BLACK ROCK FOREST NEWS

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Benefit Luncheon: Learning from Nature

A panel discussion on Learning from Nature: Lessons from the Creative Use of Technology was the highlight of the Black Rock Forest Consortium's benefit luncheon held on May 12 at the Metropolitan Club. The co-chairs of the luncheon were Dr. David K. A. Mordecai and Samantha Kappagoda, with Catherine Morrison Golden serving as vice-chair, and an active committee.

A crowd of more than 230 people gathered for the festivities. Many member institutions took tables, as did board and Leadership Council members and other friends of the Consortium. All provided vital support for the Consortium's research, education, and conservation programs.

Sibyl R. Golden, the Consortium's chair, welcomed everyone, and then Dr. Kevin Griffin, the Consortium's president, added to the welcome and introduced Dr. Mordecai who discussed the ecology model simulation which was visually enacted on large screens. Dr. Mordecai then introduced the panelists. The panel included Commissioner Liam Kavanagh, First Deputy Commissioner of the New York City Department of Parks and Recreation; Sam Keany, Dean of Students and Chair of Science at the Browning School, and a Consortium vice-president; Dr. John H. Long, Jr., Professor of Biology and Cognitive Science and Director of the Robotics Research Laboratory at Vassar College; and Peter Terezakis, Artist in Residence at Tisch School of the Arts at New York University. Dr. Griffin moderated the panel.

The Panel

Mr. Keany spoke first and described the biomimicry course he created for last

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The panel. (L-R) Sam Keany, Dr. John Long, Peter Terezakis, Commissioner Liam Kavanagh, Dr. Kevin Griffin (moderator)

Forest Wins New IBA Designation

Black Rock Forest celebrated its inclusion in an Audubon New York Important Bird Area (IBA) on June 4 in a press conference. Among the attendees were Erin Crotty, Executive Director of Audubon New York, Dr. Terryanne Maenza-Gmelch of Barnard College, who spearheaded the effort, Jim Delaune, Executive Director of the Orange County Land Trust, and many members of the Edgar A. Mearns Bird Club. The IBA is officially called the Hudson Highlands West Important Bird Area: Harriman and Sterling to Black Rock and Storm King.

Important Bird Areas are an international bird conservation effort of Audubon, but they are designated locally. In November 2014, Dr. William Schuster, executive director of Black Rock Forest Consortium, Dr. Maenza-Gmelch, and Chris Kenyon of the Orange County Land Trust applied to Audubon New York for the Black Rock Forest — Schunemunk Mountain area to become an IBA.

Audubon considers three characteristics of sites in making its decision: species at risk, specific species assemblages, and congregations of birds. At least one characteristic is needed for designation as an IBA; this area met all three. Even though the Forest is already protected and Schunemunk Mountain is a state park, designation as an IBA increases

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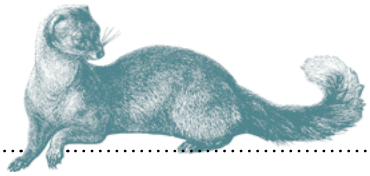
Report from the Executive Director



Ecological resilience is the ability of an ecosystem to resist damage and recover rapidly from disturbance. It is an important ecological concept but often challenging to measure and study. We do not always know why some ecosystems are resilient while others take a long time or never recover after disturbance. But more biodiverse systems often prove more resistant to disturbance or recover more quickly. Disturbance is nearly ubiquitous and thus resilience, and the ability of our ecosystems to keep providing valuable services despite disturbances, is of great practical importance.

Much current research is focused on ecological resilience. The Nature Conservancy's Mark Anderson and colleagues have recently developed an analytical framework that has allowed them to map predicted ecological resilience across much of eastern North America (https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/resilience/ne/Pages/default.aspx). In these analyses, they focused especially on identifying areas that will remain resilient to climate change and will support high levels of biological diversity in the future. They focused on "landscape complexity" in terms of landform variety and numbers of microhabitats, and "local connectedness" which they evaluated in terms of habitat fragmentation and barriers to animal movement. Complex physiography is expected to always provide more niches for organisms to occupy, even through changes in climate, and barrier-free, connected landscapes allow organisms to shift ranges and reorganize their communities in response to environmental changes.

