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Editor's Note

Fall has arrived at the Institute. Most of the leaves have fallen from the deciduous trees on campus, and the grounds staff are busy removing them from the campus' maintained areas. As the trees lose their greenery, lost limbs and branches become more apparent. Like the leaves, this dead wood litters the ground, but it is far more persistent. The first article in the newsletter touches upon the many roles dead wood plays in the ecosystem.

Pathways to professions in the ecological sciences are varied and individual. Some ecologists are influenced by early childhood exposure to nature. Others are introduced to the natural sciences by dynamic school teachers or college professors. The page 2 feature article showcases the pivotal role that IES has played in the career decisions of many college undergraduates.

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In Ecology, There is No Dead Wood


David Strayer

Fallen Trees on the East Branch of Wappinger Creek

Trees die every day. Environmental stress, human disturbance, insect pests, diseases, and old age are among the most common reasons for tree mortality. The passing of some trees, like the landmark Jeffrey pine tree that fell this year in Yosemite, is noticed by the world. Made famous by Ansel Adams and captured on countless postcards, its demise received a *New York Times* notation. For the vast majority of trees, however, local organisms inhabiting their environment are the only witnesses to their fall. And they are paying close attention.

Most people recognize that living trees play a vital role in ecosystems. As individuals they provide shade and shelter, in aggregate they form the familiar landscape of the forest. What might not be common knowledge is the important ecological role trees play after they die. Standing dead trees provide habitat to birds, rotting wood and grounded trunks add structure to forest floors, and woody debris provides ecological niches in aquatic environments. According to a *Science* paper published in 2001 (Krajick), many trees support more biodiversity in death than in life.

Dead trees serve several primary roles in ecosystems: habitat, structure, nutrients, and fuel. Of these four roles, the first two are often complementary. Structural changes in the environment can give rise to new habitat. Think of how a fallen tree might create a dam in a stream. By altering the flow, the fallen tree creates a stable slow-moving aquatic habitat. It also builds a bridge across the water and shelters aquatic animals from aerial predators.

We will revisit aquatic systems later. Let's begin with standing dead trees, which are commonly called snags. Living trees are able to ward off insect pests through chemical mechanisms. For instance, conifers are able to withstand beetle attacks by exuding an anti-bacterial resin that kills beetle eggs. Cavities have a higher probability of forming and expanding in dead trees, which no longer have such repair mechanisms. Standing dead trees are first colonized by fungi and bacteria, followed shortly by insects and birds. In some cases, they also provide homes for small mammals like bats and flying squirrels.

According to Institute ecologist Dr. Clive G. Jones, "Wood-boring insects are much more prevalent in dead trees. They are an important resource for woodpeckers, which feed off the insects in the trees." When woodpeckers feed on standing dead trees, they leave behind holes. Cavity-dwelling animals that are unable to excavate their own homes, such as chickadees and bluebirds, make their homes in these holes. Branches that fall off dead trees provide important nest material for large birds such as rooks, crows, and eagles. Smaller birds and mammals use twigs to create dens and nests.

Snags can stand for up to 40 years before falling to the ground. Once on the ground, ecologists refer to them as coarse woody debris. Rotting wood on the forest floor provides nursery habitat to seedlings. Pathogenic soil fungi, which attack and kill young seedlings, are unable to survive on dead wood. In wet habitats, such as the Pacific Northwest and southern Chile, seed regeneration happens almost exclusively on coarse woody debris. Tree limbs and branches, covered in mosses and organic matter, provide well-drained habitat for seedling colonization.

Dr. Jones notes that fallen wood also provides important structure on the forest floor. "Dead logs are like runways for small mammals to move around in the forest. They act as visual shelter from predators such as owls." In fire-dependent communities, the structure provided by dead wood is quickly converted to fuel for fires. Accumulated debris facilitates a longer burn, which is essential to fire-dependent seeds. These are seeds that require fire scarring to germinate, something achieved only when fires burn very hot.

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Shaping Tomorrow's Ecologists: The REU Program

Greg Likens

REU students Amber Walker and Corey Johnson had a hands-on research experience complete with a rattlesnake skin and bear-mangled traps.

