FALL 1992

NEWSLETTER

THE EDMUND NILES HUYCK PRESERVE
and BIOLOGICAL RESEARCH STATION
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Introduction

Richard L. Wyman, Executive Director

Huyck Preserve Board member, Laura Carter, solicited and edited these contributions from several of our researchers, creating an overview of recent work at the Preserve. We feel this newsletter presents a uniquely personal perspective of pursuing science at the Preserve. This introduction will describe some of the work of other researchers.

Our research program has grown substantially over the last six years. This summer we had over 37 scientists visit the Preserve and at times we had as many as 24 researchers at a time. Also, this year we had over a dozen graduate students working on the Preserve. Their work here is an essential part of the process that trains them for future significant work. Researchers study a variety of topics including pollination biology, evolution of bird behavior, evolution of queening in ants, and the behavior of water striders. Increasingly our scientists have begun to study the effects of changing climatic conditions on the forest and the animals living in it. For instance, Dr. Susan Beatty from the University of Colorado, with the assistance of a National Science Foundation grant, has begun new studies of the effects of drought on forest understory vegetation. This is vital research because some of the forest understory vegetation eventually will become trees. Current predictions by climatologists suggest that we can expect to have increasingly frequent droughts. Hence it is important for us to know how these droughts may affect forest regeneration.

We also are fortunate to have a team of scientists studying the effects of environmental change on the detritus food web. This is the food web that recycles the nutrients and minerals held in the leaves, twigs, and logs that fall to the forest floor each year. These studies include work on soil chemistry, soil bacteria and fungi, soil micro- and macroinvertebrates, worms, and our personal favorite - salamanders. This work is important because changing climatic conditions can alter the rate at which materials and nutrients are recycled which in turn affects the growth and health of trees. Trees, like humans, depend on a supply of nutrients that they take up through their roots, but unlike humans when those nutrients are in short supply they cannot take a vitamin and mineral supplement. When they are denied access to these nutrients and minerals, they begin to die.

Another aspect of the detritus team's work involves the production of carbon dioxide by the forest floor. As material is decomposed on the forest floor, carbon dioxide is released into the atmosphere. Since carbon dioxide is the principle green house gas, this outgassing bears potential significance. Once in the atmosphere, this gas adds to the heat trapping ability of the earth and thus may increase global warming. This year we began studies of these factors and have already found that drought, soil acidity, and temperature interact to regulate carbon dioxide production (Figure 1). Interestingly, when the soil is wet carbon dioxide production decreases along the pH gradient but when it is dry, carbon dioxide production increases. These are preliminary observations. A great deal more work remains before we can confidently state what will happen as the world warms.

Our work with forest amphibians continues to receive attention. Amphibians are reliable indicators of forest health because they depend on decomposition processes that generate their food. Forests with few amphibians can be suspect while those with a healthy amphibian community are probably functioning well. This concept has now been adopted by the U.S. Environmental Protection Agency in that they are using the amphibian community to monitor the health of our Nation's forests. This summer I undertook a new experiment which attempts

to document the role of salamanders in the detritus food web. We know salamanders eat invertebrates found in the

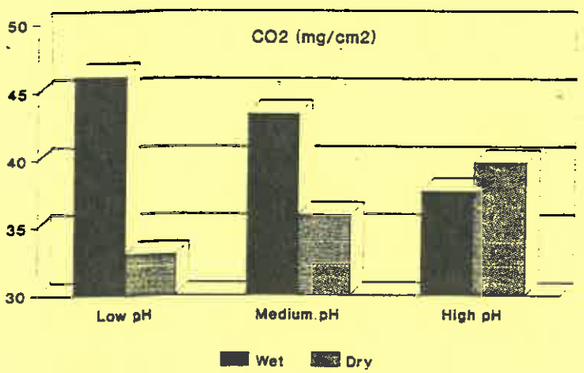

Figure 1 The production of CO_2 by the forest floor during a 24 hour period in 1992 along a pH gradient in artificially dry sites and normally wet sites.

food web but we do not know whether this predation affects the population biology of these invertebrates. With the assistance of Tom Alworth, Jamie Young, Caryn Cozzolino, Sarah Orris, and Bettina Weber, we constructed six [two square meter] salamander houses. Two of these houses have no salamanders, two have two salamanders, and two houses have six. We are now monitoring the invertebrate populations to determine how they respond to the different levels of predation. This work may show how salamanders affect the structure and function of the detritus food web upon which all of the inhabitants of a healthy forest depend.

