EIGHTH RESEARCH SYMPOSIUM
JUNE 17, 2013
BLACK ROCK FOREST CONSORTIUM

Co-sponsor
PALISADES INTERSTATE
PARK COMMISSION

The Black Rock Forest Consortium was formed in 1989 to promote scientific research, education, and conservation associated with the nearly 4000-acre Black Rock Forest in southeastern New York State. Beginning in 1999, the Consortium has hosted a Research Symposium in late June of every second year. The purpose of the Symposium is to communicate much of the research taking place in the Forest and to provide a venue for investigators to meet and discuss their work. Since 2007 the Symposium has also included presentations about research elsewhere in the Highlands region.

Plenary Session

William Schuster, Black Rock Forest Consortium, "*Future of oak forests experiment.*"

David Evers, Biodiversity Research Institute, "*Hg in songbirds of the Northeast.*"

Dorothy Peteet and **Mio Alt**, Lamont Doherty Earth Observatory of Columbia University, "*Late-glacial climate change from macrofossils in Tamarack Pond - comparisons with Sutherland Pond and Sutherland Fen.*"

Chuixiang Yi, Queens College, City University of New York, "Advection issues in eddy-flux measurements."

Edwin McGowan and **Melissa Gillmer**, Trailside Museums and Zoo, Palisades Interstate Park Commission, "*A ten-year survey of wintering bald eagles (Haliaeetus leucocephalus) along the lower Hudson River using synchronized counts at communal night roosts.*"

Erik Kiviat, Hudsonia, "*Habitat functions of Phragmites.*"

Joel E. Cohen, Rockefeller University, "*Stochastic multiplicative population growth predicts and interprets Taylor's power law of fluctuation scaling.*"

Kevin L. Griffin[1,2], **Diana Y. Hsueh**[2,3], **Wade R. McGillis**[2,4], **Wallace Broecker**[1,2] - [1]Department of Earth and Environmental Sciences, Columbia University, [2]LDEO, Columbia University, [3]Department of Ecology, Evolution and Environmental Biology, Columbia University, [4]Department of Earth and Environmental Engineering, Columbia University, "*CO_2 levels in the NYC region and the growth response of vegetation along an urban to rural transect.*"

Terryanne Maenza-Gmelch and **Sarah Gilly**, Environmental Science, Barnard College, Columbia University, NY, "*Bird diversity in relation to vegetation composition and structure at Black Rock Forest, Cornwall, NY.*"

Water Resources and Biodiversity Session

Simon Gruber, CUNY Institute for Sustainable Cities and Town of Cornwall representative, Moodna Creek Watershed Intermunicipal Council, "*Overview of water resources, biodiversity and land use issues in the Moodna Creek basin.*"

Russell Urban-Mead, PG, CPG, Sr. Hydrogeologist, The Chazen Companies, "*Low-flow stream characteristics in the Moodna Basin.*"

Allan Frei, Department of Geography, Hunter College, City University of New York CUNY Institute for Sustainable Cities and **Adao Matonse**, CUNY Institute for Sustainable Cities, "*Hydrological impacts of Hurricane Irene and Tropical Storm Lee in historical context: is the frequency of extreme hydrological events changing in southern New York State?*"

Andrew Meyer, Shoreline Conservation Specialist, Hudson River Estuary Program, NYS Department of Environmental Conservation in Cooperation with Cornell University, "*Biologic and economic cases for aquatic barrier mitigation.*"

Chris Bowser, NYS DEC, Hudson River Estuary Program, "*Hudson River Eel Project – fish conservation through citizen science.*"

Nancy B. Arias and **Damon T. Ely**, Green Mountain College, Orange County Community College, "*American eel (Anguilla rostrata) habitat selection in the Hudson River Estuary, NY.*"

Jay Westerveld, New York Natural History Council, "*The Moodna Creek: Biodiversity survey results of a 10-year survey of its westernmost headwater, the Black Meadow Creek.*"

Don Steinmetz, Highlands Environmental Research Institute, "*Watershed management priority indicies.*"

Erik Kiviat, NYS DEC, Hudson River Estuary Program, "*Habitat mapping of the Trout Brook and Woodbury Creek watersheds in the Moodna basin.*"

David Church, Orange County Planning Department, "*Water supply development and watershed planning in the Quassaick and Moodna basins.*"

Plants Session

David Werier, Ecological and Botanical Consultant, Ithaca, NY, and **James Barbour**, Ecological Consultant, Saugerties, NY, "*Plant rarities at West Point: A 200-year overview, including details from intensive surveys in 2011.*"

Angie Patterson, Columbia University, "*Physiological response to temperature across nine tree species in a northeastern temperate forest.*"

Meng Xu, Rockefeller University, "*Taylor's law and density-mass allometry predict allometric scaling of population variance with mean body size.*"

Mike Adamovic, Student Conservation Association; **Edwin McGowan,** and **Matt Shook,** Palisades Interstate Park Commission, "*Combating the invasive Mile-a-Minute Vine (Persicaria perfoliata) using the biocontrol weevil (Rhinoncomimus latipes).*"

Linda Rohleder, Director of Land Stewardship, New York-New Jersey Trail Conference, "*The Invasives Strike Force: results from citizen science surveys for invasive plants on hiking trails.*"

Nancy Falxa-Raymond, USDA Forest Service Northern Research Station, **Matthew I. Palmer** and **Kevin L. Griffin**, Columbia University, "*Urban forest nitrogen dynamics: foliar nitrogen characteristics of four tree species extensively planted in New York City reforestation sites.*"

Geoff Welch, The Ramapo River Committee, "*A study of mountainmint on Torne Mountain in Harriman Interstate Park.*"

Animals and Environment Session

Jay Westerveld, New York Natural History Council, "*The turtles of Central Park: The manifold roles of non-native species influence in herpetofaunal conservation, and applying lessons of urban ecology to natural models.*"

Eric Kutter, Queens College, CUNY, "*Meteorological gradients over the Black Rock Forest hill.*"

Timothy Eaton, Queens College, CUNY, "*Evapotranspiration at BRF: timing, source areas and soil influence.*"

Xiyan Xu, Queens College, CUNY and The Graduate Center, CUNY, **Chuixiang Yi** and **Lili Ye**, The Graduate Center, CUNY, "*Canopy flow in complex terrain.*"

