Bridging the Gap: Connecting Ecological Research and Restoration Practice

March 13 & 14, 2009

ABSTRACTS

Joint conference presented by
Mid-Atlantic Chapters of
The Society for Ecological Restoration International
and
The Ecological Society of America

Invited abstracts and biographies

Keynote Addresses

Session IA - Forest Ecosystems: Research and Restoration Meet in the Pine Barrens

Session IIA - Freshwater Ecosystems : Worms in Soils, Macroinvertebrates in Streams / New Findings and Techniques in MidAtlantic Stream Restoration

INVITED ABSTRACTS

A New Sustainable Landscape: Duke Farms Opens the Gates

Steven N. Handel[1] **and Carol Franklin**[2]
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Most of the world is now urban, and is degraded by significant ecological changes from the past, including habitat fragmentation, invasive species, and complex and increasing physical stresses. Restoration ecology must be involved with more than biological reintroductions. Successful projects must also engage the public with new perceptions of nature and societal obligations. Also, professional land managers and public officials from varied backgrounds need training in the developing needs of our environments. Duke Farms in central New Jersey is being remolded from a private estate into a 2,700 acre modern center for land stewardship for the region. Building on its history and natural context, the property has a new master plan emphasizing demonstrations of restored habitats, sustainable practices, and a public education program whose mission is the environmental needs of the future.

Steven Handel is a restoration ecologist of urban habitats, interested in plant population ecology, plant-animal interactions, and ecological services. He is Professor of Ecology and Evolution at Rutgers University. He received his B.A. at Columbia College, and Ph.D. in ecology and evolution at Cornell University. Dr. Handel has been an editor of the journals *Restoration Ecology, Evolution,* and *Urban Habitats*, and is an Aldo Leopold Leadership Fellow of the Ecological Society of America. He was elected a Fellow of the American Association for the Advancement of Science, and an Honorary Member of the American Society of Landscape Architects for his work on improving ecological services for our country. He has worked on ecological restoration in major urban areas, including the new Fresh Kills and Brooklyn Bridge Parks in NYC, The Duke Farms Foundation 2,700 acre holdings in New Jersey, the 2008 Beijing Olympic Games and the Orange County Great Park, California.

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Carol Franklin is a Landscape Architect who has always wanted to be an ecologist. She is a founding member of Andropogon and her work exemplifies the firm's commitment to finding solutions that identify and integrate the significant natural, cultural, historical, and social resources of a site. She received her B.A. from Wellesley College, and her M.L.A. under Ian McHarg at the University of Pennsylvania. She is a Fellow of the American Society of Landscape Architecture.

Carol has led the planning and design of natural areas and public gardens at Andropogon for 35 years. Recent projects include Avalon Park, the design of a private garden open to the public that includes an extensive restoration of a highly degraded landscape and blends art and science in a sequential journey through the site. She is currently working with Steven Handel at The Duke Farms Foundation's 2,700 acres in the central New Jersey piedmont and although Steve Handel's team won the 2008 Olympic competition, it was the Andropogon's team design that was actually built. She is currently finishing a large book with fellow author David Contosta, on the Wissahickon Valley, called *Metropolitan Paradise, the Struggle for Nature in the City*. It should be published in Fall 2009 and she hopes you will all buy it.

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The bio-geo-socio-chemistry of urban stream restoration

Peter M. Groffman
Cary Institute of Ecosystem Studies

In the Baltimore Ecosystem Study, one of two urban long-term ecological research (LTER) projects funded by the U.S. National Science Foundation, we are using "the watershed approach" to integrate ecological, physical and social sciences. Watersheds are a natural (and well-used) physical unit for bio-geo-chemical research and can also function as a focus for human-environment interactions, i.e. bio-geo-socio-chemistry. Suburban watershed input/output budgets for nitrogen (N) have shown surprisingly high retention which has led to detailed analysis of sources and sinks in these watersheds. Geomorphic stream restoration designed to reverse structural degradation caused by urban runoff can increase in-stream N retention by creating features with high denitrification potential. Including human goals in stream restoration can help to establish connections between people and streams, which can lead to improvements in water quality as people become monitors and advocates for stream ecosystem integrity. Creating positive feedbacks between ecological restoration and human preferences can be key for achieving specific biogeosociochemical goals in urban and suburban watersheds.

Peter Groffman is a senior scientist at the Cary Institute of Ecosystem Studies in Millbrook, NY, with research interests in soil, microbial and ecosystem ecology. Recent research efforts focus on sources and sinks of nitrogen in urban watersheds, the effects of winter climate change on ecosystem biogeochemistry and nutrient export, and the impacts of invasive earthworms on forest ecosystem nutrient cycling processes.

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Build it and they will come

Flavia Rutkosky
U.S. Fish and Wildlife Service

In recognition of the role of small areas –urban back yards, schoolyards and suburban residential properties - as both actual habitat for critters as well as sites which serve to reestablish our dwindling connection with nature, this presentation will feature several small-scale projects that illustrate that habitat can be (almost) everywhere.

Flavia Rutkosky has worked for the United States Fish and Wildlife Service, Division of Ecological Services/Habitat Conservation since 1980, beginning in the Pennsylvania Field Office in State College, then at the New Jersey Field Office in Pleasantville, NJ and for the past decade plus at the Delaware Bay Estuary Project Office which is located at Bombay Hook National Wildlife Refuge, just east of Smyrna, Delaware. This office is part of the Service's Coastal Program which concentrates on protecting and recovering habitats for Federal Trust Species (migratory birds and fish as well as threatened and endangered species) through partnerships that support voluntary restoration and enhancement of high-priority coastal habitats throughout the Delaware River Watershed.

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Atlantic white-cedar restoration and related issues

George L. Zimmermann
The Richard Stockton College of New Jersey

Since 1989 I have been working alone and with others to explore many parameters concerning the regeneration and restoration of Atlantic white-cedar (*Chamaecyparis thyoides*) ecosystems in New Jersey and throughout its range. I will discuss the long term field experiments (18th year data collected this past summer) that I am doing that are exploring the impacts of white tailed deer, logging slash loads, and various restoration strategies on white-cedar forest growth, survival, biodiversity, and other general aspects of those ecosystems. I will also touch upon my cooperative work with others that have tried to shed light on white-cedar niche parameters such as genetics, water table, salinity and flooding effects, among others.

George L. Zimmermann is a forest ecologist who received his BS and PhD from Rutgers University, and his MS in forest ecology at Utah State University. He is a Professor of Environmental Sciences at Richard Stockton College of New Jersey (RSCNJ) where he has been employed since 1982. His work, since 1989, has been primarily involved with numerous studies of Atlantic white-cedar. Recently he has been working with Drs. Andrew Windisch (NJDEP) and Ekaterina Sedia (RSCNJ) on broom crowberry restoration on the Warren Grove Range in South Jersey

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Natural Disturbance and Stand Development Principles for Ecological Forest Management- for use in forest restoration and regeneration, as well as sustaining natural forest systems over time

Bob Williams
Land Dimensions Engineering

Ecological Forestry: What role can it playing in sustaining native forest types? More and more we see the need to use silviculture in a manner that mimics, restores or enhances forest natural process' to sustain them over time. These projects restore and sustain upland and wetland forest systems. Disturbance and fire are key issues to sustaining these systems. Any forest plan that does not consider the economic costs and outcomes is simply irresponsible.
One project deals with the restoration of Atlantic white cedar to an abandoned agriculture site using a wide range of techniques to evaluate information for future projects. This is a 50 acre site in Ocean county NJ.

Other projects are upland in nature and demonstrate using silviculture thinning and the return of fire to sustain and manage natural pitch forest types as well as receive economic return on forestry investments! These techniques focus on sustaining these systems over time as opposed to some traditional silviculture techniques that look at rotation schemes that result in periodic stand liquidation.

Both case studies provide a basis for ecological forest management approaches!

Bob Williams is a certified forester with more than 34 years of experience in forest management. After graduating from Rutgers University in 1975, Bob spent his first twelve years as a forester in the states of Washington and Alaska working with the US Forest Service and Scott Paper Company. For the past 22

years he has been a consultant forester working with forest land owners in Pennsylvania, Maryland and New Jersey. He is presently responsible for forest management decisions on 158000 thousand acres of forestland annually.
In recent years Bob has focused on restoration of Atlantic white cedar systems and combining the use of silviculture and the return of fire to upland pine stands to mimic natural disturbance regimes in coastal pine plain forest systems.
His clients range from large cranberry watersheds to a wide range of public and private forest land owners.

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Ecological forestry in long unburned dwarf pine plains to restore historically open community structure and conserve broom crowberry

Andrew G. Windisch
Office of Natural Lands Management, New Jersey Department of Environmental Protection

Initial progress is reported on an "ecological forestry" project to reduce fuel hazards in long unburned dwarf pine plains stands, restore their historically open community structure, and conserve extant populations of the state endangered plant broom crowberry (*Corema conradii*), a species which is sensitive to high intensity fire. Hazard reduction burning with high intensity fire has been successfully applied in and around the East Plains since the mid-1980s to reduce fuel hazards and restore open canopy pine plains and barrens in areas lacking broom crowberry. Ecological forestry methods are now being tested in long unburned stands which support extant populations of broom crowberry, to avoid high mortality from intense burning.

Andrew Windisch is a fire ecologist and pine barrens community ecologist with the Office of Natural Lands Management at NJDEP. He holds B.S. degrees in environmental studies and geology from Stockton College, and master's and doctoral degrees in fire ecology from Rutgers University. Andrew has extensive experience in community ecology and pine barrens management, including ecological inventory work throughout New Jersey and the Northeast, community mapping and classification, fire history analysis, and ecological management planning.

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Rare Species Inventory and Management, and Ecological Restoration at the Franklin Parker Preserve in the New Jersey Pine Barrens

Emile D. DeVito
New Jersey Conservation Foundation
New Jersey Conservation Foundation has conducted extensive natural resource and rare species inventories at the 9,600 acre Franklin Parker Preserve for over 5 years, and has implemented numerous land management techniques to enhance rare plants and animal species populations. We have also begun a 1,100 acre wetland restoration of former modernized cranberry fields – habitats that had virtually zero natural resource value when the property was acquired in 2003. Wherever possible, passive public access has been blended with these wetland and rare species restoration goals. As natural resource data is accumulated and

as pilot forest manipulation research proceeds, larger forest management projects will be designed and implemented in an attempt to restore Pine Barrens ecosystem processes that have been lost due to decades of wildfire suppression.

Emile DeVito has been the Manager of Science and Stewardship at the New Jersey Conservation Foundation since 1989. He received a doctorate in Ecology in 1988 for research on bird communities and vegetation landscapes in New Jersey's Pine Barrens. Dr. DeVito develops and implements management plans for NJCF's 20,000+ acres of holdings designed to protect and enhance biological diversity. Emile educates government officials, advocacy groups, land trusts, teachers and students on forest-interior habitat and migratory stopover needs of Neotropical songbirds. He is a trustee of the Pinelands Preservation Alliance, the NJ Natural Lands Trust, and the Rahway River Association. He serves on the Endangered and Non-Game Species Advisory Committee within the NJ Division of Fish and Wildlife, the New Jersey Invasive Species Council, and the Science Advisory Committee of the NY-NJ Trail Conference. Emile resides in South Plainfield, Middlesex County.

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Is the Riparian Forest Restoration Successful? A University and Nature Center Partnership of Research for Management Decisions

Anne Bower[1], Fran Lawn[2], Joanne Donohue[2], Patricia Wetzel[1], Scott Granato[1], Joell Miller[1] and Shaheed Abdulhaqq[1]
[1]Philadelphia University Environmental & Conservation Biology Program
[2]Schuylkill Center for Environmental Education Department of Land Restoration

We will present monitoring methods used to measure the progress of a riparian forest restoration including soil chemistry, invasive earthworms, bacterial:fungal ratios, bird population estimates, water quality and plant growth, survival and biodiversity index. We will highlight what works from our eight year partnership using undergraduate students, interns, volunteers and staff at both institutions. This work was funded by the National Fish & Wildlife Foundation. Research results are available at: Abdulhaqq et al. Feb 2009. The Journal of Young Investigators (http://www.jyi.org/research/re.php?id=1573)

Two undergraduate research students will be presenting as part of our team as they are an integral part of all environmental baseline assessments and monitoring: Scott Granato is a sophomore Environmental Chemistry major and Patti Wetzel is a junior Environmental & Conservation Biology major. Joell Miller (2005 Environmental & Conservation Biology) and Shaheed Abdulhaqq (2008 Biology) are both alumnae and published work on the initial restoration

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Fran Lawn, Director of Land Restoration, has been with The Schuylkill Center for Environmental Education since 2003. He is involved with all aspects of restoration ranging from the reintroduction and management of the American Chestnut to establishing habitat for the Kentucky Warbler. He has partnered with colleges and universities on research projects focused on deer management, invasive earthworms as well as ephemeral pollinators.

Mr. Lawn founded The Schuylkill Center's Native Plant Nursery, and sale as well as established a sustainable landscape consulting service, which promotes sustainable native landscapes, by means of

educating and empowering all generations to reconnect with their natural surroundings, through the exploration of their own yards, local communities and parks.

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Dr. Anne Bower is an Associate Professor of Biology at Philadelphia University. She is the coordinator of the Environmental and Conservation Biology Program. Her research on forest restoration and invasive species management explores the relationships between White tailed deer, Red backed salamanders, and Asian earthworms in urban forest sites as well as Red bellied turtle radiotelemetry in freshwater streams. She has partnered with numerous agencies to collect relevant applied research information in restoration to use in management decisions. Her Natural Resource Management class writes and presents to the Board of Trustees or other decision-makers a detailed management plan including recommendations. Projects have included stream restoration, American Chestnut reintroduction, Kentucky Warbler habitat enhancement, trails improvement, invasive management and regeneration from fire. Her MS and PhD degrees in Forest Resources & Conservation are from the University of Florida. She has extensive international consulting and training experience for USAID and Peace Corps in agriculture, forestry, and parks management in Africa and the Caribbean.