A Movable Pond

Malcolm Pratt Frisbie

There it is, the forty-fifth Petri dish so far. It is hot and humid; not a breath of air is moving. I measure the pH of the moist filter paper lining the bottom of the Petri dish which is home for one of our red-backed salamanders. I am testing how soil acidity affects salamanders, and so I must check and adjust the pH of the laboratory "soil" daily. The reading is too high. I add a drop of dilute sulfuric acid to the dish and slosh the artificial soil solution back and forth to mix it in. Then I measure the pH again. It's better, but still a little high on one side of the dish. I add another drop and mix and measure. Now it is too low! I add a few drops of dilute potassium hydroxide. The pH doesn't change. I add some more. Finally the dish reaches the target pH. I replace the salamander and reach for dish forty-six. The radio plays that insipid ad again, for the fourth time this morning. Ah, the pastoral life on the shores of Lincoln Pond!

I have worked at the Huyck Preserve for four summers. It is a wonderful place to spend time. It is beautiful and (usually) peaceful. I can leave the cares of school behind and turn my attention to that which I get far too little time to contemplate...biology.

Most folks who do research at the Preserve spend their work time in the field. In fact, a great reason for becoming a biologist is that one has a ready-made excuse for wandering through the woods. There are, however, some questions that may be better answered in the laboratory. In large measure, I have painted myself into that corner. But the story begins in the field.

For more than a decade, Rick Wyman and an army of colleagues and students have been searching under rocks, logs, and leaf litter throughout New York's forests for *Plethodon cinereus*, a.k.a. red-backed salamanders. While these inconspicuous creatures are usually abundant, there were some areas where Rick's group found hardly any at all. Why? It seemed that soil acidity was the culprit.

The pH scale describes the acidity or alkalinity of a substance. Substances with a pH value of 7.0 are neutral, those below 7.0 are acidic, and those above 7.0 are alkaline. The pH scale is logarithmic: Every decrease or increase of one unit on the scale corresponds to a ten-fold increase or decrease in acidity. That means that a pH of 3 is ten times more acidic than a pH of 4. Forest soils in the northeast tend to be acidic, with pH's in the 4-5 range. But there are also soils with pH's of 3 and even lower. Rick and company found red-backed salamanders on soils with pH's of 3.8 or higher, but hardly any on soils more acidic than that.

What caused this pattern? Although salamanders are land-dwelling creatures, they seem to be influenced by soil chemistry the same way that aquatic organisms are affected by water chemistry. An aquatic animal is like a porous vessel, with internal chemicals continually leaking out through the skin, gills, and excretory system. To counteract this inexorable loss, many aquatic animals pump chemicals from the water back into their bodies.

Vertebrates (animals with backbones) have high concentrations of sodium in their blood and in the fluid that bathes the cells of their tissues. Vertebrates that spend all or part of their lives in water are vulnerable to water conditions that may disrupt their delicate internal chemistry. Aquatic amphibian larvae, for example, leak sodium into the water around them, but ordinarily they can balance this loss by pumping the same amount of sodium back in. When the water is too acidic, however, the sodium leaks out faster than the larvae can recover it. If this disequilibrium persists and the sodium deficit becomes too great, the animal will die.

