

Future of Oak Forests Research: From Microbes to Mammals

From microbes to mammals, scientists participating in the Consortium's Future of Oak Forests project have uncovered changes in diversity and abundance that could affect ecosystem health and function. Dr. Kate McFadden, formerly of Columbia University, and her graduate students are studying small mammals, and Dr. Krista McGuire of Barnard College is studying fungi and bacteria.

Led by a team of faculty-level scientists, the oak study is the first direct, manipulative investigation of the cascade of impacts likely to follow from the loss of oaks, in advance of what may occur should they succumb to current or future threats. It uses a species-removal technique to mimic tree loss to a pathogen, such as sudden oak death, in a series of experimental plots (some with all oaks girdled, some with half the oaks girdled, some with all non-oaks girdled, and some controls); part of each plot is fenced to exclude deer. Each treatment type is replicated at lower, middle, and higher elevations. Before girdling, scientists obtained baseline data; more than a dozen investigators from eight institutions have participated in studies so far, including examinations of biogeochemistry, microbial ecology, insect and small mammal studies, and modeling efforts.

Microbes

Dr. McGuire is examining the effects of potential oak loss on soil microbial community composition and function. "Bacteria and fungi are responsible for cycling the majority of nutrients through the forest, and without them plants and higher organisms would not be able to survive," she says. "In fact, we would not be able to survive either, as we would be buried beneath miles of trash and detritus if microbes were not breaking all of this material down!"



Graduate student Ika Djukic working on microbe study with Dr. Krista McGuire.

Working with Ika Djukic, a visiting Viennese graduate student, and Ramya Rangamannar, a Barnard undergraduate, she sampled soil from the various treated plots, examined the fungal and bacterial communities in them, and sequenced the fungal DNA. The number of microbes in the soil is remarkable: an estimated 100,000 microbial cells representing thousands of species in just one gram of soil.

Dr. McGuire found that the microbial communities were different under different treatments and that, in particular, there was increased bacterial (as opposed to fungal) dominance in the plots in which all the oaks were girdled. Changes in fungal composition were also more pro-

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The Weather Event

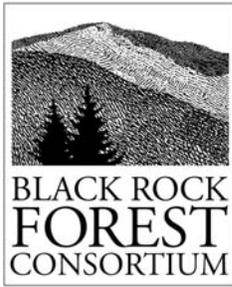
Festive Luncheon Supports Forest

Food for thought was on the menu at The Weather Event, a benefit luncheon for the Black Rock Forest Consortium that was held on May 8. Highlights of the event, which was co-chaired by Leadership Council members Valerie Colas-Ohrstrom and Vivian Donnelley, included a keynote address by Dr. Heidi Cullen on the importance of climate forecasting for science and the presentation of the William T. Golden Award to Dr. Frank Moretti. In addition, the luncheon celebrated Dr. William Schuster's 20 years as executive director of the Black Rock Forest Consortium.

A sold-out crowd of more than 200 people gathered at the Yale Club for the festive occasion – many institutions took tables, as did board and Leadership Council members and other friends of the Forest. All provided vital support for the Consortium's research, education, and conservation activities.

After the guests mingled and then sat down to lunch, Dr. Kevin Griffin of Columbia's Lamont-Doherty Earth Observatory opened the program. He welcomed the guests, explained how his work at the Forest complements the global scope of his research, and introduced Dr. Cullen, who he knew during her graduate student days at Lamont-Doherty. Dr. Cullen is the Chief Climatologist and Vice President for External Communications for Climate Central, a not-for-profit organization dedicated to climate and energy research and reporting, a visiting lecturer at Princeton University, and the author of *The Weather of the Future*, published in 2010. In her talk, Dr. Cullen discussed the different ways

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The Black Rock Forest Consortium is an alliance of public and private schools, colleges, universities, and scientific and cultural institutions engaged in research, education, and conservation in the 3835-acre Black Rock Forest. It is a not-for-profit 501(c)(3) organization supported by membership dues, grants, and gifts.