So how does Black Rock Forest look in terms of its modeled resilience? The initial map outputs of the team were 1000-acre hexagons, each rated for resilience. These indicated above average resilience across most of Black Rock Forest and surrounding forested areas. The more recently released data (available through the link above) give much more detailed resilience ratings for 90-meter-square pixels. In general, the more interior southern and western portions of Black Rock Forest are rated highly above average for resilience. A swath of the eastern portion of the Forest is rated only average for resilience mainly due to lower connectedness (this may be due to the barrier represented by Route 9W) and the northwestern part of the Forest (around Canterbury Brook) is rated below average for resilience primarily because of low scores for landscape complexity.

We are now completing our own resilience analyses on 18 parcels of land adjoining the western border of Black Rock Forest as part of our Highlands Connectivity project. Our studies allowed us to field check some of the Nature Conservancy data and to see how well their results mirror our own. Our fieldwork has identified some important resilient features, such as ephemeral wetlands, deposits of calcareous material, and animal denning sites that could not be identified at the large scale of the Nature Conservancy analyses. However, there was a significant, positive correlation between their results and our own. In particular, the flow analyses presented in their downloadable data sets identified areas that we know are heavily used animal movement corridors.

It is beneficial to have new tools to use in understanding where biodiversity is likely to persist in the future and to know more about the underlying features that promote diversity, both now and in the future. Knowledge about resilience can help guide more informed conservation decision making, although some lands with low resilience still remain important to conserve for other reasons. Environmental changes and disturbances will always occur. Promoting ecological connectivity, taking resilience into account, and using rigorous science principles and data to direct conservation actions can help assure that we will retain healthy, diverse, and productive ecosystems for the future.

— *Dr. William Schuster*

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Benefit Luncheon

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year's Summer Science Camp and will continue this year (see "Summer Science Camp," Fall 2015). In the course of a week, the students collected insects, examined them in the lab, and then, based on their adaptations, designed and created vehicles to negotiate hostile environments like the Arctic, Mars, the ocean floor, a tropical jungle, a volcano, and mountainous terrain. "Insects have been evolving for 400 million years and humans have been observing and borrowing from them for millennia," Mr. Keany said. "Their solutions for solving problems of locomotion, vision, sensing, chemical defense, and camouflage are probably the most diverse in the animal world."

Dr. Long spoke next, talking about using robots that are models of living animals to test theories about animals, or biorobotics. He explained that fossils show structure but say nothing about the process of evolution. He focuses on fish, examining how and why the first fish evolved. In his lab, students build biorobots by looking at living fish for clues about structure and give the robots autonomous behavior with bio-inspired brainlike circuitry. One model, called a Tadro, uses genetic algorithms which vary, enabling the fish-like biorobots to compete against each other in a simple environment. "When we let Tadros play the game of life, we never cease to be surprised," Dr. Long said. "We expected that our population of Tadros would evolve a complex brain allowing for optimal light-gathering behavior. Instead, the behavior got better, but then it plateaued at good enough. Selection evolved good-enough behavior by simplifying rather than complicating the brain. The evolution of robots helps us understand the evolution of animals. Depending on the situation, simple brains work better than complicated brains."

Mr. Terezakis followed, speaking about several of his environmental artworks in the southwest. "Far from things man-made, as the sun sets and before darkness falls, land and sky come alive with delicate magic," he said. "Standing in the desert while the pink and violet veil of twilight paints the expanse of both earth and heaven is an experience which is both tactile and delectable." His sculpture Heart Beats Light uses lamps which flicker in time with his prerecorded heart rate "as a digital metaphor for life and death, being and not." Last year, he brought his Green World class to Black Rock Forest; some of the students coming from dense urban environments had rarely been in nature. "For a weekend, actors, dancers, coders, musicians, and writers hiked, got wet, used microscopes, learned about collecting field data, and started to develop an artistic response to their experiences."