While osmoregulation is a continual challenge for aquatic creatures, it is not often thought of as a problem for terrestrial animals since chemicals like sodium do not constantly leak into the air. Red-backed salamanders are terrestrial and lay their eggs beneath rocks or logs. Their larvae never live in water but develop completely inside the eggs before they hatch. Thus the environmental chemistry that so dramatically affects the aquatic stages of other amphibians should theoretically have no influence on the red-backed salamanders. Yet Rick's surveys showed a definite correlation between soil acidity and salamander population; I began to suspect that osmoregulation *was* playing a role.

So over the last four years, Rick and I have been testing red-backed salamanders in the laboratory. Using moistened filter paper as imitation soil, we expose *P. cinereus* to different "soil" pH's then measure sodium loss by tracking a sodium isotope. As expected, the animals are disturbed physiologically by low soil pH. In fact, salamanders on very acidic soils (pH 3.0 or 3.5) lost sodium faster than salamanders on less acidic soils (pH 4 or higher). In another experiment, salamanders kept on pH 3.5 soil for two weeks, had significantly less sodium in their bodies than salamanders kept on pH 5.0 soil during the same period. Our suspicions were confirmed. Soil pH affects terrestrial salamanders in the same way that water pH affects aquatic amphibian larvae!

We're also looking at other soil characteristics to see how they might affect sodium balance in red-backed salamanders. We collected soil samples from a beech forest and a hemlock forest, soaked filter paper with soil extracts, and measured the rate of sodium loss from salamanders we placed on the treated paper. Since the salamanders are four times more abundant in the beech forest, we naturally expected them to do better on beech-derived solutions. We found no difference however.

In other laboratory tests, we found that salamanders generally did better on humus soils than on the lower mineral layers. We suspect that dissolved organic substances in the humus layer may interact with pH to mitigate its deleterious effects and perhaps those of some other soil chemicals, like aluminum. We will need to do further experiments to demonstrate this explicitly.

Last summer, I wandered into the field, placed enclosures in the hemlock and beech forests, and kept salamanders in them for three weeks. I wanted to find out if the actual soils, not just the laboratory analogues of them, could produce measurable differences in salamanders. The next step is to measure sodium and other chemicals in those salamanders. That task awaits me, alas, back in the laboratory.

In retrospect, perhaps it is not so strange to ask questions about osmoregulation in terrestrial salamanders. Although evolution has freed them from water, for much of their history they were, and many of their close relatives still are, linked to water. Being moist and slimy, they have typical amphibian skin. The red-backed salamander has no lungs but breathes through its skin and the lining of its mouth. In order to function in gas exchange, the skin must be highly permeable and moist. As salamanders crawl through leaf litter and soil, chemicals diffuse into and out of this skin moisture. Are these really terrestrial animals? In some important physiologic respects they are still aquatic. They just carry their own private ponds with them, wherever they go.

Malcolm Frisbie, an associate professor of biological sciences at Eastern Kentucky University in Richmond, Kentucky, won a faculty research award for his work on the Huyck Preserve. He plans to continue his work here and hopes to also study physiological changes in overwintering salamanders and in predaceous diving beetles. Frisbie, who served as a Peace Corps volunteer in Africa, has also done field research in Peru and in Pennsylvania.

When the Tree Falls

David Goldblum

As I stroll through the Huyck Preserve, I can't help noticing the remarkable array of plants growing on the forest floor. More than a hundred plant species thrive in the rich understory, nourished by the sunlight that penetrates the leafy forest canopy. In places where trees have fallen, the sunlight floods the forest floor, pouring through the holes in the canopy. My research focuses on how small disturbances like treefalls (particularly in Eastern deciduous forests) help maintain the rich diversity of the understory flora.

Fallen trees are a normal part of the forest landscape. Wind, ice, or heavy snow can knock trees down suddenly. Or the process can take longer, as trees weakened by storms, disease, beavers, or insects, die slowly, sometimes taking years to fall. While they may seem undramatic when compared to disturbances like forest fires, avalanches, and hurricanes that can destroy hundreds or thousands of trees at a time, treefalls actually play a key role in determining the makeup of the understory plant community. Many researchers have studied how treefalls affect tree communities, but few have looked at how treefalls affect the smaller plants on the forest floor.