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Integrating stream and wetland restoration as a means to provide multiple ecosystem benefits

Joe Berg
Biohabitats, Inc.

This work is based on the premise that the longer we hold water on our landscape, the better for aquatic and riparian ecosystems, the greater the contact time for material processing, and the greater social benefits delivered from our stream and wetland restoration projects. We have developed an integrated stream and wetland restoration design approach that uses a stream channel sized to convey base flow. Precipitation which generates runoff is not contained in the baseflow channel and conveyed downstream immediately, but instead expands the baseflow channel to a wide, shallow floodplain/riparian-connecting flow that receives the many benefits associated with floodplain and riparian system function (i.e., groundwater recharge, baseflow maintenance, sediment and nutrient processing, floodflow attenuation, etc.). As a result, adjacent floodplains, riparian habitats and associated depressions are more frequently hydrated, extending the temporal and spatial distribution of saturated soils and shallow inundation, extending wetland hydrology, supporting the chemistry of hydric soils, and delivering ecological and social benefits. Retaining water on the landscape in this fashion represents an integration of aquatic, wetland and upland habitats that occurs naturally in undisturbed landscapes and needs to be our paradigm for providing high quality riparian and aquatic restoration in the future. Independent research work on nitrogen processing in streams documents the greater denitrification occurring in integrated stream and wetland restoration projects relative to unrestored streams or streams restored using 'normal' channel designs. Similarly, other recent research indicates that the idea of a baseflow channel well connected to its adjacent riparian habitat and floodplain compares favorably with the recent geologic record based on work focused on legacy sediments that includes transects excavated across stream valleys to expose conditions predating the results of colonial land clearing practices.

Joe Berg is a restoration ecologist and practice leader with Biohabitats, situated in Baltimore. He graduated from the University of Maryland's Horn Point Lab and has more than 25 years in the environmental consulting field. He has worked in upland forests, headwater streams and wetlands, larger streams and floodplain forests and wetlands, and estuarine habitats. His experience ranges from the assessment of resource presence and condition, mapping of resource distribution, analysis of site conditions supporting restoration, development of restoration concept plans through final construction documents, peer review of restoration plans prepared by others, construction oversight, post construction monitoring, and a variety of other related efforts. Joe is a certified Professional Wetland Scientist (Society of Wetland Scientists) and Certified Senior Ecologist (Ecological Society of America). His work passion is pushing for change in the way the engineering community uses natural resources.

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Regenerative Stormwater Conveyance (RSC) as an integrated approach to sustainable stormwater planning on linear projects.

Keith Underwood
Underwood & Associates

Stormwater conveyance practices are grounded in industrial design that neglects integration with system processes, economics, and aesthetics. As a result, the greater volume of runoff from impervious surfaces, coupled with smooth and hardened conveyance systems (e.g., pipes and trapezoidal concrete channels), magnifies and transfers energies to the discharge or outfall. Conventional stormwater outfalls cause erosion, conveyance structures fail, stream channels are degraded, in-stream sedimentation increases the influence of localized erosion upstream and downstream of the outfall, and an increasing spiral of degradation results. Local governments are forced to spend scare public funds on remediation measures. Alternatively, the technique of using stream restoration techniques to create a dependable open channel conveyance with pools and riffle-weir grade controls is a regenerative design since the use of these elements result in a system of physical features, chemical processes, and biological mechanisms that can have dramatic positive feedback effects on the ecology of a drainage area. This approach results in the delivery of low energy storm water discharge, potential volume loss through infiltration and seepage, increased temporary water storage, restoration of lowered groundwater, increases in vernal pool wetland area, improved water quality treatment, improvements in local micro-habitat diversity, and provides a significant aesthetic value. These projects are generally a win-win-win arrangement, as conventional construction practices and materials are more expensive, conventional conveyance provides no environmental benefits and are more difficult to permit, and people generally enjoy the aesthetics associated with a well vegetated channel form when compared to the conventional conveyance alternative.

Keith Underwood is a landscape architect that has specialized in understanding, protecting, and restoring bog ecosystems. He is the sole proprietor of Underwood & Associates, a Design-Build firm in Annapolis, Maryland. He has pioneered sand-seepage wetland restoration techniques and has been effective in dramatically increasing the population of Atlantic white cedar in the western shore coastal plain of Maryland using this technique.

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Attempts to bring the Great South Bay hard clam population back from the brink – lessons learned from four years of restoration.

Carl LoBue
The Nature Conservancy Long Island Chapter

The Nature Conservancy in collaboration with town, county, state, and federal agencies has expanded efforts to restore self sustaining hard clam, (*Mercenaria mercenaria*) populations in Great South Bay, which have been declining for three decades. Past population surveys compared to published stock-recruitment relationships suggest that vast portions of the bay have been recruitment limited. Restoration work has emphasized rebuilding reproductive potential by stocking a network of spawner sanctuaries with adult clams relocated from nearby estuaries. Since 2004 over 3 million adult clams have been stocked on a network of 50 sites. Results are monitored in at many levels, with emphasis on survival, spawning, and recruitment. Environmental conditions have varied annually. In 2006 and 2007 clam condition and gonad ripeness indices showed that spawning was good. We estimate that about 1.8 million stocked adult clams were in place and alive during summer of 2007. A bay wide shellfish survey in 2008 shows a 4,000% increase in juvenile clam abundance in the central bay, bolstered by a strong 2007 year class. These results suggest that the project scale and design are sound. However in 2008 the most severe brown tide on record plagued the entire bay and spawning was minimal. Efforts have been set in motion maintain the spawner sanctuary network and protect the 2007 year class to the extent possible in hopes of further expanding the population's reproductive potential.

Carl LoBue is the Senior Marine Scientist for the Long Island Chapter of The Nature Conservancy. He has been doing marine conservation and restoration for The Nature Conservancy since 2003. Prior to his current position, Carl was the head of the Marine Crustaceans Unit and also worked in the Anadromous Fisheries Unit at The New York State Department of Environmental Conservation. Carl received his M.S. in Coastal Oceanography from Stony Brook University in 1996 where he studied the biological and physical transport mechanisms of coastal fish and crab larvae.

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The role of monitoring in shellfish restoration: A case study of a hard clam (*Mercenaria mercenaria*) restoration effort in Long Island, New York

Michael Doall
Department of Ecology and Evolution, Stony Brook University

Monitoring is an essential component of shellfish restoration. It is needed to measure success and guide the adaptive management of restoration strategies, and can provide important information that is otherwise difficult if not impossible to gain through experimental or laboratory studies. Here, we present a case study of how monitoring has been integrated with a large-scale hard clam restoration effort led by The Nature Conservancy (TNC) in Long Island, New York. To restore hard clams and the ecosystem services they provide, TNC has been transplanting large numbers of adult clams into localized, harvest-free areas, creating a network of spawner sanctuaries throughout Long Island bays. The goal is to boost recruitment in these bays by increasing spawning stocks and fertilization efficiencies, thereby allowing hard clams to naturally repopulate and become self-sustaining once again. The success of this strategy requires that the

transplanted clams survive, spawn, recondition, and spawn again in subsequent years. Results from 4+ years of monitoring have shown that while transplanted clams do indeed survive, spawn, and recondition, there is large variability among transplant locations, source populations of clams, clams of different sizes, and high interannual variability. This information has been used to help select the most favorable source populations and sites for transplant to help maximize the spawning potential of transplant populations and chances of restoration success. This work also indicates that short-term assessments are inadequate for determining the success of restoration for long-lived species such as *Mercenaria*.

Michael Doall is a research scientist and adjunct lecturer in the Department of Ecology and Evolution at Stony Brook University. In addition to being an active researcher in the field of marine biology, Michael also manages his department's research service and training facilities, which include the Functional Ecology Research and Training Laboratory (FERTL) and the Molecular Evolution of Adaptation and Diversity Laboratory (MEAD). Michael received an M.S. in marine sciences from Stony Brook University, and has studied various aspects of the ecology and biology of estuarine habitats in and around New York State since 1990. Michael's current research focuses on the ecology and restoration of bivalves, particularly the hard clam *Mercenaria mercenaria* and the eastern oyster *Crassostrea virginica*, in New York waters. Since 2004, Michael has partnered with The Nature Conservancy on a large scale monitoring program in the estuaries surrounding Long Island, NY, intended to help measure the success of hard clam restoration efforts, guide the adaptive management of these efforts, and provide a more complete understanding of the ecology of Long Island's bays and hard clam populations.

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Large Scale Wetland Restoration in the Delaware Estuary – Integrating Science and Practice

Kenneth A. Strait
PSEG Services Corporation

PSEG is restoring over 4,550 ha of diked salt hay farms and degraded *Phragmites*-dominated marshes along the Delaware Estuary. Designed to expand and protect the habitat for fish and other aquatic species, PSEG's efforts have achieved unparalleled success. The restoration program integrated the expertise of marsh ecologists, restoration scientists, and local stakeholders in the development of restoration designs and biological monitoring programs. An advisory committee comprised of academic scientists, wetland regulatory agencies, and local community representatives provided input into the restoration design; and participates in the adaptive management process. The establishment of local community involvement committees helped to ensure that the concerns of adjacent residents were fully addressed prior to initiating site development. This presentation will examine how the integration of science and practice contributed to the success of this large-scale program.

Ken Strait is the Manager for the Public Service Enterprise Group Estuary Enhancement Program and is responsible for the ongoing cooling water intake studies, wetland restoration efforts, and biological monitoring programs associated with PSEG's Salem Generating Station. Ken received his B.S. and M.S. in Wildlife Resources from West Virginia University. He has been involved in cooling water intake, Section 316(b), wetland restoration and related fisheries research for over 20 years. The Estuary Enhancement Program (EEP) is the largest privately funded wetland restoration program in the country. It includes a

combination of environmental and technological enhancements designed to reduce and offset potential adverse environmental impacts of the Salem Generating Station cooling water intake

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Large Scale Wetland Restoration in the Delaware Estuary – Biological Monitoring To Support Adaptive Management

Raymond L. Hinkle, CWB
URS Corp

PSEG is restoring over 4,550 ha of diked salt hay farms and degraded *Phragmites*-dominated marshes along the Delaware Estuary. Designed to expand and protect the habitat for fish and other aquatic species, PSEG's efforts have achieved unparalleled success. Restoration success is being achieved through application of an adaptive management process with input from a comprehensive biological monitoring program. Monitoring of the success of the restored salt marshes has involved the collection and analysis of both remotely sensed and field data relating to the extent and production of desirable marsh vegetation present on an annual basis since 1996. Use of historical time-series data from natural and self-restored reference marshes were utilized to develop the success criteria for restoration; and comparable data have also been collected from these reference marshes over this 12-year time period to provide an assessment of natural variability within the estuary. This presentation will discuss the importance of comprehensive biological monitoring in supporting an adaptive management process and in meeting the established wetland restoration success criteria.

Ray Hinkle is a Principal Ecologist with URS Corporation in Wayne, New Jersey. Mr. Hinkle has more than 35 years experience as an ecological consultant which has included conducting and managing aquatic, wetland and terrestrial ecology studies in a wide variety of habitats. For more than 14 years, Mr. Hinkle has worked as a consultant to PSEG in implementing and monitoring the tidal marsh restoration component of their Estuary Enhancement Program on Delaware Bay. Mr. Hinkle is also providing wetland restoration services to the New York State Department of Conservation and New York District Corps of Engineers relating to various projects in the Hudson River Estuary.

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Can We Achieve Sustainability? - Understanding Time, Scale and Change

Roger James Kuhns
Black & Veatch

Sustainability has become the buzzword for companies, universities, municipalities and politicians. But what does it really mean? There is the triple bottom line (environment/ economics/culture); and there are a variety of definitions varying from the Bruntland Commission ("Meeting the needs of the present without compromising the ability of future generations to meet their needs") to others that variously focus or stray

from true sustainability. But what is true sustainability? Nature provides us with the template. But for scientists, educators and engineers to work together to guide policy, remediate damaged lands, restore habitats, improve our built spaces, and conserve resources there must be a sound understanding of time, scale and change. There are many perspectives, for example: Geological - global warming is in part natural, and in part accelerated by anthropomorphic impacts; Ecological - habitats are dynamic and changing; Hydrologic - much of our groundwater is actually fossil water; Natural resources - ore deposits were formed in situations we would consider hazardous to our environment; and so on. Balancing our policies and practices with the understanding of these and other tangible components of a dynamic Earth is the most crucial step towards approaching sustainability.

Roger Kuhns is a geologist, ecologist, practitioner of sustainability, and writer with more than 28 years of experience. Dr. Kuhns has worked in over 65 countries throughout the world on natural resource and ore deposits, water resources, climate change, remediation and sustainability, economics, and policy and government. He helped write mining and environmental policy for several African countries to improve environmental protection and cultural awareness and sensitivity through business practices. He currently works on sustainable practices application for large-scale energy, resources, and remediation projects. Kuhns has authored numerous technical and science-related articles, and was an elected official for two years in Wisconsin where he helped write groundwater protection policies. He teaches sustainability and geological-ecology as a guest educator at University of Wisconsin Field Station, and elsewhere.

