearest neighbor distances", to learn if these distances change along the gradient. Then he builds a computer model relating spatial data to the five environmental factors.

How is a computer model born? Dr. Higgins originally developed this one to explain how savanna grass and trees coexist with an even distribution of biomass. The theory at the time had been that grasses obtained their water from surface soils while trees accessed deeper water resources; Dr. Higgins wrote a computer program to explain this equilibrium mathematically. But measurements showed that both types of vegetation depended on water in the upper soil horizon, and that the populations were controlled, at least in part, by fire: during periods that are free of fires, tree seedlings grow above the grass and take their place in the savanna scene. These data formed the basis of a new model, which, typed in to Dr. Higgins' existing one, supported a new hypothesis that variability creates opportunities for species to succeed, a non-equilibrium explanation for the way the ecosystem works.

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* ***savanna:*** *a type of biogeographical region, or biome, that typically has drought-resistant vegetation dominated by grasses with scattered tall trees;* ***riparian:*** *pertaining to a river bank*

Using his model, Dr. Higgins integrates data on herbivory, fire, moisture, stress and competition and makes predictions as to their relative importance. There is a constant feedback between the data that he and his colleagues collect during field work and the model's predictions. The scientists then use the latter to help direct future research.

* * * * *

IES ecologist Dr. Mary Cadenasso explains that the South African research project has three objectives. "The riparian corridors," she says, "are 'hotspots' of activity because they integrate terrestrial and aquatic systems." The major goal, therefore, is to develop an understanding of the structure and function of these areas and the role they play in the savanna landscape. The second objective is an educational one. Dr. Cadenasso explains, "Because improved scientific understanding of riparian-upland ecosystems, and the understanding of ecosystem processes in South Africa in general, are limited by the small number of trained ecologists in the region, this project aims to diversify future generations of South African and American ecologists." Finally, the project's collaborators are looking forward to integrating new scientific knowledge into the management of Kruger National Park, to ensure both the quality of its environment and the education and enjoyment of the many who visit.

S.T.A. PICKETT

Scientific collaborators on the South African research project met at IES earlier this year. From left to right: *Dr. Scott Elliott, University of Washington; Dr. Kevin Rogers, University of Witwatersrand, Dr. Robert Naiman, University of Washington; Dr. Tracy Benning, University of California at Berkeley; Dr. Mary Cadenasso, IES; Dr. Harry Biggs, Kruger National Park, National Parks Board; Dr. Steve Higgins, University of Witwatersrand. Dr. Steward Pickett, IES, is kneeling in the foreground.*

Landmark Volunteers Move In, Clean Up, Move Out

The Smith Barn on Fowler Rd. had been unused pending some necessary reconstruction. The Institute was running out of space to store samples of water and soil. Supervised by IES manager of operations Mr. Chuck Kimberling, twelve high school students, spending part of their summer with a service organization called Landmark Volunteers, helped to stabilize the foundation and prepared the exterior of the old building for painting.

Visitors to the Institute who came for a walk on the nature trails were sometimes puzzled by exactly where the trail head was. Now such confusion is in the past thanks to the hard work of the same batch of volunteers, who – under the tutelage of Mr. Brad Roeller, manager of the display gardens – built a pathway from the Perennial Garden to the pine allée.

Left: *Mr. Brad Roeller and Landmark Volunteers level the new path by the Carriage House.*

This was the first year that the Institute joined the list of approximately 50 not-for-profit organisations participating in the Landmark Volunteer program. The students, who came from as far away as Florida and Kansas and as nearby as Hyde Park, New York, were accompanied by a team leader and lived for two weeks in an IES residence. IES Aldo Leopold Society members Noreen and Richard Coller were their Millbrook liaisons, making the students feel at home in the community.

Below: *Taconic Newspapers reporter Julie Gibbs, center, interviewed the volunteers as they constructed a border for the pathway.*

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Calendar

CONTINUING EDUCATION

For **fall 1999** program information, call the Continuing Education office at 914-677-9643. Programs during September and October include:

Gardening

Sept. 18: **The Art of Combining Perennials**
Sept. 18 (+ 6 Tuesdays beginning Sept. 28): **Plants for the Landscape: Herbaceous Perennials — Extended**
Sept. 23 (5): **Plant Propagation**
Sept. 25: **Annuals and Perennials for Autumn**
Sept. 25: **Insect Pests and Diseases of Plants — Revisited**
Oct. 2: **Garden Rooms: Bringing the Inside Out**
Oct. 2 (6): **Soil Science**