Vladimir Ovtcharenko, American Museum of Natural History and **Boris Zakharov**, Natural Sciences Department, LaGuardia Community College, "*Seasonal dynamics, biomass and biodiversity of spiders and other soil invertebrates in oak forests of BRF.*"

Max Garfinkle, **Ed McGowan** and **Matt Shook**, Palisades Interstate Park Commission and **John Confer**, Ithaca College, "*Golden-winged warbler in Sterling Forest and Harriman State Parks: A species in decline.*"

Katherine Pavlis, Black Rock Forest Consortium, **Terryanne Maenza-Gmelch**, Barnard College, **Sara Pace**, Columbia University and **Chris Kenyon**, Orange County Land Trust, "*Important Bird Area designation for the Black Rock Forest-Schunnemunk State Park connectivity area.*"

Kate Keck and **Kate W. McFadden**, Clemson University and **William Schuster** and **Kate Pavlis**, Black Rock Forest Consortium, "*Loss of foundation tree species: consequences for small mammal assemblages in forest ecosystems.*"

Madeline Hirshan, Barnard College, "*An analysis of culverts and their ability to promote mammal connectivity between Black Rock Forest and Schunemunk State Park.*"

Posters

Amanda E. Lindsey and **Kathleen Weathers**, Cary Institute for Ecosystem Studies, "*Soil water chemistry in response to oak canopy tree simulated pathogen attack.*"

Ika Djukic, BOKU Institute of Soil Science, Austria, **Krista McGuire**, Barnard College, **William Schuster**, Black Rock Forest Consortium, and Kevin L. Griffin, Columbia University, "*Effects of losing keystone oak species on soil microbial community composition in temperate forests in the USA.*"

Kevin Purce, CUNY City College, "*Slave drivers: increased foraging by host workers under the slavemaking ant Protomognathus americanus.*"

G. Gary and **J.D. Lewis**, Fordham University, "*Changes in plant growth, reproduction and offspring vigor with increasing distance from and urban center.*"

Jennifer Levy-Varon and **Kevin L. Griffin**, Columbia University and **William S.F. Schuster**, Black Rock Forest Consortium, "*Soil respiration following partial stand disturbance by tree girdling rapidly rebounds within a three-year period in a temperate forest.*"

Sara Gilly and **Terryanne Maenza-Gmelch**, Barnard College, "*Songbird species diversity and its relationship to vegetation composition and structure in Black Rock Forest, Cornwall, NY.*"

Angie Patterson and **Kevin Griffin**, Columbia University and **William S.F. Schuster**, Black Rock Forest Consortium, "*Physiological response to temperature across nine temperate tree species in a northeastern U.S. forest.*"

Abstracts Listed Alphabetically by Author

Combating the invasive Mile-a-Minute Vine (*Persicaria perfoliata*) using the biocontrol weevil (*Rhinoncomimus latipes*).

Mike Adamovic, Student Conservation Association; Edwin McGowan, and Matt Shook, Palisades Interstate Park Commission

Mile-a-Minute (*Persicaria perfoliata*) is an invasive Asian vine which is rapidly expanding within the Hudson Highlands. With a growth rate of up to 30 feet per year and a persistent seed-bank, Mile-a-Minute has the capacity to smother native vegetation, especially in mesic, early successional habitats. The Mile-a-Minute Project of the Hudson Valley was founded in 2006 to track the distribution of MaM and reduce the plant's coverage and spread. While manual removal is used for small occurrences, the main means of control is *Rhinoncomimus latipes*, a species of weevil, also native to Asia, which feeds exclusively on MaM, markedly reducing its fecundity. To date, weevils have been released at seven sites in southeastern NY, including locations in two Hudson Highland state parks. Biocontrol sites are surveyed once a month from late spring to early autumn to monitor the impacts of the weevils. Weevils have successfully established populations at all release sites, though feeding damage to MaM varies between sites. Large reductions in MAM cover may not be witnessed for up to a decade.

American eel (*Anguilla rostrata*) habitat selection in the Hudson River Estuary, NY

Nancy B. Arias and Damon T. Ely, Green Mountain College, Orange County Community College

Declines in diadromous fish populations have been linked to pollution, obstructions such as dams, habitat loss and fragmentation, and climate change; eel populations had been extirpated in some areas. In 1999, The American Eel Fishery Management Plan (FMP) was developed by the Atlantic States Marine Fisheries Commission (ASMFC) to conserve and protect American eels. The FMP requires that each state develop and implement a management plan promoting the sustainability of its eel population by monitoring eel abundance for at least one site. The New York State Department of Environmental Conservation (DEC) follows the sampling protocols outlined by the ASMFC through the Hudson River Eel Research Project (HRERP)

We used the DEC total Young Of Year data to identify any patterns in eel migrations. What the data showed was a 'high' annual migration catch for total YOY for some tributaries while the other tributaries showed a consistently 'low' migration catch. To understand these differences we identified tributary characteristics that eels may search for in preferred habitats.

We identified the physical, chemical and biological characteristics related to observed differences in the the number of migrating YOY (glass stage) American eels with high (>12,000 cpue) and low (<600 cpue) among four tributaries of the estuarine portion of the Hudson River (data acquired from the Hudson River Eel Research Project). Physical parameters (obstructions, and number of upstream lakes and ponds) of the streams were obtained from maps. Tributaries were sampled for chemical (pH, conductivity, temperature, & dissolved oxygen), and biological (algal biomass, stream macroinvertebrates) characteristics. Tributaries with high number of migrating eels had more ponds and lakes compared to tributaries with fewer migrating eels.

Hudson River Eel Project – fish conservation through citizen science

Chris Bowser, NYS DEC Hudson River Estuary Program

Species face conservation challenges not just in "far-away" places but in our local waterways as well. Eels are important migratory fish along the entire Atlantic Coast, yet recent declines are poorly understood. The Eel Project, initiated by the New York State's Hudson River Estuary Program and National Estuarine Research Reserve, involves over 500

diverse community members in shared goals and methodologies to study juvenile American eels during their migrations from sea to stream. March through May, fyke nets staked in up to twelve tidal stream mouths are checked daily by teams of trained citizen-scientists. Since 2008, over 100,000 eels have been counted, weighed, and released above barriers. Participants answer questions about recruitment along the tidal estuary from urban streams to quiet creeks. Data yield information about the timing and strength of eel migrations, suggest favorable conditions, and help managers prioritize restoration efforts in barrier passage.