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ORAL PRESENTATION AND POSTER ABSTRACTS

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The effects of tail loss on escape behavior in *Sceloporus jarrovii*: Aerial righting and vertical run-speed

The effect of tail loss on righting behavior and vertical run-speed was examined in Yarrow's spiny-lizard (*Sceloporus jarrovii*), a species that can induce autotomy as an anti-predator defense mechanism. While this behavior has obvious immediate benefit in escaping a predation event, the loss of a portion of the tail may have associated costs—one of which is perhaps a decrease in mobility. To examine the effect of tail loss on mobility, we studied lizard aerial righting success – the likelihood of a lizard to landing "on its feet" (ventrum down) when dropped from a supine position and vertical run-speed – the time required for a lizard to complete a vertical route when chased by hand. Our hypotheses were that if the tail functioned in righting behavior, tail loss would diminish the lizard's ability to right itself and that if the tail functioned to facilitate vertical running, tail loss would impair running ability, increasing the time taken to complete the route. For both analyses, we tested two treatments of lizards (T1 and T2) in two sets of trials. In the first set of trials, all lizards had intact tails, but prior to the second trial, autotomy was induced in the T1 group. The T2 group was handled in the same manner as T1, but not induced to autotomize any of the tail. We compared performance on both measures for both treatments and trials. Tail loss significantly reduced *S. jarrovii*'s ability to right itself. Results for the run analysis are currently being analyzed and will be included in the presentation, but preliminary data do not appear to show a clear effect of tail loss. *(IIC-Animal/Disturbance Ecology, 2:10pm)*

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Mystery of the blue dot: Is it a sexually selected trait in *Uca pugnax*?

In fiddler crabs, males use physical characteristics to signal their potential fitness to females. We explore whether a blue dot, which appears on the anterior carapace of some *Uca pugnax*, has the potential to be a sexually selected trait. Blue dot presence, size, and color were evaluated as potential signals of fitness. The presence and size of a blue dot correlate strongly with two other known sexually selected traits, claw length and carapace width. In addition, there is variation in dot color among individuals of similar sizes. Thus, dot coloration has the potential to convey information that is not redundant with other fitness signals. These results establish the possibility that the blue dot serves as an honest predictor of fitness. *(Poster 7, Animal Ecology)*

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Urban stream continuums and gutter subsidies: the effects of upland riparian zones and engineered "urban karst" on organic matter and lotic ecology

Urban streams have often been viewed as simple extensions of stormwater networks. They are, rather, very complex catchment-wide hydrologic ecosystems. Of great importance is the degree of connectivity between civil infrastructure and receiving streams, including pathways for the routing of stormflow, augmentation of baseflow by potable water networks, "upland riparian" sources, and riparian interactions with sanitary sewers. Since every hectare of the urban landscape can be underlain by this dense network of pipes and drains this creates a kind of "engineered karst." This gives rise to an exponential three dimensional expansion of the stream network density connecting almost every groundwater and surface drainage feature in the landscape, essentially making every gutter and rooftop a zero order stream. This creates unique fluxes from ultra-urban hotspots, upland organic matter "gutter subsidies" as well as a novel "urban stream continuum." The ecological implications for urban streams are far-reaching in terms of vastly greater CPOM, FPOM & DOC inputs and stream metabolism, which greatly alter the energetics of food webs. We present several years of base and stormflow data for streams and storm drains of the BES LTER & Baltimore City stream networks, which suggest that the altered drainage pathways and strong terrestrial-aquatic linkages of urban catchments may combine in a way such that these are important locations for the management of catchment pollutant loads to minimize impacts on aquatic ecosystems. *(IIIC-Stream Ecology, 3:25pm)*

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Freshwater mussels of the eastern Congo River, Africa: Preliminary results of genetic variation in three common taxa

In the past, African biodiversity has received considerable attention yet currently biodiversity issues are in need of revision. Freshwater mussel taxa have recently been revised several times, but the results continue to be ambiguous. One objective that is rarely considered in African invertebrates is the distribution of genetic diversity across the landscape to determine historic barriers to dispersal. During the past year, we were part of a study whose objective was biological collections/ phylogeny of freshwater mussels from two rivers in Africa. As a supplement to the aforementioned study, our objective was to address genetic diversity of common taxa in the eastern Congo River, Africa. From three sites in the eastern Congo drainage, we collected live individuals from four genera within three families: *Etheria* (Etheriidae), *Mutela*, *Aspatharia* (Iridinidae), and *Coelatura* (Unionidae). In addition, we sampled three sites in the central Zambezi drainage where we collected live individuals from three genera within two families: *Chambardia*, *Aspatharia* (Iridinidae), and *Coelatura* (Unionidae). Low water conditions allowed for sampling of a large number of individuals from the same location (N~16 per species). The most abundant taxa sampled were *Etheria elliptica*, *Aspatharia pferreriana*, and *Coelatura choziensis* from the eastern Congo. We were able to amplify a mitochondrial locus (COI) from individuals from three different sampling locations. Our analysis will include an analysis of molecular variance (AMOVA) within and among populations, nucleotide diversity, and mismatch analysis for these species in the eastern Congo. *(Poster 9, Animal Ecology)*

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2009: The critical year for addressing global warming by reducing tropical deforestation

After several years in which there was little progress, 2009 promises to be a key year for both U.S. and international action to address climate change, including emissions from tropical deforestation. This source contributes 15-20% of total global warming pollution, a figure comparable to the U.S.' or China's emissions and more than the total from the whole global transportation sector. Although countries such as Brazil have reduced deforestation considerably in recent years, and plan further large reductions in the next decade, they will need substantial support from industrialized countries to carry out these plans.

To be effective, a global program to reduce emissions from tropical deforestation will need to support efforts by three kinds of countries: 1) those with high deforestation rates (e.g. Brazil, Indonesia), 2) those with low deforestation rates and large amounts of remaining forest (e.g. Guyana, Congo Basin countries), and 3) those that are restoring their forests (e.g. India, China). Combining different funding streams (e.g. voluntary donations, limited carbon market offsets, and 4% percent of the revenue from auctioning cap-and-trade emissions permits) would make this possible. Estimates of the funding needs are converging on relatively low amounts: with global funding of $ 20 billion annually, deforestation can be reduced in half in the year 2020. Climate legislation being considered in Congress this year, and the international negotiations leading to signing a new climate change treaty in Copenhagen in December, could provide these resources and reduce deforestation dramatically in the next two decades. *(IIB-Ecological Restoration of Terrestrial Ecosystems, 2:30pm)*

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Trends in tree species composition across vertical strata in a mixed hardwood forest in the New Jersey Highlands

Tree communities in New Jersey Highland forests are in a highly dynamic state as invasive herbivores and diseases are causing population declines in many species. The purpose of this study was to examine trends in tree species composition across five vertical strata (seedlings, lower midstory, upper midstory, subcanopy, canopy/emergent) in conjunction with quantitative evidence of impacts by herbivores and fungal pathogens to predict future species composition in one mixed hardwood forest in the New Jersey Highlands. Over 8,400 seedlings, saplings and adult trees were surveyed across twenty 1,000 m^2 plots along a 150 m elevation transect on one southeast facing ridge. Trends among strata were used to classify the population of each tree species as either declining, stable or increasing. Four species, *Acer rubrum, Betula lenta, Liriodendron tulipifera*, and *Sassafras albidum* appear to be declining because they are being outcompeted for light. Populations of each of the four *Quercus* species are in decline due to periodic defoliation by *Lymantria dispar* and sustained seedling browsing by *Odocoileus virginianus*. *Fagus grandifolia* and *Fraxinus americana* are declining due to fungal pathogens. In contrast, populations of *Acer saccharum, Cary glabra, C. tomentosa, Nyssa sylvatica*, and *Prunus serotina* appear to be increasing in part because of the space that is vacated as large *Quercus* trees die after *L. dispar* outbreaks. In conclusion, mid-successional and late-successional tree species that are not currently suffering from severe herbivory or diseases appear to be increasing in abundance. All other tree species in the study plots are in decline. *(Poster 14, Plant Ecology)*

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Differences in the acclimation response of Gray Treefrogs (*Hyla versicolor*) from northern and southern populations

Acclimation is the ability of an organism to physiologically adjust to changes in environmental conditions. It is often thought that acclimation is adaptive because it enhances the performance of an organism. Gray Treefrogs, *Hyla versicolor*, were obtained from two geographically separate locations and tested for the occurrence of an acclimation response to temperature. A sample of 9 frogs were obtained from the southern portion of the species range (Bucks County, PA [40.31°N,75.13°W]) and ten frogs were obtained from a northern population (St. Lawrence County, NY [44.66°N,74.99°W]). Frogs were acclimated to both 26° C and 12° C for a minimum of 7 days. The frogs were then tested to determine their critical thermal minimum (CT_{min}) and critical thermal maximum (CT_{max}). New York frogs held at 12° C had significantly lower CT_{min} and CT_{max} than the same frogs held at 26° C (CT_{min}: $t_s^9 = 11.342$, $P < 0.05$; CT_{max}: $t_s^9 = 6.801$,

$P < 0.05$). The CT_{min} and CT_{max} of Pennsylvania frogs did not differ after being held at 12° C or 26° C (CT_{min}: $t_s^8 = 1.743$, $P > 0.05$; CT_{max}: $t_s^8 = 0.933$, $P > 0.05$). These results suggest that an acclimation response was present in the frogs from the northern population, but absent in the frogs from the southern population. The results provide supporting evidence for the hypothesis that harsher climatic conditions, such as those of northern New York, may provide a stronger selection force for acclimation ability than the milder climatic conditions of southern Pennsylvania. *(Poster 2, Animal Ecology)*

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Increasing fish utilization by enhancing ecosystem complexity via the integration of subtidal and intertidal habitat components in an urban estuary

As part of the remediation for 9.7 acres of contaminated common reed (*Phragmites australis*) dominated wetland associated with the landfill closure for the 160 acre Bayonne Golf Course urban redevelopment project in Bayonne, New Jersey Princeton Hydro developed an innovative compensatory wetland mitigation plan that focused on modifying 13.9 acres of unproductive intertidal habitat to an estuarine complex of subtidal open water, intertidal mudflat, low marsh, and high marsh. The focus of the design was to increase the productivity of the estuary by integrating complex habitat elements including site access to increase fish utilization. The determination that this mitigation approach would provide suitable compensation for the loss of degraded wetland was based on the results of a baseline fishery study that yielded an abundance of 189 fish and 14 species in four quarterly events indicating sparse site utilization related to low habitat quality. Construction of the mitigation project was completed in November 2001. In the single 2002 survey richness increased to 19 with an abundance of 620. In semi-annual surveys fishery abundance was 7,667 in 2005, 4,662 in 2006, and 12,862 in 2007 with corresponding richness of 16, 17, and 21 including juvenile striped bass (*Morone saxatilis*) and winter flounder (*Pseudopleuronectes americanus*). The fishery data illustrates the value of juxtaposing habitat elements. The establishment of smooth cordgrass (*Spartina alterniflora*) has been problematic due to ice scour, floating debris, and herbivory. Despite these complications vegetative coverage has progressed from 5.0% in 2005 to 47.3% in 2008. *(IC-Ecological Restoration of Rivers and Estuaries, 11:35am)*

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Assessment and habitat/host plant restoration for Lepidoptera species of concern in the NJ Pine Barrens

This project is part of an insect biodiversity survey sponsored by the American Entomological Society and the NJ Conservation Foundation. A three-year study of the moths and butterflies at the approximately 8000-acre Franklin Parker Preserve in Chatsworth NJ identified several rare Pine Barrens specialist species, some of which are expected to benefit from host plant restoration, as well as one species that might be reintroduced to the preserve. I will show ongoing efforts to provide host plants for selected species at both the Parker Preserve and the Richard Stockton College of New Jersey. Species of interest include *Callophrys irus, Callophrys hesseli, Lithophane lemmeri* and *Catocala pretiosa* (frosted elfin, Hessel's hairstreak, Lemmer's pinion and precious underwing). Hostplants include *Chamaecyparis thyoides, Baptisia tinctoria* and *Aronia* spp. (Atlantic white cedar, wild indigo and chokeberry). Much of the work has been carried out by volunteers, including students at Richard Stockton College. *(Poster 34, Terrestrial Ecology and Restoration / Education)*

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Can Japanese knotweed serve as a source of biomass energy?