I am trying to figure out how long it takes the vegetation in treefall areas to return to pre-treefall conditions. Last summer, I selected 32 treefall gaps and began to determine how old they were, the amount of light

they received, soil conditions, and the types of plants growing there. I'm also measuring those factors in undisturbed areas for comparison.

I'll also be looking at small scale environmental variations within each treefall gap area, and, how overstory conditions influence the timing of plant growth, reproduction, and dormancy. Scientists already know that the amount of light reaching the ground can vary within the same treefall gap area. I suspect there are variables (e.g. soil temperature and moisture, air temperature) which also affect the plants growing there.

I hope my work at the Edmund Niles Huyck Preserve will contribute to a better understanding of how forest ecosystems operate. That understanding is essential to our being able to manage, protect, and preserve natural areas like the Huyck Preserve. I would like to thank the Preserve members, the Scientific Advisory Committee, the Board of Directors, and Dr. Richard Wyman for giving me the opportunity to pursue my research interests here.

David Goldblum undertook his research on vegetation dynamics of treefall gaps because he realized there was a gap in understanding how forests operated. A graduate student in the Geography Department at the University of Colorado in Boulder, Goldblum has done field work in Ontario, Canada, and Belize, Central America, as well as in Colorado and at the Huyck Preserve.

Who Shall Be the Mallard's Mate?

Kevin Omland

Late one night last summer, I was awakened by the sounds of loud quacks and flapping wings. Armed with a flashlight, I sprinted from my cabin, ready to confront whatever was terrorizing my mallard ducklings. Their pens had been carefully designed to keep out predators: I had built the three six foot high enclosures myself, stapling every edge, meticulously weaving together sections of chicken wire, and burying a chicken wire skirt two feet deep to foil burrowing foxes and coyotes. But maybe I had missed a hole or a weak spot somewhere. As I approached the pens, a barred owl, badly frightened by the terrible creature in boxer shorts, flew from the top of a cage into the forest. Luckily, the wire roof had held and my ducklings were safe.

My ducklings are now adults and ready to participate in my research project. I am testing a theory that says female mallards select the "flashiest" males for their mates. In many species of animals, females choose to mate with showier, more brightly colored males. The more flamboyant males, therefore, have the best chance of passing their genes (and their flashy traits) on to future generations. But why are the females drawn to these males in the first place? According to one theory, females are attracted to males with the brightest plumage and most elaborate ornamentation because they are most likely to produce vigorous offspring of high genetic quality. Another popular theory suggests that distinctive male traits evolved so females could avoid mating with the wrong species.

But there may be other reasons why females behave the way they do. In 1990, University of Texas scientist who was studying female choice in two related species of fish--swordtails, which have swords, and platyfish, which don't-- discovered that platyfish females preferred males equipped with artificial tail swords. The scientist hypothesized that these females had a pre-existing sensory bias to sworded males.

I decided to test this hypothesis on mallard ducks, to see if female mallards have a pre-existing preference for males with red patches on their bills. Male mallards don't have red bills, but the male Bahama pintails, a related species, do and the ones with larger and brighter red patches are more likely to attract females.

So I put red tape on some of the male mallard ducks. Then I present each female mallard with two males--one with red on his bill and one without. If the female mallards choose the red-billed males as mates, it could mean that a pre-existing preference led to the evolution of red bill patches in male Bahama pintails. Perhaps bright plumage in male mallards and other birds evolved the same way.

My work may also contribute to a better understanding of why black ducks are disappearing in the Northeast. Mallards and black ducks often flock together. One study suggests that female black ducks seem to be promoting the decline of their own species by choosing to mate with the colorful mallards rather than the drab black ducks. The hybrid offspring are more apt to resemble their fathers because the mallard genes are dominant. Eventually, I intend to conduct controlled experiments with black ducks to see whether the females have a pre-existing preference for bright plumage.

