RESTORATION ON THE EDGE

Exploring the Frontiers of Restoration, Collaboration, and Resilience in Changing Ecosystems

Session III – Concurrent Contributed Papers on Assorted Topics

Room A: Coastal Restoration

Room B: Urban Restoration

Room C: Successes, Failures, and Current Status of Restoration Projects

Hudson River Sustainable Shorelines Project: Promoting Ecological Resilience and Sustainable Shorelines in an Era of More Rapid Sea Level Rise

Betsy Blair
New York State DEC, Hudson River National Estuarine Research Reserve

Along the Hudson River Estuary's 300 miles of shoreline, communities are experiencing increased flooding from changing rainfall patterns and greater inundation from rising waters. Pressure is growing to alter shorelines to hold back the waters and control erosion, and community leaders, regulators, landowners, and funders are faced with important decisions about investments in shoreline infrastructure. These decisions will affect community waterfront use – and determine the future of vital near-shore river habitats.

The Hudson River National Estuarine Research Reserve, with the involvement of many partners, launched the Sustainable Shorelines Project in 2008 to provide science-based information about the engineering, economic, and ecological tradeoffs among shoreline management options, given likely future conditions. New work is focusing on how aspects of structures can be manipulated, such as the roughness of the substrate used and the vegetative cover, to increase ecological benefits. The project will also increase our understanding of how physical forces are reshaping shorelines, develop innovative shoreline demonstration sites, and integrate project results into a decision support tool.

The project's collaborative approach involves diverse stakeholders to identify priority information needs, respond to project findings, and shape products and tools. Local government officials, shoreline experts and consultants, shoreline land owners, policy-makers, regulators, engineers, and others shape and guide the project by participating in advisory committees, focus groups, surveys, and case studies.

Project findings are being used to make decisions about community waterfronts, regulatory and land use policies, shoreline development and long-term plans that will allow important natural shore zone areas to exist into the future.

Betsy Blair has managed the Hudson River National Estuarine Research Reserve's research, education, and stewardship programs since 1985. Beginning in 1992, she has also overseen a variety of other New York State Department of Environmental Conservation habitat programs on the Hudson River Estuary and Long Island Sound, including habitat restoration, submerged aquatic vegetation and river bottom mapping initiatives, functional assessment projects, tidal wetlands research, and public education and outreach programs. She leads the interdisciplinary Sustainable Shorelines Project team, which is working with scientists and user groups to develop science-based shoreline best management practices that sustain or enhance ecological values, while being cost-effective and appropriately engineered for changing conditions that result from climate change. A graduate of Tufts University and the Yale School of Forestry and Environmental Studies, she previously worked on resource policy issues, wetlands mapping, and forest ecosystem research projects, and as a foreign fisheries observer in the Bering Sea. She recently received the National Oceanic and Atmospheric Administration's Excellence Award for Ocean and Coastal Resource Management.

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The Theory and Practice of Seagrass Restoration: Lessons Learned over the Last 20 Years in New York

Chris Pickerell
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Seagrass losses have been widespread and dramatic worldwide. Studies have indicated that this large-scale loss of habitat has led to alternative stable states where natural re-establishment of native species may not be possible unless some minimum size or density thresholds are met. This situation has been described as a catastrophic shift between two stable states (e.g., vegetated meadows vs. unvegetated bottom) where natural recovery and/or restoration attempts have failed in spite of generally favorable habitat suitability. On closer examination, these altered systems appear to be limited by one or more biotic (e.g., bioturbation) or abiotic (e.g., current velocity, wave energy, water clarity, water temperature, etc.) thresholds caused by severe changes to the environment that prevent colonization by the seagrasses that naturally occurred prior to the disturbance or loss. In terrestrial and marsh systems this condition can lead to colonization by novel species (both native and non-native), but in seagrass ecosystems, in particular, this change often results in total loss of this habitat type and the associated ecosystem services it provided. When this occurs, local species diversity and the overall carrying capacity and productivity of the near-shore environment can be severely impacted. Given the importance of seagrass ecosystems and the fact that they are declining worldwide, it would seem appropriate that every effort be made to protect remaining meadows and, where losses have already occurred, take action to restore these meadows if possible. The Cornell Cooperative Extension Marine Program has been actively involved with restoration and monitoring of local eelgrass (*Zostera marina*) meadows in New York waters for the last 20 years. Over this time we have built a successful program and gained valuable experience relating to a number of practical factors, ranging from site selection and planting method to timing that affect restoration success. This talk will provide a general overview of these lessons learned in a way that relates to additional species of Submerged Aquatic Vegetation in both brackish and freshwater environments.