Concerns over the supply and environmental impacts of fossil fuels have spurred development of alternative energy sources during the past decade. Energy derived from cellulosic biomass has received special attention because it is potentially sustainable and has relatively little impact on our food supply. Candidate plants for cellulosic biomass include those that rapidly develop dense vegetative structures, like corn, switchgrass, and poplar. Thanks to its rapid growth, sprawling vegetative structure, and propensity to grow in high densities, Japanese knotweed (*Fallopia japonica*) appears to have potential to be another source of cellulosic biomass. To investigate that possibility, plants were harvested from high-density populations in the Wyoming Valley of northeastern Pennsylvania in the summer and fall 2008. Height and stem diameter were recorded for all plants growing in representative 10'x10' plots. A subsample of those plants was returned to the lab, dried and weighed. Separate regressions comparing weight as a function of plant height and stem diameter yielded r-squared coefficients of 0.83. When applied to the plots, biomass production ranged from 7.7 to 46 g / sq. ft., translating to production levels of 336 to 2032 kg / acre. The degree to which those values represent meaningful energy production will be discussed. *(Poster 31, Terrestrial Ecology and Restoration / Education)*

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A GIS model of wildlife habitat at scales appropriate for land use planners

Landscape-level conservation planning relies on geographic relationships among biodiversity distributions, protected habitat, and unprotected habitat, to develop models for enhancing wildlife population persistence and connectivity. This perspective is especially critical in agricultural landscapes, where biological conservation occurs primarily by default on private lands, and future land use decisions will be made mostly by local governments. However, information about the distribution of species and their habitats is incomplete and fragmented, maintained by diverse agencies and institutions in a variety of spatial formats. Assembling and organizing data for planning purposes is difficult and requires resources that are not readily available. We have developed a wildlife habitat model that synthesizes spatial information from multiple sources into an easily understood format, at a scale that is appropriate for town or county level planning. The analysis units are hexagons, nested within Environmental Monitoring and Assessment Program (EMAP) grid that is used nationally. Each hexagon is scored using a consistent set of parameters related to wildlife habitat: land cover, known occurrences or predicted habitat of rare plants and animals and significant natural communities, high-quality soils, streams under forest cover, fragmentation of forests and pastures, and the area of developed land with impervious surface. This model identifies large blocks of high-quality habitat for further investigation at a detailed level. Potential applications of the model include conducting a county-scale gap analysis, establishing priorities for open space preservation, and identifying potential areas for habitat restoration. *(IIIB-Conservation Management, 3:25pm)*

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Decision framework for restoration riverine habitat following remediation

A habitat replacement and reconstruction program (hereafter, habitat construction) has been developed for the Upper Hudson River and will be implemented following the completion of the first phase of dredging and backfilling. The overall goal of the program is to return habitat conditions within dredged areas to conditions similar to that in non-dredged areas. Based upon the results of a habitat assessment program, combined with projections of post-dredging conditions, key design criteria were developed, based on

backfill type, water depth, and the results of a submerged aquatic vegetation model developed specifically for the site. These criteria were then integrated into a decision framework, which was used to generate construction drawings and specifications for the replacement and reconstruction of four distinct habitats: unconsolidated (unvegetated) river bottom, aquatic vegetation beds, shorelines and riverine fringing wetlands. The decision framework was used to combine the key design criteria to produce maps depicting the habitat type to be constructed, and, in particular, to identify areas appropriate for planting aquatic vegetation beds and areas where natural recolonization is expected. Once the Phase 1 habitat replacement/reconstruction has been completed, an Adaptive Management Program will be implemented with the objective of creating the desired range of habitat characteristics by applying site-specific habitat information in an iterative framework of measurement and response. *(IC-Ecological Restoration of Rivers and Estuaries, 11:55am)*

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Comparison of two methods for rapid assessment of herbivory by white-tailed deer

White-tailed deer help determine forest structure by browsing selectively, which can potentially decrease plant diversity and abundance at the high deer densities found in the Mid-Atlantic region. Ecological studies of forests in this region therefore need to incorporate knowledge of deer pressure. A rapid method to assess long-term deer pressure can offer a preliminary foundation for more comprehensive forest analysis or experiments. We compared two rapid methods: "forest Secchi" and "browse transects," in 11 upland hardwood forests in Mercer County, NJ having different levels of deer management. For the forest Secchi method, we used a white, 1 m^2 board divided into 16 squares, which we positioned vertically in the forest at deer height (0.5 – 1.3 m), at points 10 m in each cardinal direction from 10 random points. We recorded the percentage of grid squares obstructed partially/fully by native foliage, as viewed from the random points. For the transect method, we analyzed the closest native woody branch at deer height every 10 m along three 100 m transects, by counting the number of buds that were intact, browsed, or had other damage. Both methods separately showed significant variation among the 11 forests, ranging from 1– 67% Secchi cover and 3 – 38% browsed buds. In some forests these results corresponded, but in others they did not, resulting in a nonsignificant correlation. Differences in the abundance and diversity of deer-palatable native species among forests may drive these conflicting results, requiring a more species-specific approach. *(Poster 27, Suburban/Urban Ecology and Restoration)*

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Options for managing a population of the invasive herb *Aegopodium podagraria* (goutweed): A pilot study looking at three control techniques in Prospect Park

Goutweed is a rhizomatous invasive perennial native to Eurasia, brought to North America as an ornamental ground cover. In the 580-acre Prospect Park in Brooklyn, NY, goutweed covers approximately 30 of the park's 200 acres of woods. Invasive plant removal is a major component of the park's woodland restoration and management efforts. Invasive management professionals elsewhere have indicated that goutweed may be resistant to glyphosate, but staff at the park hoped it could be an effective tool. A pilot study is being conducted to explore the viability of three treatments for the eradication of goutweed. The treatments include: a 2% glyphosate application; weed whipping the plants, allowing them to regrow, then applying 2% glyphosate; and weed whipping the plants, then covering them with a layer of newspaper and a layer of woodchips. Each plot is 2m by 2m, and the plots are clustered (one of each treatment, plus a control plot) in each of three locations in the park. Percent cover of goutweed was assessed in each 1m by 1m quadrant of each plot. Cover records taken periodically over 155 days indicate that all treatments had an effect on the cover of goutweed. All three treatments decreased cover to less than 30% average cover from day 73 to day 155. The cut/spray treatment appears to be the most effective in decreasing goutweed cover,

bringing cover to less than 5% from day 73 to day 155. During this time period, the control plots averaged 82 to 94.5%. The experiment is ongoing. *(Poster 19, Suburban/Urban Ecology and Restoration)*

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Plant-pathogen interactions in an anthropogenic landscape: contrasting effects of undisturbed succession and mowing

The warm season, perennial grass *Andropogon virginicus* (broomsedge) can dominate successional fields in eastern North America, particularly on post-agricultural poor soils. It persists in communities with regular disturbance (e.g. mowing); otherwise it decreases as woody vegetation increases. A survey of populations from Pennsylvania to South Carolina showed that 50% of populations were infected by the smut fungus *Sporisorium ellisii* (Basidiomycota, Ustilaginales), which decreases photosynthesis and host size, reduces/eliminates reproduction, and increases mortality. We have studied a 100x100 m section of an infected population in New Jersey since 2003, in order to understand host and pathogen population dynamics and their reciprocal influences. Disease rates declined from 2003 to 2006, while the community underwent succession without major disturbance. In the human-modified landscapes common to broomsedge, mowing is a frequent disturbance that may act to increase disease rates by spreading fungal teliospores, reducing woody competitors and increasing host density, and producing multiple wound sites for pathogen entry. We tested this idea by mowing three of five 20x100 strips once in the study site in 2007, and then comparing changes in host size, density, and disease from 2006 to 2008, in the mowed and unmowed strips. Mowed plants were only 76% as tall as unmowed plants on average. Broomsedge density decreased and disease frequency increased across the site, with significant variation among strips, but independent of the mowing treatment. This suggests that other environmental factors acting at the scale of 20 m may influence both host and pathogen dynamics more than does physical disturbance. *(Poster 15, Plant Ecology)*

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Maintenance of Eastern hemlock forests: Pre-infestation silvicultural treatments to reduce vulnerability to hemlock woolly adelgid

Eastern hemlock (*Tsuga canadensis* (L.) is the most shade-tolerant and long-lived tree species in Eastern North America. Because hemlock tolerates low light, it grows in all canopy layers. Overstocked stands are common, but hemlock can grow slowly in these crowded conditions providing a unique ecosystem component. The hemlock woolly adelgid (*Adelges tsugae*) (HWA), is a non-native invasive insect that feeds on eastern hemlock and Carolina hemlock (*Tsuga caroliniana* Engelm.). Currently, HWA is established in 17 eastern states, and is causing tree decline and wide-ranging tree mortality. Mortality can occur quickly and uniformly throughout a stand, or slowly and in patches for more than a decade. Widespread chemical control is economically unfeasible and biocontrols are still being tested. Therefore, scientists and managers are investigating management strategies for the maintenance and restoration of Eastern forest threatened by HWA.

HWA appears to spread more slowly in colder areas with mean minimum temperatures of -15^{o} F. Other site attributes, such as aspect, show a weak relationship with probability of hemlock decline. Results from a previous study suggest that hemlock crown vigor relates to a predictable pattern of hemlock vulnerability at light and moderate HWA infestation levels. Crown variables such as live crown ratio, and crown density and transparency are accurate predictors of hemlock decline; more vigorous trees appear to be less vulnerable to HWA. This information has been incorporated into silvicultural treatments that are being experimentally tested in 4 states as a means for improving crown vigor and increasing tree survival and regeneration potential. *(IID-Species Interactions, 1:50pm)*

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Silk filaments facilitate larval dispersal through freshwater stream pools

For species using ambient flow to facilitate dispersal, the heterogeneous nature of the lotic environment can have serious fitness consequences. For non-swimming larvae such as the black fly *Simulium tribulatum*, the presence of large regions of slow flow (pools) may impede downstream movement, limiting population size and spatial distributions. Time spent in pool habitat increases predation and greatly reduces feeding opportunities. *S. tribulatum* may, however, use silk threads to increase their chances of successfully transiting pools by reducing fall velocity and/or increasing the chance of resuspension after deposition. In this study we employ video analysis to determine the fall velocity of larvae both with and without naturally produced silk threads. In addition we measure the drag forces exerted on larvae both with and without silk threads under simulated pool-bed flow conditions using scale models. We find that the presence of silk caused a significant reduction in fall velocity ranging from ~50% for the smallest neonates (0.6mm) to ~20% for the oldest (7mm) larvae. In addition, it was shown that the presence of silk threads should significantly increase the drag force exerted on larvae already settled to the bed. This drag should increase the chance of resuspension from the bed, allowing them to continue their downstream transport. The combined effect should be to increase the chances for all larvae to successfully transit unsuitable pool habitat. However, the success rate should be much greater for the youngest/smallest larvae and may be important in determining the spatial and demographic distributions of larval populations. *(IIIC-Stream Ecology, 3:05pm)*

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The Establishment of a Flood Prone Wetland System on the South Branch of the Raritan River

An 8.1 – acre wetland was constructed within a flood prone setting in Branchburg Township, Somerset County, New Jersey in the spring of 2004. Using hydrologic modeling the mitigation site was designed to flood a minimum of four times per year while the wetland portion of the project floods more frequently. Additionally, the model served to evaluate tractive force and flow velocity at different flood stages to help guide the ecological aspect of the wetland design. The project resulted in the establishment of a mosaic of habitat types, ranging from emergent wetland to riparian forest, all subject to the dynamic hydrologic regime of a flood prone landscape. The conversion of a flood prone agricultural setting to a floodplain wetland increased the flood storage and sediment removal functions of the site while providing wildlife habitat for a variety of amphibian, fish, and bird species. Constructed less than five years ago, the site has been stable despite several major flooding events and currently possesses 152 plant species, including two species that are designated as rare by the New Jersey Department of Environmental Protection (NJDEP). *(ID-Wetland Ecology and Restoration, 11:15am)*

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Translocation negatively impacts the genetic structure of populations of the Timber Rattlesnake, *Crotalus horridus*

The Timber Rattlesnake, *Crotalus horridus*, is endangered or threatened in most northeastern states, and its historic range is highly fragmented. In Pennsylvania, it is subject to various threats including deliberate translocation, organized snake hunts, and collecting. We used microsatellite genetic analysis to study the genetic structure of two *C. horridus* populations, one in Pike County and one in Cumberland County, that have been subjected to the deliberate introduction of snakes from other populations. We compared these to

two populations, one in Adams County and one in Fayette County, that were not known to have been subjected to such activities. The Fst value for all four populations was 0.094721 (95% C.I. 0.0748 – 0.112). The highest Fst value was for the Cumberland population (0.090593, 95% C.I. 0.0166 – 0.148). This was the only population in which the 95% C.I. did not include zero. When Fst values were calculated for pairs of populations, the lowest Fst value and the only Fst value for which the 95% C.I. included zero was for the Pike and Cumberland populations (0.026, 95% C.I. -0.0006 – 0.025). These populations are 140 km apart, compared to the smaller distances of 14 km between Adams and Cumberland and 110 km between Fayette and Cumberland. There was a trend towards lower levels of genetic variation in the Cumberland population; however, these data are preliminary. Our results indicate that genetic analyses can be used to detect deliberate translocation and that the genetic structure of populations affected by such activities may be negatively impacted. *(Poster 1, Animal Ecology)*

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Earthworms in the urban environment: Can population augmentation help improve urban forest performance?