(above): Dalton faculty. (center): Dr. David K. A. Mordecai, luncheon cochair. (right): Sibyl R. Golden, board chair (seated), Chip White, musician, and Christie Van Kehrberg, board secretary.
Photos: Jennifer Strader

Mr. Kavanagh spoke last, noting that the city may not look like Black Rock Forest but the Parks Department manages about 10,000 acres of "traditional" nature, forests, meadows, wetlands, and marshes with a similar amount in the hands of state and federal colleagues, as well as 523,000 street trees. The Department uses traditional scientific methods and technology to learn from nature, using Lidar, which is basically lasers and radar, to create digital elevation models that allow them to capture tree height, biomass measurements, and canopy distribution. They also use information technology and geospatial mapping software to turn static data sets into interactive maps that capture information in compelling visual displays. One result of this is a New York City street tree map. "That alone is pretty exciting to us," he said, "but we'll invite everyone who cares about trees and nature to access the site, use it to see, learn, share, and care for the trees. They can adopt trees, see all their attributes, species, size, condition, the full range of ecological services they provide, record and share their stewardship activities, report problems, create events and network with people who share their passion. It will be a platform for citizen science research."

A question and answer period followed over dessert.

Finally, Dr. William Schuster, executive director of the Consortium, spoke about how the Consortium is creatively using technology. "Black Rock Forest has long been a great place to explore creative use of available technologies to improve our understanding of nature," he said. "The pioneering work of our panelists shows how exponential growth in tools of inquiry allow us to now study nature in greater detail and across vaster scales of time and space than ever before. We aim to keep increasing scientific focus and creative use of technologies in the forest as tools to help guide us toward a more sustainable future."

STUDENT RESEARCH SPOTLIGHT

Testing Equations for Black Birch Biomass by Emma Bartnick

In Black Rock Forest and similar oak-dominated forests in the Hudson Highlands, black birch (*Betula lenta*) is emerging as a major tree species in the understory. I have observed that most young black birch trees are growing in areas where the canopy is open and light due to the loss of large oak or hemlock canopy trees. The transition of the Forest understory from an oak and maple mix to primarily black birch could have important implications for carbon storage and nitrogen cycling in the Forest. During the summer of 2015, I lived and worked in the Forest, testing two published equations for the biomass of black birch trees. An accurate equation for biomass can be used to examine the carbon and nitrogen storage capacity of the trees. My research expanded upon previous research on oak trees in the Forest by Dr. Peter Bower of Barnard College and his previous research mentees.

Forests absorb huge amounts of atmospheric carbon dioxide each year, helping to mitigate anthropogenic carbon dioxide emissions. Carbon content is a function of total biomass within a forest, so there needs to be an accurate and practical method of measuring biomass to evaluate the carbon storage. In studies for which it is too expensive and time-consuming to develop a site-specific biomass equation, previously established equations from other sites are often used to estimate the aboveground biomass. In my research, I tested the only previously established equation for biomass of black birch trees, along with an equation for the biomass of general hardwood trees.

Over the course of several months, the staff at Black Rock Forest and I felled seven black birch trees, ranging in diameter at breast height (DBH) from 0.60 inches to 15.67 inches. It was expected that the existing equation for the biomass of black birch trees would be accurate and could be used to extrapolate the cumulative biomass of black birch trees in Black Rock Forest, as well as to estimate the amount of carbon and other nutrients stored in these trees. The trees in this study were selected from regions with natural openings in the canopy due to the deaths of large oak canopy trees. Forest staff used tractors and chainsaws to fell large trees and I used a handsaw to fell small trees. We sliced each tree into manageable sections in the field and measured the wet weight of each section using a digital scale suspended from a tractor. Samples of the stem were dried in the lab and the drying factor calculated from each sample was used to determine the dry biomass of each tree.

Statistical analyses revealed that the published equation for the biomass of black birch trees is accurate enough to be used, but is not very accurate for trees with a DBH less than five inches. The equation for biomass of general hardwood trees was not accurate for the trees felled in this study. The observed data were used to generate a new allometric equation that can be used to more accurately estimate the biomass of black birch trees in Black Rock Forest.

—Emma Bartnick graduated from Barnard College with a major in Environmental Science and a minor in Mathematical Sciences.

Member Profile The Dalton School

The Dalton School is an original Consortium member and, over the years, it has made extensive of the Forest. All Dalton students visit the Forest in fourth grade to study science and nature, while older students make field trips to the Forest to study topics including ecology and astronomy. Recently, in addition to having their classes explore scientific subjects, they have included art and architecture in their use of the Forest. Teachers have also visited the Forest for professional development.

The Consortium is considering establishing a yurt village to increase visitor capacity and invited the Dalton architecture students to design one. According to Emily Wilson, AIA LEED, their teacher, the students first researched precedents for the project, including modern and traditional designs and radial structure. Then they visited the projected site, both in the morning and the evening, to look at how the lighting varied. Back at the school, the students learned digital model building and structure and site analysis.

