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FOURTH *BLACK ROCK FOREST* RESEARCH SYMPOSIUM

June 20, 2005

PROCEEDINGS

BLACK ROCK FOREST CONSORTIUM
129 Continental Road - Cornwall, NY 12518

Fourth Black Rock Forest Research Symposium
June 20, 2005

Talk Titles and Presenters

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William Schuster, Black Rock Forest, "Biomass change over 75 years in the Black Rock Forest."

Will Bowman, Center for Environmental Research and Conservation (CERC) at Columbia University and Lamont-Doherty Earth Observatory (LDEO) of Columbia University, "Age-related changes in stem respiration in red oak trees."

Kevin Griffin, LDEO of Columbia University, *W. Schuster*, Black Rock Forest, *J.D. Lewis*, Louis Calder Biological Field Station, Fordham University, *M. Turnbull*, University of Canterbury, Christchurch NZ, *D. Tissue*, Texas Tech University, *W. Bowman* and *R. Carson*, CERC at Columbia University and LDEO of Columbia University, and *C. Xu*, LDEO of Columbia University, "Age-related decline (?) in red oak function and growth."

J.D. Lewis, Louis Calder Biological Field Station, Fordham University, "Interannual variation in eastern hemlock decline associated with invasion by the hemlock woolly adelgid."

Abby Sirulnik, *J.D. Lewis*, *A.R. Tuininga*, and *J. Johnson*, Louis Calder Biological Field Station, Fordham University, "Hemlock woolly adelgid (*Adelges tsugae*) infestation reduces ectomycorrhizal diversity and accelerates N cycling in eastern hemlock (*Tsuga canadensis*) stands."

Session II

Chengyuan Xu, LDEO of Columbia University, "The effect of leaf phenology on the annual carbon gain abilities of Japanese barberry and co-occurring native shrubs in the Black Rock Forest."

Neil Pederson, *G. Jacoby*, Tree-Ring Laboratory/LDEO, *E. Pyle*, Harvard University, *T. Zimmern-Kahan*, LDEO of Columbia University, *A.B. Plotkin*, Harvard Forest and *S. Wofsy*, Harvard University, "Growth and climatic sensitivity of northern red oak in the northeastern U.S.: placing a regional context for Black Rock Forest."

Dorothy Peteet, NASA/Goddard Institute for Space Studies and LDEO of Columbia University, *T. Maenza-Gmelch*, New York University, *D. Pederson*, LDEO of Columbia University, *D. Kurdyla*, and *T. Gulderson*, Center for AMS, Lawrence Livermore Labs, "Wetlands in Black Rock Forest, NY: changes in carbon storage since deglaciation."

Dallas H. Abbott, LDEO of Columbia University, *W.B. Masse*, Los Alamos National Laboratory, *D. Breger*, Drexel University and *L. Burckle*, LDEO of Columbia University, "Burckle abyssal impact crater: did this impact produce a global deluge and impact layer?"

Bruno Tremblay, LDEO of Columbia University and H. Hwald, Swiss Federal Institute of Technology Zurich, "The effect of snow on the thermodynamic evolution of the sea-ice cover at SHEBA."

Jessie Cherry and *B. Tremblay*, LDEO of Columbia University, "What can we learn from snow research at Black Rock Forest?"

Session III

Josslyn Shapiro, H.J. Simpson, K. Griffin, LDEO of Columbia University, and *W. Schuster,* Black Rock Forest, "Chloride and acidity in precipitation and surface waters in the Black Rock Forest."

John Mickelson, Columbia University/Center for International Earth Science Information Network (CIESIN), *F. Koontz,* Wildlife Trust and Teatown Lake Reservation and *W. Schuster,* Black Rock Forest, "Delineating detailed ecological land units in the New York Bioscape using multi-temporal Landsat imagery."

Elizabeth Nichols, American Museum of Natural History and *J. Danoff-Burg,* CERC at Columbia University, "Dung beetles on an urban-to-rural gradient."

Vladamir Ovtsharenko and *A. Tanasevitch*, American Museum of Natural History, "The insect and arachnid diversity of Black Rock Forest: our first steps."

Sean Giery and *Rick Ostfeld*, Institute of Ecosystem Studies, "The role of lizards in Lyme disease ecology: tick burdens, reservoir competence and population density in the northeastern United States."

Session IV

Randy Stechart, Consultant to New York State Department of Environmental Conservation, "Conservation of an endangered reptile in New York State."

Julie Feinstein and *Angélique Corthals,* American Museum of Natural History, "Freezing Black Rock Forest: long-term preservation of genetic resources at the American Museum of Natural History."

Jean Rothe, Quinnipiac University and *E. McGowan,* New York-New Jersey Trail Conference, "The effects of hiking trails and forest roads on avian diversity."

James Danoff-Burg, CERC at Columbia University and *E. Nichols,* American Museum of Natural History, "Black Rock Forest fragmentation and urbanization diminishes beetle biodiversity."

Posters

Stephan Ekernas, C. Bennett, and *D. Burg,* Wild Metro, "Small mammal diversity in the New York Metropolitan region: Survey 2004."

Nicole Buzzetto-More, University of Maryland Shore, "How Black Rock helped inspire the American Environmental Movement." and "Global ecosystems education and the Black Rock Forest: The SEE-U Project."

Rob Carson, CERC at Columbia University and LDEO of Columbia University, "Eastern hemlock decline and hardwood tree response as revealed by tree rings."

Susan Elbin, Wildlife Trust and *F. Koontz*, Wildlife Trust and Teatown Lake Reservation, "Coyotes of the Hudson Highlands, New York: predicting coyote/human conflict through understanding spatial ecology"

Terryanne Maenza-Gmelch, New York University, and *D. Peteet,* LDEO of Columbia University, "Comparison of Sutherland Pond and Sutherland Bog pollen profiles over the last 12,000 years."

Jenn Nagel, University of Tennessee and *K. Griffin*, LDEO of Columbia University, "Exploring influences of leaf-level physiology on plant community assembly in the Black Rock Forest."

Kelly Nolan, Hudson Basin River Watch, "Water quality of Black Rock Forest streams compared to elsewhere in Orange County using macroinvertebrates as indicators."

Dee Pederson and *D. Peteet,* LDEO of Columbia University, "Evaluation of stored soil carbon in Cascade Brook watershed."

W.A. Cerbone, American Museum of Natural History and Fordham University and *D. Karrmann*, American Museum of Natural History, "Morphological intergradation of two subspecies of *Chrysemys picta* within a discrete metapopulation."

D. Karrmann, American Museum of Natural History, "Differential habitat selection in a *Chrysemys picta* metapopulation."

Abstracts

Session I

Biomass change over 75 years in the Black Rock Forest.