Urban forests perform essential ecological functions, and their performance is highly dependent on soil quality, which is often degraded by human activity in urban areas. Because earthworms play a key role in soil health, augmenting earthworm populations in degraded soils may help improve urban tree performance. Yet we know very little about earthworm ecology in highly urbanized soils. The objectives of our ongoing study are twofold: [1] to assess earthworm demographics across a range of urban land uses and [2] to evaluate earthworm augmentation techniques for rehabilitating disturbed urban soils and improving tree growth. For objective one, we conducted an observational study in Roanoke, VA in 2008 to assess earthworm abundance and diversity as well as associated soil properties. Preliminary results show that forested sites have significantly higher earthworm densities than residential and commercial sites, which may reflect observed differences in soil moisture and temperature. For objective two, we are conducting an earthworm inoculation experiment at Virginia Tech on a highly degraded field soil with a very low existing earthworm population. In 2008, three soil treatments (control, compost, and compost + earthworm inoculation) were applied to replicated field plots into which two common urban tree species (red maple and flowering dogwood) with contrasting soil tolerances were planted. In the plots, we are periodically measuring soil physical and chemical properties along with earthworm survival and soil respiration. Preliminary results show that five months after treatment, soil in worm-inoculated plots has significantly higher pH, CEC, and organic matter than compost-amended and control plots. Tree physiological responses to the treatments will be measured over the next several years. Preliminary results from both studies will be discussed in this presentation. *(IB-Urban Ecology, 10:55am)*

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Development of success criteria for evaluating submerged aquatic vegetation in the habitat restoration program for the Hudson River PCBs Site

In 2007 and 2008, USEPA and GE collaborated on development of technical criteria and statistical analysis methods for evaluating the success for GE's habitat restoration program to be implemented following

remediation at the Hudson River PCBs Superfund Site. The complexity of the riverine ecological system required the collection of reference data on several metrics to adequately characterize the submerged aquatic vegetation (SAV), shoreline, fringing wetland and unconsolidated bottom habitats. Since ecological systems vary temporally, development of a fixed standard to evaluate success for SAV was rejected in favor of a before-after control-impact (BACI) analysis that explicitly accounts for temporal variability not due to the dredging project. To evaluate the post-dredging (restored) SAV habitats, a reverse null hypothesis was chosen as the statistical test for the evaluation (i.e., assume that habitat conditions are below criteria until the data prove the converse with a level of confidence). Tests for bioequivalence within a BACI study design were selected that will evaluate whether restored SAV conditions are reasonably close (i.e. bioequivalent) to reference conditions with a level of statistical confidence. The value of the equivalence coefficient was selected through simulations designed to balance false positive and false negative errors at rates that would provide adequate power to demonstrate success, while ensuring an appropriate level of regulatory protectiveness. Results of the simulations of post-dredging conditions indicated that percent cover is the most robust metric, providing reasonable false positive and false negative rates under a range of simulated conditions. Biomass and stem count are more variable, and under some simulated conditions, give less desirable error rates. *(IC-Ecological Restoration of Rivers and Estuaries, 10:55am)*

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Geographic Information Systems augment ecological monitoring in dam removal project

As dam removals have increased in frequency, due to dam deterioration and interest in ecosystem restoration, there is a growing need to determine the ecological effects of dam removal. Few studies have been conducted on dam removals and pre-dam removal data is particularly limited. We present here a case study that explores the use of Geographical Information Systems (GIS) to supplement vegetation sampling data on the ground. Our part of an interdisciplinary study aims to measure changes in distribution and abundance of vegetation after the removal of 2 earthen dams on a tributary of Holts Creek in New Kent County, VA. We previously reported results of plant distributions and abundances measured before the removal of these dams. Our sampling revealed that at least one invasive species, *Murdannia keisak* and *Microstegium vimineum* were broadly distributed and in high abundance within the dams' watershed. As dam removal proceeds, it will be essential to monitor the establishment of these invasive species and other species. Based on our current knowledge of GIS applications we 1) will visualize vegetation samples as spatially related information, 2) have gathered existing geo-referenced information for the impacted watershed, and 3) have uncovered potentially useful spatially related information, for which no data exists. This process has led us to collect geo-referenced data that will improve our ability to monitor vegetation changes after dam de-construction. *(Poster 10, Aquatic Ecology and Restoration)*

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Characterization of nitrogen dynamics in urban restored streams: an evaluation of wetlands and engineered floodplain features

The main objective of this study was to identify areas within urban stream restorations where transformations of nitrogen processing are optimal for nitrogen removal and retention; the most effective mechanism of nitrate removal in riparian areas being microbial denitrification. Given the importance of nitrogen removal in urban watersheds, the high denitrification potential, and the tight cycling of N often found in wetlands suggests that if a portion of the stream flow can be routed through these areas (e.g. engineered or relict wetlands), these sites could function as important sinks for NO_3^- in urban restored streams. In this study we focus on in-stream processes and measured denitrification potential (DEA), net nitrification, organic matter content and moisture content, in pool, riffle and organic debris dam s in six

sites (two degraded, two restored, two forested) streams in the Baltimore Metropolitan area. Results show pools tended to have higher denitrification rate than riffles; forested sites showed significantly higher nitrification rates than all other sites for each feature. As expected, organic debris dams located in forested sites had significantly higher DEA compared to degraded and restored sites. The significant difference in denitrification potential between forested reference and urban streams suggests that incorporation of organic debris structures within restored sites could potentially increase microbial denitrification rates. Based on this preliminary work, we were able to select floodplain features (relict wetlands) within the study reach for future investigation of nitrogen uptake and removal and examine the affect of hydrologic flowpaths on nitrogen processing. *(Poster 21, Suburban/Urban Ecology and Restoration)*

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Conservation status and fire dynamics of high elevation pitch pine on Panther Knob, eastern West Virginia

High elevation pitch pine (*Pinus rigida*) communities in West Virginia support rare plants and animals, but remain critically understudied, and threatened by development. In collaboration with the Nature Conservancy and the WV Natural Heritage Program, I seek to elucidate plant community dynamics and the role of fire above 1200 m on Panther Knob, Pendleton County, WV, to facilitate conservation and management. In 2008 I measured the diameter at breast height (DBH) of trees and estimated percent cover of trees, shrubs, and herbs within 18, 20 x 20 m plots. I extracted increment borings from trees of each canopy class, and removed disks from dead trees having fire scars. Bark charring and soil charcoal were recorded. I collected mineral soil from the top 10 cm to determine if soil characteristics influenced community composition. Importance values for tree species were calculated as the mean of relative density and relative basal area. Cluster analysis identified four intrinsic site groupings, two dominated by pitch pine and two by hardwoods. Pitch pine ranged from 95%-0% importance, and was present at 17 sites. Clear evidence of fire was discovered at 15 sites, though it appeared that the fires had taken place decades ago. Preliminary DCA analysis indicated community structure was not straightforwardly correlated with the presence of fire evidence. Size structure diagrams indicated that pitch pine was not well represented under 10 cm DBH, and fewer than 10 pitch pine seedlings were recorded. Dendrochronological analysis to date past fires and edaphic analysis are currently in progress. *(Poster 17, Plant Ecology)*

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The Central Role of Plants in the Remediation and Ecological Monitoring of a Metal-Contaminated Site in Eastern Pennsylvania

The Lehigh Gap Wildlife Refuge is a 750-acre tract on the Kittatinny Ridge in eastern PA that is bordered by the Lehigh River, the Appalachian Trail, and the Delaware and Lehigh National Heritage Corridor. The site is also part of the Palmerton Zinc Pile Superfund site. Eighty years of zinc smelter air pollution (SO_2 and metal particulates) resulted in a landscape almost devoid of vegetation. Beginning in 2003, metal-tolerant warm season grasses were planted as a means to revegetate the steep terrain, stabilize the severe erosion problem, sequester the toxic metals, and serve as the first step in habitat restoration. Some pioneering species, as well as a number of aggressive invasive plants are emerging at the site. The grey birch (*Betula populifolia*) shows extreme signs of stress: stunted growth, severe leaf necrosis, and elevated levels of phenolics. Other tree species such as aspens appear healthier, even though they also have elevated levels of zinc in the leaf tissue. Unexplainably, the PA endangered native species *Dicentra eximia* and a rare, non-native species *Minuartia patula* (Arenaria) thrive on the contaminated sites. The latter species is of particular interest; the population size and distribution of *Minuartia patula* is being monitored as this plant may serve as an indicator of bio-availability of the heavy metals. With the completion of a baseline

assessment of the biodiversity at the refuge, it is now important to study plant succession events and develop sound adaptive management practices to build on the success of the initial remediation efforts. *(Poster 32, Terrestrial Ecology and Restoration / Education)*

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The status of an exotic ant (*Paratrechina flavipes*) in the greater Cleveland area and its potential impact on regional natural resources

Invasive species can be ecologically devastating, and understanding their impact is important for the conservation of native biota. In 2005, a population of exotic ants (*Paratrechina flavipes*) was discovered within the Doan Brook watershed in Cuyahoga County, Ohio, and several populations of these ants are currently well established within Doan Brook Gorge. The objectives of this study were to document the potential impact of *Paratrechina flavipes* on [1] native ant communities and [2] resource use by an important forest floor predator (red-backed salamander, *Plethodon cinereus*). *Paratrechina* are highly abundant where they occur, comprising over 80% of the total number of ants captured. The predominance of this species results in lower ant diversity, due primarily to decreased community evenness (rather than a decrease in species richness). *Paratrechina* often are the first ants to arrive at baits. However, they show little or no aggression towards other ant species and are quickly displaced from baits as native ants arrive. *Plethodon cinereus* has incorporated *Paratrechina* into its diet, and does not appear to discriminate between native and non-native ants. Due to the number and magnitude of environmental stressors that occur within the watershed, it is difficult to determine whether *Paratrechina* is responsible for any negative biological impacts or if it is an opportunist in an already stressed system. Our results reinforce the need for quality baseline data of community composition and structure in order to determine the true impacts of an environmental disturbance on a system. *(Poster 22, Suburban/Urban Ecology and Restoration)*

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Behavioral responses of a dietary specialist, *Regina septemvittata*, to potential chemoattractants released by its prey

Queen Snakes (*Regina septemvittata*) are extreme dietary specialists, feeding nearly exclusively on freshly molted crayfish. *Regina septemvittata* populations are threatened throughout much of their historic range, remaining only in clean, unpolluted streams. Using multiple methods, including the Tongue-Flick Attack Score and feeding trials, we have determined that ecdysone plays a critical role in the interaction between *R. septemvittata* and their prey. Northern Water Snakes (*Nerodia sipedon sipedon*), a dietary generalist, exhibited no differential responses to the arthropod molting chemicals tested in these trials. With numerous stream contaminants known to imitate ecdysone and disrupt the arthropod molting cycle, this finding may have important implications for the conservation of *R. septemvittata*. *(Poster 3, Animal Ecology)*

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Prioritization of ecological restoration sites: planning at the landscape scale using habitat analysis modeling

Stakeholders are increasingly recognizing the value of incorporating ecological enhancements as a component of remediating and restoring contaminated sites. Ecological enhancements can include the creation or restoration of ecological habitat and can be an effective means of meeting regulatory objectives. Even when a habitat project meets established site-specific ecological, economic, regulatory, or aesthetic

goals, it is important for the ecological value of a project to be considered in the context of the larger landscape. By planning habitat projects in view of the broader landscape, ecological value can be enhanced by ensuring the project site's connectivity with other neighboring habitat areas. In cases where multiple potential sites are under consideration, the prioritization of sites based on connectivity can maximize their ecological value while taking into account budgetary or timeline constraints. Using a landscape connectivity model and frameworks from the fields of conservation biology and metapopulation theory, we compared dispersal and traversability results for potential restoration sites considered alone or in pairs. Our results illustrate the degree to which habitat patches are dependent upon neighbors for ecological value and demonstrate how landscape connectivity models can be used to guide the prioritization of habitat projects at contaminated sites. Use of such approaches early in the planning process can ensure that habitat projects simultaneously meet stakeholder needs while maximizing ecological value at the landscape scale. *(Poster 33, Terrestrial Ecology and Restoration / Education)*

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Community evolution: Individual responses to neighborhood change

Community evolution is the idea that genetic diversity is the major unit of community diversity that is filtered through competitive processes leading to a set of populations that are competitively balanced within a community. A number of authors have shown that plant communities increase in stability and productivity as it ages and is dependent on it neighbors' origin. In an effort to further elucidate these previous finding we undertook a suite of experiments intended to detect differences in plant behavior, performance, and fitness across treatment where origin of individuals was varied. Our collection and field sites were an urban brownfield at Liberty State Park and an oldfield in rural NJ. The experimental regime included greenhouse and field experiments. The greenhouse studies were designed to detect differences in root behavior and plant performance. The field study was a transplant experiment intended to extend our greenhouse results to the real world. All experiments followed the same treatment regime, where species pairs were chosen based on class (native/native or native/non-native) and proximity (adjacent populations,100m away, and 1km away). The two classes were planted in a manner where treatments included border/border, border/l00, and borderl/km. Our results show significant differences in performance by treatment. Generally, productivity and growth-rate was greatest for individuals planted with their natural neighbor and their roots avoided interaction more than other treatments. This pattern was true for the native/native class but not for the native/non-native class suggesting that evolutionary history may have significant impact in competitive balancing in community assembly. *(IID-Species Interactions, 2:10pm)*

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Tree selection by foraging, male red-eyed vireos (V*ireo olivaceus*) in a New Jersey Highlands forest

As tree species composition of northern hardwood forests shifts due to succession and impacts by a variety of invasive insects and diseases, sparse attention has been given to implications for forest birds. This study examines tree species selection by foraging *Vireo olivaceus* in a mixed hardwood forest in the New Jersey Highlands. The primary goals were to determine if foraging patterns may help explain why *Vireo olivaceus* is so common, and whether predictions of future population trends based on possible preferences for particular tree species may be apparent. Tree selection by 49 foraging *Vireo olivaceus* was observed. Only singing males were observed, and observations were mapped so that care could be taken to observe each bird only once. The species and trunk diameters of the trees in which study birds were observed foraging, and of all trees within 15 m of the focal trees, were recorded. The species composition of trees selected by study birds was subsequently compared to a species composition index of neighboring trees. Results suggest a slight preference for *Liriodendron tulipifera* and *Fagus grandifolia*, and slight avoidance of *Quercus rubra* and *Betula lenta*. However, the proportion of time spent in each of the other 32 tree species

was strongly predicted by the tree species composition index. Therefore, male *Vireo olivaceus* appear to be generalist foragers that can likely acclimate to future shifts in tree species composition. The approach reported here could serve similar studies that focus on insectivorous bird species that are known to be in decline. *(Poster 5, Animal Ecology)*

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Pollinator composition on native and non-native plants in an urban brownfield (Liberty State Park, NJ)