Chris Pickerell has over 19 years' experience in coastal habitat monitoring and restoration. His primary focus has been on eelgrass (*Zostera marina*). Recent work has involved developing innovative seagrass restoration methods for high energy and exposed sites as well as the use of land-based volunteers to enhance restoration efforts.

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A Case Study of Seven Presidents Oceanfront Park and Achieving Breeding Success for Threatened and Endangered Species

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Monmouth County (NJ) Park System

Seven Presidents Oceanfront Park is a 40-acre park within the City of Long Branch, NJ. Part of the Monmouth County Parks System and located on the Atlantic Coast, this Special Use Area has tremendous pressure to provide public access to the water resource, with 480,000 visitors a year, yet manages to share this critical coastal habitat with a variety of Threatened and Endangered Species. This 10-year-old project strove to transform a 'white bread beach' into a park where 'Natural beach processes were allowed to prevail' amidst the thousands of beach users. The original intention evolved into a complex plan involving the public, Park administration and staff, researchers and Federal and State coastal regulators and Endangered Species Program staff, not to mention providing the requirements of the many species themselves.

The restoration of a functioning coastal ecosystem involved applying evolving biological sciences in a social and political environment. The partnering with University researchers to understand the latest science provided support to propose radical measures to State and Federal Regulators to achieve the common goal of species breeding success while working to maintain the support of administration and staff for sharing this valuable real estate. This all in an ever-changing and dynamic coastal environment with all the challenges of being surrounded by a highly urbanized environment of invasive species, human activity, and challenges of actually implementing on the ground actions.

This presentation will show how this project was initially implemented and then how it adapted to evolving science and worked with the regulatory environment to achieve success not only for the species themselves, but provided value to the public and park management as well.

Note: This paper pertains to re-establishing landscape connectivity by using the evolving species science to model applications on the ground and to gain sanctioning by regulatory agencies. The success of this project evaluated the failures along the way and adapts the plan to improve success. This project also shows how value can be made to public and management interests while achieving restoration objectives.

Ken Thoman, a certified Professional Wetland Scientist, serves as the Parks Resource Manager for the Monmouth County Park System in New Jersey. For 24 years he has coordinated the development of management and restoration plans for over 15,000 diverse acres that form the parks landscape today.

The plans include inventories, evaluations and strategies for managing field, forest, and aquatic habitats and strive to provide maximum benefit to wildlife and human populations in the most efficient manner.

With a B.S. from Cornell University, he previously managed designated Wilderness Areas in Colorado, during the formative years of this National initiative.

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Salt Marsh and Seaside Sparrows of Saw Mill Creek Park, Staten Island

Nate McVay
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A census of breeding populations of the Salt Marsh Sparrow (*Ammodramuscaudactus*) and Seaside Sparrow (*Ammodramusmaritimus*) was conducted by NYC Parks and Recreation – NRG ecologists during the 2011 breeding season at Saw Mill Creek Park. The park has 95 total acres of salt marsh including the successful addition of 15 acres through a berm removal restoration finished in 2007. Saw Mill Creek, situated on the edge of the Arthur Kill tidal straight, has also received several previous restoration efforts to both high and low tidal marsh in the last two decades. Results of avian surveys from 1992 to 2006 indicated a strong population of Salt Marsh and Seaside sparrows when compared to salt marshes in surrounding region, and justified a closer examination, especially in light of regional concerns about the viability of populations of salt marsh-breeding sparrows. The nests of both species are well concealed and locating nests can be a significant challenge. All sparrow nests found in 2011 were GPS mapped and a strong association was observed between location of nests and the proximity to the edges of mosquito ditches and small tidal creeks. With the low number of sparrows observed in marshes with few ditches, the conclusion has been made that sparrows prefer nesting in marshes with greater access to a two meter zone on either side of a mosquito ditch or creek. These results suggest that blocking or filling of mosquito ditches as a restoration technique may be detrimental to these sparrow species, and studies in additional ditched and restored marshes are warranted.

Nate McVay has served in multiple capacities with the New York City Department of Parks and Recreation, Natural Resources Group since 1998. Currently in a role as Research Ecologist, he participates in monitoring diverse populations of biota throughout the natural areas of the five boroughs of New York City. Most recently he has brought a focus to a thriving population of Sparrows found in a salt marsh on Staten Island.