W. Schuster, Black Rock Forest

Total biomass and annual increment in biomass are important measures of ecosystem status, productivity, and health. I used Black Rock Forest historical data from several sources (1930 and 1985 forest-wide inventories, partial inventories from 2000, 2003 and 2004, and a series of long-term plots starting in 1930) to estimate aboveground tree biomass and examine how it has changed over the past 75 years. Species specific allometric equations that predict live aboveground tree biomass based on diameter measurements, tested by drying and weighing felled trees from the forest, were used to convert tree inventory data to area-based biomass estimates.

On the long-term plots there was an increase in forest biomass from about 60 to 200 metric tons per hectare between 1930 and 2000, an average long-term aggradation of about 2 metric tons of biomass per hectare per year. The most productive period was between 1930 and the early 1960s (aggradation of nearly 3 metric tons per year) and the lowest period was between the early 1960s and the early 1980s (less than 1.3 metric tons per year), apparently due to the severe regional drought of the 1960s and defoliation-induced mortality caused by the introduced gypsy moth in the 1980s. Soil pH was positively correlated and percent slope was negatively correlated with annual biomass increment. However, canopy tree mortality rates of about 3% per year from 1999 through 2004 resulted in an overall loss of more than 10% of the live aboveground biomass on these plots, decreasing to an average of 180 metric tons per hectare.

Forest-wide inventory data show similar trends. Forest-wide aboveground biomass averaged 75 metric tons per hectare in 1930 and 150 metric tons per hectare in 1985. A subset of 47 of these inventory plots spanning much of the eastern half of the forest was re-surveyed in 2000, 2003, and 2004. From an average live biomass density of 170 metric tons per hectare in 1985, these increased to 195 metric tons per hectare by 2000, but then declined to 175 – 180 metric tons per hectare in 2004. Important factors have been drought-induced mortality, insect-mediated mortality (due to hemlock wooly adelgid), and disturbances in the form of fires and ice damage/windthrow. As a result, substantial changes in productivity, composition, and other ecosystem characteristics and processes have begun in forests of this region.

Age-related changes in stem respiration in red oak trees.

W. Bowman, CERC at Columbia University and LDEO of Columbia University

Respiration from woody stems and branches is an important carbon flux in forest ecosystems, typically accounting for 7-15% of gross primary productivity. However, the actual contribution of woody tissue respiration to forest carbon cycles and whole-tree carbon budgets has been difficult to assess due to the interaction between CO_2 efflux from woody tissues and transport of respiratory CO_2 in the transpiration stream. Measurements of CO_2 efflux from woody stems were conducted in a chronosequence of red oak (*Quercus rubra*) stands located at Black Rock Forest in southern New York State. The chronosequence consists of five stands ranging in age from 30 to 130 years. An automated, multi-chambered system was utilized to make measurements of CO_2 efflux from the stems of nine trees in each of the five stands. Coincident measurements of sap flux and the internal CO_2 concentration

of the stems were also made in each of the stands. The anatomical and physiological traits that serve as barriers to the diffusion of CO_2 into the atmosphere were investigated and compared between stands.

Age-related decline (?) in red oak function and growth.

K. Griffin, LDEO of Columbia University, *W. Schuster*, Black Rock Forest, *J.D. Lewis*, Louis Calder Center, Fordham University, *M. Turnbull*, University of Canterbury, *D. Tissue*, Texas Tech University, *W. Bowman* and *R. Carson*, CERC at Columbia University and LDEO of Columbia University, and *C. Xu*, LDEO of Columbia University

A long held paradigm in forest ecology posits that the growth rate of trees declines with age. While this paradigm permeates the literature, very few tests of this idea have been made, particularly in tree species common to the forest of Northeastern America. We examine 3 commonly held hypothesis regarding the mechanisms of this decline: first that as a tree ages the ratio of carbon gain to carbon loss decreases, second that hydraulic resistance increases as trees age, and third that nutritional limitations limit further growth in older trees. To assess these questions we measured a variety of leaf and tree level physiological, biochemical and physical properties in 60 *Quercus rubra* trees varying in age from 31 to 150 years growing in the Black Rock Forest. No significant relationships were found between tree age and any of the measured variables including: maximum photosynthesis (A), leaf respiration (R), A/R, the temperature response of R, the maximum rate of RuBP carboxylation, the maximum rate of photosynthetic electron transport, Rubisco activity, total protein, leaf N, C or C:N, leaf $D^{13}C$, the ratio of total leaf area to sapwood area, or even tree height. Only variables such as total canopy volume, tree diameter and LAI were significantly positively correlated to tree age. Examination of tree cores demonstrates that the growth rate remained relatively constant from 30 to 150 years of age. Since red oaks are believed to live on average 150 to 175 years, we conclude that age related decline does not affect this species and that high rates of photosynthesis, constant rates of leaf respiration, and decreasing rates of stem respiration with tree age (W. Bowman – previous talk) allow this species to remain a vigorously growing component of the ecosystem until it is ultimately replaced through ecological succession following stochastic events, disease or disturbance leading to tree mortality.

Interannual variation in eastern hemlock decline associated with invasion by the hemlock woolly adelgid.

J.D. Lewis, Louis Calder Center, Fordham University

Invasive non-native insects may significantly reduce forest productivity by increasing mortality rates of host trees. However, the impact of invasive insects on mortality rates may vary from year to year due to environmental factors. In the eastern U.S., introduction of the hemlock woolly adelgid (*Adelges tsugae*) has been associated with extensive mortality of eastern hemlock (*Tsuga canadensis*). To examine interannual variation in defoliation and mortality, we established six 40 m X 40 m plots in the Black Rock Brook watershed. Three plots were established in hemlock-dominated stands, while the other three plots were established in hemlock-hardwood stands to determine if hemlock density influenced defoliation and mortality patterns. Between 1999 and 2004, 65% of hemlocks in the hemlock-dominated stands died while 51% died in hemlock-hardwood stands. Canopy defoliation progressively increased across this time period, but was consistently lower in hemlock-hardwood stands. Annual mortality rates between 1999 and 2000 and between 2001 and 2004 consistently averaged approximately 20% in hemlock-dominated

stands and 15% in hemlock-hardwood stands, but the mortality rate between 2000 and 2001 was essentially 0% in both stand types. These results demonstrate substantial interannual variation in hemlock mortality rates associated with invasion by the hemlock woolly adelgid. In addition, these results suggest that defoliation and mortality rates are higher in hemlock-dominated stands compared to stands where hemlock is not the dominant species.

Hemlock woolly adelgid (*Adelges tsugae*) infestation reduces ectomycorrhizal diversity and accelerates N cycling in eastern hemlock (*Tsuga canadensis*) stands.