Last May a colleague sent Kevin Omland a postcard with a family of ducklings on the front and the message "Congratulations Dad!" on the back. "I doubt she realized how appropriate that was," says Omland who behaved like a nervous new father when he took charge of his young ducklings. Omland, a former high school biology teacher and now a graduate student at the State University of New York in Albany, spent the winter in Lincoln Pond Cottage on the Huyck Preserve where he could keep a close eye on his ducks.

Drummers Can't Be Choosers

Gretchen Schawe

It's 4:30 on a dark, chilly, spring morning before the sun is even up, and a thumping sound is coming from somewhere deep within the forest. I begin moving slowly and quietly, inching towards what I recognize to be the drumroll of a male ruffed grouse. I must find his drumming log without scaring him away. My task is cold, tedious, and lonely in the dark. I sometimes wonder why I have chosen to spend April and May this way. But as soon the sun begins to rise so do my spirits. And when I find the ruffed grouse on his drumming log, I forget everything else and concentrate on my work.

Every spring, the male ruffed grouse stands on his drumming "log" and "advertises" for mates by beating his wings to produce the vibrant drumroll sound. When a female grouse arrives, he will stop drumming, hop off his log, and dance for her, proudly spreading his fan-shaped tail and raising the ruff feathers on his neck. If she is impressed, she may stay and mate with him. If not, she marches off in search of a better match. She will choose only one mate (the male will mate with several females), but no one knows exactly how or why she selects a particular male to father her offspring. Does she pick one that drums or dances more vigorously than other males? Or does she choose a mate because she is attracted by the color of his feathers or the length of his tail? My research may help to answer these questions.

Another question is one that evolutionary biologists have been trying to answer since before Darwin's time: What motivates a female to choose a particular mate? Is she looking for a healthy male, one that will sire hearty offspring? If so, can she tell by his courtship behavior or by his physical appearance whether he is healthy and strong? Or, does she select an attractive male simply because he is likely to produce attractive male offspring who will, in turn, be more successful than less attractive males at reproducing? In other words, does she want to ensure the perpetuation of her genetic line?

Last spring, when I began my project, I found 38 drumming logs and started collecting drumming data. About 90 percent of the drumming "logs" on the Huyck Preserve and at the nearby Partridge Run Preserve aren't logs at all: they are the tops of rock walls, recognizable as drumming platforms by the telltale signs of grouse droppings. I put voice-activated tape recorders at each "log," to capture the drumming sounds. I can determine just how vigorously each bird drums by using a sonograph to analyze the speed, frequency, and duration of the recorded sounds. To see whether there is a connection between drumming behavior and health, I will measure the number of parasites in grouse droppings since healthier birds have fewer parasites.

To measure a male's tail and feathers, I must first capture him. I use a decades-old trapping technique that takes advantage of the male's territorial behavior: he will defend the area around his drumming platform and fight any male grouse who comes too close. At dusk, I place a mirrored trap on the platform. The next morning, the bird begins drumming, and as the sun rises, he sees his reflection and charges into the trap to fight the "other male," tripping a mechanism that slams the door shut. We're careful not hurt the birds as we band, measure, and release them.

My assistants, hidden behind blinds near the drumming logs, observe and record female visits, matings, and drumming characteristics. After the chicks are born, I will compare their blood to that of the adult males (using DNA "fingerprinting" techniques) to confirm which males fathered each brood.

Anyone interested in being a volunteer research assistant on my project should contact me at the Department of Biology, SUNY-Albany.

Although she sometimes wishes she were home eating a sandwich in those cold predawn hours when she's homing in on the grouse drumroll, Texas-born Gretchen Schawe says, "I am so lucky that my study of grouse mating behavior gives me the opportunity to experience the Huyck Preserve during this incredible season." Gretchen, a graduate student at the State University of New York in Albany, specializes in animal behavior and ecology and has also studied the mating systems of bobolinks.

The Tackle Box

Paul Wilson

I have a tackle box inspired by one used by my major professor, James Thomson. It's not very big (13x9x4 inches), it opens on both sides, and its compartments are filled with ordinary things you might find at any five-and-ten or general mercantile. Using a few modest tricks, I've turned those ordinary items into research tools for my work on the pollination biology of jewelweed flowers.