In traditional undergraduate settings most of the education process takes place within the walls of a lecture room. While the foundations to understanding can be laid in this setting, a passion for ecological inquiry is usually sparked when students are engaged in hands-on fieldwork. Since 1988, the Institute has been actively involved in providing scientifically rigorous research experiences to undergraduates. Through competitive funding from the National Science Foundation and The Andrew W. Mellon Foundation, 154 undergraduates have been immersed in ecological science in the Institute's Research Experiences for Undergraduates (REU) program. Dr. Alan R. Berkowitz, the Head of the Institute's Education Program, initiated the program. "The collaborative research-oriented nature of IES is an ideal setting for cultivating tomorrow's ecologists," remarked Dr. Berkowitz.

One of the chief goals of the IES REU program is to help students become better equipped to choose and pursue a career in ecology. To meet that goal, the program introduces students to a holistic view of life in the sciences. In addition to generating results from a self-designed research project, students are exposed to communication methods, data analysis techniques, and a seminar series on the role of science in society. The young scientists present research results to high school students and the IES community, fine-tuning their communication skills. Scientific papers, generated from student research, are published in IES *Occasional Publications*, with many eventually appearing in the peer-reviewed literature.

REU Coordinator Ms. Heather Dahl remarks, "We try to convey the reality of a scientist's job. Ecologists perform field research, but they also teach the public, manage grants, present lectures, write papers, and collaborate with non-government agencies. They need to manage a suite of non-field research activities." Ms. Dahl also stresses the importance of introducing students to the collaborative nature of ecological research. This is encouraged by having the students reside on-site, where communal living fosters networking, nurtures camaraderie, and immerses students in the culture of IES. Many participants establish life-long friendships along with their intellectual pursuits.

Undergraduates entering the REU program are a special group of motivated young researchers. The 10-12 students that arrive at the Institute each summer have undergone an arduous application and selection process from among as many as 250 applications. Strong student response to the program underscores the importance of undergraduate research experiences and the attractiveness of the opportunities offered by IES. Ms. Dahl comments, "Some students come with strong academic backgrounds while others have never worked in a research capacity before and without REU would probably not get the opportunity to perform research at the undergraduate level."

As one of the longest continually funded REU programs, the Institute has had the opportunity to assess the long-term benefits of undergraduate research programs. This is done in two ways – analyzing survey responses and documenting the stories of alumni. The numbers themselves are impressive. This past September, Dr. Berkowitz presented the findings to 148 project directors at a national REU meeting. Of the 143 alumni who participated in the program through 2002, the Institute has current information on 78% and at least some information on 92%. Of these students, over 72% had completed or were attending graduate school when contacted, with 35% completing or working on a Ph.D. Detailed surveys, ranking how the REU program impacted student's career choices, have been received from over half of the alumni. Respondents consistently rank the IES REU program as pivotal in their decision to pursue ecology-related careers and advanced degrees.

Alumni stories convey the nature of some of these impacts. Staff Ecologist Dr. Valerie T. Eviner began her relationship with the Institute during her 1992 REU experience. Then an undergraduate at Rutgers University, Eviner worked with Dr. Clive G. Jones researching how cottonwood trees respond to insect pests. When reflecting on her REU experience, she recalls, "It was an amazing research opportunity and a great way to network with people in the field. At the time, I did not realize I was establishing a community. Now, I see many of the people I spent that summer with at professional meetings."

Eugenie Euskirchen, also a 1992 alumna working with Dr. Jones, describes her experience as essential to becoming an ecologist. "I was a math major with barely a science course. Working with Dr. Jones exposed me to how ecologists work in the field and in the lab. More importantly, it made me realize that I could apply my math background to ecological problems, giving me a venue to apply the theory I had learned. Without my REU experience, I seriously doubt I would be in the field today." Adding, "It was more than science, it taught me how to work within a collaborative community and it was a whole lot of fun." Ms. Euskirchen currently is preparing to defend her thesis for her Ph.D. in forest science at Michigan Technological University. She will be spending the next three years as a postdoctoral researcher, melding ecology and math at the Institute of Artic Biology in Fairbanks, Alaska.