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Report from the Executive Director

Dr. Heidi Cullen's book, *The Weather of the Future*, highlights how long-term climate modeling can help us avoid or reduce some disastrous effects of future weather events like heat waves and floods. She points out that climate is simply weather over the long-term, and that climate and weather forecasting have become more accurate and reliable. In her hypothetical scenario for New York in 2050, a perfect storm, amplified by extra heat and energy in the atmosphere from human activities, hits the city head-on. But thanks to robust long-term data and model analyses, the event is predicted and the city is ready. Instead of extensive erosion, flooding, and energy grid failure, investments in ecosystem protection, infrastructure improvements, and storm surge barrier construction make the city less vulnerable, minimizing damage, suffering, and loss of life.

Clearly, the value of long-term scientific study is high, both systematic recording of focused scientific data and its extension through analysis and modeling. Long-term study is an important emerging science trend for clarifying historic patterns of variability and understanding processes that operate over extended time-scales. It is a prerequisite for sustainable management of ecosystems and natural resources. And combined long-term studies from different disciplines can enable prediction of even complex natural dynamics. The US has made substantial investments in long-term environmental research through the National Science Foundation, the National Oceanic and Atmospheric Administration, and other agencies.

Long-term research includes both historical information and continuing research. Many investigators, and institutions like field stations and marine laboratories, have legacy datasets that can help us study current issues and make future predictions. Too often, these data are not preserved, e.g., fading photographs or hard copies, or digital data in archaic formats. Sometimes they lack information about how they were collected or what they represent. And even well preserved and documented data are of limited use unless widely available.

Black Rock Forest has forest growth records dating back 82 years, climate records for 52 years, a 33-year record of acid precipitation, and stream flow records from 1995. But even decades-old datasets may not be long enough to reveal important long-term patterns. For example, in New Hampshire's Hubbard Brook Forest, stream chemistry has been monitored since the 1960s. During the first years of study, stream water leaving that forest contained substantial nitrogen in the form of nitrate. It was presumed that the documented nitrogen input from acid precipitation exceeded the forest's ability to retain nitrogen, leading to stream and pond pollution. A February 2012 paper in the *Proceedings of the National Academy of Sciences* sought to explain why this nitrate export decreased from the 1980s to the 2000s, even though nitrogen deposition remained high. Analysis revealed that warmer winters have led to more frequent snowpack melting and more contact with soils, which absorb more nitrogen. But this explains less than half of the decline. The authors concluded that the "baseline" nitrate export in early years was probably an anomalous response to earlier disturbances, logging and extreme weather events, that happened well before data collection began.

Legacy datasets are important, but many must be continued, including proper curation and sharing, to be most useful. Maintaining long-term studies can be challenging, since funders often prefer to support new studies. The increasing appreciation of long-term studies is heartening and will hopefully lead to increased funding. Scientists and science facilities are increasingly compelled to think outwards, to share and collaborate, and to preserve key findings for uses that might not be apparent today. Some of Black Rock Forest's earliest forest records, collected by Hal Tryon starting in 1930, are again proving useful in ways that he could not have envisioned. When I arrived in 1992, I found Hal's records intact (though on fading paper!), with enough information to make them useful for others, setting an important example for future generations. ■

— Dr. William Schuster

New Education Initiatives for Consortium

The arrival of Dr. Jeff Kidder last summer as the Black Rock Forest Consortium's first director of education set the stage for new educational initiatives in the Forest. Now, nearly a year later, ideas are taking shape, including an energetic new educators committee, progress towards an integrated K-12 curriculum, the potential for involving graduate students from Consortium institutions in curriculum development and teaching of K-12 students, plans for a teacher symposium, development of a mammal science module based on live mammal trapping for the Virtual Forest Initiative, and a natural history scavenger hunt, among others.

One of Dr. Kidder's first actions was to form an educators committee. "I wanted to create this committee," explains Dr. Kidder, "to incorporate input from teachers in assessing the Consortium's curricular needs so we can integrate the curricula across grade levels and scale them for the different schools." He found out after the first meeting, which attracted nine teachers from five schools as well as four university representatives, that the teachers first wanted to talk about education issues generally, such as the ability to network and share ideas among themselves.

Lisbeth Uribe, a teacher at The School at Columbia, is chairing the Education Committee. She is excited that the committee can "contribute to the work of developing an interdisciplinary education program that builds on the Forest's scientific research and conservation efforts. The committee will help to deepen and expand the educational offerings at Black Rock Forest by promoting new joint possibilities for its members."