Water supply development and watershed planning in the Quassaick and Moodna basins

David Church, Orange County Planning Department
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Stochastic multiplicative population growth predicts and interprets Taylor's power law of fluctuation scaling

Joel E. Cohen, Rockefeller University

Based on: Cohen, Joel E., Xu, Meng and Schuster, William S. F. 2013 Stochastic multiplicative population growth predicts and interprets Taylor's power law of fluctuation scaling. Proceedings of the Royal Society B 280:20122955. http://dx.doi.org/10.1098/rspb.2012.2955.

Taylor's law (TL) asserts that the variance of the density (individuals per area or volume) of a set of comparable populations is a power-law function of the mean density of those populations. Despite the empirical confirmation of TL in hundreds of species, there is little consensus about why TL is so widely observed and how its estimated parameters should be interpreted. Here, we report that the Lewontin–Cohen (henceforth LC) model of stochastic population dynamics, which has been widely discussed and applied, leads to a spatial TL in the limit of large time and provides an explicit, exact interpretation of its parameters. The exponent of TL exceeds 2 if and only if the LC model is supercritical (growing on average), equals 2 if and only if the LC model is deterministic, and is less than 2 if and only if the LC model is subcritical (declining on average). TL and the LC model describe the spatial variability and the temporal dynamics of populations of trees on long-term plots censused over 75 years at the Black Rock Forest, Cornwall, NY, USA.

Evapotranspiration at BRF: timing, source areas and soil influence

Timothy Eaton, Queens College, CUNY

Evapotranspiration (ET) is the source of water vapor in forest canopies. Both carbon dioxide and water vapor fluxes are controlled by the local micrometeorology. Eddy covariance flux methods are being used to quantify the local micrometeorology at two tower sites at BRF - one at the top of the hill and the other along a slope. Preliminary modeling of ET using BROOK90 shows that fluxes are not affected by soils deeper than 50 cm, but increase with greater canopy height. The silty sand/sandy loam soils are more gravelly than expected. Recirculation of prevailing wind patterns in the lee of the hill likely affects advection of water vapor in the canopy.

Hg in songbirds of the Northeast

David Evers, Biodiversity Research Institute
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Urban forest nitrogen dynamics: foliar nitrogen characteristics of four tree species extensively planted in New York City reforestation sites

Nancy Falxa-Raymond, USDA Forest Service Northern Research Station, Matthew I. Palmer and Kevin L. Griffin, Columbia University

Urban forests provide important environmental benefits, leading many municipal governments to initiate citywide tree plantings. However, nutrient cycling in urban ecosystems is difficult to predict, and nitrogen use in urban trees may be quite different from use in rural forests. To gain insight into these biogeochemical and physiological processes, we compared foliar nitrogen characteristics of several common northeastern deciduous tree species across four New York City reforestation sites as well as at the Black Rock Forest (BRF), a rural oak-dominated forest in the Hudson Highlands, New York. *Amelanchier canadensis*, *Nyssa sylvatica*, *Prunus serotina*, and *Quercus rubra* showed significant differences in leaf nitrogen isotope signatures (δ15N) among the four urban sites, and foliage sampled in BRF was consistently depleted in 15N compared to urban foliage. *Amelanchier* canadensis and *Prunus serotina* showed significantly greater ability to assimilate nitrate at BRF compared to urban sites, as measured through nitrate reductase activity (NRA). There were no significant differences in NRA among tree species growing at the four urban sites. Only *Prunus serotina* and *Nyssa sylvatica* showed significant differences in foliar nitrogen content (%N) both among urban sites and compared to BRF. The isotopic and %N data suggest differences in

nitrogen availability between the urban sites and BRF, possibly due to different anthropogenic inputs or higher rates of nitrification and nitrate leaching at the recently planted urban sites compared to likely lower rates of nitrogen cycling in the intact rural forest. In addition, these tree species varied in their response to changes in nitrogen availability in urban systems, with potential implications for ecosystem structure and function. Understanding nitrogen cycling in urban systems and the associated physiological changes in vegetation is critical to a comprehensive evaluation of urban forest restoration, and may have implications for carbon sequestration and water quality issues associated with nitrate export, two important areas of management concern.

Hydrological impacts of Hurricane Irene and Tropical Storm Lee in historical context: is the frequency of extreme hydrological events changing in southern New York State?

Allan Frei, Department of Geography, Hunter College, City University of New York, CUNY Institute for Sustainable Cities and Adao Matonse, CUNY Institute for Sustainable Cities

In August and September of 2011 Hurricane Irene and Tropical Storm Lee precipitated large amounts of rain across various parts of the eastern US. Anecdotally, these were among the historically largest precipitation events in this region, and resulted in unprecedented flooding accompanied by significant material damage in a number of regions including our study area, the Catskill Mountains and Hudson River Valley in southern New York State. In this study we analyze (1) how large these events were in historical context; and (2) whether this region has experienced a change in the frequency of extreme events in recent years. Application of the standard hydrological frequency analyses indicates that for most sites these events were not unprecedented, revealing a discrepancy between public perception and quantitative results. However, when the analysis is performed on a seasonal basis, and a more varied set of statistics is considered, we find that while storm severity was spatially heterogeneous, each event individually was in fact among the most extreme on record in some portions of the study region.

Moreover, there has been a marked increase in the frequency of extreme hydrologic events during the last two decades. This increasing trend is evident during the late summer and early fall (the "warm season"), rather than during the snow melt season. Records from most precipitation gauges, and all streamflow gauges, display an increasing warm season trend in the frequency of extreme events since 1985 with an accelerated rate of increase since the mid-1990s.