As non-native plants establish and spread, ecosystem functions may be altered and ecosystem services that humans depend upon may be changed or lost. Additionally, the interactions between native plants and their pollinators may be disrupted. These disruptions may then in turn lead to the continued spread of non-native plants, localized loss of native plants in communities and loss of pollinator specialists of vanishing plants. Competition for pollinator services is one mechanism by which non-native plants prevent the recruitment of native plant species. Our research examines the bee pollinator community composition on native versus non-native plants. Working in Liberty State Park, an urban brownfield site in northern New Jersey, we periodically netted bees for fifteen-minute intervals on two native (Goldenrod *(Solidago canadensis)* and Thoroughwort *(Eupatorium serotinum)*) and two non-native (Purple Loosestrife *(Lythrum salicaria)* and Spotted Knapweed *(Centaurea biebersteinii)*) plant species using two stands of each plant species. We observed significantly higher numbers of visits to non-native plants then to native plants. In terms of diversity we found insignificantly greater diversity in genera that landed on/pollinated native plant species compared to non-native plants. At the species level we found insignificantly greater diversity at the non-native flowers. These findings indicates that the invasive plants are successfully competing for pollinators and future research will focus on the specific life histories of the bees found and what that may imply. *(IB-Urban Ecology, 11:35am)*

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A science-based regional restoration initiative in the Delaware estuary

Regional restoration planning is emerging nationally as a means to promote better coordination among restoration practitioners, planners and project decision-makers on a watershed basis to ensure that the most meaningful ecological outcomes are realized. Restoration, enhancement and conservation projects are often in reaction to particular program interests, issues or incidents, without scientific consideration for how they fit within the broader landscape of ecological needs. The goal of the new Regional Restoration Initiative (RRI) is to provide a science-based decision-support system that proactively guides restoration activities to ensure that outcomes: 1) are tailored to maximize ecological needs for specific sub-watershed regions and 2) minimize short-term loss of opportunity and maximize long-term "bang-for the-buck" by considering ecological compounding relative to economic investments (a.k.a. "Restoration Up-front".)
Beginning in 2006, work began collaborating entities to outline a RRI that consists of three components: 1) a **"science track**" that will develop ecological matrices and decision support tools to help elevate needs and opportunities that are expected to yield the greatest ecological goods and services; 2) **a "policy track**" that will synthesize and coordinate regional program priorities and activities among restoration decision makers, and 3) **a "project registry**" that will serve as a clearinghouse for restoration projects across the watershed. Initially, the RRI science track is focusing on four case studies: urban waterfronts, tidal wetlands, bivalve shellfish and headwaters. *(IC-Ecological Restoration of Rivers and Estuaries, 11:15am)*

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Lehigh Gap restoration project: Revegetating a Superfund site with native grasses

The Lehigh Gap Wildlife Refuge is a 750–acre tract on the north slope of the Kittatinny Ridge in eastern Pennsylvania. The land is part of the Palmerton Zinc Pile Superfund site, which was devastated by air pollution, erosion, and accumulation of heavy metals – the result of 80 years of zinc smelting. The mountain is moderately to steeply sloped and rocky, making it difficult to access or inaccessible to agricultural equipment. Applying what was learned by USDA-NRCS in reclaiming abandoned mine sites in the northeastern United States, the Lehigh Gap Nature Center, in conjunction with US EPA and the Superfund responsible party, CBS Operations, developed a restoration plan beginning in 2003 planting eleven species of native prairie grasses (mostly warm-season) in 56 one-acre-test plots. Based on the initial success observed in these test plots, full scale planting of the refuge lands and private lands throughout the Superfund site continued through 2006 and included the use of aerial seed applications. The remediation effort has been highly successful, resulting in 400 acres of grassland on the formerly barren slopes. Mapping of plant communities, along with inventories of birds, insects and mammals provide evidence of the return of a functioning ecosystem on the once barren mountainside. Ongoing studies include monitoring total cover, succession, and the ability of the grasses to continue to meet the goals of the EPA Record of Decision for the site. Adaptive management includes invasive species control, introducing native forbs and monitoring browsing using deer exclosures. *(IIB-Ecological Restoration of Terrestrial Ecosystems, 1:50pm)*

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Early detection, rapid response at work in Maryland forests: A case study of wavyleaf basketgrass

Rarely is a new invasive species recognized as such before it becomes an expensive, perhaps insurmountable problem. Wavyleaf basketgrass (*Oplismenus hirtellus* ssp. *undulatifolius*) may be one of those species. In Maryland, this southeast Asian perennial grass was first found in 1996, positively identified in 1999, and rediscovered on public lands in 2006 and 2007. In little over a decade, the infestation had spread from small scattered patches to blanket hundreds of acres of mesic hardwood forest. This discovery prompted state and county agencies, conservation organizations, community and student groups to launch efforts to find, map and eliminate wavyleaf basketgrass, while also trying to learn more about it. We initiated life history studies and designed an extensive herbicide trial. We began an outreach effort to local park users and community groups, including more than 700 private landowners with lands adjacent to the heavily infested regions of the state park. Maryland's Departments of Natural Resources and Agriculture chemically treated over 60 acres of frequently used trails in the state park, to reduce the chance of inadvertent spread by park visitors. Well-organized volunteer removal efforts have nearly eliminated the grass from one regional park, and more volunteers have offered assistance this year. Here we present our practical findings from the first year of an Early Detection Rapid Response effort, and share the lessons learned and progress made. We also extend condolences and any possible assistance to our neighbor to the south, as Virginia reported its first finds of wavyleaf basketgrass in 2008. *(IIIB-Conservation Management, 3:45pm)*

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Initial riparian restoration along an urban stream gradient, Onondaga Creek, New York

The purpose of this study was to investigate riparian plant establishment along an urban stream, with the ultimate goal of restoring self-perpetuating native riparian plant communities. Three sites were selected along a rural to urban gradient on Onondaga Creek, near Syracuse, New York, U.S. Plant communities at these sites were dominated by grasses and forbs. Numbers of species of alien plants increased at more urban sites. The riparian seed bank also showed disproportionate dominance by herbaceous plants at all locations surveyed. Seedlings of native riparian trees nonetheless germinated at all sites along the rural to urban gradient. Recruitment of native riparian species (especially *Populus deltoides, Fraxinus pennsylvanica,* and *Acer negundo*) exceeded non-native and invasive ones. While the data in this study do not address survival of seedlings over the long term, they nonetheless suggest system resilience that could be engaged to promote riparian plant restoration. *(Poster 20, Suburban/Urban Ecology and Restoration)*

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Avian diversity and Wood Thrush habitat quality in small riparian forests of Delaware's Coastal Plain

In the eastern United States, 45% of forest breeding neotropical migrant songbirds declined significantly from 1978-1987; many of which continue. Consequently, the conservation value of remaining riparian forests for breeding birds needs investigation, especially in agriculturally-dominated landscapes such as Delaware. Our objectives were to both compare overall avian diversity and the quality of Wood Thrush

habitat in riparian forest fragments in north-central Delaware. We selected three 12-ha riparian forests and conducted five 10-minute point counts in each during June-July of 2008. We estimated Wood Thrush density and productivity using the spot-mapping procedure and a reproductive index. We analyzed point count data for species richness using the program ComDyn4 and Wood Thrush productivity using the Mann-Whitney *U*-test. An estimated 32 and 29 species occurred in the Steamboat (STE) and Finis (FIN) forests, respectively, while an estimated 16 species occurred in the Upper Blackbird Creek (UBC) forest. Wood Thrush density was 3 males per 10-ha in the UBC forest and 15 males per 10-ha in the FIN forest. Wood Thrush productivity was not significantly greater in the FIN forest compared to the UBC forest. Species richness may be reduced by invasive species like multiflora rose as the degree of rose invasion is greatest in the UBC forest. However, future research coinciding with rose removal and control measures is needed to infer such a relationship. Wood Thrush habitat quality appears greatest in the FIN forest. While habitat quality varies among forests, some small forest fragments likely provide high quality habitat in the region. *(Poster 6, Animal Ecology)*

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Deceptive chemical signals induced by a plant virus attract insect vectors to inferior hosts

The impact of pathogen infection on plant quality and attractiveness to insect vectors is a key aspect of transmission, and the dependence of pathogens and herbivores on a common host creates the potential for both mutualistic and antagonistic interactions. We examined interactions among the non-persistently transmitted pathogen *Cucumber mosaic virus* (CMV), aphid vectors (*Myzus persicae* and *Aphis gossypii*), and cultivated squash *Cucurbita pepo* 'Dixie'. The effects of CMV on host quality for aphids and on plant volatile production were examined in field and greenhouse experiments. Aphid population growth, host preferences, and behavioral responses to plant odors and surfaces were assayed. Our results indicate that CMV induces changes in host plants that enhance initial attraction aphid vectors but lead to rapid dispersal. Infection induces increased production of plant volatiles in a composition similar to that of healthy plants, and behavioral tests demonstrate that this leads to increased attraction of vectors to infected plants. However, experiments examining the fecundity of aphids on healthy and infected plants suggest that infected plants are relatively poor hosts for aphids. Field experiments assessing aphid preference and growth on healthy and infected plants support this result. Behavioral tests in the laboratory demonstrate that aphids emigrate from infected plants at a higher rate than from healthy plants. Collectively, our study demonstrates that CMV induces a deceptive phenotype in *C. pepo* – aphids are more attracted to plants based on odor cues, but then repelled from plants based on contact cues – a behavioral pattern that facilitates transmission of CMV. *(IID-Species Interactions, 1:30pm)*

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Source sink dynamics of anurans in stormwater basins of the New Jersey coastal plain

Stormwater basins are a commonly employed BMP designed to deal with the negative effects of runoff from impervious surfaces. They are ubiquitous in the landscape; yet the effect of these basins on faunal assemblages has not been investigated. Stormwater basins have the potential to influence the breeding distribution of anurans by being sources for some species and sinks for others. Our study aims to determine which species benefit from the existence of stormwater basins, which species are negatively impacted, and what variables are the best predictors of these effects. Thirty-six permanently ponded stormwater basins in southern New Jersey were monitored for the presence of mating adults and anuran larvae by aural surveys, dipnetting and trapping. Fish presence was assessed by interviews, visual encounters, dipnetting, and traps. Vegetation within 100 foot buffer areas was divided into managed and unmanaged categories. Two

connectivity metrics, distance to canopied corridor and percent of undeveloped upland were analyzed with ArcGIS. Resistance to fish predation distinguished successful species, those with larvae present, from unsuccessful species, those with calling activity but no larval presence. Connectivity to and availability of terrestrial habitat were significant predictors of how many species mated at the basins. Number of species increased as access to and amount of terrestrial habitat increased. Therefore, placement of ponded basins near populations of threatened or endangered species susceptible to fish predation is unadvisable. Additionally, as wet basins are sources for *Rana catesbeiana*, in areas where bullfrogs are invasive, basins will likely increase propagule pressure. *(Poster 24, Suburban/Urban Ecology and Restoration)*

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Urban ecology in miniature: spatial analysis of antibiotic resistance in *Enterobacter* spp. isolates gathered from soils of Lancaster City, Pennsylvania

The increase in microbial antibiotic resistance is a major public health concern but is also an interesting ecological phenomenon. Antibiotic resistance in the environment may result from ecological interactions among soil microbes, from anthropogenic application of antibiotics, or from co-selection for resistance to heavy metals (*e.g.* lead, copper, mercury). The relevant importance of each factor is currently unknown. If resistance is related to soil contamination, then urban areas may show high levels of antibiotic resistance. We examined the spatial heterogeneity of antibiotic resistance in an urban environment and are relating observed levels of resistance to soil metal concentrations. We gathered isolates of *Enterobacter* spp. from 26 sites in the city of Lancaster and analyzed them for resistance to ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole. Of the 26 sites, 18 sites yielded *Enterobacter spp.* with 70% or more of the isolates resistant to each antibiotic. Doubling these antibiotic concentrations dropped the average to 47%. In addition to this overall high level of resistance, 4 sites also showed antibiotic resistance in excess of 90% to all three antibiotics at the highest concentrations. In ongoing studies, we are examining soil lead, copper, and mercury content in order to determine whether presence of metals is correlated with drug resistant bacteria. Our analysis contributes to our understanding of urban ecology, both in how human health is impacted by the environment and on the ecological and evolutionary consequences of human activity. *(Poster 25, Suburban/Urban Ecology and Restoration)*

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What are the milestones in recovery of forest communities after deer control is implemented?

To preserve forest habitats damaged by deer, resource managers are increasingly using managed hunting and sharpshooting as control measures. Ecologists have clearly documented cascades of damage by deer and other ungulates, but there are few biological tools to identify and measure how communities recover. This presentation examines methods primarily developed to assess damage, and asks how to use them to find where forest communities revive. My focus is on the 1,500 acre Jug Bay Wetland Sanctuary where deer hunting will resume in fall 2009. Some Sanctuary areas are severely overbrowsed while others are moderately damaged. Searches in a severely overbrowsed one hectare area found zero seedlings and saplings <2 meters of any browse-sensitive tree species. In five canopy gaps, surveys found <6 individual tree seedlings of 4 species, no 1 m saplings, and few sensitive herbs. Even in an area that was hunted up to 2000, by 2007 searchers found adult red oaks in 37 10x10 m plots, but 31/37 plots lacked saplings.
I will discuss the following five assessment studies: 1) Ripple and Beschta found far fewer frogs, butterflies, young trees, and hydrophytic plants at overbrowsed streams than controls. 2) Stout, deCalesta recorded forest regeneration and invasives using transects. 3) Pedersen measured canopy gap traits and deforestation from below. 4) deCalesta, Shea determined which birds are most sensitive to deer overbrowsing. 5) Tallamy clarified which plant species contribute most to insect diversity and biomass, thus

sustaining birds. The goal is to learn exactly where forest communities are again self-sustaining. *(IIIB-Conservation Management, 3:05pm)*

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Utility of fluctuating asymmetry in caddisflies (trichoptera) as an indicator of coastal wetland health in Lake Erie

Fluctuating asymmetry (FA) in caddisflies can serve as a tool to determine ecosystem stress. Eight Lake Erie coastal wetlands were sampled to determine if biotic differences between impacted and un-impacted wetlands of two types (protected embayments and open lacustrine wetlands) could be detected. Adult caddisflies were sampled with modified UV light traps. *Hydroptila waubesiana*, *Agraylea multipunctata*, and *Oecetis cinerascens* were the most abundant trichopterans collected. We investigated whether levels of FA in the three species are correlated with wetland quality. Species richness and diversity are common measures of wetland health. We calculated the diversity and richness of caddisflies for wetlands of differing quality to investigate how FA correlates with these measures. We assessed whether habitat generalist species, such as *H. waubesiana,* exhibit less symmetry than habitat specific species, such as *A. multipunctata*. Measurements of the FA on the length of three morphological characters were assessed, 1) front tibia, 2) front wing costal vein, and 3) antennal scape. In order to calculate FA, the absolute value of log right measurement minus log left measurement were taken for each character (FA=/logR-logL/). There was a significant increase of FA in the tibial length of *H. waubesiana* in impacted wetlands, implying that FA in *H. waubesiana* may be useful as an indicator in wetland quality. Neither character in *A. multipunctata* or *O. cinerascens* exhibited a significant difference in FA between unimpacted and impacted wetlands. There is no evidence that habitat specialists are more susceptible to asymmetry than habitat generalists. *(Poster 8, Animal Ecology)*

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Urban soil characteristics in Baltimore County (URDL), and how they compare with soils in Baltimore City and Washington, D.C.