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Sand as a Substrate for Restoring Coastal Upland Habitat Mosaics including Grassland, Scrub, and Forest

Michael Feller
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Between the 1930s and 1970s the city destroyed 90% of its wetlands – tens of thousands of acres – by filling them with household trash (sanitation landfill), construction and demolition debris (C&D landfill), and sand (ocean dredge spoils). Each landfill type resulted in a characteristic vegetation community as follows:

- Vegetation on sanitation landfills is dominated by dense, tall stands of common reed, (*Phragmites australis).*
- C&D landfills are characterized by a mosaic of plant communities dominated by mugwort (*Artemesia vulgaris*), white mulberry (*Morus alba*), black locust (*Robinia pseudo-acacia*), and tree of heaven (*Ailanthus altissima).*
- Among the three landfill types only ocean dredge spoils are dominated by native plants: forb-rich grasslands dominated by warm season grasses including switchgrass (Panicum virgatum), little bluestem (Schizachyrium scoparium), broomsedge (Andropogon virginicus); scrub dominated by bayberry (Morella pensylvanica) and beach plum (Prunus maritimus); and coastal forest characterized by sassafras (Sassafras albidum), tupelo (Nyssa sylvatica), and others

The observation that native plant communities developed on ocean dredge sand and excluded or resisted colonization by invasive non-native plants led to the premise that if Robert Moses could create high-quality native plant communities by accident, we should be able to do the same on purpose, and the key was to use sand as a planting substrate.

Offered here are case studies of ecological restoration projects performed by the New York City Parks Department and our partners in which low-nutrient sand and sandy-loam derived from "salvaged" sub-soils and ocean dredge have been or are being used to restore a mosaic of upland plant communities to replace Phragmites- and mugwort-dominated uplands.

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Green Roofs as Habitat for Wild Bees in City Landscapes

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Green roofs are often touted for their contribution to habitat for wild species in urban landscapes. For highly mobile species like bees, which have important relationships with flowers, nest sites, and nesting material, green roofs might provide suitable habitat analogues for urban bee communities. Green roofs are exposed to the sun and can be planted with a wide range of flowering species. Both of these factors are good predictors of bee abundance. Yet whereas considerable attention has been given to the management of honey bees on green roofs, many species of wild bees could also benefit from increased foraging and nesting opportunities through details of green roof design. This is a unique opportunity in light of global pollinator declines and increasing interest in local agriculture and food security.

In this study, colonization and diversity of cavity-nesting bees, wasps, and parasites were evaluated from 30 green and conventional roofs and 175 sites at ground level set throughout the city of Toronto to examine limitations of green roofs in providing habitat. Height, roof area, type, distance to habitat at ground, and other landscape metrics were included in comparative analysis. This presentation documents Year 1 of the project, which demonstrated that colonization and diversity was lower on roofs, and decreased with increasing height from ground. All mason bee species (*Osmia* spp.) were noticeably absent on roofs but common at ground level. Nest abandonment by bees was also greater on roofs than at ground level. A positive correlation between roof colonization and proximity to semi-natural habitat was evident. This ongoing research is part of a larger effort aimed at linking bee populations more directly to urban land use and building design strategies such as green roofs.

Scott MacIvor is a Ph.D. candidate in the Department of Biology at York University and researcher at the Green Roof Innovation Testing (GRIT) Lab at the University of Toronto. His research interests include landscape ecology of bees in cities, green roof design, and ecosystem functions of novel and urban habitats.

Scott has authored several manuscripts and popular articles on green roof performance and urban ecology. He has won several awards for his research and presentations, including the2011 Governor General Gold Medal for Graduate Research, the 2010 MENSA Canada Scholarship, and the 2007 Animal Behavior Society Genesis Award.

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Integrating Habitat Restoration with Urban Stormwater Treatment