A.G. Sirulnik, J.D. Lewis, A.R. Tuininga, and *J. Johnson*, Louis Calder Center, Fordham University

In northeastern temperate forests, eastern hemlock (*Tsuga canadensis*) has been experiencing defoliation and subsequent mortality from infestations of hemlock woolly adelgid (HWA; *Adelges tsugae*), an invasive exotic aphid-like insect. Eastern hemlock hosts a range of ectomycorrhizal (EM)-fungal symbionts. Changes in forest composition that follow eastern hemlock decline may co-occur with changes in EM fungal species. This study examines the effects of HWA-induced defoliation on EM communities in a watershed of a mixed conifer-hardwood forest in southeastern New York. EM communities were compared among HWA-infested and healthy eastern hemlock stands and oak (*Quercus sp.*) dominated stands. Soil cores were collected in June, August and October of 2004 and ectomycorrhizal species on root tips were identified by morphotype. Because EM fungi can affect and be affected by ecosystem processes, soil extractable nitrogen (N), soil moisture, and pH were measured in soils and analyzed with respect to forest type. HWA-infested hemlock-dominated stands had lower EM richness and fewer EM tips cm^{-2} soil than the healthy hemlock-dominated or oak-dominated stands. HWA-infested hemlock-dominated stands had higher levels of NO_3^- than the healthy hemlock-dominated or oak-dominated stands. pH was higher in the oak-dominated stands than the HWA-infested hemlock-dominated stands. Soil moisture was higher in HWA-infested hemlock-dominated stands than the oak-dominated stands. Results show that EM species richness in hemlock stands may be reduced by HWA-induced defoliation and that N cycling and soil moisture may be altered by hemlock decline.

<u>Session II</u>

The effect of leaf phenology on the annual carbon gain abilities of Japanese barberry and co-occurring native shrubs in the Black Rock Forest.

C. Xu, LDEO of Columbia University

The seasonal variations of photosynthetic properties were studied in 3 co-occurring understory shrubs (*Berberis thunbergii*, Japanese barberry, early leafing deciduous; *Vaccinium corymbosum*, high bush blueberry, late leafing deciduous; and *Kalmia latifolia*, mountain laurel, evergreen) with different leaf phenological characteristics in the Black Rock Forest in 2004. Japanese barberry exhibited the highest photosynthetic capacity (indicated by Vc_{max} and J_{max}) in early spring when the upper canopy was open. The photosynthetic activity of mountain laurel was the highest near the end of the growth season, and was moderately high in early spring. In contrast, high bush blueberry showed typical shade plant characteristics throughout the whole growth season and the leaf level photosynthetic capacity is significantly lower than the other two species. Temporal variations in nitrogen allocation explain well the photosynthetic variations in Japanese barberry and high bush blueberry but do not apply to mountain laurel. However, the photosynthetic rate in early spring and late fall can be limited by stomatal conductance. The results indicated that the photosynthetic activity in early spring can

significantly contribute to the annual carbon gain of Japanese barberry, the invasive understory shrub, which may facilitate its competitive ability against some other co-occurring native species.

Growth and climatic sensitivity of northern red oak in the northeastern U.S.: placing a regional context for Black Rock Forest.

N. Pederson, G. Jacoby, Tree-Ring Laboratory/LDEO, *E. Pyle*, Harvard University, *T. Zimmern-Kahan*, LDEO of Columbia, *A.B. Plotkin*, Harvard Forest and *S. Wofsy*, Harvard University

Repeated forest inventory measurements at Black Rock Forest (BRF) have indicated an average net uptake of roughly 2t carbon ha^{-1} yr^{-1} in forests dominated by northern red oak (*Quercus rubra* L., NRO). A tree-ring based network of NRO across New York State and central New England region (NYNE) composed of stands with a range land-use histories and stand-level productivity was developed to address the following questions: "Is tree-level growth rate of the BRF NRO typical of NYNE?" and "What are the non-climatic factors correlated to growth rates of NRO?" Two collections were made at BRF: one at a high productivity site and a second at a low productivity site. Average ring-width chronologies of each population were placed into a NRO allometric equation to reconstruct average annual carbon increment (kg yr^{-1}). To determine potential site productivity in the absence of overstory suppression, a new dendrochronological method was developed. The new methodology reduces the influence of age and climatic trends as the averaging process for each year includes trees of different ages and different climatic periods.

Average regional NRO growth rates have increased steadily since 1930 and peaked in the late-1970s and from the late-1990s to 2001. BRF growth rates are lower than the NYNE average with the low productivity site significantly lower than the regional mean. The high productivity site is not significantly different than the regional mean in the late-1940s, late-1970s and early-1990s. Growth rates of both BRF populations have declined since the early-1990s, which is in opposition to the regional trend.

NRO with larger diameters at breast height have higher growth rates than smaller trees. Once site quality is standardized, growth rates are positively correlated to age; older trees have higher growth rates than younger trees. The trend in growth rates from 1977-2001 is negatively correlated to latitude; trends increase moving south. It is not yet known what is driving this trend. Climate has improved more in the south (wetter, warmer) than in the north. So the latitudinal trend in growth rates may be reflecting this climate change gradient.

The new tree-ring based index of site productivity indicates that, on average, potential growth rates of NRO in NYNE increase steadily in the first 70-year post canopy-accession. Both BRF sites are lower than the regional mean. Only the low productivity site, however, is significantly lower than the regional mean.

Our NRO carbon uptake network indicates that the BRF NRO are below the NYNE average of potential productivity. Given that the BRF and Harvard Forest (another low productivity site) sequester a significant amount of atmospheric carbon annually, our results suggest that estimates of carbon sequestration in NRO-dominated forests based on these two forests may underestimate the amount being sequestered across the northeastern U.S.

Wetlands in Black Rock Forest, NY: changes in carbon storage since deglaciation.

D. Peteet, NASA/Goddard Institute for Space Studies and LDEO of Columbia University, *T. Maenza-Gmelch*, New York University, *D.*

Pederson, LDEO of Columbia University, *D. Kurdyla*, and *T. Gulderson*, Center for AMS, Lawrence Livermore Labs

Mid-latitude forest ecosystems have been proposed as a "missing sink" for carbon today. The role of soils (including wetlands) in this proposed sink is unknown. How did past climate change affect net wetland carbon storage? An AMS-C-14 dated record of vegetational change from Sutherland Fen in Black Rock Forest, NY spanning the last 12,400 years is compared with existing data from nearby Sutherland Pond, NY and Glycerine Hollow riparian wetland cores. While Sutherland Fen demonstrates a high carbon accumulation rate during the late-glacial compared to the Holocene, the pond and riparian wetlands do not. Macrofossils reveal the local dominance of spruce at the Sutherland Fen. Cores from the northern portion of the riparian wetland are restricted to late-Holocene deposits. Changes in hydrology, temperature, and vegetational composition have all contributed to the changes in fen carbon storage from the late-glacial to the present.

Burckle abyssal impact crater: did this impact produce a global deluge and impact layer?