I use my 45 cent clear plastic ruler to measure the amount of nectar that bees leave behind in the flowers after dining on the sweet liquid. To get to the nectar, a bee crawls inside the jewelweed flower, squeezes past a pair of

porch petals, then sticks her tongue into the nectar spur. The long tongued bumble bees can drink almost all the nectar, while the shorter tongued honeybees get only about half of it. Some, like the green metallic bees, have such short tongues that they get hardly any nectar at all.

I keep wax paper bags and a Top Ministapler in my box. I bag the flowers when they're in bud and staple each bag shut so the bees can't visit the flowers when I'm not looking. Once a flower opens, I remove the bag. As the bee enters a flower to collect nectar, her back brushes against the flower's reproductive organs and she inadvertently collects some pollen too. Other types of bees gather pollen grains deliberately, scraping them from the flower with their mouth parts and forelegs.

Jewelweed flowers have distinct male and female phases. For the first day or so, the flower is in the male phase and pollen is available for removal. Then the flower is in the female mode and is receiving pollen needed to set seed. I was able to calculate the approximate number of pollen grains a bee removed from a flower in its male phase: I counted the number of pollen grains left on the male organ and subtracted it from the average number of pollen grains a jewelweed flower produces. To determine how many pollen grains a bee brings to a flower in the female phase, I simply count the grains on the plant's female organ.

My tackle box has compartments filled with centrifuge tubes, vials of alcohol (basically vodka), microscope slides and cover slips, glycerine jelly, and a rubber cork. I fill the tubes with alcohol and use them to preserve the plants' male organs. The female organs are placed in the jelly, sandwiched between a slide and cover slip, then squashed with the rubber cork.

My box is equipped with everything I need to make labels for the centrifuge tubes and the slides: an old piece of plexiglass (5 x 8 inches), five different colored rolls of masking tape, a ballpoint pen, and a razor blade. To make the labels, I put the tape on the plexiglass, use the razor blade to cut the tape into little squares, and write a number on each square. I give each flower a unique number. Last year I had more than 1,300 of them.

My box is also stocked with Knox unflavored gelatine, packets of sugar, and an assortment of straws. Pollen grains germinate well on jello that's ten percent sugar, and, in a mere fifteen minutes, they will grow to many times their original size. The trick is to spread the pollen grains in a thin layer and that's where the straws come in handy. I simply point a straw at a flower, blow gently, and the pollen settles nicely across the jello.

I even have something you might expect to find in a tackle box--fishing line. I use it to hand pollinate some of the flowers. Because of their electrostatic properties, pollen grains will cling to the burnished microfilament. When I cross pollinated two different species of local jewelweeds-- orange *Impatiens carpensis* and yellow *Impatiens pallida*--fertilization occurred, but the embryonic seeds failed to develop. Although the two types of

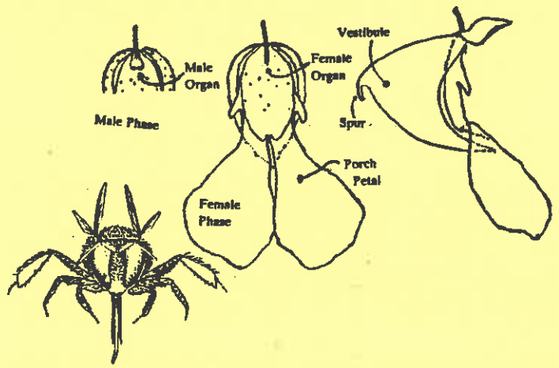

Figure 1 Male and female phases of jewelweed and a bee.

jewelweeds grow near one another, they will remain distinct species, perhaps forever, because of their physiologic incompatibility.