Phillip M. Rury, Ph.D., Bioengineering Group, Salem, MA

As part of the Boston Harbor Cleanup project efforts to eliminate Combined Sewer Overflows (CSOs) into Alewife Brook, the City of Cambridge negotiated an agreement with the Massachusetts Department of Conservation and Recreation (DCR) to build a vegetated stormwater management basin on the state-owned Alewife Reservation, part of Olmstead's Emerald Necklace, an urban wild managed by DCR as fish and wildlife habitat and recreational area laced with informal hiking and bike trails. For the DCR, Bioengineering Group had prepared a Master Plan for the Alewife Reservation, and was then enlisted by the City to design and oversee construction of a detention basin containing a treatment wetland. The challenge was to site, adapt, and integrate the system within the 100-year flood plain of a tributary to Alewife Brook, to meet stormwater treatment requirements, and to fulfill the habitat restoration and recreational goals set in the Master Plan, while also fostering support from vocal stakeholders. Alewife Reservation supports a diverse wildlife population, including breeding habitat for American Woodcock and other migratory birds and fish including the anadromous, state-listed alewife. Bioengineering Group designed a multi-functional wetland to meet the multiple goals of stormwater detention, water quality improvement, anadromous fish habitat enhancement, invasive vegetation removal, wildlife habitat restoration, public recreation and environmental education. The system shave reduces peak flows into the Alewife Brook during major storm events and minimizes downstream flooding along the Little River and Alewife Brook by retaining up to 10.3 acre-feet of stormwater. It also provides first flush treatment of stormwater via sediment removal in a pretreatment forebay. Water leaving the forebay and moving into the vegetated wetland will experience biological filtration, contaminant and nutrient immobilization/uptake, and thermal regulation. Invasive vegetation dominating most of the site was eradicated, the surface layer of invasives-infested soil (seed bank) was removed for offsite disposal, and the remaining upland and hydric soils will be replanted and seeded to diversify, enhance, and restore habitats. Numerous species of native, upland and wetland plants installed along elevation and soil moisture gradients as live plants, dormant stakes and seed mixtures create a series of communities including upland woodlands and meadows, wet meadows, scrub shrub wetlands, riparian woodlands, and emergent marshes. Water quality monitoring stations provide for long term operational evaluations of the stormwater treatment efficacy of the new wetland. Finally, a new bike path and recreational trails, including an amphitheater, boardwalks, and overlooks on the berm of the forebay and main basin, afford controlled, low impact access for viewing enhanced wildlife habitats and wetlands. Educational kiosks and trail signage explain beneficial wetland functions, promote stormwater best management practices, and highlight the ecological, hydrologic, and historical features of the site. Not only has the CSO problem been addressed on a cost-effective basis saving many millions, but a historically filled and degraded urban stream and wetland corridor been functionally restored and public awareness and stewardship is promoted through access and interpretive features.

Dr. Phil Rury is a Senior Ecologist with the Bioengineering Group in Salem, MA. He has over 30 years of academic research, field botanical, and environmental consulting experience in ecological resource inventory and management, sustainable development, environmental compliance, and site remediation. His expertise includes botany, wetland ecology, endangered species biology, habitat restoration, ecological risk assessment (ERA), permitting, and engineered wetland design for water pollution control for energy, industrial, infrastructure and development projects. As a contractor for USEPA Region 1, he designed and led a decade of ERAs, guided media sampling for remedial investigations, and established food chain and toxicity-based cleanup goals for remedial design and risk management decisions at Superfund sites in New England. As a Botany graduate student at the University of North Carolina in 1978, Phil also discovered and published a new plant species found only in Georgia, *Isoetes tegetiformans* Rury, then convinced the USFWS to list and protect it as a federally-endangered species in 1988.

Urban Forest Restoration Effects on Diversity and Composition of Vegetation in NYC Parks

Sanpisa Sritrairat
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With increasing urbanization around the world, there is a growing interest in rehabilitating degraded urban land through ecosystem restoration. New York City is an example of a complex social-ecological system with a long history of human disturbances. Nonetheless, it has been estimated by the U.S. Forest Service that NYC's urban forest provides ecosystem services worth over five billion USD compensatory value from urban cooling benefits, pollution control, storm buffering, and carbon sequestration. The MillionTreesNYC initiative seeks to enhance these services by afforesting 2000 acres of public parkland throughout NYC. In collaboration with NYC Department of Parks & Recreation, we studied the initial vegetation and soil responses to forest restoration and management at eleven permanent research plots throughout New York City since 2009. Urban forest restoration practices include invasive species control, soil amendments, and native tree and shrub planting with a goal to create multi-layered urban forests with increased ecosystem function. We tested forest restoration practices by manipulating tree diversity (six species vs. two) and shrub abundance (planted vs. not), in research plots nested within the restoration plantings at replicate sites. We monitored tree growth, vegetation cover, soil chemistry, and carbon storage over three years. The vegetation prior to restoration varied in species richness, abundance, nativity, and invasiveness. Heterogeneity in soil properties and nutrient concentrations among sites may contribute to the variation observed in the study. Additionally, non-native species coverage was reduced by up to 50% following invasive species management and tree-planting. Native species coverage significantly increased at all sites. For example, at Marine Park in Brooklyn, native herbaceous species coverage increased from 5% to 50% from 2009 to 2010. Variation in tree growth and survival will be presented as will a discussion of major challenges to urban forest restoration in highly heterogeneous urban sites. Overall, the reforestation regime has initially stimulated an increase in plant diversity and the abundance of native species while limiting invasive species at these sites. Urban forest restoration methods and the influence of various management practices will be discussed in the context of best practices for urban forest restoration.