One initiative the committee will plan is an annual teacher symposium that will be a forum for teachers to share what they are doing in the Forest and develop Consortium-wide activities and a modular system of classes. "The committee is evolving and growing," notes Dr. Kidder. "There's lots of enthusiasm, and everyone has ideas to contribute."

Graduate Students

Before Dr. Kidder came to the Consortium, he worked for years connect-

ing graduate students with K-12 students, starting at Cornell University when he was a graduate student himself and continuing in his work at Rutgers and the University of Colorado. He is eager to adapt his experiences at those institutions to the Consortium, which includes both schools and universities among its members. He envisions engaging graduate students as content experts who can partner with and support teachers for both curriculum development and classroom activities.

For curriculum development, he suggests creating modules in such fields as forest ecology, entomology, herpetology, geology, and mammalogy that will be used both at Black Rock and in the classroom, with graduate students as part of a team with Consortium staff, scientists, and teachers. "Aside from content expertise," he explains, "graduate student experts will ensure the inclusion of appropriate laboratory and field activities and current research methods, practices, and technologies in the modules. The classroom teachers and Consortium staff will work with the graduate students to develop activities that serve the needs of the schools, are age- and developmentally appropriate, integrate with and expand on existing school curricula, align with science content standards, and incorporate and enhance existing Forest curricula." He also envisions involving graduate students in mini-courses and summer and after-school classes.

Mammal Biology

With generous support from the Toyota USA Foundation, Dr. Kidder and the staff from the Columbia Center for New Media Teaching and Learning (CCNMTL) are developing a rigorous mammal biology module for the Virtual Forest Initiative (see "Virtual Forest Partnership Links Harlem Schools with Forest," Winter 2012). This module will include online habitat maps that illustrate the distribution of mammals in the Forest, but will have field and classroom components as well, including live trapping (and release) of mammals from shrews to coyotes in the Forest and study collections of mammal skins and skulls that can travel to classrooms of mem-



Students in the Toyota USA-funded program study mammal biology in the Forest.

ber schools (see "Forest News in Brief," p. 7). The Consortium has permits from New York State to conduct live trapping; Dr. Kidder is developing a sampling protocol with the CCNMTL group so that the trapping information will create a growing habitat database for the Virtual Forest module.

Scavenger Hunt

The teachers participating in the educators committee were also enthusiastic about Dr. Kidder's idea for a natural history scavenger hunt. Students will use cards with illustrations of plants and animals that can be found in the Forest, some all year round and some only at specific times, and hints about where to find them. The organisms will be chosen for the interesting natural history stories they represent. The backs of the cards will list questions about the organisms that can form a basis for discussion when the class returns from the field. For the water strider, for example, two questions will be: How many legs are involved in its locomotion? Which legs appear to be its main source of power?

"Most of the science learning takes place after the students have searched for the organisms and have returned for a group discussion," explains Dr. Kidder. "The instructor will facilitate a discussion based on the questions on the cards and have the students derive the answers by asking them leading questions. It is critically important to engage the students in this process." ■

Student Research Spotlight: Breeding Birds

by Sarah Gilly

Last summer, I worked with my research mentor, Dr. Terryanne Maenza-Gmelch, on a census of the migratory songbirds of the Forest. We collected bird presence/absence and abundance data in five structurally different habitats to identify areas that support rare birds and to document bird diversity overall. The project was the beginning of a long-term study of bird population trends and habitat change. Our preliminary results, which indicated the existence of species specialized to particular habitats, support our hypothesis that having a variety of habitats fosters a higher level of biodiversity. Maintaining this variety of habitats is an important bird conservation tool.

This summer, I will continue collecting data for this project, but I will also branch off to do research for my senior thesis. Last summer's docu-

mentation that the increasingly rare cerulean warbler (*Setophaga cerulea*) is still breeding in Black Rock inspired me to identify what habitat characteristics are most important to them. Using the habitat they were in last year as a starting point, we will choose a few other similar habitats. At these sites, we will measure variables such as maximum tree height, percent canopy cover, percent understory cover, dominant tree species, distance to wetlands/water, distance to major roadways, approximate habitat patch size, and distance to the nearest other study site. We will compare these data to cerulean warbler abundance to see what correlations exist. We will also establish study sites in the nearby Schunemunk Mountain forest, where cerulean warblers are also known to be present. We seek to study a site in privately

owned land between Black Rock and Schunemunk since it has the potential to serve as a habitat corridor.