Golden-winged warbler in Sterling Forest and Harriman State Parks: A species in decline

Max Garfinkle, Ed McGowan and Matt Shook, Palisades Interstate Park Commission and John Confer, Ithaca College

The golden-winged warbler (*Vermivora chrysoptera*, GWWA) has declined over much of its range due to the loss of early successional nesting habitat, hybridization with blue-winged warblers (BWWA), and nest predation and parasitism. However, long-term research by John Confer in Sterling Forest State Park suggests swamp forest habitats in the Hudson Highlands may serve as important nesting refugia for GWWA. He found early successional red maple swamps to support GWWA with a high nesting success rate and little to no BWWA hybridization, in contrast to GWWAs nesting in nearby early successional uplands. Our study builds on Confer's Sterling Forest work in an effort to characterize more broadly the distribution and abundance of both GWWA and BWWA in the swamp forests of the western Hudson Highlands. To this end, we surveyed a set of 37 randomly selected swamp forest habitats, embedded within the 65,000-acre forested landscape of Harriman and Sterling Forest State Parks. At each site, we used call-playback recordings over multiple visits between May 15 and June 15 to survey for both warblers and their hybrids. We also characterized the habitat and mapped the extent of *Phragmites australis*, an invasive plant known to degrade the sedge-dominated nesting habitat of GWWA. GWWA were present during at least one site visit at only 10 of 37 survey wetlands. BWWA were also present at 8 of these 10 sites and 17 of 37 sites overall. Sixty-three percent (23 of 37) of survey wetlands also contained *Phragmites australis*, exhibiting varying degrees of habitat degradation. Although based on a single breeding season, our results suggest that BWWA are now more abundant than GWWA in early successional swamp forests of the western Hudson Highlands. The implications of this shift for the persistence of GWWA in the Hudson Highlands remain unclear. Further research into the dynamics of this species complex is needed to guide future management of swamp forests.

CO_2 levels in the NYC region and the growth response of vegetation along an urban to rural transect

Kevin L. Griffin[1,2], Diana Y. Hsueh[2,3], Wade R. McGillis[2,4], Wallace Broecker[1,2] - [1]Department of Earth and Environmental Sciences, Columbia University, [2]Lamont-Doherty Earth Observatory, Columbia University, [3]Department of Ecology, Evolution and Environmental Biology, Columbia University,

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Precise records of global atmospheric CO_2 concentrations are one of the most widely recognized and important data sets documenting anthropogenic influences on the atmosphere and potential climate forcing. It is generally acknowledged that there is an increasing need for quantifying the same CO_2 record at smaller spatial scales, particularly those associated with large metropolitan urban areas where populations may have a significant impact on local conditions and ecosystem services. While many recent monitoring networks have been established, few records of direct human contributions to local levels of atmospheric CO_2 extend beyond a few years. Here we show a 150-year record of fossil fuel CO_2 levels determined from tree ring ^{14}C in New York City (NYC) and the surrounding rural areas including Black Rock Forest and the Ashokan reservoir. The historically dense urban population has had a limited influence on the local atmospheric CO_2 relative to both rural and mean global background levels. Furthermore, the CO_2 emissions per capita have been decreasing since the 1950's. With increasing attention being given to national emissions monitoring, establishing historical patterns of local atmospheric CO_2 levels can provide important data for large urban areas such as NYC.

Overview of water resources, biodiversity and land use issues in the Moodna Creek basin.

Simon Gruber, CUNY Institute for Sustainable Cities and Town of Cornwall representative, Moodna Creek Watershed Intermunicipal Council
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An analysis of culverts and their ability to promote mammal connectivity between Black Rock Forest and Schunemunk State Park

Madeline Hirshan, Barnard College

As human populations increase and forest becomes more developed, the resulting wildlife habitats may become fragmented. There are several problems associated with habitat fragmentation such as mortality due to crossing roads, a reduction in genetic diversity due smaller population sizes, and barriers that would prevent immigration which would have been a stabilizing force (Hunt et al., 1987). Thus, as mammal species become localized in one area in a divided habitat, many issues can result. The presence of corridors can facilitate this movement to connect the fragmented parcels of land.

Beneath roads, culverts are constructed to regulate water flow and prevent erosion (Foresman, 2001). These culverts are primarily intended for water management, however research has shown that mammals and other organisms do utilize these passageways as a way to bypass traffic crossing. By having an alternate route around busy infrastructure, mammals can avoid accidents with oncoming traffic and move between the different sectors of its habitat.

The purpose of this experiment is to determine which mammals use these culverts in areas surrounding Black Rock Forest, the frequency of use, and the differences in landscape and culvert characteristics that may have an effect on the species that utilize them. The results can help demonstrate if these passageways can serve dual functioning purposes and allow mammals to gain access to their entire habitat.

Loss of foundation tree species: consequences for small mammal assemblages in forest ecosystems

Kate Keck and Kate W. McFadden, Clemson University and William Schuster and Kate Pavlis, Black Rock Forest Consortium

Invasive pathogens can significantly alter forest ecosystems by killing foundation tree species. Oak (*Quercus* sp.) dominated forests have experienced widespread mortality due *to* the fungal pathogen, *Phytophthora ramorum,* which causes the disease sudden oak death (SOD). We investigated the impact of a simulated pathogen attack on the small mammal assemblage of an oak forest near Cornwall, New York. Small mammals were chosen as the organism of interest because their abundance and community composition are tightly linked to changes in both abiotic and biotic conditions. In 2008, oaks were girdled to cause tree mortality, mimicking the symptoms of SOD. Four treatments of varying gradients were established, with three replicates of each: 100% oaks girdled, 50% oaks girdled, 100% non-oaks girdled, and control. From 2008 to 2012, small mammals were live captured, individually marked, and released. A suite of environmental variables was collected throughout the study to quantify the ecological changes associated with each treatment. A repeated measures ANOVA indicated that small mammal species diversity did not vary by treatment ($p=0.93$), but it significantly decreased in years 4 and 5 of the study ($p=0.02$). The relative abundance of the two most common species, white-footed mice and eastern chipmunks, did not significantly vary by treatment or over years. A repeated measures ANOVA revealed that while environmental variables such as soil temperature, air temperature, and leaf litter significantly varied between treatments, these altered environmental conditions did not influence white-footed mouse or eastern chipmunk relative abundance. Although relative abundance of these

species was not impacted by experimentally replicated SOD treatments, resource specialists appeared negatively impacted as seen by the decrease in species diversity. As the movement of pathogens globally accelerates, it will be increasingly important for ecologists to understand the bottom-up cascade of impacts related to the loss of foundation tree species.