Sanpisa Sritrairat is an Andrew W. Mellon Postdoctoral Fellow in Urban Ecosystems at Tishman Environment and Design Center at The New School in New York City. In collaboration with NYC Parks and Recreation, PlaNYC, and researchers at The New School and Columbia University, her research group use ecological and chemical tools to investigate plant diversity, invasive species expansion, plant-soil interactions, management impacts, and reforestation success in NYC Parks around New York City as part of the Million Trees NYC project. Prior, at Lamont-Doherty Earth Observatory of Columbia University, she has investigated long-term anthropogenic and climatic impacts on terrestrial and wetland ecosystems along the Hudson River, from New York harbor to Troy, NY.

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Responses of Multiple Taxa to Exotic Vegetation in a Northeastern Urban Forest

Ellen Pehek
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Although some invasive exotic plants have been shown to have negative effects on components of the forest ecosystem, few studies examine differences between heavily invaded forest and uninvaded forest, or follow responses to restoration, using organisms from multiple trophic levels and taxonomic groups. We studied spring ephemeral herbs, macro-invertebrates, red-backed salamanders, and breeding birds in paired invaded and uninvaded forest plots in Van Cortlandt Park, Bronx, New York. We found that at least some aspects of all taxonomic/trophic groups studied differed between forest areas with and without heavy exotic plant invasions, suggesting that organisms from different taxa and trophic levels may be used to assess forest condition or effectiveness of habitat restoration. Invaded plots were dominated by non-native trees (e.g., *Robinia pseudoacacia*), shrubs (e.g., *Rosa multiflora*) or both. Uninvaded plots were dominated by native trees (*Quercus, Liquidambar styraciflua* and *Acer rubrum*) and shrubs (e.g., *Lindera benzoin*). Most spring ephemeral herbs (e.g., *Erythronium americanum*, *Polygonatum sp*., *Geranium maculatum*) were either limited to uninvaded sites or achieved greater percent cover in uninvaded sites than in invaded sites. Slugs and pseudoscorpions were more frequent in invaded, and flies were more frequent in uninvaded, plots. Although earthworms have been implicated in facilitation of exotic species invasions, we found no significant differences in earthworm abundances or frequencies between invaded and uninvaded plots. Salamander relative abundance did not differ significantly between the two plot types, but salamander size was greater in uninvaded than invaded plots. The invaded plots were the only locations for three exotic bird species: Rock Dove, House Wren, and House Sparrow. Two species typical of disturbed habitat, the Gray Catbird and the Yellow Warbler, were more abundant in invaded than uninvaded plots. In contrast, two species typical of mature forest interior, the Scarlet Tanager and the Wood Thrush, were respectively restricted to and more abundant in uninvaded plots.

Ellen Pehek is Principal Research Ecologist at the Natural Resources Group, Urban Field Station. Dr. Pehek has worked with the Natural Resources Group since 1998. She received her Ph.D. in ecology and evolution, with a specialization in aquatic community ecology and biology of rare species, from Rutgers University. She is involved in the design and implementation of research, restoration, and monitoring projects in New York City's woodlands and wetlands. Dr. Pehek is also responsible for proposing new research initiatives. Currently she works on three major projects: Salamander and dragonfly ecology in small streams; Responses of vegetation and salamanders to forest restoration; and Dragonflies as indicators of wetland condition.

Before joining Parks, Dr. Pehek was an Ecologist with The Nature Conservancy at its Delaware Bayshores Office. There she designed and performed surveys and experiments on wildlife and rare plants, supervised students and interns in survey work, trained staff and volunteers in survey and monitoring techniques, and led interpretative field trips. Dr. Pehek has also served as a Wildlife Biologist for the New Jersey Department of Environmental Protection, Division of Fish, Game, and Wildlife. Her work as a Resource Assistant took her to Texas, Arizona, and Oregon, where she conducted inventories and surveys of rare plant and animal species, researched management problems and implemented solutions, designed restoration plans, and wrote Environmental Assessments.