D. H. Abbott, LDEO of Columbia University, *W.B. Masse*, Los Alamos National Laboratory, *D. Breger*, Drexel University and *L. Burckle*, LDEO of Columbia University

We have found an impact crater that is likely <6000 years old. Burckle crater is in the central Indian Ocean at 30.87°S 61.36°E. The crater is 29 ±1 km wide. The crater is deepest SE of its center. There is a deep gouge in the surface topography to the SE and a topographically smooth area NW of the crater rim. These topographic features suggest that the impactor came from the SE and that the tektite field lies NW of the crater rim. We are looking for tektites in young abyssal sediments from NW of the crater. Because the impactor hit a fracture zone wall, the rim of Burckle crater is unusually well defined. The crater rim shows evenly spaced notches that we interpret as resurge gullies. Near Burckle crater, we found a 26 cm thick layer with high magnetic susceptibility that extends to the top of core DODO132P. The crater is the inferred source of layers with high magnetic susceptibility in 3 deep-sea cores. Each layer goes to the top of the core, consistent with an age of <6000 years. Two out of 3 of the cores have basal Pleistocene ages and the basal age of the third is unknown. The high susceptibility layers contain broken plagioclase, spinel periodotite, and chrysotile asbestos. One sample contains pure Ni with drops of oxidized Ni. Because pure Ni melts at 1453°C, it is very likely that the drops formed during an impact. Burckle crater impact event is in the right location to be the source of devastating rains, tsunamis, winds, and associated social upheaval around 2807 B.C. (Masse, in press). However, the impact that produced Burckle crater is not large enough to produce globally devastating rains. We postulate a Shoemaker-Levy type event with multiple sites of large impact, including one site in the northern hemisphere. We are searching for this impact ejecta layer in a marsh core from Black Rock forest.

The effect of snow on the thermodynamic evolution of the sea-ice cover at SHEBA.

B. Tremblay, LDEO of Columbia University and *H. Huwald*, Swiss Federal Institute of Technology, Zurich

The SHEBA program (Surface Heat Budget of the Arctic Ocean) seeks to understand how interactions between atmosphere, ocean, sea ice, and snow cover in the arctic affect climate. We investigate the different mechanism by which heat is transported through the snow pack (i.e. conduction, latent heat transport and wind pumping). Measured in-situ thermal conductivities over Arctic sea-ice during the SHEBA project are typically much smaller than those derived from internal temperature profiles, assuming

continuity of heat fluxes at the ice interface. This implies that heat transported by latent heat and wind pumping (not accounted in in-situ measurement) is a significant proportion of the vertical heat lost through snow. Snow density measurements with depth, together with other atmospheric variables already recorded at Black Rock will be used to investigate this problem. Finally, we will study horizontal heat conduction through the snow pack associated with small scale spatial variability in snow depth variability, a fact that is also obscuring the interpretation of vertical heat transport estimates derived from internal temperature profiles.

What can we learn from snow research at Black Rock Forest?

J. Cherry and *B. Tremblay*, LDEO of Columbia University

A dual-use snow research station is proposed for winter deployment at Black Rock Forest (BRF), a Columbia University research facility, and for summer deployment at various sites in the Arctic. Thus, the investigators will get a maximum amount of use from a single set of equipment. Monitoring and modeling snow at BRF should prove important for water resource planning in Orange County, NY. Observation and modeling of snow in the Arctic is important for investigating basic snow physics, as well as snow-related change and variability in this climatically sensitive region.

<u>Session III</u>

Chloride and acidity in precipitation and surface waters in the Black Rock Forest.

J. B. Shapiro, H.J. Simpson, K. Griffin, LDEO of Columbia University and *W. Schuster*, Black Rock Forest

Chloride derived from the atmosphere can be a valuable tracer in ecosystem and watershed processes since of first order, Cl^- is considered to move conservatively through ecosystems. Cl^- input via precipitation indicates high concentration during winter and low concentration during summer, probably as a result of more frequent marine air storms in the winter. However, the ratio of $[Cl^-]/[Na^+]$ was higher in summer and lower in winter, often reaching values twice the sea water ratio indicating a significant source of excess Cl^- on the order of ~24% of total Cl^- wet deposition. Consistent with large regional sources of non-marine Cl^-, we attribute ~ 29-50% of the excess Cl^- wet deposition to HCl emission from coal fired generating stations, ~ 5-9% to HCl emissions from domestic and industrial waste incineration and ~ 40-60% to HCl formation in the atmosphere from reactions of sea-salt aerosols with acidic gases. In considering the balance between Cl^- input via wet deposition and Cl^- export in stream water, the ratio of steam Cl^- export to Cl^- wet deposition is ~ 3:1, indicating additional sources comparable to that from precipitation. We conclude that additional Cl^- export is consistent with a combination of input from Cl^- dry deposition and from mineralization of organic material formed in prior decades during periods of elevated atmospheric $[Cl^-]$. Seasonal and decadal trends in wet deposition of acidic precipitation in the northeastern USA can have important impacts on terrestrial and aquatic ecosystems. Seasonally, precipitation (mean annual pH = 4.29) was more acidic in summer (4.09) and less acidic in winter (4.5), consistent with $[SO_4^{2-}]$ and $[NO_3^-]$ summer maxima and winter minima. From 1981-2003, $[SO_4^{2-}]$, $[NO_3^-]$ and $[H^+]$ wet deposition decreased significantly. Hydrogen ion deposition decreased by 38% from 1981 to 2003, resulting in current $[H^+]$ levels likely at the lowest average concentration since the late 1930's. In general, wet deposition decadal trends are consistent with those for local, state and regional SO_2 and NO_x emissions, indicating that average precipitation chemistry has been responsive to temporal changes in large spatial scale upwind emissions.

Delineating detailed ecological land units in the New York Bioscape using multi-temporal Landsat imagery.

J. Mickelson, Columbia University/CIESIN, *F. Koontz*, Wildlife Trust and Teatown Lake Reservation and *W. Schuster*, Black Rock Forest

This project seeks to advance our ability to resolve, map and analyze more accurate and precise digital geospatial data and information systems representing land cover and ecological communities' patterns and processes within the New York Bioscape. Specifically, we seek to establish the mechanisms and protocols for establishing adequately detailed spatial and thematic information and data baselines to be used for effectively mapping (locations and distributions), monitoring (conditions and changes), and modeling (historic paleo-ecological patterns, underlying drivers and system influences, and projected future conditions and trends) integrated, multivariate environmental patterns and processes, across spatial and temporal scales. Multi-date Landsat TM and ETM+ imagery as well as a wide array of ancillary digital geospatial data and GPS referenced ground plots are being used to evaluate the phenologically based spectral and spatial signals that ecological communities (as defined by the National Vegetation Classification System and the NYS Heritage Program) exhibit across the growing season. Results have shown that we can improve our ability to resolve ecologically based land cover classes dramatically using this approach; we are now extending it to attempt to include patterns of invasive species such as purple loosestrife – (*Lythrum salicaria)* and common reed-(*Phragmites australis).*

Dung beetles on an urban-to-rural gradient.