Dr. David Whithall, a 1994 REU alumnus, gained insight into the collaborative nature of ecosystem science while investigating leaf litter and pollution with IES visiting scientist Dr. Richard V. Pouyat. Dr. Whithall conveyed, "My participation as an REU greatly impacted my career path. Had I not spent time at IES, I doubt that I would have pursued a graduate degree in science and would probably not be involved in research today." Adding, "The biggest thing I took away from the experience was an understanding of what makes up the research process. I think there is a big disconnect between what is learned in the classroom (the scientific method, lab techniques, field

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trips) and the synthesis, creative thinking and collaborative work that goes into novel environmental research. I went from thinking graduate school was something I wasn't interested in, to believing it was not only a good idea professionally, but might be fun as well." Dr. Whithall received his Ph.D. in environmental science and engineering from the University of North Carolina at Chapel Hill in 2000. He currently is a staff scientist at the Center for Coastal Monitoring and Assessment in Silver Spring, Maryland.

Some REU alumni are so inspired by the program that they continue the legacy once they become professionals. Dr. Erin Connelly, a 1989 REU alumna, had her first research experience investigating tree succession on powerline rights-of-way with Drs. Berkowitz and Charles D. Canham. When she entered the program, she was still considering medical school. Now a plant geneticist, she remarks that, "My work revolves around genes and proteins. Having an ecological understanding puts things in perspective and helps me think about the bigger picture." Her accolades for the program are underscored by her own involvement in the REU program at the University of South Carolina, where she is an Assistant Professor of Biology. She has gone from being an REU student to being an REU mentor for the past three years. "When I was a student I never knew how much went into running an REU program, but as a mentor I certainly know what comes out of it and that makes it well worth my effort," Dr. Connelly remarked.

Holiday Sale Weekend
at the IES
ECOLOGY SHOP

Featuring unique eco-friendly handmade gifts, educational toys, books on natural history and ecology, and an array of beautiful holiday plants!

Friday, Saturday, & Sunday
December 5, 6, & 7
10am - 4pm

10% off regularly priced merchandise
15% off for Members, Aldo Leopold Society, & Volunteers

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Dead Wood, continued from page 1

The nutrients tied up in coarse woody debris do not become available to living trees without help from microbes and invertebrates. Microorganisms, such as bacteria and fungi, are often the first to colonize dead wood. They act like little sponges when they feed on coarse woody debris, taking up soluble nutrients that would otherwise be lost to groundwater or run-off. Invertebrates, such as slugs and millipedes, require dead wood rich in bacteria and fungi for food and forage. When they feed on these nutrient sponges, they excrete excess nutrients back into the soil, enriching the forest floor.

IES graduate student Sasha Hoffner (SUNY College of Environmental Science and Forestry) conducted one of the first studies looking at the effects of dead wood on carbon and nutrient dynamics while at IES. On the property's lowland flood plain old logs are hotspots for dissolved organic carbon (DOC) production. "The take home message from Hoffner's research," comments his IES advisor Dr. Peter Groffman, "is that while it only covers 3% of the soil surface in the lowlands, dead wood is responsible for 25% of DOC leaching." Why is DOC relevant? It can change the nutrient dynamics of the soil and adjacent aquatic systems.

There are literally thousands of species of microbes and invertebrates in the upper humus layer of soils, which also have the highest nutrient content. Anyone who has tinkered in a garden knows that rich soils are key to plant growth, so it is no surprise that plants are most likely to take root in this layer. Many lichens and mosses grow exclusively on moist rotting wood. Invertebrates are also an important food source for reptiles, amphibians, birds, and small mammals. These animals, in turn, provide a food source for large mammals and birds of prey.

When trees fall into freshwater systems, such as streams, decomposition is much slower. Large logs can persist for decades, altering stream flow and creating microhabitats that aquatic animals depend on. Since 1987, IES ecologist Dr. David L. Strayer has been monitoring the movement of coarse woody debris in the East Branch of Wappinger Creek. By observing the fate of marked logs he hopes to gain insight into the ecological effects of dead wood. One major role that it provides is structure. "Imagine a stream with no plants at all. Water flows rapidly, tearing out a deep channel. Anything you put into the stream is subject to being moved out. When a large log falls into a stream, slowing the flow of water, material can be retained within the system," Dr. Strayer comments.