The Urban-Rural Demarcation Line (URDL) was established in 1967 by Baltimore County to protect rural land and to concentrate urban development within growth corridors. In the summer of 2007, the U.S. Forest Service with cooperation of the Baltimore County Department of Environmental Protection and Resource Management (DEPRM) established 200 UFORE plots within the URDL to measure vegetation structure and characterize urban soils. We present here the soil data from 150 of the 200 plots and compare these data to soil data collected from Baltimore City and Washington, DC. Soil samples in all three areas were collected at 0-5 cm and analyzed for Ag, Al, As, Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, P, Pb, Tl, Zn, K, Ca, Mg, NO3, organic matter, and pH. The spatial distribution of these characteristics was examined based on the following 9 land-use classifications: commercial, forested, industrial, institutional, multi-family residential, open space, residential-large lot, residential-small lot, and transportation. Results suggest that overall metal concentrations were significantly lower in Baltimore County compared with Baltimore City and Washington, DC. In addition, the nutrient status of the URDL soils fell within the range of most horticultural and native plant species. Differences were found across the land-use types with concentrations of residential-large lot plots having higher concentrations of Al, P, Fe, and Co and lower pH than the other types. *(Poster 26, Suburban/Urban Ecology and Restoration)*

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Optimizing direct polymerase chain reaction (PCR) with germinated smut fungus (*Sporisorium ellisii*) teliospores, for use in ecological studies

Plant pathogens can strongly affect plant populations by influencing the structure and dynamics of natural populations and by decreasing crop yield and quality, yet they have received far less attention from ecologists than have herbivores. In many cases, little is known about even the most fundamental aspects of fungal pathogen ecology, such as the in situ life cycle and basic population genetic features. *Sporisorium ellisii* is a smut fungus (Phylum Basidiomycota, Order Ustilaginales) that infects populations of the common, old-field perennial grass *Andropogon virginicus* in its native range within the eastern United States. Infection can cause host sterility and mortality. A goal of our laboratory group is to document the population genetic structure of *S. ellisii* within and among individual host plants, populations, and regions. Currently, nothing is known about genetic variation in this ecologically important fungal pathogen. Identification of DNA markers in fungi traditionally requires costly and time consuming DNA extraction from slow-growing fungal cultures or scarce teliospores, prior to PCR. We are optimizing a new technique to perform PCR directly on newly germinated teliospores, without first culturing the fungus and extracting DNA. The direct PCR method is most successful when three germinated, one-day-old teliospores are used per reaction. Single germlings produce unacceptably inconsistent results. If all teliospores within an individual host are genetically identical, the three-spore direct PCR method will enable very efficient and inexpensive genetic data collection at the multiple-population scale, making this technique very useful for fungal pathogen population genetics. *(Poster 16, Plant Ecology)*

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Human accessibility affects habitat use preferences and movement patterns of suburban white-tailed deer

We monitored habitat use preferences and movements of seven individual white-tailed deer (*Odocoileus virginianus*) fitted with GPS/GSM radio-collars in the Pennypack Ecological Restoration Trust's natural area preserve and its surrounding residential, industrial and commercial developments located 15 miles northeast of central Philadelphia, PA. The preserve contains a mixture of mature forests, regenerating woodlands, riparian forests, and fields of cool- and warm-season grasses. The preserve is open to the public from dawn to dusk and the Trust sponsors a deer hunt during the state-sanctioned hunting season. We have collected over 65,000 GPS fixes from the monitored deer and analyzed their movement with respect to land ownership, habitat parcel size, and the ability of the public to visit the various parcels. The monitored deer preferentially spent the daylight hours on private lands outside the preserve, although in some cases the deer also used the preserve's grasslands. The deer spent the nighttime hours in unmown grasslands and shrub stands, which are common habitat features of the preserve. The daily movement patterns also demonstrated two peaks of activity that alternated with periods of relative quiescence. Taken together, our results suggest that one factor that influences deer habitat use and movement is human accessibility to the lands. *(Poster 28, Suburban/Urban Ecology and Restoration)*

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Habitat restoration in a suburban preserve from the perspective of white-tailed deer

The Pennypack Ecological Restoration Trust is a private, non-profit conservancy located 15 miles northeast of central Philadelphia. The Trust manages 771 acres of meadows, woodlands and floodplain forest in the Pennypack Creek valley. For two decades, the Trust has been engaged in restoration of native woodlands and grasslands, which, to date, encompass 0.99 km^2. We monitored the movement of seven individual white-tailed deer (*Odocoileus virginianus*) in the preserve that were fitted with GPS/GSM radio-collars, and analyzed movements of the deer with respect to habitat restoration type and movement type (i.e., encamped vs. transiting). The high rate of location fixes provided by the collars offered an accurate method for evaluating habitat preferences. All monitored deer came across restoration plots but appeared to avoid staying in the plots for long periods of time. Three deer (two females and one male) spent a significant amount of time (up to 32%) on overgrown grassland plots. Woodland restoration plots were frequented at a much lower rate (average 1.1, range 0-4% fixes). These data suggest that reasonable protection such as tubing and keeping grass and shrub mown can keep deer away from restoration plots. *(Poster 29, Suburban/Urban Ecology and Restoration)*

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Using cross-system comparisons as an approach to study urban effects on soils: A case study of three urban metropolitan areas

An overarching theme in urban ecological theory implies that anthropogenic drivers will dominate natural drivers in the control of ecosystem response variables. We investigated the effects of a natural soil forming factor (parent material) vs. anthropogenic factors (urban environment) on the chemical properties of forest soils in the metropolitan areas of Baltimore, New York (NY), and Budapest. We hypothesized that soils in forest patches in each city will exhibit changes in chemistry corresponding to environmental changes along urbanization gradients. Moreover, differences in parent material and development patterns would differentially affect the soil chemical response in each city. Results showed that soil properties varied with measures of urban land use in all three cities, including distance to the urban core. Moreover, the results showed that the spatial extent and amount of change was greater in NY than in Baltimore and Budapest for Pb, Cu, and to a lesser extent Ca. The spatial relationship of the soil chemical properties to distance varied by city. In NY, concentrations of Pb, Cu and Ca decreased to background concentrations at 75 km from the urban core. By contrast, concentrations of these elements decreased closer to the urban core in Baltimore and Budapest. Moreover, a threshold was reached at 75% urban land use, above which concentrations of Pb and Cu increased by more than twofold relative to concentrations below this threshold. Results suggest that forest soils are responding to urbanization gradients in all three cities, though characteristics of each city influenced the soil chemical response. *(IB-Urban Ecology, 11:15am)*

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The impact of commercial logging operations on Timber Rattlesnakes (*Crotalus horridus*)

Forest management practices directly impact large parcels of land that serve as habitat for Timber Rattlesnakes (*Crotalus horridus*), a species of conservation concern throughout the eastern United States. This research assessed the behavioral response of *C. horridus* to commercial logging activities and the impact of such activities on a *C. horridus* population in northcentral Pennsylvania. The project utilized radiotelemetric monitoring of 67 individual snakes over periods of up to four years, mark and recapture of 306 snakes, and search/survey efforts before, during, and after commercial logging operations on three timber sale parcels (totaling 154.2 ha). The location and timing of timber sales created the maximum opportunity for the interaction of snakes with logging operations and with altered habitat. The impact of the logging operation on rattlesnakes at the study site was minimal. Direct mortality of snakes was very low (< 2% of the population/year). Logging activity and the resulting habitat changes did not alter the behavior or movement patterns of monitored snakes. Timbering increased the structural diversity of the habitat and, concurrently, the diversity of habitat used by *C. horridus* increased. Experimental canopy removal at designated sites successfully created basking habitat that was rapidly utilized by rattlesnakes. The results suggest that the opportunity exists to develop forest management practices that provide timber products while maintaining, and even improving, *C. horridus* habitat. *(IIC-Animal/Disturbance Ecology, 1:30pm)*

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Relaxation rate: A consistent metric for linking habitat fragmentation to extinction threat

Habitat fragmentation is one of the primary threats to biodiversity. Satellite imagery is providing increasingly detailed information on habitat distributions, yet efficient techniques for linking these data to species survival are in short supply. Starting with metapopulation theory, we compared two methods of making this link: 1) metapopulation capacity and, 2) relaxation rate. We tested our methods on threatened and non-threatened birds from four regions around the world (the Sichuan province of China, the highland forests of northern Central America, the Eastern Malagasy Wet Forests of Madagascar and the Atlantic Forest of Brazil), using satellite-based estimates of original and remaining forest habitat. We compared our results against current IUCN Red List threat classifications due to fragmented range (Criterion B). We found that our calculations correlate fairly well with the IUCN's current listings of threat status, however we discuss a number of outliers that may require reevaluation. Finally, we use the metrics to evaluate the impact of restoring different areas of the original range on the species as a whole. *(IIC-Animal/Disturbance Ecology, 1:50pm)*

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Distribution of Rusty Crayfish (*Orconectes rusticus*) in the Monocacy River, MD, in relation to water quality variables

The Rusty Crayfish (*Orconectes rusticus*) is an aggressive species from the mid-western U.S. that has been invading aquatic ecosystems in the eastern U.S. for some time. Its discovery for the first time in Maryland in the Monocacy River in 2007 prompted an investigation to determine the rate of expansion of *O. rusticus* in this new habitat along with the water quality variables that may be related to its success. Crayfish were captured with a kicknet at seventeen sites along the mainstem and in five tributaries in October of 2007 and 2008. Water samples were collected from the same locations in June and October 2008. *O. rusticus* was found only in the six northernmost sites and in none of the tributaries on both sampling dates suggesting that its range expansion is stalled. *O. virilis,* which is abundant in the middle portion of the river, is much

less abundant when *O. rusticus* is present, suggesting a competition effect. The physicochemical parameters that exhibited the highest correlation with *O. rusticus* relative abundance were temperature (r = -0.77), dissolved reactive phosphorus (DRP; r = 0.52), total dissolved phosphorus (TDP; r = 0.69) and total suspended solids (r = -0.55). The effects of DRP and TDP, if any, on *O. rusticus* are expected to be indirect. Higher levels of phosphorus may lead to greater primary productivity in the upper portion of the river which may provide a selective advantage to *O. rusticus* over *O. virilis*. *(IIIC-Stream Ecology, 3:45pm)*

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Windstorms, white-tailed deer, exotic plants and bigger trees: The perfect invasion

Remnants of Hurricane Isabel damaged patches of forest canopy in central Maryland in September 2003. We surveyed the herbaceous layer in 400 5x5 meter quadrats in a pre-existing forest plot following Isabel in 2003 and in subsequent years. Exotic plants were able to exploit the increased light available at the forest floor and increased both species richness and abundance. Using 24 exclosed and open quadrats, we determined that preferential herbivory of native species by white-tailed deer facilitated the spread of exotic plants.

Remnants of Hurricane Ivan damaged forest in Catoctin Mountain Park in September 2004. A paired exclosed-open plot experiment in 14 blow downs confirmed that preferential deer browse benefitted exotic plants. Half of the forest gaps were treated with herbicide by National Park Service Exotic Plant Management Teams in 2005, 2006, and 2007. Herbicide application did not significantly reduce exotic plant cover in the gaps; weed treatments were ineffective. Excluding deer significantly reduced exotic invasion and increased cover of native plants.