E. Nichols, American Museum of Natural History and *J. Danoff-Burg*, CERC at Columbia University

This work investigates the impacts of forest fragmentation, urbanization and reserve size on community composition of coprophagous beetles and muscoid flies. Coprophagous beetles (Coleoptera: Scarabaeidae) mediate several critical ecological processes, including vertebrate parasite suppression, secondary seed dispersal, waste removal, nitrogen cycling, and soil aeration. Beetles and flies were sampled with baited pitfall traps in New York and New Jersey June-July 2003, in contiguous forest and individual forest fragments surrounded by a matrix of forested, agricultural, suburban, or urban land use. Both taxa responded significantly to the impact of forest fragmentation at the species and community level, while reserve size and extent of urbanization were less influential. With increasing matrix urbanization, total individual dung beetle abundance declined while species diversity and the relative proportion of introduced species increased; muscoid flies showed a similar pattern. This study and several others have found dung beetles to numerically dominate dung-breeding flies in undisturbed habitat. Here this trend was observed to reverse in areas with less than 75% forest cover, with flies numerically dominating beetles in urbanizing areas. If fly presence prevents dung manipulation and oviposition by beetles through interspecific competition as has been suggested, these results suggest that reserves in urbanizing areas may be insufficient to maintain the ecological services dung beetles provide. Dung beetles have been shown to be an ideal taxon to describe relationships between community structure and ecological function. This study serves as a pilot study for future work aiming to assess the species-specific traits that confer extirpation proneness in beetles, and the correlation between the individual and aggregate impacts of these traits on the ecological services mediated by this important group of insects.

The insect and arachnid diversity of Black Rock Forest: our first steps.

V. Ovtsharenko and *A.V. Tanasevitch*, American Museum of Natural History

The project is closely related with our previous project "Biodiversity of Spiders of BRF" and combines research and educational approaches to biodiversity studies looking in particular at the biodiversity of the Black Rock Forest arthropods: arachnids and insects. The first part of the project comprises a research study of the biodiversity of the BRF arachnids and insects. Interactive multimedia keys of all orders of arachnids and insects are an additional tool for biodiversity research in BRF and we will create these keys on the basis of LucID program. LucID is a multimedia expert system designed specifically to help users make a correct identification of a biological specimen. The creation of the website "Gallery of Arachnid and Insect Orders" will be an important aspect of this project. The educational aspect involves a special project called "Field Biodiversity". This project is aimed at two different groups: high school students and high school teachers. It involves one-day classes in BRF for students and six-week classes for teachers (with some classes in BRF). The idea is to show students the general principles of studying biodiversity in the field. The course concentrates on arachnids and other invertebrates. Focusing on invertebrates for biodiversity research is still rare. However, they are a remarkably diverse group in any ecosystem and occur throughout the year. In BRF these groups will contain mostly arachnids and insects.

The role of lizards in Lyme disease ecology: tick burdens, reservoir competence and population density in the northeastern United States.

S.T. Giery and *R. S. Ostfeld*, Institute of Ecosystem Studies

The role of lizards in Lyme disease ecology has been studied in the western United States, where lizards commonly host, but do not frequently infect ticks with the Lyme disease spirochete, *Borrelia burgdorferi*. In this study, we investigated the potential role played by lizards in influencing Lyme disease risk in the hyper-endemic zone of the northeastern United States. Species specific roles of hosts depend on their tick burdens, *B. burgdorferi* reservoir competence (i.e. their probability of infecting feeding ticks), and population density. We estimated these parameters for three common eastern lizards: *Aspidescelis (Cnemidophorus) sexlineatus*, *Eumeces fasciatus*, and *Sceloporus undulatus*. We estimated population densities of up to 28, 16 and 7 individuals per hectare for *S. undulatus*, *E. fasciatus* and *A. sexlineatus*, respectively. Larval tick burdens were correlated with seasonal changes in tick abundance and varied with sex and age (*E, fasciatus* only) but during the larval peak in July and August averaged 1.5, 0.13 and 0.0 larvae/individual for *E. fasciatus*, *S. undulatus* and *A. sexlineatus*, respectively. Reservoir competence was determined in the laboratory by infesting wild-caught *E. fasciatus* and *S. undulatus* with larval *I. scapularis*. Preliminary data show *E. fasciatus* to be incompetent reservoirs, infecting 0 of 79 larvae, and *S. undulatus* to be poor reservoirs infecting 1 of 38 larvae. Low reservoir competence of these species was not the result of low exposure to Lyme disease as the infection prevalence of field-collected nymphs from our study sites evidence frequent inoculation by ticks. These data suggest that lizards can serve a protective role in the northeastern U.S. Lyme disease epidemic. The strength of this protective role is being assessed using a Lyme disease risk model that incorporates lizards together with better-studied mammalian and avian hosts.

Session IV

Conservation of an endangered reptile in New York State.

R. Stechart, Consultant to the NYS Department of Environmental Conservation

No abstract available

Freezing Black Rock Forest: long-term preservation of genetic resources at the American Museum of Natural History.

J. Feinstein and *Angélique Corthals*, American Museum of Natural History

In a time of massive species loss, natural history museums should lead the way in providing digital access to biodiversity information, especially for genetic materials used in taxonomic studies. The American Museum of Natural History (AMNH) established the Ambrose Monell Cryo Collection (AMCC) to help meet the demand for properly documented frozen tissue specimens used for genetic analysis. The rapidly growing AMCC collection houses over 40,000 specimens and we continue to acquire and bank biomaterials, while actively developing and improving protocols for long-term storage of biomolecules. The collection maintains an online relational database, which is integrated with the National Center for Biotechnology Information. This allows for AMCC records with nucleotide sequence accession numbers to link out to corresponding pages on the NCBI GenBank and Taxonomy sites. The AMCC database also links specimen records to digital images (e-vouchers), allowing a virtual connection between sequence data and the visual identity of the organism. Specimen records in the collection may be located by any data field associated with the sample: barcode number, NCBI taxonomy number, GenBank sequence number, taxon name, partner name, collection locality, etc. In the context of our mission, we are conducting a taxonomic inventory of selected faunal groups at Black Rock Forest. The work is coupled to our outreach and education program to provide training in field biology, collecting techniques, and bio-preservation practices for AMCC interns. Museum scientists will accompany teams of students and staff on collecting expeditions to BRF and will identify specimens. Tissue samples will be archived in our collection and will be freely available to the scientific community for genetic analysis. The AMCC extends an offer of free collection support and archiving services to all researchers conducting animal studies at BRF.

The effects of hiking trails and forest roads on avian diversity.