(top): Architecture students; (below) Watercolor students.

Watercolor students also visited the Forest recently. Teacher Lotos Do commented that "after a year-long study of watercolor technique, students in the advanced course felt prepared to encounter the North American Forest." The class visited the reservoir and painted a sunset, and visited the Storm King Art Center the next day. "As a teacher, I was so gratified to see that students' skills jumped to a professional level as they gained confidence by encountering nature using watercolor techniques without drawing in pencil at first," Ms. Do also said. "The cohesiveness of the group grew, as students saw each other beyond the classroom experience and more as a community of artists." The school exhibited the art in a second floor gallery.

The Forest Is in an Important Bird Area

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awareness about integrating bird conservation into management and development decisions.

Birders from Black Rock Forest Consortium, Barnard College, the Orange County Land Trust, and the Mearns Bird Club conducted surveys of birds in 2012 in preparation for the application to Audubon. Survey areas included Black Rock Forest, Schunnemunk Mountain State Park, Houghton Farm, Clove Brook Farm, Black Rock Fish and Game Preserve, Hudson Highlands Nature Museum (Kenridge Farm), Hilmare, and the Storm King Art Center. They conducted stationary and traveling counts and recorded latitude/longitude (or trail name), dates, times, bird species names, and abundances.

The listed species at risk in the new IBA are the worm-eating warbler, prairie warbler, cerulean warbler, blue-winged warbler, and wood thrush. Birds that meet the so-called "responsibility" assemblage criteria included the rose-breasted grosbeak, scarlet tanager, Louisiana waterthrush, black-and-white warbler, black-throated blue warbler, blue-gray gnatcatcher, yellow-throated vireo, least flycatcher, Eastern wood peewee, Northern flicker, and sharp-shinned hawk. There are also large numbers of migratory birds, as well as large numbers of year-round residents and grassland/open habitat birds. Additionally, the Forest has five species that are on Audubon's WatchList (based on population size, range size, threats, and population trend): rusty blackbird as well as wood thrush, blue-winged warbler, prairie warbler, and cerulean warbler.

"This is a nice example of a scientific study leading to beneficial outcomes," Dr. Schuster said. "The IBA designation highlights for communities and planners the area's especially high biological diversity which should be taken into account to prevent losses of critical habitats and species. Current and future research will benefit from these baseline data and the designation may help secure funding to better understand what allows these threatened species to survive and how they can flourish in the future. Focusing on birds as ecological health indicators can also help engage citizen scientists to add to the database and support our development of new conservation education programs with partners including Audubon New York."

(cover): Wood thrush; (top): Cerulean warbler. Bird photos: Adobe Stock; (bottom): Dr. William Schuster, Erin Crotty, and Katrina Shindledecker (Director of Conservation, Hudson Highlands Land Trust). Photo: Francie Schuster

RESEARCH STUDIES IN BLACK ROCK FOREST 2016

The Black Rock Forest Consortium is committed to encouraging collaboration among member institutions and also between researchers and students.

Nitrogen fixation and nutrient cycling experiments in Black Rock Forest. Duncan Menge (Columbia University). *Contact: dm2972@columbia.edu*

Are garlic mustard effects on soil processes and microbial communities reversable? Kristina Stinson (Harvard Forest) and Serita Frey (University of New Hampshire). *Contact: kstinson@harvard.edu*

Mercury concentrations and exposure levels in terrestrial foodwebs: Pathways for mercury bioaccumulation in insectivorous, songbird communities in New York State. David Evers (Biodiversity Research Institute). *Contact: devers@bri.com*

Analysis of avian diversity in relation human activity in Black Rock Forest. Terryanne Maenza-Gmelch and Marissa Wasmuth (Barnard College). *Contact: Terryanne Maenza-Gmelch (tm263@columbia.edu)*

Scaling of variability in populations, individuals, and ecosystems: Taylor's law and beyond. Joel E. Cohen and Meng Xu (Rockefeller University), and William Schuster (Black Rock Forest Consortium). *Contact: Joel Cohen (cohen@rockefeller.edu.*

Physiological response to temperature across nine tree species in a northeastern temperate forest. Angelica Patterson and Kevin Griffin (Lamont-Doherty Earth Observatory of Columbia University). *Contact: Kevin Griffin (griff@ldeo.columbia.edu)*