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Native Seed Production in New York City: Supporting Ecological Restoration through Urban Agriculture

Tim Chambers
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The Greenbelt Native Plant Center, a municipal native plant nursery operated by NYC Parks, has been developing a program to provide native seed mixes genetically derived from local plant populations for use in City restoration. Seed mixes with local genetic integrity are suited to the unique conditions presented by NYC project sites and provide the diverse genetic foundation for site adaptability and sustainability through time. Acting conservatively through wild seed collection protocols and propagation, foundation seed production plots are established and managed to yield first generation foundation seed with high genetic diversity. This foundation seed then serves as the basis for larger increases using agronomic farming practices that will yield bulk seed on the scale needed for restoration and land management activities.

The GNPC has recently embarked on a partnership with a local land trust organization to facilitate the production of its first bulk native seed mixes for large-scale restoration in the City, supported in part through a USDA/NRCS *Conservation Innovation Grant*. The seed production program at the Greenbelt Native Plant Center serves as a model of how municipalities in the mid-Atlantic region can address the lack of commercial availability of locally sourced, ecotypic native seed for their land management activities. The bulk seed project also provides local commercial and other growers with the technical knowledge to diversify their existing production with a niche agricultural product while contributing to local biodiversity. Promotion of markets for local ecotypic bulk seed is necessary to stimulate a native bulk seed industry in the East, which is largely lacking. The GNPC believes production of ecoregionally-based foundation seed in support of commercial seed production activities is a workable policy that will contribute to wise management of our regional seed resources.

Tim Chambers is currently the Deputy Director of the Greenbelt Native Plant Center, City of New York Department of Parks and Recreation, a 13-acre greenhouse, nursery, and seed bank complex providing native plants and seeds from local plant populations in support of plant conservation and ecological restoration/management of many of New York's most valuable natural areas. Before becoming Deputy Director, Tim worked as the Taxonomist/Seed Collector and Nursery Manager at the Native Plant Center. Tim holds a BS in Biology from the University of Wisconsin – Stevens Point and a MSc in Ethnobotany from the University of Kent, U.K.

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Reestablishing Landscape Connectivity via Dam Removal and Stream/Adjacent Plant Community Restoration in Western Massachusetts

Tom Touchet
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Linear ecosystems, such as rivers and streams, are often prone to fragmentation from a variety of human activities, including the installation of culverts and dams. The presence of dams in these riparian systems is particularly disruptive to a host of functions including sediment and nutrient transport, among others. The presence of dams often hinders movement and usage of portions of the system by resident and migratory organisms. The presentation case study focuses on the removal of the Upper and Lower Hathaway Dams located in Dalton, Massachusetts and subsequent restoration of the adjacent plant community and stream channel for brook trout (*Salvelinus fontinalis*) habitat.

The Lower Hathaway Dam was constructed around 1893 to provide a water supply source for the City of Pittsfield. The Upper Hathaway Dam, constructed in 1908, served to impound Hathaway Reservoir, also as a water supply source for the City of Pittsfield until its use ceased in the late 1950s. After the dams were decommissioned by the City, they became severely deteriorated and presented a potential hazard to pedestrians and wildlife that encountered them as well as a physical barrier to the movement of fish (including brook trout) and other aquatic organisms. Both dams were removed in 2010 as off-site mitigation for a dam repair project located in the adjacent town of Washington.

The overall goals of the project were to restore connectivity of Hathaway Brook to allow migration of brook trout and other aquatic organisms from the Housatonic River to the upper reaches of the brook; restore natural flow patterns; reestablish natural sediment and nutrient transport; improve water quality; and enhance habitat value and long-term sustainable benefits for aquatic organisms.

Activities included: installation of temporary bypass piping, demolition of both dams, reuse of impounded sediment, re-grading of the riparian zone, installation of biodegradable erosion control blankets, installation of a new stream bed, and extensive planting of native vegetation using the adjacent natural ecosystem as the target model for the final restoration product.

Tom Touchet is a Senior Wetland Scientist with AECOM located in Wakefield, Massachusetts. Tom has experience in wetland and upland plant ecology, environmental restoration, wetland delineation, wetland mitigation design and monitoring, and federal, state, and local environmental permitting. Tom is also a Certified Professional Wetland Scientist and is advanced SCUBA certified and has performed underwater ecological surveys and underwater eelgrass (*Zostera marina*) restoration projects for AECOM. Tom has a BS in Biology and Earth & Space Science from the State University of New York at Stony Brook and a MS in Environmental and Forest Biology with a concentration in Wetland Plant Ecology from SUNY College of Environmental Science and Forestry in Syracuse, New York. Tom also currently serves as the State Director of Massachusetts for the Society of Ecological Restoration's New England Chapter.