J. Rothe, Quinnipiac University and *E. McGowan*, New York-New Jersey Trail Conference

The goal of this study was to assess the impacts of forest roads and trails on birds breeding in Black Rock Forest. Eighteen field sites (6 trailside, 6 roadside, and 6 forest interior) were set up at which both bird diversity and abundance were recorded. Early morning point count surveys were conducted between May and July of 2003 and 2004. Human trail use data was collected using six sign-in boxes and two motion-sensor camera traps during the 2004 field season. The average bird diversity and abundance were not statistically different among roads, trails, and forest interior sites. During 2003, the average avian diversity at the three site types ranged from 18 to 19 species, while in 2004, the average diversity range was 17-18 species. Average bird abundance (average number of birds recorded during 5 minute point counts) ranged from 7 to 9 birds during both survey years. During 2003, 999 bird observations were recorded, while in 2004 1186 bird observations were made. In both years, ovenbirds and red-eyed vireos constituted the largest proportion of recorded birds. There was an absence of four wood warbler species at survey sites during 2004, a

decrease in mourning doves, and an increase in ovenbirds. No correlation between human trail use and bird diversity/abundance was found. Minimal impacts on avian diversity and abundance along the forest roads and trails can most likely be attributed to consistent canopy cover over these sites. Further studies should be completed to assess more subtle effects of nesting success and site preference along forest roads and trails.

Black Rock Forest fragmentation and urbanization diminishes beetle biodiversity.

J. Danoff-Burg, CERC at Columbia University and *E. Nichols,* American Museum of Natural History

We are attempting to answer the question, what are the effects of urbanization via roads on decomposer beetle communities? Urbanization in the areas surrounding the Black Rock Forest has continued and even escalated in recent years due to suburbanization and an increase in commuter traffic to New York City. This escalating trend should have serious negative consequences for biodiversity more generally, but may even have a greater impact upon native decomposer community. These native decomposers, such as those that feed upon animal carrion or necrophages, are particularly sensitive to the abiotic changes that come with edge effects. The presence of necrophage beetles have helped to reduce several serious human and domestic animal health risks elsewhere. We summarize results of several years of studies in the BRF that suggest that the impacts of roads – ranging from a four-lane divided highway down to even the little-used woods roads – significantly harm necrophage beetle biodiversity at the individual level, population level, and at the community level. Preliminary data support the idea that increasing road presence and impact leads to the loss of necrophage beetles – thus allowing an increase in fly abundance and ecological dominance. We suggest that the loss of the vital species of necrophage beetles due to increasing urbanization may have significant human health consequences, including increased incidences of myiasis, cryptosporidiosis, and giardiasis.

Posters

Small mammal diversity in the New York Metropolitan region: Survey 2004.

S. Ekernas, C. Bennett and *D. Burg,* Wild Metro

We surveyed small mammals from June to October, 2004, to determine species diversity, distribution and abundance in urban habitats throughout the New York Metropolitan region. Small mammals were captured and released during 4-day trapping periods using 49 Sherman traps at 4 different locations – Pelham Bay Park southern zone, Pelham Bay Park Hunter's Island, the New York Botanical Garden, and Black Rock Forest. We captured representative from six different species: white-footed mouse (*Peromyscus leucopus*), Southern red-backed vole (*Clethrionomys gapperi*), Northern short-tailed shrew (*Blarina brevicauda*), least shrew (*Cryptotis parva*), meadow vole (*Microtus pennsylvanicus*), and the Southern flying squirrel (*Glaucomys volans*). White-footed mice were the most abundant species in all four location (~15 animals/100 trapnights), followed by the Northern short-tailed shrew (~1 animal/100 trapnights). Greatest densities were found at the New York Botanical Garden, but Black Rock Forest and Pelham Bay Park had higher species richness and greater species evenness. During late summer, 75% of the surveyed sites supported white-footed mice that were parasitized with bot fly larvae. Mice trapped at the New York Botanical Garden had the highest parasite load, while no mice at Black Rock Forest contained larval cysts.

How Black Rock helped inspire the American environmental movement.

N.A. Buzzetto-More, University of Maryland Shore

The Black Rock Forest is a 3,800-acre wilderness area located in the Hudson Valley region of New York State. It was established as one of our Nation's earliest sustainable and experimental forests in 1928 by Ernest Stillman, who bequeathed the forest upon his death in 1949 to his alma mater, Harvard University.

Throughout their ownership of Black Rock, Harvard put most of its attention to another owned and operated forest, located in closer proximity to Cambridge. The modern environmental movement in America began in 1962 when area residents banded together after Black Rock and adjoining Storm King Mountain were threatened with electricity generation development by Consolidated Edison.

A bitter struggle ensued after Consolidated Edison submitted plans to build a hydroelectric pumped-storage-and-electricity-generating station in the forest and adjoining lands and Harvard officials toyed with the idea of selling a portion or all of the property. The proposed actions engendered fear and raised significant environmental concerns. Issues of pollution, seepage, water quality, and impact on indigenous species became quandaries that fueled the debate.

Despite having begun as a small intervention from the local community and environmental interest groups, the cause quickly became a statewide campaign, and eventually this conflict became a national concern. This battle became part of a legal action known as the Storm King Mountain lawsuit, which ultimately yielded a transcript of 18,000 pages. The case was brought by Scenic Hudson and the Natural Resources Defense Council (NRDC), both of which were formed in response to the controversy.

During the course of the lawsuit in a precedent-setting decision, the U.S. government acknowledged the importance of environmental impact studies. This decision helped to inspire the National Environmental Policy Act (NEPA). Signed into law by President Nixon on January 1, 1970, the act requires agencies to prepare environmental-impact statements when proposing actions that may affect the environment. NEPA also established the Council on Environmental Quality (CEQ) in the Executive Office of the President.

When in 1980 the battle was finally resolved through mediation after 17 grueling years, the result was a historic victory for the environment and its advocates, leaving an illustrious and inveterate legacy. In the end, Con Ed agreed to halt construction of the plant and to establish an endowment along with the other utility companies in the region to fund independent research on the impact of power plants on the aquatic life of the area.

The campaign set legal precedent, resulted in watershed legislation, caused the formation of several environmental advocacy groups, created the Council on Environmental Quality, and encouraged and empowered communities to take charge of their environmental legacies. It gave birth to our Nation's environmental movement by setting a precedent for environmental activism and encouraging small communities and environmental groups to battle and win cases against major corporations in order to protect their natural resources.

Today, the forest is permanently protected and stewarded by the Black Rock Forest Consortium, a unique amalgamation of K-12 public and private schools, colleges and universities, and science and cultural centers that successfully collaborate to enhance scientific research, environmental conservation, and education.

Global ecosystems education and the Black Rock Forest: The SEE-U Project.

N.A. Buzzetto-More, University of Maryland Shore

Today, the proliferation of well-designed digital technologies are facilitating and expanding the possibilities of global education projects and engendering international learning communities. Replete with symbolic interactions, these transgeographic communities inspire new realms of educational possibility, allowing educators and learners to broaden perspectives through discourse and collaboration while eradicating cultural divides.

In order for these experiences to be successful, they must contain a shared platform; a clear understanding of purpose; extensive preparedness for technology usage; sustained and reliable technology support; a back-up plan in the event of technology failure; exemplary curricula; a central question for investigation; interaction with experts; extensive opportunities for intellectual discourse; collaborative projects; and either a common language or an effective method for translation.