In the lowlands on the Institute's campus most of the pools in the East Branch are associated with fallen trees. Dr. Jones remarks, "Pools of still water created by woody debris dams provide stable habitat for key players in aquatic habitats, such as insect larvae, many of which require stable temperature and flow." Strayer adds, "While not a great food resource itself, woody debris serves as a net to catch other food resources in the water. Next time you are near a stream, and you see a wood jam, you'll notice a lot of leaves and twigs caught in the wood. If you pull a wad of leaves out, you will find it is full of bugs, which are a great resource for amphibians and birds."

Maintaining a healthy aquatic invertebrate population is as critical in the water as it is on land. Animals like daphnia and water gliders provide essential forage for fish and amphibians. Low-flow waters tend to have larger algae and aquatic plant populations, making them important refuge for the amphibians and fish that lay their eggs in the pools. "Any angler who has ever been fishing for more than an hour in fresh water knows that logs provide habitat for fish," comments Dr. Strayer. Adding, "If you look at fishing magazines the big word they talk about is fishing near 'structure.' In most of our streams here in the northeastern U.S., wood is one of the most important structures, maybe THE most important structure." Dead wood is especially important in smaller streams (i.e., less than 15 meters wide). The bigger the stream is, the more capable it is of ejecting logs.

Dead wood is also important at the aquatic-terrestrial boundary. Fallen trees let animals move freely across streams, creating a bridge between aquatic and terrestrial systems. Decaying logs at the water's edge serve as refuge for riparian invertebrates that need to live outside the water. Leaf matter that accumulates on coarse woody debris on stream banks helps retain shoreline soil nutrients.

So really, there is no dead wood in ecology- only snags and coarse woody debris, in varying states of decomposition, providing shelter, structure and food to a suite of organisms. Dr. Strayer sums it up best, "The term dead wood just does not convey how critical and interesting dead wood really is. It impacts environments on so many levels, from habitat to food resources."

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Newsletter

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Calendar

CONTINUING EDUCATION

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

Biology

Jan. 4 (4 Sat.): Introduction to Botany

Gardening

Nov. 15 (1 Sat.): Gardening with Mosses
Dec. 6 (1 Sat.): Garden Design for Beginners
Jan. 25 (1 Sun.): Invasive Plants in the Garden
Jan. 31 (2 Sat.): Growing Fruit
Feb. 3 (4 Tues.): Principles of Propagation
Feb. 8 (1 Sun.): Using Grasses in the Garden

Landscape Design

Dec. 2 (3 Tues.): Starting a Landscaping or Gardening Business
Jan. 8 (5 Tues.): Principles of Landscape Design

Natural Illustration

Nov. 17 (4 Mon.): Pen and Ink Workshop
Jan. 25 (5 Sun.): Gouache: Enhancing Botanical Illustrations
Jan. 30 (Fri.,Sat.,Sun.): Drawing the Greenhouse: An Intensive Weekend

HOURS

Winter Hours: October 1 - March 31
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.

IES SEMINARS

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

Nov. 21: The role of scientists in fixing international trade rules based on pre-Darwinian biology. Dr. Faith Campbell, American Lands Alliance.
Dec. 5: Integrating K-12 education with scientific research and teaching. Dr. Robert Bohanan, University of Wisconsin-Madison.
Dec. 12: Tribulations and tradeoffs: the influence of predation pressure on the size and behavior of mayfly nymphs. Dr. Lee Anne Martinez, University of Southern Colorado (Director's Program for Visiting Scientists).

THE ECOLOGY SHOP

New items in the shop. Shade grown coffee, bowls made from recycled record albums, Raku pottery and telephone wire baskets from South Africa, baby hats and bath toys - and more arriving every day. Please stop in for a visit.
Senior Citizens Days: 10% off on Wednesdays.

Holiday Sale Weekend
Friday, Saturday & Sunday
December 5, 6 & 7
10 a.m. to 4 p.m.
10% off all regularly priced mechandise
(15% for Members, Aldo Leopold Society & Volunteers)

GREENHOUSE

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

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.

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

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

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

... IES website: www.ecostudies.org

For information on current IES public events and attractions, visit: www.ecostudies.org/ThisWeek.html.
For garden tips, visit: www.ecostudies.org/gardens.html.