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Mulhockaway Creek Stream Restoration: Using Monitoring to Gauge Success and Implement Adaptive Management

Kathy Hale and Rick Anthes
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In 2003, the New Jersey Water Supply Authority (NJWSA) received a USEPA Targeted Watershed Grant to protect and improve surface water quality in the Raritan River Basin. NJWSA used stream visual assessments in the Spruce Run and Mulhockaway Creek Watersheds to assess overall stream health and identify potential restoration sites. In addition, NJWSA began a Watershed Restoration Plan for the Mulhockaway Creek Watershed in 2003. The visual assessment effort identified the Mulhockaway Creek in Hoffman Park as a potential restoration site.

Mulhockaway Creek is one of the two main tributaries that feed Spruce Run Reservoir, the third largest drinking water reservoir in New Jersey. NJWSA worked with Hunterdon County Parks and the Louis Berger Group to design a restoration project to:

- Remove the culvert system and replace it with a natural bottom culvert to allow fish passage, sediment passage and unobstructed flow during high water events;
- Adjust the stream sinuosity to establish an appropriate channel slope to effectively transport the high sediment load;
- Establish a bankfull bench adjacent to the stream to provide energy dissipation during high flow events, to provide riparian habitat and to provide floodplain storage of sediment;
- Install cross vanes, rock vanes, log vanes and root wads to stabilize the channel bed and reduce bank erosion; and
- Plant native trees and shrubs to provide riparian habitat.

Historically, little or no pre or post-construction monitoring was conducted for stream restoration projects. Recent efforts have shown the value of such monitoring for multiple purposes, including an assessment of project success and determination of the need for adaptive management or maintenance. NJWSA developed a monitoring program for the Hoffman Park project and two other projects conducted under the EPA grant. Pre-restoration biological (macroinvertebrate and habitat) and geomorphological monitoring began two years prior to construction. Eight sets of macroinvertebrate samples were conducted post-construction, along with several sets of geomorphological data. In addition, vegetation monitoring was conducted to meet permit requirements.

The Hoffman Park monitoring allowed NJWSA to assess the success of the restoration project, to document changes in the stream's biological and geomorphic state since construction and to identify needed adaptive management and maintenance. For instance, during the first 18 months following construction, additional structures and vegetation were added. In 2011, additional trees were added to meet vegetation survival requirements.

We will discuss the trends revealed from the data, successes and failures of the project, and the current status of the restoration. We will also discuss the overall importance of including monitoring within a stream restoration project plan.

Kathy Hale is a Principal Watershed Protection Specialist for the New Jersey Water Supply Authority. At NJWSA, Kathy is responsible for managing watershed protection and restoration projects, including in-stream and riparian buffer restoration projects, stormwater management projects and NJWSA's River-

Friendly programs. She is also the past president of the NJ Section of the American Water Resources Association, served as chair of NJ-AWRA's Stream Restoration Committee, and co-chaired the 2010 AWRA Annual Water Resources Conference. She has eighteen years of experience in watershed management in New Jersey, including work in the private and public sectors, and also serves on her Township's Environmental Commission.

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Rick Anthes is an Assistant Watershed Protection Specialist with the New Jersey Water Supply Authority. He serves as a program manager for NJWSA's River-Friendly program, which helps businesses and golf courses improve their land management techniques to improve water quality. Additionally, Rick completes tasks associated with the development and implementation of watershed restoration plans, conducts a variety of stream monitoring techniques, and promotes watershed education through a wide range of outreach events. He completed a term of service as an AmeriCorps Watershed Ambassador and received his Bachelor's of Science degree in Wildlife and Fisheries Conservation from the University of Massachusetts – Amherst.