The Summer Ecosystems Experience for Undergraduates (SEE-U) is a superior model of how technology can be used to foster global learning. Available to colleges and university students worldwide, the SEE-U program operates at three geographically distinct locations concurrently. The program includes global networking, GPS and GIS usage, real-time interactions, data collection, a globally networked geo-referenced digital database that was specifically created for this project, data manipulation, online lectures, bulletin board discussions, Web-based office hours, links to relevant resources, expert presenters, online demonstration videos, networked simulations, collaborative research, and a series of student presentations.

Scientists rarely work independently or in isolation from other scientists. As a result, participants in the SEE-U program conduct scientific research and make discoveries in cooperative learning groups and participate in program-wide research projects shared among all participants. The learners create presentations that result in their sharing of findings and entering into discourse with students located remotely. Because success for the students is largely dependent on collaboration, learners develop an understanding that science is in and of itself a collaborative practice.

Created by the Center for Environmental Research and Conservation (CERC) in conjunction with representatives of the Black Rock Forest, the activities included in the SEE-U program have been designed to bridge the gaps between scientific practice and science education while preparing the next generation of scientists to use cutting edge technologies, be active in global discourse, and collaborate with fellow scientists. As a result of its design, the SEE-U program provides a unique experience that is unparalleled in field-science education.

Eastern hemlock decline and hardwood tree response as revealed by tree rings.

R. Carson, CERC at Columbia University and LDEO of Columbia University

This summarizes the findings of an analysis of existing tree sections ("cookies") taken from four species of trees during the establishment of the Canterbury Brook Exclosure (CBE) in Black Rock Forest.

Sections were surfaced, and tree rings were measured on each section. A chronology was developed for the over-story samples from each species. Analysis of average tree ring width, and patterns of net primary production (NPP) in the form of aboveground

biomass (AGBM) accumulation were compared across species.

The results suggest that eastern hemlocks exhibit a strong negative growth trend apparent since 1992 that is likely due to the defoliation by the hemlock wooly adelgid (HWA) (*Adelges tsugae* Annand), an introduced insect.

Also evident, is an increase in AGBM accumulation rates in both red oak (*Quercus rubra*), and maples (*Acer saccharum* and *A. rubrum)* that coincides with the decrease seen in eastern hemlock.

The near total hemlock mortality evident from the main hemlock groves in Black Rock Forest, and the result of this analysis suggest that the patterns of canopy dominance are in the process of dramatic change in traditional hemlock groves. With the suppression of hemlocks by the HWA, traditional forest dominant species such as red oak are demonstrating an ability to use the surplus resources available to grow more quickly and dominate the canopy.

Coyotes of the Hudson Highlands, New York: predicting coyote/human conflict through understanding spatial ecology.

F. Koontz, Wildlife Trust and Teatown Lake Reservation, *J. Brady, M. Munson* and *W. Schuster*, Black Rock Forest Consortium and *S. Elbin*, Wildlife Trust

Human-coyote interactions have increased during the last few years because of growing coyote and human populations and habitat loss. This multi-year project on human/wildlife conflict and suburban sprawl in the New York Bioscape will integrate knowledge about coyote biology and health in order to recommend policy and management actions toward coyotes in the Hudson Highlands. The first phase of this study is to predict areas of coyote occurrence. Our study site for year one was Black Rock Forest, Cornwall, New York, a 3,800 acre forest featuring a wide diversity of habitats, including neighboring farmland and suburban development. We set box traps at each of eight study spots along a 15-mile route in the forest so we could radio-collar coyotes and follow their movements. Traps were placed in areas where coyotes would likely occur. Traps were wired open and left un-baited for three months (August - October) to allow coyotes to habituate to the traps. In November we baited the traps with deer meat and bones. We trapped for 160 trap nights (8 traps for 20 nights) between December 2003 and February 2004. Coyotes visited all the traps within 5 days of being baited, as evidenced by tracks near the trap entrances, but no coyotes were caught using this method. We did catch 10 raccoons, 7 skunks, and 2 hawks. Lack of box trapping success led us to try camera trapping to record presence/absence. We attached 8 camera traps (Deer Cam, Park Falls, WI) to trees along deer trails and dirt roads. A chemical lure was placed 15 feet in front of each camera. Five of the 8 units 'captured' coyotes. In the next phase of this study, we will use camera traps to assess relative abundance of coyotes on a larger scale and in various habitat types throughout the town of Philipstown. By combining photo data with GIS computer-assisted mapping, we will develop and test a habitat probability model for coyotes, which will reveal likely coyote-human conflict areas.

Comparison of Sutherland Pond and Sutherland Bog pollen profiles over the last 12,000 years.

T. Maenza-Gmelch, New York University and *D. Peteet*, LDEO of Columbia University

Preliminary pollen analysis and AMS radiocarbon dating of sediments from Sutherland Bog, Black Rock Forest, NY provide a record of forest history spanning the last 12,350 radiocarbon years (yr BP). These data are compared to fossil pollen, plant macrofossil, and charcoal data from

Sutherland Pond, a large basin, 4.05 ha in surface area (Maenza-Gmelch, 1997a,b).

Preliminary results indicate a mixed pollen assemblage of boreal and temperate tree taxa (*Picea, Abies, Ostrya/Carpinus, Fraxinus, Quercus*) and herbs like *Cyperaceae, Gramineae* and *Tubuliflorae* from 12,350 to 11,300 yr BP. This is followed by increased dominance of *Pinus strobus* and *Betula* pollen until ~10,000 yr BP.

The early Holocene (~10,000 to 8500 yr BP) is characterized by increased *Quercus* pollen percentages and sustained high values, expansion of *Tsuga canadensis* pollen at ~9500 yr BP and a decrease in pollen percentages of *Pinus*. From 8500 yr BP to present is a dominance of *Quercus* pollen, high pollen percentage values of *Alnus, Ericaceae, Cyperaceae, Tubuliflorae* and spores of *Sphagnum*, possibly signaling a well developed fen environment.

A comparison of the two sites reveals that both sites begin recording pollen of the mixed boreal and temperate tree assemblage at approximately the same time: 12,350 +/- 70 yr BP for the bog and 12,600 +/- 380 for the pond. The bog accumulated approximately 250 cm of sediment in roughly 12,000 yrs. whereas the pond accumulated 830 cm of sediment during the same period. Both sites appear to have had the same sensitivity in recording the diversity of plant taxa.

Exploring influences of leaf-level physiology on plant community assembly in the Black Rock Forest.