Habitat functions of *Phragmites*

Erik Kiviat, Hudsonia

Phragmites australis (common reed) is widespread in North America, with native and non-native haplotypes. Many ecologists and wetland managers have considered *P. australis* a weed with little value to the native biota or human society. I document important ecosystem services of *Phragmites* including support for many common and rare species of plants and animals. *Phragmites* sequesters nutrients, heavy metals and carbon, builds and stabilizes soils, and creates self-maintaining vegetation in urban and industrial areas where many plants do not thrive. These nonhabitat ecosystem services are proportional to biomass and productivity. *Phragmites* also has habitat functions for many organisms. These functions depend on the characteristics of the landscape, habitat, *Phragmites* stand, species using *Phragmites* and life history element. The functions that *Phragmites* provides for many species are optimal at lower levels of *Phragmites* biomass and extent of stands. Old World *Phragmites*, contrary to many published statements, as well as North American native *Phragmites*, provides valuable ecosystem services including products for human use and habitat functions for other organisms. *Phragmites* stands may need management (e.g. thinning, fragmentation, containment or removal) to create or maintain suitable habitat for desired species of animals and plants, depending on management goals, local situation, and target species.

Habitat mapping of the Trout Brook and Woodbury Creek watersheds in the Moodna basin

Erik Kiviat, NYS DEC Hudson River Estuary Program
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Meteorological gradients over the Black Rock Forest hill

Eric Kutter, Queens College, CUNY
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A ten-year survey of wintering bald eagles (*Haliaeetus leucocephalus*) along the lower Hudson River using synchronized counts at communal night roosts

Edwin McGowan and Melissa Gillmer, Trailside Museums and Zoo, Palisades Interstate Park Commission

The lower Hudson River Valley is an important wintering area for Bald Eagles (*Haliaeetus leucocephalus*) from the eastern US and Canada. Attracted to the river's open water and winter foraging opportunities, large numbers of eagles travel to the area annually. However, due to their high mobility and dispersion across the landscape, wintering eagles are difficult to accurately census using conventional approaches. Typical daytime surveys may overlook less obvious birds or double count eagles that have moved during the survey. We devised a synchronized survey of multiple night roosts, where eagles aggregate to spend the evening, as a means to minimize these sampling problems. Over a ten-winter period from 2004 to 2013, volunteers synchronously counted eagles at dusk at 5-7 known communal night roosts on select evenings in January and February. Roost locations spanned a 40-mile stretch of the lower Hudson River from Beacon NY to the NJ border. Count totals were highly variable, between roosts, between survey dates, and between years. Eagle numbers peaked in early February in all years (range 82-254 birds), with a high count of 254 individual eagles on Feb 8, 2009. All roosts were on forested hillsides with a southern exposure. Two "mega-roosts", both on forested public lands, accounted for 60-80% of eagles counted on most survey nights. Between years, counts were considerably higher during colder winters with more extensive river ice, presumably because inland water bodies were frozen and offered inferior foraging conditions. Thus winter severity was a strong predictor of eagle concentration along the lower Hudson. Our results highlight the importance of the lower Hudson River's forested landscape for wintering bald eagles and also the efficacy of citizen science for landscape scale biological surveys.

Bird diversity in relation to vegetation composition and structure at Black Rock Forest, Cornwall, NY

Terryanne Maenza-Gmelch and Sarah Gilly, Environmental Science, Barnard College, Columbia University, NY

Black Rock Forest has a rich assemblage of bird taxa likely due to the variety in its landscape which features toposequences (*e.g.*, hemlock ravines and pitch pine-scrub oak ridge tops) and chronosequences (different aged successional patches) within the deciduous forest matrix. We set out to answer the following questions:

What are the most abundant birds at BRF? Which birds are restricted in distribution? Which locations have the highest bird species richness? Is forest structural complexity more important than plant species richness in determining bird species richness? Can the information we gather be used to make bird conservation recommendations?

We surveyed bird populations at Black Rock Forest using point-counts throughout May, June, and July of 2011 and 2012 in six habitats (100 minutes at each). The habitats were either structurally homogeneous or structurally heterogeneous. We conducted a vegetation survey with vertical and horizontal components at each habitat in order to calculate plant vertical density indices (as a measure of forest structural complexity) and plant species richness values.

The fifteen most abundant bird taxa during the breeding season are American robin, red-eyed vireo, American crow, veery, cedar waxwing, common yellowthroat, gray catbird, chipping sparrow, scarlet tanager, American goldfinch, great-crested flycatcher, American redstart, Baltimore oriole, yellow warbler, and eastern towhee.
Our data suggest that structurally complex habitats at BRF support a higher diversity of birds than simpler ones. And, that unique habitats within the forest matrix support species that are not found in other parts of the forest, for example, chestnut-sided and blue-winged warblers in early successional patches, Acadian flycatcher in hemlock ravines , and cerulean warbler in deciduous forest near streams.

Our bird conservation recommendation for BRF is to maintain the mosaic of different aged forest patches within the forest matrix, continue creating structural complexity during timber management and attempt hemlock ravine restoration in order to preserve Black Rock Forest's rich bird diversity. Loss of hemlock habitat due to HWA and ecological succession in general could cause some losses of bird taxa.

Biologic and economic cases for aquatic barrier mitigation

Andrew Meyer, Shoreline Conservation Specialist, Hudson River Estuary Program, NYS Department of Environmental Conservation in Cooperation with Cornell University

Aquatic habitat fragmentation from dams and culverts are a large factor in degrading and shrinking habitat for fish, mussels, and other aquatic or riparian organisms in the Hudson Valley. Aquatic barriers can also be flooding hazards when they are improperly maintained or installed, and strong cases can be made for removing the dam or increasing the size of the culvert from both a biological and an economic perspective. The Hudson River Estuary Program is addressing both these issues with two connected projects. We are identifying the most biologically important barriers in the Hudson Estuary watershed, the barriers that will benefit species the most if they are removed, and we are also conducting watershed hydrologic modeling projects to identify culverts that are too small to pass the predicted amount of streamflow from current storms and predicted future storms. We think that with these two projects, we have strong case studies to push barrier mitigation projects in the Hudson Estuary watershed.