Based on past records, we expect the results to support an Important Bird Area designation for Black Rock Forest. Data collected this summer will be sent to Audubon New York and BirdLife International as a nomination for this status. Benefits of this designation could include access to competitive conservation funds, depending on the priority level of the designation. Loss of habitat is the biggest cause of bird population declines, so our hope is that increased funds would allow for the preservation and maintenance of habitats that support cerulean warblers and other sensitive forest-interior birds. ■

Sarah Gilly is majoring in Environmental Policy at Barnard College and will be a senior in the fall.

Research (continued from page 1) pronounced in the oak-girdled plots. "Our results indicate that a loss of oak tree species from eastern temperate forests could have significant implications for soil microbial diversity and function," she says. "These changes could alter nutrient cycling dynamics and carbon storage processes." Next steps include setting up litter decomposition experiments to examine "how different groups of fungi are affected by oak loss and what this means for nutrient cycling of particular leaf species."

Small Mammals

For the past five years, Dr. McFadden and her graduate students, including Sharon Newman and Stephanie Seto (see "Student Research Spotlight," Fall 2008), have studied small mammal populations in the oak forest plots. "Research on small mammals is important," Dr. McFadden explains, "because they serve a central role in increasing and maintaining plant diversity and in the decomposition of plant material within ecosystems. They are excellent indicator species because their patterns, abundance, and distribution often are tightly linked to ecosystem health and productivity. The goals of the study are to examine both population and for-

aging ecology of small mammals relative to forest disturbance."

The researchers annually sampled small mammal populations by trapping and releasing them, using 20 traps per plot and sampling each plot monthly from May to September. Over 45 trapping nights, Ms. Newman captured nine species, including mice, shrews, voles, chipmunks, a flying squirrel, and a weasel. The vast majority, 71.2%, were eastern chipmunks (*Tamias striatus*), followed by white-footed mice (*Peromyscus leucopus*, 25.5%). She tagged them to identify unique captures, measured and weighed them, estimated age, and collected blood, tissue, and fecal samples.

Ms. Newman discovered that the alterations in forest structure in the treated plots "significantly influenced small mammal capture frequencies." Unique captures of mice were statistically significantly higher in plots in which all the non-oak trees were girdled, and higher, but not significantly, in the oak-girdled plots, when compared with the controls. She hypothesized that this could be due to greater complexity in the understory on girdled plots and in woody debris, which may provide increased habitat for the mice. Since *P. leucopus* is a host for the ticks that cause Lyme

disease, increased populations could affect human health. On the other hand, unique captures of chipmunks declined in the girdled plots, possibly due to different microhabitat uses, higher soil temperatures and light in plots in which oaks were girdled, or lower acorn production in them.

Because she was interested in what the mammals ate, and how this might change due to the oak treatments, Ms. Newman surveyed the vegetation and arthropods (insects and spiders) across the study plots, analyzed the mammal fecal samples for food remains, and conducted stable isotope analyses on them and on tissue samples. She notes that while both the mice and the chipmunks were able to vary the proportions of what they ate, this may not be true for other small mammal species. For species that are already less abundant, such as shrews and voles, "further reductions in [their] numbers could reduce overall survival rates and thereby decrease species diversity at degraded sites."

The study continues this summer, with new research assistants, both undergraduates and masters students, coming to the Forest. Dr. McFadden is also preparing her earlier research for publication. ■

Luncheon (continued from page 1) people think about climate change, experientially and analytically; varied degrees of belief in and concern about it among the population of the United States; shifts in public opinion here and abroad; and the implications of global warming for the New York area. Guests received Dr. Cullen's book, as well as a copy of *James W. Carey: Sentinel of Democracy*, co-authored and edited by Dr. Moretti.

Dr. Schuster gave an overview of recent multi-institutional research and education programs at Black Rock Forest. Then Sibyl R. Golden, chairman of the Consortium's board, thanked the speakers, the co-chairs, and the guests for supporting the Consortium's work and said she wanted to start with a few words about Dr. Schuster "Difficult as it is to believe," she said, "Bill Schuster has now been here 20 years, and the Consortium has emerged from its fledgling status to the busy and productive organization you see today." She then outlined some of his many accomplishments over these years, as facilities were built and staff and programs grew, and presented him with a photograph of the Forest by Tom Doyle and a gift on behalf of the board of the Consortium.