J. Nagel, University of Tennessee and *K. Griffin*, LDEO of Columbia University

In three distinct Black Rock Forest communities, we designed projects to investigate the influence of leaf-level physiological properties and processes on the relative success of constituent plant species. We chose to focus our research on physiological properties related to energy acquisition, expenditure and use because energy is the most basic unit of comparison among organisms – spanning studies of molecules, individuals, communities, ecosystems and global dynamics. Because photosynthetic activity provides the energy essential for plant growth, and biomass production entails an energetic expense, it has been suggested that the most successful (i.e., the most abundant, the most productive, etc.) plant species within a given community would be those that maximize the physiological benefits of accrued costs to enhance their photosynthetic capacity. In the Black Rock Forest, we compared leaf-level energy acquisition, expenditure and use in three relatively successful species within their given communities with less successful co-existing species. These species included nonindigenous *Lythrum salicaria* (purple loosestrife) along pond banks, native *Acer rubrum* (red maple) in a deciduous forest, and nonindigenous *Berberis thunbergii* (Japanese barberry) in a forest understory community. We hypothesized that these relatively successful species would use energy more efficiently (i.e., acquire more energy via photosynthesis per unit of energy invested in photosynthetic biomass) than less successful co-existing species. All three studied species exhibited more efficient use of energy than their less successful neighbors in their respective communities, suggesting that this leaf-level physiological attribute could influence species' success within a community assemblage. Collectively, our research conducted in the Black Rock Forest presented a novel approach to understanding community assembly by considering physiological properties and processes related to both energy acquisition and expenditure collectively as mechanistic determinants of plant species' success at the community level.

Water quality of Black Rock Forest streams compared to elsewhere in Orange County using macroinvertebrates as indicators.

K. Nolan, Hudson Basin River Watch

The purpose of this study was to sample streamsites within Orange County for benthic invertebrates and to determine both water quality and impact source, if any, affecting a site based on the invertebrate community structure. The dissolved oxygen concentration, percent oxygen saturation, pH, temperature, and specific conductance of the water at each site were taken *in situ*.

Based on the analysis of the invertebrate communities from each site, the water quality categories ranged from non-impacted to moderately impacted. All Black Rock Forest streams were non-impacted. The major source of impairment, determined by Impact Source Determination, was from non point source nutrient enrichment, which affected 56 percent of the impaired water.

As expected, an increase in specific conductance correlated with declining water quality, based on resident benthic macroinvertebrates. Land use has been well documented to affect water quality (Hynes, 1975; Allan; 1995; Roy *et. al.*, 2003; Ometo *et al.*, 2000; Tate and Heiny, 1995; Imert and Stanford, 1996) and specific conductance can be used as an indicator of anthropogenic-source (land use) contaminants, as it correlates with the increasing anthropogenic affects within a watershed.

A negative correlation also occurred between specific conductance and macroinvertebrate taxa richness of Ephemeroptera, Plecoptera, and Trichoptera (EPT). Research indicates that with declining EPT richness there is a corresponding loss of sensitive fishes (Miltner and Rankin, 1998; Kilgour and Barton, 1999). The loss of sensitive fish may occur in waters assessed as slightly impacted, as the definition of slightly impacted is: "Water quality is usually not limiting to fish survival, but may be limiting to fish propagation" (Bode *et al.*, 2002).

Evaluation of stored soil carbon in Cascade Brook watershed.

D. Cabanis Pederson and *D.M. Peteet*, LDEO of Columbia University

The quantification of soil carbon is not trivial. Soil variability is large, and this variability increases the already significant error associated with most soil carbon estimates. As much as 50% of belowground carbon is stored in mineral soil. In order to produce more accurate carbon cycle models, the uncertainty in the soil carbon pool must be reduced. Our study in the Cascade Brook watershed affords the opportunity to intensively quantify soil carbon along the upland to wetland gradient, which mimics more regional topographic variability. The objective of this study is to quantify the carbon within the watershed (not to discuss residence time). Our findings indicated that more carbon is stored in the litter layer associated with upland soils. At these upland sites, leaf litter decomposes more slowly, which increases the residence time of the litter carbon. Although peripheral wetland soils are typically deeper than upland soils, they possess less litter due to increased decomposition, resulting in lower carbon contents along the profiles within the wetland.

Morphological intergradation of two subspecies of *Chrysemys picta* within a discrete metapopulation.

W.A. Cerbone, American Museum of Natural History and Fordham University, *D.E. Karrmann*, American Museum of Natural History

Chrysemys picta is a complex of four subspecies, two of which have ranges which include New York State. *C. p. picta* (Eastern

Painted Turtle) is morphologically distinguishable from *C. p. marginata* (Midland Painted Turtle). The margins of the dorsal scutes of *C. p. marginata* are disaligned, while those of *C. p. picta* are not. The plastron of *C. p. marginata* bears a distinct central figure touching on every plastral scute. *C .p. picta* general has no platral figure. Intergrades typically display intermediate characteristics and are readily distinguishable from individuals of either subspecies. From April to November, 2003, five demes of the metapopulation in Black Rock Forest, New York, were sampled and digital images were taken of each individual's plastron and carapace. These images were examined to determine the frequency of the expression of each characteristic. The population had a mean disalignment of 30%, with significant disalignment (>40%, indicative of intergradation) seen in 27% of the population. Significant plastral blotching (>10% coverage) occurred in 27% of the population. If present, the mark averaged less than 20% of the plastral area. The frequency of significant disalignment and plastral marking varied greatly between subpopulations (frequency ranged from 12% - 50% for disalignment, and 09% - 53% for marking). Profiling the metapopulation did not accurately model the subpopulation profiles, nor did subpopulation profiles accurately model the metapopulation's. The population appeared to be *C. p. picta* population with limited *C. p. marginata* influence. The traits appeared to be dimorphic; with females more likely to be disaligned and males more likely to be marked.

Differential habitat selection in a *Chrysemys picta* metapopulation

D.E. Karrmann, American Museum of Natural History and American Museum of Natural History interns: *A. Lee*, Brooklyn Technical High School, *J. Small*, Bard College, *W.C. Cerbone*, Fordham Univ., *A. Effendy*, Drew Univ., *C. Chow* and *F. Zannat*, Fordham Francis Lewis High School

Black Rock Forest (BRF), Orange County, NY, is a 3800-acre preserve dedicated to research, education, and conservation. Census data compiled since 1997 indicates the *Chrysemys picta* metapopulation (276 PIT tagged adults) of the forest is differentially distributed amongst the seven ponds of the forest that each constitutes a discrete habitat patch. The one natural pond is glacial in origin and is the presumed source of the current metapopulation. Six anthropogenic ponds are 75-110 years old. One local population in an artificial pond comprises 50% of the metapopulation. Other ponds each have 9-12%, or 5-6%. Different factors that may have affected, and continue to affect, dispersal and distribution selection by the turtles were examined. The BRF watershed is high quality water, and the ponds are all part of the local water supply. Anthropogenic impacts such as pollution and habitat destruction are not contributing factors, though five of the artificial ponds have been drained at least once for maintenance. Within the forest, turtle population density is positively correlated with dissolved oxygen, pH, and aquatic plant diversity/density. There is an inverse correlation with pond elevation. Additional physical water factors, aquatic insect diversity, and available nesting habitat are to be evaluated as well.