Seasonal dynamics, biomass and biodiversity of spiders and other soil invertebrates in oak forests of BRF

Vladimir Ovtcharenko, American Museum of Natural History and Boris Zakharov, Natural Sciences Department, LaGuardia Community College

Our study is part of a large, multistage BRFC project: "Ecosystem Consequences of Dominant Taxon Loss: the Future of Oak Forests." Comparison of the experimental plots A4, B2, and C1 (all oak trees girdled by chain saw) and control plots A3, B4, and C2 shows that the maximum spider biomass for the season (06.02.10) was 110.9 g/ per sq. m. Average seasonal spider biomass on experimental plots was 47.1 g/m^2; on control – 48.6 g/m^2 (difference not significant). The spider seasonal biomass dynamic on experimental and control plots showed the same bimodal pattern with peaks in late May-early June and end of July-early August. Comparison of spider biomass dynamics between uphill (series C) and downhill (series A) plots demonstrated that average spider biomass in downhill plots in 2010 was 0.21 g/per trap, whereas in uphill plots only 0.12g/per trap, presumably because higher on the slope the soil is drier and rockier than at the foot of the hill. The effect of whitetail deer on the dynamic of spider biomass on Pilot Project area in 2009 illustrated that the spider biomass was greater outside of areas fenced to exclude deer. The seasonal dynamics inside and outside the fenced areas were similar and demonstrated a bimodal pattern. The total biomass of soil living invertebrates showed no effect of whitetail deer browsing: average seasonal biomass of invertebrates (6.5 g/per trap both inside and outside of the fence). Average spider biomass on oak-removal plots in the Pilot Project area in 2008 was 65.2 g/m^2; in 2009 – 22.8 g/m^2; and in 2010 – 35.9 g/m^2. On control plots this biomass in 2008 was 88.0 g/m^2; in 2009 – 58.7 g/m^2; and in 2010 – 62.0 g/m^2. The ratio of spider biomass on experimental plots to control plots was calculated: in the first year of the experiment they were comparatively close (ratio 0.74). Next year this difference increased (ratio 0.47). In 2010

spider biomass on experimental plots became closer to that on control (index 0.58).

Physiological response to temperature across nine tree species in a northeastern temperate forest

Angie Patterson, Columbia University

Extensive botanical surveys and long term plots at Black Rock Forest in southeastern New York has shown that since the early 1930's, three northern-ranged tree species were extirpated and eleven tree species were introduced or had migrated from the southern USA. These observations are consistent with a warming climate and suggest the Hudson River Valley may be an important location to study the effects of climate change on Northeastern forests. In this study, we compared a suite of physiological and leaf traits across nine tree species that have one of four distribution ranges (northern, central, southern, introduced) and one of two leaf types (broad-leaf and coniferous). Carbon to nitrogen ratio, and nitrogen content (N) differed significantly among species and range category for both broad-leaved and conifer trees.

Specific leaf area (SLA) of broad-leaved trees differed significantly between species and range category. Photosynthetic rate at light-saturation (A max), maximal rate of carboxylation (Vc max), electron transport limitation (J max), triose phosphate limitation (TPU), and dark respiration (Rd) differed significantly between species and range category where southern ranged species had the highest photosynthetic and respiration rates for broad-leaved species. *Pinus strobus*, a centrally ranged conifer species had higher photosynthetic and lower respiration rates than *Pinus resinosa*, a northern ranged conifer species. There were strong correlations between leaf traits and physiological traits for both broad-leaved and conifer species revealing that trees with high N content and high SLA have higher photosynthetic rates and is consistent with the literature. These results highlight the physiological advantages southern and introduced species have over their northern ranged counterparts with influential effects on forest community composition and energy flows.

Important bird area designation for the Black Rock Forest-Schunemunk State Park connectivity area

Pavlis, Katherine, Black Rock Forest Consortium, Terryanne Maenza-Gmelch, Barnard College, Sara Pace, Columbia University and Chris Kenyon, Orange County Land Trust

The collaborators on the Hudson Highlands Connectivity Project assessed the bird populations in the Black Rock Forest-Schunemunk State Park Connectivity area over the past year. Obtaining Important Bird Area (IBA) status, if merited, could help galvanize conservation support and bring attention to the area's importance for future wildlife survival. Throughout the course of the year we confirmed the presence of many species on the Audubon watch list. Additionally we are close to obtaining or have obtained the required threshold level for several species such as the cerulean warbler, worm-eating warbler and the wood thrush. Over the next year we will continue to observe and record distribution and abundance data for the birds within the connectivity area in order to apply for official IBA status.

Late-glacial climate change from macrofossils in Tamarack Pond - Comparisons with Sutherland Pond, and Sutherland Fen

Dorothy Peteet and Mio Alt, LDEO of Columbia University

A 7.2 m core was excavated from Tamarack Pond, Black Rock Forest, NY in 4 meters of water in Fall, 2012. The stratigraphy of the basal 2 meters was examined at 2 cm contiguous intervals for LOI and macrofossil by Mio Alt for her Columbia University senior thesis. The stratigraphy in the basal clays documents a diverse assemblage of tundra taxa, including *Dryas integrigolia*, *Salix*, and *Rumex orbiculatus*. A basal date indicates ice left just prior to 16,600 +_ 400 years ago. Numerous crane fly/beetle remains are present, along with cladoceran headshields, bryozoan statoblasts, and moss leaves of *Polytrichum juniperus* and *Sphagnum*. A major shift to organic sediment and warmer conditions took place at 40 cm upcore, where *Picea macrofossils* first appear. The timing suggests that the shift represents the Bolling warming, comparative with the shifts to more organic sediments in both Sutherland Pond and Sutherland Fen and the rise of *Picea* throughout the region. *Picea* dominates this zone, although *Abies* and *Betula* seeds are also present. A return to colder conditions, probably the Younger Dryas cooling, is indicated by a slight decline in LOI and the presence of *Betula glandulosa* and *Larix*. A return to warmer conditions upcore in the Holocene is indicated by the loss of boreal conifers and the presence of *Tsuga* needles. Comparisons with Sutherland Fen suggest that Tamarack Pond formed about a millennium earlier than Sutherland Pond and Fen, and that while Sutherland Fen records *Pinus banksiana* in the early record, it is missing from Tamarack Pond. Further research upcore is ongoing by Mio Alt.

The Invasives Strike Force: results from citizen science surveys for invasive plants on hiking trails

Rohleder, Linda, Director of Land Stewardship, New York-New Jersey Trail Conference

The New York-New Jersey Trail Conference is a non-profit organization which mobilizes volunteers to create and maintain 2,000 miles of hiking trails across northern New Jersey and southern New York. Two years ago, in support of its mission to provide stewardship for the lands these trails traverse, the Trail Conference started the Invasives Strike Force. The goals of the Invasives Strike Force include mapping and managing invasive plants along hiking trails in the region. Volunteers are taught to identify a set of invasive plants and then conduct surveys along the hiking trails. The survey methods will be discussed and some results from the 375 miles of survey completed over the past 2 years will be presented. The organization's strategy for invasive species management through volunteer work days will also be discussed.