The latest additions to my tackle box include a pair of cuticle scissors and a tube of Superglue which I use to reshape the flowers. I want to see whether the jewelweed morphology affects the amount of pollen the bees can move. In some flowers, I trimmed the vestibules so the bees could get to the nectar without brushing against the flower's reproductive organs. In other flowers, I pleated the vestibules with glue so the bees would have more contact with the reproductive organs, or I snipped the porch petals to allow less contact. I bought the cuticle scissors and the Superglue at the Greenville Pharmacy. It was a gesture that made me think fondly of James Thomson.

Paul Wilson has spent two summers on the Preserve and is known around Rensselaerville as Scientist Paul. He is a graduate student in the Department of Ecology and Evolution at the State University of New York at Stony Brook.

Food for Worms

Bill and Nancy Elliott

If it weren't for decomposition, a forest might drown in a sea of its own waste in the form of the dead leaves, branches, twigs, and other natural debris that fall continuously to the forest floor. Decomposition is essential for recycling the forest canopy, forming soil, and in determining the plant and animal communities that will thrive on the forest floor. But it's a complex process, one that scientists are only beginning to understand. We began our own research project at the Huyck Preserve five years ago and have made some interesting discoveries about how forest litter decomposes.

We found that the speed of decomposition varies from forest to forest. On the Huyck Preserve, it's slowest in the hemlock forest, fastest in the mixed hardwoods forest, and proceeds at an intermediate rate in the beech and red pine forests. To find out why, we designed a "mixed litter bag" experiment: we prepared tiny bags of litter from each forest and placed them in each of the other forests and measured how fast the litter decomposed. We wanted to know, for instance, whether the hemlock litter would decompose faster in the mixed hardwoods forest. It didn't. In fact, the "guest" litter, no matter which forest it was from, decomposed pretty much the way it would have at "home." Although there is some interaction between the litter and the type of forest it's in, the decomposition rate seems to depend on the litter itself.

Forest litter is the basis for the elaborate detritus food web. Bacteria and fungi feed on the litter, and they, in turn, are eaten by small invertebrates (springtails, mites, and nematodes), which are devoured by larger invertebrates (earthworms, euchytraeid worms and insects), which are in turn eaten by vertebrates like the red-backed salamander -- the top carnivore of the detritus food web. Bacteria and fungi seem to be least active in the hemlock forest, where decomposition is slowest and the standing crop of litter deepest, and most active in the mixed hardwood forest, where decomposition occurs more rapidly. One might expect the hardwood forest to be teeming with invertebrates since the bacteria and fungi, on which they feed, is so plentiful. Yet, surprisingly, the invertebrates were more abundant in the hemlock forest. Perhaps they found the hemlock's deep litter layer more appetizing than the bacteria and fungi fare offered by the hardwoods.

The decomposition process seems to be sensitive to acidic conditions. Generally, the more acidic the litter and forest soil, the slower the litter decomposes. The hemlock forest is, predictably, the most acidic of the four forests on the Preserve, the hardwood forest the least. While we don't completely understand why soil acidity has an adverse affect on the decomposition process, our studies did show that the decomposer bacteria are more sensitive to acidic conditions than the fungi are.

Our acidity-decomposition correlation did not consistently hold up. In the beech forest the soil conditions varied. The dry upland areas were more acidic than the moist lowland areas. But, the litter decomposes at the same rate regardless of the acidity of the soil. We don't know why this is so. In fact, there's a lot we don't know about decomposition. What would happen, for instance, if the decomposer food web were compromised by acid precipitation? We're eager to continue our work for there's a lot we need to learn.

Bill Elliott and his wife Nancy have travelled all over the world in pursuit of their various research interests. Bill, a biology professor at Hartwick College in Oneonta, New York, has studied wasps in Panama, stromatolites (fossils formed by blue-green algae) in the Bahamas, as well as decomposer bacteria and fungi on the Huyck Preserve. Nancy's research on wasps has also taken her to Panama and the Bahamas, and she recently visited Rwanda to see the wild Mountain Gorillas. She is an associate professor of biology at Siena College in Loudonville, and is studying the insects of the detritus based food web at the Huyck Preserve.

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