A survey of the pattern of tree damage from Hurricane Isabel suggested that larger trees were more susceptible to wind damage. As forests in the Mid-Atlantic age and individual trees grow larger, wind damage will become more common. The exuberant response of exotic plants to canopy damage and the conducive effect of deer browse suggest that forests in the region will become more heavily invaded by exotic plants. Herbicide application, the most frequently used exotic plant management tool, may be ineffective in forests with high deer populations. *(IID-Species Interactions, 2:30pm)*

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Paleoecological evidence for herbaceous wetland communities and their dynamics in the Delaware River floodplain

Ecological restoration seeks to reestablish natural plant and animal communities where they have been disturbed, usually by human activities. The evidence for the prior existence of these communities is often sketchy, as many were changed beyond easy recognition before there was any effective documentation of their composition, or often even precise location. We must rely on general descriptions, the ecology of less disturbed surviving communities and basic ecology of native species that flourish in a given environment. Paleoecology of northeastern North America provides evidence of extensive forest, with very little evidence for herbaceous species before the arrival of European settlers who cleared the forest. Some slight increases in herbaceous taxa such as *Ambrosia* may indicate the advent of maize agriculture in the 500 or so years before massive clearing, and some palynological studies of riverine wetlands show some evidence of more herbaceous species. In this study, I will present evidence for extensive, dynamic, herbaceous and shrub wetland plant communities in the area of the Trenton marshes from 8000 to 4000 years before the present. This is the first evidence of the persistence of this kind of vegetation for such long time periods, and suggests the unique kind of conditions that provided habitat for these communities during the Holocene. *(ID-Wetland Ecology and Restoration, 10:55am)*

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Enhancing rain garden design to promote nitrate removal: Testing a media carbon amendment

Rain gardens effectively remove some stressors from stormwater, in particular heavy metals, phosphorus, and oil and grease, but in most cases they show much smaller removal rates of nitrate. This is likely due to the high sand and low organic matter content specified for rain garden media. These properties promote stormwater infiltration, but they inhibit nitrate removal by denitrification, a microbial process that requires anoxic conditions and a source of labile carbon. EPA's pilot-scale research explores the use of shredded, unprinted newspaper as a carbon source to fuel denitrification. A bench-scale experiment was conducted to test the drainage capability of media containing shredded newspaper layers. Stormwater was introduced at low and high rates to bins containing zero, one, and two layers of newspaper at varying depths. While there were differences in effluent volumes and flow rates between control and newspaper treatments, surface ponding occurred in all three treatments, suggesting that some other factor besides the newspaper had an effect on drainage properties. Grain size and clay mineralogy analyses indicated the migration of finer particles into the deeper soils which could have inhibited drainage, particularly because one of the minerals contained in the clay, illite, may become gel-like when saturated. The larger, pilot-scale study is currently being designed to test the effects of shredded newspaper, the presence of a deep saturated zone, vegetation type, and hydraulic conductivity on the nitrate removal capacity of rain garden media. *(IB-Urban Ecology, 11:55am)*

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A comparison of greenroof and tar roof runoff hydrographs for storms of varying size in Baltimore

Greenroofs are rooftop gardens that are being planted in cities in order to address a number of environmental concerns including excessive stormwater runoff. In Baltimore, for example, new buildings must retain one inch of stormwater on site in order to be permitted; greenroofs are now considered an acceptable technology to achieve this requirement by the Maryland Department of the Environment. However, little is known about how greenroofs perform during storms of varying size and frequency. Weirs were installed at the downspouts of both a control and a greenroof in the late summer of 2008 in the Herring run watershed. Hydrographs depicting runoff from both roofs were compared. Stormwater retention by the greenroof ranged from 30% to 75% for storms of increasing size compared to minimal retention by the control roof. Implications for this variation at the watershed scale are considered. *(Poster 23, Suburban/Urban Ecology and Restoration)*

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Evaluating and restoring grassland resources for the regal fritillary butterfly (*Speyeria idalia* Drury)

Eastern grasslands are one ecosystem that has seen a severe decline in overall quality and quantity. This decline has had a detrimental effect on many of the species that rely on this disturbance-dependent habitat. One of these species is the regal fritillary butterfly which has seen an extreme contraction of its range since the 1970's. One of the only two remaining populations in the East is found at Fort Indiantown Gap (FIG) in Annville, PA. To preserve this rare species a repatriation effort has been initiated to return the regal to localities having a historic or probable occurrence. To increase the chances of a successful repatriation sites have been selected based on existing vegetative characteristics and support from potential partners. FIG staff initiated baseline monitoring plots and developed management plans for each of the current partner sites. Restoration began at two locations and is set to begin at the remaining sites in 2009. This talk will

describe methods used to develop baseline habitat requirements, the use of local eco-type seed to conserve genetic integrity, and the evaluation techniques of selected repatriation sites. Essential habitat components for the regal at each of the partner sites were in general significantly deficient. How these findings influenced the restoration methods and management plans will be reviewed. *(IIB-Ecological Restoration of Terrestrial Ecosystems, 1:30pm)*

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Comparative thermal ecology of sympatric pond turtles and water snakes

The thermal environment of an ectotherm plays a major role in its behavior. Many species of ectotherms have been observed exhibiting behaviors that aid in maintaining a desired body temperature and activity level. Often, populations of different species of ectotherms share the same habitat, yet utilize the thermal environment differently. In this study, the different ways that individual reptiles utilize the same habitat to meet their thermal needs was investigated. Temperature data from two Northern Water Snakes (*Nerodia sipedon*), two Painted Turtles (*Chrysemys picta*), and one Red-eared Slider (*Trachemys scripta elegans*) were collected via radio telemetry. Animal temperatures were compared to environmental temperatures to investigate how different individuals utilize their thermal environment. *N. sipedon* was found to display a variable tendency to thermoregulate, displaying both thermoconforming tendencies and some levels of thermoregulation. Both *C. picta* and *T. s. elegans* were found to thermoregulate much more consistently than *N. sipedon*, maintaining relatively narrow ranges of temperatures at a variety of environmental temperatures measured. One *C. picta* and one *T. s. elegans* (both female) maintained either a narrow set of high temperatures or a narrow set of lower temperatures at a range of environmental temperatures. *(Poster 4, Animal Ecology)*

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Claw morphology in *Sceloporus* spp.

Lizard claw and toe morphology are expected to reflect the niches utilized by the species. As a preliminary part of a larger study, we examined variation in toe and claw morphology of the Mountain Spiny Lizard (*Sceloporus jarrovii*), a predominantly saxicolous species. It frequents rocky areas and unlike other members of the *Sceloporus* genus, is not typically found on trees or the forest floor. Another species included in the study is *Sceloporus virgatus*, the Striped Plateau Lizard. This lizard's choice of varied microhabitats in the same general vicinity of a congener suggests specialization to a different substrate. Toes of adult and juvenile lizards of both sexes were photographed and measured using Image J software. Comparison of claw length, angle, and height of claw among individuals of *S. jarrovii* females revealed no significance when correlated to Snout-Vent-Length. *Sceloporus jarrovii* males revealed a positive correlation with toe nine height and claw thirteen. angle to SVL. There is an inverse relationship of claw angle in toe three to SVL. The study will be expanded to include other members of the *Sceloporus* genus and the information gathered will be used to test the hypothesis that claw and tail morphology are related to patterns of microhabitat use. *(IIC-Animal/Disturbance Ecology, 2:30pm)*

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A Tier III, EFH approach to evaluating the functional ecology of *Phragmites*-dominated marshes

By one pathway or another, organic matter from tidal salt marshes is made available to the trophic spectrum of juvenile transient and resident finfish *in situ* and in open waters of the estuary. The estuarine dependent life history strategy that characterizes so many of these taxa can be evaluated in the context of essential fish habitat (EFH) by integrating factors that affect survival and well-being during the first year of life. Foremost among these are the tradeoffs between size and the risk of predation, the bioenergetics of reproduction, and in northerly climes, the ability to survive the winter. In work comparing functional ecology in *Phragmites* versus *Spartina*-dominated salt marshes in the Hudson River estuary, stable isotopes and biochemical condition factors were used to infer habitat value for the common mummichog, *Fundulus heteroclitus.* The focus of this research was to compare the ability of individuals in the two marshes to lay down sufficient energy reserves for growth, reproduction and/or overwintering. The utilization of a specific lipid classes, primarily TAG proved to be a sensitive measure of energy allocation to growth and/or long-term energy stores. *(ID-Wetland Ecology and Restoration, 11:35am)*

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Native vegetation classification system (nvcs): On-the-ground application of the nvcs and planning for the future

Natural communities are unique assemblages of plants and animals that reoccur within specific environmental settings. These unique assemblages can reflect ecological conditions at a scale broader than the species' population, yet more refined than the landscape. *The Guide to the Natural Communities of the Delaware Estuary* describes 35 ecological systems and 185 natural community types known to occur in the region. The Guide also contains a cross-walking table between the NVCS classification and the New Jersey, Pennsylvania and Delaware state classification; therefore, assisting in regional resource management, conservation and restoration. Over the past two years, the Partnership has worked with NatureServe and the Nature Conservancy to prepare comprehensive maps of the ecological systems across the Delaware Estuary Program's study region, including areas of Delaware, New Jersey and Pennsylvania. Initial maps have been completed for the watershed in Delaware, New Jersey, and the Brandywine River area of Pennsylvania, and this work continues in Pennsylvania. In addition, an *Addendum to the Guide to the Natural Communities of the Delaware Estuary* has been drafted and will soon be finalized. In addition to the ecological systems maps and guide, two on-the- ground demonstration projects for the Native Vegetation Classification System (NVCS) were completed in fall 2008 to show how restoration targets can be set based on native plant communities. More restoration projects and additional NVCS applications are planned for 2009. *(Poster 18, Plant Ecology)*

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Stand thinning and the reintroduction of a diverse assemblage of native tree species in a young secondary forest in the Peruvian Amazon

Basic knowledge about reintroducing native, late-successional tree species into secondary forests in the Amazon basin is sparse. I examine the use of stand thinning as a technique for aiding the active reintroduction of a diverse assemblage of native tree species in one young successional forest in northeastern Peru. Specifically, I monitored juvenile growth and survivorship of seventeen native tree species across an experimental canopy gradient that I created by implementing seven 144 m^2 replicates of each of four levels of stand thinning treatments (no trees removed, 60% stand basal area removed, 80%

stand basal area removed and 100% stand basal area removed). Seedlings were established from seeds, and plants were monitored monthly for 13 months, and then at six, ten and fourteen years following establishment. Results suggest that the potential for tree reintroduction is substantial. By fourteen years of age, individuals of 12 of the 17 study species had grown to at least 15 m height. Stand thinning was critical for 14 species, indicating that management strategies that do not include canopy thinning will likely fail. The optimal levels of canopy openness varied among species, however, which suggests that the implementation of stand thinning in ways that create spatially heterogeneous forest canopy structure is needed to promote the successful reintroduction of diverse tree assemblages. Small landholders in the region are combining conclusions from this study with their general knowledge of tree management as they seek to develop effective strategies for managing native timber species in young secondary forests. *(IIB-Ecological Restoration of Terrestrial Ecosystems, 2:10pm)*

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Pursel Mill Dam removal: Balancing ecological restoration and historic preservation

The Pursel Dam, located on the Lopatcong Creek in Warren County, NJ was breached in April 2006. The dam was a first blockage on the Lopatcong Creek, a protected C-1 waterway and trout production tributary of the Delaware River, the longest non-dammed river east of the Mississippi. The dam is part of the Morris Canal, a national historic site, and was retrofitted to provide water power to a gristmill till 1945. In 2001 NJ Dam Safety identified this dam as a Significant Hazard structure in need of substantial repairs. The cost to repair was estimated to nearly $600,000 whereas breach and deregulation of the dam was estimated at nearly half the cost. In addition, financial assistance was secured from several habitat restoration programs through the NRCS, NJDEP, and, NOAA and American Rivers. Permits were required from NJDEP (Dam Safety, Land Use Regulation Program, and Historic Preservation) and County Soil Conservation District approvals. A step pool system was designed to transition the stream elevation while providing fish passage for local species. The key to project success was balancing goals of aquatic organism passage with the need for historic preservation. Construction of the project was completed in early May 2006. *(Poster 12, Aquatic Ecology and Restoration)*

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Dam removal, geomorphic response and restoration design

Two dams on the Musconetcong River in northern New Jersey have been removed in 2008 and 2009 as part of a watershed-wide effort to remove or breach all major obstructions to reconnect river habitat and create passage for cold water fish, migratory fish and other aquatic organisms. The Musconetcong is a state designated trout maintenance river with major segments federally recognized as Wild & Scenic. A broad base of watershed partners includes environmental nonprofits, municipalities, and, state and federal agencies that collaborated on project goals and funding. The first removal required the installation of boulder rock vanes that would stabilize sediment, direct flow away from infrastructure, allow fish passage and blend in with the character of the waterway using native boulders. The second removal involved stabilization of a failed bank and restoration of a cobble-bottom channel. Both projects necessitated field changes to ensure ultimate success. Several miles of river habitat have been reconnected and sediment transport regime has been restored. *(Poster 11, Aquatic Ecology and Restoration)*

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Clonal diversity and resistance to invasion in remnant salt marsh patches dominated by *Spartina patens*

Restoration efforts are attempts at creating and assembling local communities that have vanished. Recent studies have shown the importance of using local ecotypes of species as building blocks in these assemblies and the need of including information on genotypic differentiation has been stressed. Large portions of brackish east coast marshlands have been invaded by non-native, European genotypes of the common reed, *Phragmites australis*. As a result, only a small fraction of the NJ Hackensack Meadowlands is now dominated by native marsh species and only isolated patches of *Spartina patens* remain. As these patches vary in size and seem to resist encroachment by *Phragmites* differentially, we are investigating (a) whether larger patches are able to resist invasion more than smaller patches and (b) whether large-patch clones are better suited for restoration efforts. In a combined approach that includes surveys of permanent transects, common garden transplant experiments and genetic analysis, we are monitoring border dynamics and assess genetic identity and performance of clones of different patch sizes. Current results of the ongoing project indicate that (a) border zones between the invader and *Spartina* tend to be more defined in large *Spartina* remnant patches than in small patches, and (b) *Spartina* increases in dominance at large-patch borders but decrease in small-patch borders. There appears to be large genetic differences between adjacent large- and small-patch clones that are often more pronounced than differences between clones of different regions. In contrast, small-patch clones grow faster than large-patch clones in a common garden setting. *(Poster 13, Aquatic Ecology and Restoration)*