Future of Oak Forests experiment

William Schuster, Black Rock Forest Consortium

Black Rock Forest represents a typical oak forest of the Highlands region and oak-dominated forest is the native cover type of much of the eastern U.S. However, many oak forests are undergoing rapid change, are not regenerating, and canopy tree mortality rates have been increasing in many locations. The goal of this experiment was to experimentally test the role of oak trees in these forests by removing them in a replicated, controlled experiment and studying the resulting impacts on ecosystem processes and the food web. Results after four years indicate that if oaks in these forests were to be devastated by an oak-pathogen, with deer remaining at their current density (about 30 per square mile), there will be a prolonged period of reduced forest productivity with minimal new tree recruitment and much carbon loss. Black birch and red maple trees that remain will increase growth and dominate the new canopy, the understory will become overrun by invasive plants, nitrogen will be lost to soil waters and streams, and native animal biodiversity will be reduced. In the same scenario but with deer populations substantially reduced, forests will transition much more rapidly to a black birch/mixed hardwood forest. Compared to the prior oak forests, these forests will produce less timber and wood products, will store less carbon annually, and will provide less control over nitrogen cycling. However, if oak canopy tree loss can be kept to half or less of the oaks, then productivity, forest ecosystem processes, and native biota will be substantially less affected.

Watershed management priority indicies

Don Steinmetz, Highlands Environmental Research Institute

"In the Northeast and Midwest United States, forests are critically important to the supply of clean drinking water. Protecting and managing forests in source watersheds is an essential part of future strategies for providing clean safe drinking water that citizens can afford."
- Barnes, et al. (2009). *Forests, Water, and People: Drinking Water Supply and Forest Lands in the Northeast and Midwest United States.* U.S. Forest Service.

The "Watershed Forest Information Management System" was developed by the *Forest to Faucet Partnership* (U.S. Forest Service, U. Mass. Amherst, and the Trust for Public Land). It is a decision support system that delineates and prioritizes conservation, remediation, and stormwater management strategies on a watershed scale. The primary component of the Watershed Management System is a GIS-based statistical module (Watershed Management Priority Index, WMPI) that categorizes and analyzes land use and land cover conditions to prioritize conservation, remediation, and mitigation strategies with a consistent methodology throughout a landscape. The WMPI module produces systematic patterns in each of the categories in relation to slope, distance from streams and waterbodies, flow accumulation, soil properties, and other salient watershed characteristics. By pairing the WMPI results with knowledge of field conditions, planners and managers can make informed assessments for various landscape-scale plans and decisions. Using digitized tax parcel maps, the priority indices can be further enhanced for watershed management and aid in conservation planning, nonpoint source pollution monitoring and prevention, and cooperative agreements and partnerships.

Low-flow stream characteristics in the Moodna Basin

Russell Urban-Mead, PG, CPG, Sr. Hydrogeologist, The Chazen Companies

Stream gauging during dry summer weeks of 2010 by The Chazen Companies (Chazen) under contract with Orange County Water Authority documented low-flow conditions during a period when other regional streams including the Wappinger Creek and Ten Mile River in Dutchess County were recording approximately Q90 conditions.

The Moodna watershed appears drier than other regional watersheds. For example, the Wappinger Creek, Ten Mile River and Moodna River are somewhat similar in size, yet flows in the Wappinger Creek and Ten Mile River were 25 cubic feet per second (cfs) and 12 cfs, respectively,

while the Moodna flow was 4 cfs. Normalized flows of the Moodna Creek, equalized on a "yield per square mile" basis were similarly low, and lower also than small streams elsewhere in Orange County.

The Woodbury Creek supports higher proportional flows than other Moodna Creek tributaries. The findings suggest this tributary hosts either fractured bedrock or sand and gravel with greater aquifer storage capacity than other watershed tributaries.

These data suggest that aquifers under the Moodna watershed either receive very little recharge (perhaps due to clayey soils) or that underlying aquifers have low storage capacity in minimally fractured bedrock or sparse sand and gravel overburden deposits. Very large, water-rounded boulders in the streambed of the Moodna below its confluence with Woodbury Creek attest to extreme flood conditions in the Moodna Creek, which may be reflective of low infiltration capacity in this watershed.

These findings have planning implications for sustainable water use/reuse/septic system density planning, and for water consumption management (e.g. evaporative or interbasin transfer uses).

A study of mountainmint on Torne Mountain in Harriman Interstate Park

Geoff Welch, The Ramapo River Committee

Torne Mountain is a well know scenic landform near the southern end of Harriman Park just north of N.Y. Thruway exit 15A in the Ramapo Pass. While most of Torne Mountain (also called Ramapo Torne) is in Harriman Park, land preservation efforts in the past two decades have resulted in the purchase of about 2,000 additional acres in the area including the cliffs and terraces of Torne Mountain descending towards the Ramapo River. Torne Mountain provides habitat for at least two mountainmint species: *Pycnanthemum virginianum* (Virginia mountainmint) and *P. incanum* (hoary mountainmint). Troy Weldy a botanist doing research for New York State, hiked parts of Torne Mountain with me in the late 1990's and asked me to keep checking because he thought that *Pycnanthemum torrie* (Torrey's mountainmint), a NYS Endangered species, might also be found in this habitat. We also checked High Mountain across the Ramapo Pass to the south but found no mountainmints. Over the years, I have observed *Pycnanthemum incanum* in several areas on Torne Mountain including along the summit and on the lower slopes in sunny areas. It seemed quite tolerant of dry conditions.

Pycnanthemum virginianun occurs at the toe of a lower slope with a sunny southern exposure, along an access road for electric power lines. This area is a bit moister as it receives water from uphill drainage. *P. virginianun* grows in areas at the edge along both sides of this dirt road.

Because I have not checked some other promising areas on the Torne, I hope to be able to do more mountainmint field work this summer. For the past several years, have been successfully cultivating *Pycnanthemum muticum*, (blunt mountainmint) a NYS Threatened species on the grounds of Harmony Hall in Sloatsburg, N.Y. Mountainmint flowers attract large amounts of insects. The plants are highly aromatic with a distinctive bracing scent.