Ms. Golden then turned to the presentation of the William T. Golden Award for innovative leadership in promoting science and science

Dr. Heidi Cullen. (Photo: Jennifer Strader)



education, named after her father, who founded the Consortium in 1989 after years of effort. Dr. Moretti is only the second recipient of this award; the first was presented to Helene L. Kaplan at the Consortium's 20th anniversary luncheon in 2009 (see "Consortium Celebrates Its 20th Anniversary," Spring 2009).

First, Melissa Mannis, one of Dr. Moretti's children, gave a moving talk about how he inspired her to think creatively and analytically. Then Ms. Golden described how Dr. Moretti got involved with the idea of the Consortium and then the Consortium itself nearly 30 years ago after Gardner Dunnan, then the head of the Dalton School, asked him to represent the



Sibyl R. Golden, Bill Schuster, and Frank Moretti at William T. Golden Award presentation. (Photo: Jennifer Strader)

school in the planning group for the Consortium. "He hasn't slowed down since," she said. "In addition to Frank's many accomplishments in his professional life, as a leader in the field of the use of digital technology in education, he has devoted himself to the Black Rock Forest Consortium. He has introduced the Consortium to countless people and organizations, to his own Columbia Center for New Media Teaching and Learning, which has been endlessly helpful to the Consortium, creating, for example, our Virtual Forest Initiative, and to potential new members of the Consortium, and to new supporters and enthusiasts. He has a deep understanding, both intellectual and



The Browning School was one of many Consortium members that bought tables or tickets to the luncheon. (Photo: Jennifer Strader)

practical, of the Consortium's past, present, and potential."

She then presented Dr. Moretti with another wonderful photograph of the Forest by Tom Doyle, framed by Forest Manager John Brady with wood from the Forest. In his acceptance speech, Dr. Moretti described his vision for an educational future for the Consortium, featuring increased networking between students working in the Forest and those working in classrooms and labs, as well as national and even international connections.

"This event was really a great success," says Dr. Schuster, "and inspires us to think we could hold a luncheon every year. It was wonderful to see so many friends – and new faces – in the room; Dr. Cullen's talk was thought-provoking; it was rewarding to pay tribute to Dr. Moretti's visionary work; and the funds raised will directly support new research, education, and conservation activities in the Forest" ■

Guests mingled at the Yale Club. (Photo: Jennifer Strader)



Research at the Forest

The Black Rock Forest Consortium is committed to encouraging collaboration among member institutions and also between researchers and students. To help members learn what other members are doing and explore opportunities for collaboration, we here present a list of current research projects at the Forest, along with contact information. ■

Scaling of Variability in Populations, Individuals, and Ecosystems: Taylor's Law and Beyond. Joel E. Cohen (Rockefeller University and Columbia University), Meng Xu (Rockefeller University), and William Schuster (Black Rock Forest). *Contact: William Schuster (schuster@blackrockforest.org).*

Consequences of Oak Loss on Microbial Community Composition and Function. Krista L. McGuire (Barnard College). *Contact: kmcguire@barnard.edu.*

Impacts of Oak Mortality on the Black-Legged Tick (*Ixodes scapularis*), the Primary Vector of Lyme Disease. Mary Killilea (New York University). *Contact: mek5@nyu.edu.*

The Future of Oak Forests. William Schuster (Black Rock Forest), Kevin Griffin (Lamont-Doherty Earth Observatory of Columbia University), Shahid Naem (Columbia University), Kathleen Weathers (Cary Institute for Ecosystem Studies), and Jerry Melillo (The Ecosystems Center, Marine Biological Laboratory). *Contact: William Schuster (schuster@blackrockforest.org).*

Population Dynamics of Painted Turtles in the Black Rock Forest. Christopher Raxworthy (American Museum of Natural History), William Schuster (Black Rock Forest), and Martha Villaba (Barnard College). *Contact: William Schuster (wschuster@blackrockforest.org).*

The Ecological and Evolutionary Processes of Invasive Species Integration into Native Communities. Richard Lankau (University of Illinois at Urbana-Champaign). *Contact: rlankau@illinois.edu.*