Landscape Design

Sept. 22 (7): **Graphics I**
Sept. 28 (2 Tu. + 2 Sa.): **Constr. II: Site Detailing**
Oct. 13 (7): **Landscape Design I: Site Analysis and Schematic Design**

Natural Science Illustration

Sept. 13 (6 sessions): **Drawing I: The Basics**
Sept. 19 (4): **Seasonal Plants in Watercolor — Special Topics**
Sept. 25 (6): **Introduction to Media: Pencil, Pen and Ink and Watercolor**
Oct. 17 (3): **Seasonal Plants in Watercolor — Special Topics**

Nature Photography

Sept. 18 (3): **Garden Photography: Seeing the Picture**

Biology and Earth Science

Sept. 12: **Drying and Preserving Fall Herbs**
Sept. 14 (8): **Basic Botany**

Workshop

Oct. 24: **Bringing Out the Best in Shrubs**

Ecological Excursions and Garden Tours

Sept. 12: **Ecology of the Shawangunks and Exploration of Sam's Point Dwarf Pine Ridge**
Sept. 18: **Sunrise Adventure at Constitution Marsh**
Oct. 9: **Explore Balsam Lake Mountain**
Oct. 14-15: **Garden Tour of the Brandywine and Delaware Valleys**

Natural Crafts

Oct. 2: **Exploring Environmental Art**
Oct. 16 & 30: **Keepsake Pine Cone Wreath**

IES SEMINARS

Free **scientific seminars** are held each Friday from September until May at 11:00 a.m. in the IES Auditorium.

• This fall we are beginning a special, multi-year seminar series on "Ecosystem Function in Heterogeneous Landscapes." Lectures will parallel research of IES scientists and colleagues and are partially sponsored by The Andrew W. Mellon Foundation. Professor Anderson's lecture on September 24 is the first in the series.

Sept. 17: **The Role of Mesozooplankton in Marine Planktonic Nitrogen Cycling**. Dr. Carolyn Miller, Bard College
Sept. 24: SPECIAL SEMINAR SERIES ON HETEROGENEITY **Linking Organismal Functions and Ecosystems Processes: Problems and Perceptions of Scaling**. Prof. J.M. Anderson, Exeter Univ., U.K.
Oct. 1: To be arranged
Oct. 8: Title pending. Dr. Charles S. Hopkinson, The Ecosystem Center, MBL, Woods H ole, Ma.
Oct. 15: To be arranged
Oct. 22: **Perturbing Protist Populations: The Color of Environmental Variability Affects Population Dynamics**. Dr. Owen Petchey, Cook College, Rutgers University
Oct. 29: **Assessment of the Contribution Made by Atmospheric Nitrogen Deposition to the Total Nitrogen Loads to 34 Estuaries on the East and Gulf Coasts of the United States.** Dr. Mark S. Castro, Appalachian Laboratory, Md.

IES ECOLOGY SHOP

New in the Shop ..."Grow-a-Notes" recycled cotton notecards with seeds in the paper — plant the card and watch it grow! ... pressed flower bookmarks ... **for children** ... frog backpacks with the IES logo ... firefly T-shirts in a jar ... insects "Fit-a-Shape" books ... **and in the Plant Room** ... "Burt's Bees" gardeners soap, poison ivy soap and more ... painted clay vases and pots
Senior Citizens Days: 10% off on Wednesdays

• *Gift Certificates are available* •

GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 3:30 p.m. daily except public holidays. Admission is by free permit (see HOURS).

HOURS

Summer hours: April 1 - September 30
Public attractions are open Mon. - Sat., 9 a.m.-6 p.m. & Sun. 1-6 p.m., with a free permit.
(Note: The Greenhouse closes at 3:30 p.m. daily.)
The **IES Ecology Shop** is open Mon.- Fri., 11 a.m.-5 p.m., Sat. 9 a.m.-5 p.m. & Sun. 1-5 p.m.
(The shop is closed weekdays from 1-1:30 p.m.)

Winter hours begin on October 1
The grounds and Ecology Shop close at 4:00 p.m.

• *Free permits are required for visitors and are available at the IES Ecology Shop or the Education Program office daily until 5 p.m. (3 p.m. after Oct. 1)*

MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the 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: $30; family membership: $40. Call Ms. Laura Corrado in the Membership Office at 914-677-5343.

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 Ms. Jan Mittan at 677-5343.

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