The future of oak forests. William Schuster (Black Rock Forest Consortium), Kevin Griffin (Lamont-Doherty Earth Observatory of Columbia University), Shahid Naeem (Columbia University), Kathleen Weathers and Amanda Elliott Lindsey (Cary Institute for Ecosystem Studies) and Jerry Melillo (The Ecosystems Center, Marine Biological Laboratory). *Contact: William Schuster (wschuster@blackrockforest.org)*

Native plant performance along an urbanization gradient. Kevin Griffin (Lamont-Doherty Earth Observatory of Columbia University), William Schuster (Black Rock Forest Consortium). *Contact: Kevin Griffin (griff@ldeo.columbia.edu)*

Loss of foundation tree species: Consequences for small mammal assemblages in forest ecosystems. Katie Keck (USGS), Katie Terlizzi and William Schuster (Black Rock Forest Consortium). *Contact: Katie Keck (krh1985@gmail.com)*

Ecophysiological functions of urban and rural forest trees: Testing the "urban ecosystem convergence" hypothesis. Nancy Falxa Sonti (US Forest Service). *Contact: nsonti.fs@gmail.com*

Historical and aracheological studies on Whitehorse Mountain in Black Rock Forest. Christopher Lindner (Bard College). *Contact: lindnerarch@gmail.com*

Improving estimates of biomass in Black Rock Forest trees and the impact of changing species composition. Peter Bower and Emma Bartnick (Barnard College). *Contact: Peter Bower (pb119@columbia.edu).*

Species richness of cutaneous bacteria varies with urbanization: Implications of habitat conditions on defense mechanisms of *Plethodon cinereus*. Soon il Higashino (Ossining High School) and J.D. Lewis (Fordham University). *Contact: Soon il Higashino (soonil.higashino@gmail.com)*

Plant Respiration and Climate Change

Black Rock Forest was one site in a worldwide study of how plant respiration may respond to climate change, and a recent paper in the *Proceedings of the National Academy of Sciences* (PNAS) highlighted the results. The study measured plant respiration in 231 species, including grasses, shrubs, and trees, and in Alaskan tundra; boreal, temperate, and tropical forests; and Texan and Australian savannahs. Dr. Kevin Griffin of Columbia University's Lamont-Doherty Earth Observatory was one of the coauthors of the paper; Dr. Mary Heskel, a postdoc who worked at the Forest with Dr. Griffin, was lead author of the study.

When plants photosynthesize, they take up carbon dioxide (CO_2), a gas that contributes to climate change. But when they respire, they release CO_2 back to the atmosphere, and they release more when the temperature rises. Overall, plant respiration puts many times more CO_2 into the atmosphere than all human sources combined. Dr. William Schuster, executive director of the Consortium, said the study "discovered global limits to plant respiration that result in less than the expected increase with temperature."

The study found that, worldwide, all kinds of plants have the same internal controls that regulate the response of respiration to temperature increase, and the same curve describes this response across all habitats and plant types. "What we thought was a steep curve in some places is actually a little gentler," said Dr. Griffin. "With this new model, we predict that some ecosystems are releasing a lot less CO_2 through respiration than we previously thought. All this adds up to a significant amount of carbon." But he added, "We now have a better way to estimate one process, but it's only one process. The whole system is quite complicated; a small change in the balance between one part and another could produce a really big result. That's the challenge we face when we think about the earth as a whole."

"Our Consortium's mission is to learn from nature using the most appropriate means, whether high tech or low tech," said Dr. Schuster. "We need accurate, unbiased predictions of what the future holds. This new paper will make forecasting models more accurate."

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Forest News in Brief

New Cochair for Consortium Board. David Redden, a long-time board member, has joined Sibyl R. Golden as cochair of the Consortium Board. Mr. Redden has been active in the Hudson Valley, serving on the Scenic Hudson board and as former chair of the Hudson Highlands Nature Museum board.

Update on Visitor Access Pathway. After the preliminary work by Consortium staff, the contractor, Tahawus Trails, has started its work on the Pathway. As noted in the article in the Winter 2016 newsletter, there are opportunities for volunteers to help with the project and the first dates have now been scheduled. Saturday June 18 from 10 AM to 1 PM was set aside for Consortium members, and Saturday June 25 at the same time for members of the public or corporations who wished to do public service work. Volunteers helped clear brush and roots as well as performing some preliminary treadwork. Half of the lower parking lot will be cordoned off for construction equipment and materials during the 120-day construction period.