Native Plant Performance along an Urbanization Gradient. Kevin Griffin and Natalie Boelman (Lamont-Doherty Earth Observatory), William Schuster (Black Rock Forest), Matthew Brown (Central Park Conservancy), and J. D. Lewis (Fordham University). *Contact: Kevin Griffin (griff@ldeo.columbia.edu).*

Ecology of Slave-Maker Ants and Their Hosts: The Effect of Geographic Variation in Parasite and Host Range on Co-Evolutionary Trajectories. Christine A. Johnson (American Museum of Natural History). *Contact: cjohnson1@amnh.org.*

The Carbon and Nitrogen Dynamics of Coarse Woody Debris in an Oak-Dominated Northern Forest. Matthew Palmer and Dan Flynn (Columbia University) and Kevin Griffin (Lamont-Doherty Earth Observatory, Columbia University). *Contact: Matthew Palmer (mp2434@columbia.edu).*

Linking Holocene Vegetation and Carbon Accumulation with Hydrological Change using Macrofossils, C/N, Stable Isotopes and Biomarkers from Sutherland Pond/Fen and Tamarack Pond. Dorothy Peteet (Lamont-Doherty Earth Observatory, Columbia University). *Contact: peteet@ldeo.columbia.edu.*

Small Mammal Response to Oak Removal. Kate McFadden (Department of Ecology, Evolution and Environmental Biology, Columbia University). *Contact: kwm6@columbia.edu.*

Insect and Arachnid Diversity of Black Rock Forest. Vladimir I. Ovtsharenko and Boris Zakharov (American Museum of Natural History). *Contact: Vladimir Ovtsharenko (ovtshare@amnh.org).*

Total Below-Ground Carbon Budget in Black Rock Forest. Kevin Griffin and Jennifer Levy (Lamont-Doherty Earth Observatory, Columbia University). *Contact: Kevin Griffin (griff@ldeo.columbia.edu).* ■

Summer Activities

More than a dozen young people will be working in the Forest this summer. A Calhoun high school senior, in fact, worked at the Forest from late April to early June, on a Senior Work Internship. She gained experience in field and lab biology methods by helping with turtle and small mammal population studies and with research on the wood decomposition rate of forest trees; she also helped with environmental education classes.

Some students will conduct their own research. Sarah Gilly, a Barnard environmental science major, will study cerulean warblers for her senior thesis project (see "Student Research Spotlight," p. 4). Another Barnard environmental science major, Marty Hershon, will probably work on the Consortium's Highlands connectivity project (see "Addition to Forest Helps Build Wildlife Corridor," Spring 2011), mapping habitat and movements of local animal species, while a third, Fiamma van Biema, will study deer population management.

Angie Patterson will start her research for her doctoral dissertation for Columbia University's Earth and Environmental Science department, tracking physiological processes and responses to environmental variation in forest tree species that are near the northern or southern ends of their ranges. Sarah Pace, a recent masters graduate from Columbia's Department of Ecology, Evolution, and Environmental Biology, will examine vegetation response to deer exclusion and experimental tree girdling as part of the Consortium's Future of Oak Forests study (p. 1).

For the oak forest study, the Consortium is hiring three Cornwall High School graduates to work as research assistants, and a Columbia student will help Angie Patterson. Kelly Seiz, a Storm King School graduate who is now a journalism major at SUNY Albany, will work as an administrative assistant and help with some writing projects.

Finally, Dr. Kate McFadden will send graduate and undergraduate students to the Forest to extend her earlier small mammal studies on the oak forest plots (see p. 1). ■

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Forest News in Brief

Mammal Skull and Skins Study Collection Available.

The Consortium has two sets of native Forest mammal skulls and skins for study, one that remains at the Forest for visiting classes and one that can travel to member schools. Both skulls and skins can be used to study classification and adaptations. With structured inquiry, students can learn how to determine whether a mammal is a carnivore, herbivore, or omnivore by looking at its teeth, or learn about predator misdirection and warning coloration by looking at hair on the skins, among many other activities. Teachers interested in borrowing the collection should contact Dr. Jeffrey Kidder, the Consortium's Director of Education, to learn how to use the materials; curriculum/teacher guides are in development.