Plant rarities at West Point: A 200-year overview, including details from intensive surveys in 2011

David Werier, Ecological and Botanical Consultant, Ithaca, NY, and James Barbour, Ecological Consultant, Saugerties, NY

West Point (WP), in the Hudson Highlands of Orange and Putnam Counties, New York, encompasses approximately 6400 hectares of land, much of which is undeveloped. In 2011, we conducted intensive botanical survey work, did herbarium research, and reviewed relevant literature related to rare plants at WP. We found evidence for a total of 187 populations involving 51 rare plant taxa at WP. In 2011, we surveyed 107 of these populations involving 36 taxa. Sixty-one of these populations and nine of these taxa are new reports for WP. Of these nine taxa, three are new reports for Orange Co. and two are new to the Hudson Highlands. We deem erroneous 50 previously reported WP populations involving 31 rare taxa. For 25 of these 31 taxa all of the reported populations are erroneous. This amounts to 33% of all rare taxa that have been reported from WP. As a result of the huge number of new finds and unearthing of erroneous reports, a significantly different picture of the status of rare plants emerges for WP. We suggest some management considerations regarding deer browse and conservation of intertidal habitat. Finally, we recommend that our study be scaled up to include all of New York in order to work towards the conservation of the flora of the state.

The Moodna Creek: Biodiversity survey results of a 10-year survey of its westernmost headwater, the Black Meadow Creek.

Jay Westerveld, New York Natural History Council

The Moodna Creek, Orange County's largest endemic watercourse, spans eastward from the Town of Warwick,

NY, in Western Orange County, to the Hudson River at Cornwall, NY.

Like many dynamic watercourses, it exhibits variable biological richness throughout its length; it both loses and gains species in its fall toward the Hudson River. As is often the case with watercourses which flow through variable terrain, a stream's point of origin dictates much of its downstream biodiversity. Species richness, occurrence, hot spots, 10-year fluctuations and rare/unusual presentations are discussed.

The turtles of Central Park: The manifold roles of non-native species influence in herpetofaunal conservation, and applying lessons of urban ecology to natural models

Jay Westerveld, New York Natural History Council

Non-native species evidence multiple functions, both negative and positive, in wildlife conservation, at large. In herpetological conservation, these roles are often magnified, especially in urban models.

The New York Natural History council is completing a 4-year study of the turtles of New York City's Central Park, an artificial system in which both native and non-native species interact in both the presence and absence of pressures classically expressed in natural habitats.

The NYNH's "Urban Safari" series has magnified several subtle relationships in non-native/native species ecology. As a result of these subtleties, the standard model of applying natural research and management principles to urban environments would seem, in many cases, a misapplication; Current field research suggests that urban models might be better applied to natural research and management approaches. These principles are examined and discussed through examples drawn from original, current research of the NYNH.

Taylor's law and density-mass allometry predict allometric scaling of population variance with mean body size

Meng Xu, Rockefeller University

Based on: Cohen, Joel E., Xu, Meng and Schuster, William S. F. 2012 Allometric scaling of population variance with mean body size is predicted from Taylor's law and density-mass allometry. Proceedings of the National Academy of Sciences USA 109(39):15829–15834. online September 10, 2012; doi:10.1073/pnas.1212883109, September 25.

Two widely tested empirical patterns in ecology are combined here to predict how the variation of population density relates to the average body size of organisms. Taylor's law (TL) asserts that the variance of the population density of a set of populations is a power-law function of the mean population density. Density–mass allometry (DMA) asserts that the mean population density of a set of populations is a power-law function of the mean individual body mass. Combined, DMA and TL predict that the variance of the population density is a power-law function of mean individual body mass. We call this relationship "variance–mass allometry" (VMA). We confirmed the theoretically predicted power-law form and the theoretically predicted parameters of VMA, using detailed data on individual oak trees (*Quercus* spp.) of Black Rock Forest, Cornwall, New York. These results connect the variability of population density to the mean body mass of individuals.

Canopy flow in complex terrain

Xiyan Xu, Queens College, CUNY and The Graduate Center, CUNY , Chuixiang Yi and Lili Ye, The Graduate Center, CUNY

Air flows within and just above forest layers over mountainous terrain are most complicated, which substantially influence the vegetation-atmosphere exchanges of mass and energy. We employ numerical model to study air flow within and just above forest canopy in complex terrain. We examined the impacts of hill geometry, canopy structure, and thermal radiation on canopy flow and associated scalar transport. Our results show that under neutral condition, recirculation regions are formed behind hills and create complex patterns of airflow. H/L=0.8 is a threshold value of flow-pattern formation in the recirculation region: (1) below 0.8 the reversed flow is characterized by intermittent positive and negative streamwise velocity; (2) at 0.8 one vortex is formed; and (3) above 0.8 a pair of counter-rotating vortices are formed. Under stably stratification, the canopy layer shows stronger stratification than ambient atmosphere with two super stable layers located on the top of canopy and deep canopy, respectively. Drainage flows present in the upper canopy and slope surface, while air sweep up or down between drainage flows depending on the slope angle. Strong stratification decouples the nocturnal canopy layer from the atmosphere aloft, which makes it difficult for scalar to vent out of the forest canopy. Black Rock forest is a typical complex terrain with hills and valleys. The heterogeneous structure of forest and ponds around the hill may affect stratification condition around hills. Our preliminary results show a recirculation formed on the east slope of the forest hill, as the west wind is dominant. Further studies will focus on the flow pattern around the

hill with different synoptic condition and the results will be validated with tower measurements.

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Advection issues in eddy-flux measurements

Chuixiang Yi, Queens College, City University of New York

Eddy covariance (EC) is a tower-based micrometeorological technique that is widely used to measure net ecosystem CO2 exchange (NEE) between the biosphere and atmosphere. Over 500 EC towers exist globally, and these are loosely organized into a global consortium called FLUXNET, which comprises several regional networks that advance the frontiers of climate-carbon knowledge. However, EC tower measurement does not work well in landscapes with hills and mountains (70 % of land surface). Particularly during calm nights cool air near the ground flows down hill carrying away CO2 emitted by respiration so that it is not included in the EC measurements. This introduces substantial errors that can be of the same order as the measured NEE. Such topographic advection errors make nocturnal EC measurements less accurate and have confounded scientists for decades. I will talk about this long-standing issue in eddy-flux measurements and why we are looking for a solution in the Black Rock Forest.

Black Rock Forest Consortium Members

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The Browning School
The Calhoun School
Central Park Conservancy
Columbia University
Cornwall Central School District
The Dalton School
The Hewitt School
Hunter College
Marine Biological Laboratory-The Ecosystems Center
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