June 4 Bird Walk. The bird walk on June 4 sold out within hours! The ever-popular walk, led by Dr. Terryanne Maenza-Gmelch of Barnard College, led participants on a two-hour, easy-to-moderate walk in the Forest through many different habitats to observe which birds occur in multiple locations in the Forest and which are habitat-specific. This year, the walk was followed by a press conference announcing the Important Bird Area (IBA) (see p. 1).

Consortium Coordinates Community Tree Planting. In May, the Consortium connected 18 volunteers from Time Warner Cable, which has funded scholarships for the Summer Science Camp, with the Department of Environmental Conservation (DEC) which needed volunteers to help plant 240 trees and shrubs in Cronomer Park in Newburgh. Jack Caldwell and Katie Terlizzi from the Consortium staff coordinated the project with the DEC and the Quassaick Creek Watershed Alliance, an organization of community volunteers. "The idea is to plant trees and shrubs along the stream to help stabilize and beautify the area and improve the quality of the water," Jack Caldwell said. The Boys and Girls Club of Newburgh was invited to participate, although a schedule conflict prevented this.

Bird Observation Walkway and Platform. The Consortium's Forest Crew, sixth graders at Metropolitan Montessori School (MMS), and seniors at the Calhoun School, in a joint effort, constructed a new bird observation walkway and platform, made from the Forest's most decay-resistant wood, black locust and white oak. It starts at a new signpost along the southern portion of the White Oak trail and runs westward out into the large wetland below Sphagnum Pond. The area is very open and provides good birding opportunities, especially for wetland birds. Fifth graders from MMS also erected birdhouses.

Brienne Cliadakis Joins Staff. In November, Brienne Cliadakis joined the Consortium staff as Annual Fund and Communication Manager.

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Inside This Issue

Report from the Forest Manager

First called "coydogs" and then "coywolf," the northeastern coyote is now the name of this animal we hear calling in the night. DNA research has confirmed the hybridization of western and eastern wolves, domestic feral dogs, and western coyotes resulting in the evolution of our coyotes. Evolutionists marvel at the swift development of this year-round super-survivalist and predator, filling a longtime void in the northeast ecosystems. The coyote's movement to the northeast apparently took two primary routes. One was a migration from the west above the Great Lakes, interbreeding with a fragmented wolf population in the Ontario region. The second took place south of the Great Lakes, mingling with feral domesticated dogs in the Ohio Valley, and then both merged in the vast mountainous areas of the northeast. The known behavior of dogs, coyotes, and wolves to not co-exist well must have been overcome for this interbreeding to occur. Possessing both dog DNA for adaptability to people and the genetic material of wolves to evade humans has led to contrary and sometimes unpredictable behaviors.

The continued development of this creature has affected ecosystems including the Hudson Highlands. White-tailed deer studies at Black Rock Forest have observed its presence and influence on deer populations for thirty years. Winter tracking studies to determine deer groups and herd size have also witnessed the communal hunting strategies of coyote family groups, called packs, herding winter deer groups and chasing and harassing deer. While there is seldom physical contact between the two, these actions of coyotes may explain why so many deer now remain in the sanctuary of residential areas despite poor conditions. Biological measurements of young deer harvested during the fall Cornwall-on-Hudson bow hunting seasons (2012-2015) have indicated their sub-healthy status. Homeowners have witnessed fawning in their backyards as it has been long understood that female deer choose to give birth in the most secretive and safe portions of their range.

Currently there are more deer in residential areas than in Highlands forests. This condition is contrary to past conditions but has persisted despite three years of very good mast crops and growing seasons in the Forest. Coyote predation is now considered a population management factor. Predation upon deer is greatest upon springtime fawns but is difficult to confirm. We are investigating this through coyote scat studies to determine their seasonal diets and the frequency of fawn hair and bone during the months of May, June, and July.

The interplay between coyotes and deer has resulted in remarkable recent tree seedling and understory growth in the Forest. After decades of high deer abundance and stagnating forest regeneration, a natural solution has appeared. The northeastern coyote helps save the highlands forests. —*John Brady*