Stillman Trail Improved. A portion of the Stillman Trail between Reservoir Road and Mt. Misery, well traveled by Consortium members and recreational hikers, has been relocated. The old section will now recover from heavy use and erosion dating back to the days of horse and wagon. Ben Brady and Joe Oliva of the Forest Crew completed the new trail section last year, simplifying the steep northern approach to Mt. Misery. The next project will reroute the steep scramble near the top. Volunteers and classes are welcome to help in projects to minimize forest erosion.

Publicity for Urban-Rural Gradient Studies. A research paper describing how urbanization affects plant growth by Stephanie Searle, who as a student worked with Dr. Kevin Griffin of Lamont-Doherty Earth Observatory and Dr. William Schuster at the Forest, received wide publicity in such

online publications as the *New York Times* Green blog, ClimateWire and Science Daily. Her research was part of the Consortium's ongoing urban-rural gradient studies (see "Urban-Rural Gradient," Fall 2007).

Member School Receives Grant for Summer Program in Forest.

The Urban Assembly School for Applied Math and Science has received a grant from the Fund for Public Schools, the New York City Department of Education, and the New York City Department of Youth and Community Development to run an educational summer camp for 120 middle school students at the school this summer, and possibly for the next three years. Designed to address the problem of "summer learning loss," the program will include academic and arts programming as well as two-day camping trips to the Forest for each grade. Students will learn basic hiking and camping skills, tour the science lab, hike to the Old Stone House and up to Eagle Cliff, and spend a night cooking at a campfire and sleeping in tents. "We expect the camping trips to be the highlight of the entire summer," says Assistant Principal David Krulwich.

High School Student Semifinalist in AMNH Competition for Research at Forest.

Peter Gmelch, a junior at Monroe-Woodbury School in Orange County, was a semifinalist for the American Museum of Natural History's Young Naturalist Award for research he conducted in Black Rock Forest. He studied the effects of deer browsing on plant and animal diversity and leaf physiology. Dr. Schuster and Dr. Kevin Griffin shared time and equipment with Peter for his work on this project. ■

**Forest Changes:
 Mammals & Microbes
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Report from the Forest Manager

Spring in the Hudson Highlands has been referred to as a week-long transition from the windy cold of March to the rains of April. This year's extra-long spring was set up by a very mild winter. Only two snowfalls temporarily covered the Forest and soil was mostly free of the usual deep ground frost. When temperatures rose above normal in early February, red-winged blackbirds arrived a month early, and flowers and yard trees commenced an early bloom.

In March, nights returned to cold, but days were warm, and early forest fire danger was realized with six brush fires around the region during the month. White flowering shadbush bloomed two weeks earlier than average. Leaf-out, when northern red oak leaves are one inch long, occurred April 16, just over a week early. By the end of April, the timing returned to near-normal as the barn swallows at the Forest shop showed up right on time, the last week in April.

While driving the region's highways, the spring color of the forest

canopy gives an indication of species. The yellowish flower of elm, the white flower of cherry, the red of red maple, and the dark green of tulip tree leaves are all seen together. All of these species are related to successional stages and a forest that is changing.

Forest regrowth followed the abandonment of farm and field that coincided with the building of the Erie Canal and railroads, and the westward movement of farming. The Great Depression contributed to these developing forests, as farms were lost and hungry families took to the woods for subsistence. Deer herds were consumed by a hungry nation, decreasing their browsing of developing seedlings.

Today, land owners can be perplexed over managing our current forests. The majority of forests in this region face a difficult future, having to compensate for insects, disease, invasive species, deer, and a changing climate. These factors will result in development of a new forest type.

Careful management and harvesting of trees can create profit for landowners while also reinvesting in a developing forest. The replacement of old second growth stands with young forest growth can increase diversity and help to suppress some forest enemies. This can be done by partial harvesting of trees, creating holes in the canopy to light the forest floor and stimulate regeneration, while retaining enough shade to discourage aggressive invasive species. Larger-scale cuttings can also be appropriate, but will need investment to reestablish forest. Deer exclosures will usually need to be constructed to protect young trees, accelerate growth, and increase the diversity of plants and animals.

The management of land and forest has gone from "take what you need and sell the rest" to "hands-off" preservation. Neither works well in the Hudson Highlands. It is time to pursue sustainable management plans for our beloved forests. ■

— John Brady