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Using Historical Data to Guide Wetland Restoration Designs

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Wetland restoration efforts typically involve the use of various techniques meant to “undo” past efforts to drain, clear and convert wetland and riparian habitat. Commonly used techniques include ditch plugs, breaking drainage tile, excavating depressions and planting native species. While reestablishing general wetland hydrology is often feasible, returning a site to its preexisting natural community can be more challenging without first determining what once existed on site and how it was altered. By coupling on the ground assessments with research on historic documents (e.g. USDA job reports), historic and current aerial photos and topographic maps as well as soil maps and natural community determinations, restoration efforts can be more focused on restoring the lost habitat of the site. In addition, knowledge of regional land use history, advent of various types of mechanization and larger agricultural trends on a national scale can provide additional insight. Appropriately guided restoration efforts will likely result in the long-term success of the property as a site continues to develop (succession, structural complexity, etc.) after construction is completed. Two recently completed projects in Vermont will be discussed on how using historic information was used in the assessment, design, permitting, and construction of these wetland restoration projects.

Ryan Crehan is a Biologist and Professional Wetland Scientist with the Partners for Fish and Wildlife Program, a program of the U.S. Fish and Wildlife Service. The Partners Program is a voluntary, citizen and community-based fish and wildlife habitat restoration effort in which willing landowners are provided technical and financial assistance to conserve, restore, and protect fish and wildlife habitat on their property. Ryan works closely with the U.S. Department of Agriculture, the State of Vermont, Ducks Unlimited, and private landowners to restore wetlands. His work focuses largely on the assessment, design, and implementation of restoration projects that strive to restore the lost functions and values of wetlands. Prior to coming to the U.S. Fish and Wildlife Service, Ryan worked for the State of Vermont and the private sector on wetland-related projects.

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Integrated Remediation and Ecological Restoration: A Case Study in Woodbridge, NJ

Michael Parkes
Great Ecology

The Former Nuodex Corporation facility is a 185-acre site located in Woodbridge Township, New Jersey operated as an organic chemical manufacturing facility for much of the last century. Historically, much of the site was tidal wetlands, but approximately two-thirds of the site was filled via dredge material placement during channel deepening of the Raritan River during the 1940s and 1950s. This converted the tidal wetlands to stormwater-fed, freshwater wetlands mainly vegetated by an invasive plant, *Phragmites australis*. The site became contaminated with a suite of constituents including Dense Non-aqueous Phase Liquids (DNAPLs) in groundwater as a result of the facility's operation. DNAPL in groundwater can be problematic to delineate and remediate.

In 2008 Great Ecology and Brown and Caldwell initiated the remedial and ecological investigation for the current site owner, EPEC Polymers Inc. The subsequent remedial action workplan included a hydraulic barrier wall to contain groundwater impacted by DNAPL source material that resulted in approximately 30 acres of permanent impacts to open water and wetland. An integrated approach to the remediation and required wetland mitigation was necessary to achieve the project goals of attaining cleanup standards protective of human health and the environment, compensating for wetland impacts due to implementation of the remediation, preparing the site for eventual redevelopment, and providing public access to the Raritan River in Woodbridge Township for the first time in over 100 years.

We present our innovative approach to remediation, wetland mitigation, regulatory compliance, and stakeholder outreach. This strategic approach resulted in a novel, integrated design now under construction.

Michael Parkes is a wetland and wildlife ecologist with over ten years' experience in the processes and regulations of ecological restoration with particular focus on wetlands and wetland mitigation as regulated by the Clean Water Act. His experience varies over a wide range of flora, fauna, and geography, with focus on human-environment interactions affecting wetland systems. At Great Ecology he has proven himself as a strong project manager with comprehensive knowledge of mitigation regulations, ecological investigation and processes, and restoration practices. He is particularly well-versed in the 2008 Mitigation Rule and his work with habitat valuation using Great Ecology's functional analyses. Mr. Parkes' expert technical and communication skills allow him to address environmental issues scientifically, and discuss them with stakeholders in ways easily understandable to all.

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Novel Ecosystems and the Forgotten Food Web

Marilyn Jordan
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Novel ecosystems – new, historically unprecedented combinations of species caused by environmental change, human actions, introduction of new species and loss of native species – collectively occupy ~40% of the terrestrial ice-free globe. Conservationists differ on whether novel ecosystems are degraded and worthless, or are potentially valuable habitats that should be included in conservation efforts. I think we need to base our assessments on an understanding of both the benefits and deficiencies of novel ecosystems *and* their implications for genetic and species diversity, trophic linkages, and ecosystem function.

Effects of introduced, invasive plant species in novel ecosystems are less obvious and more controversial than the better known intertrophic impacts of invasive predators and pathogens. Invasive plants typically cause decreases in an ecosystem's producer species diversity and biomass, and reduced nutrient uptake. These patterns hold true in both aquatic and terrestrial ecosystems, and among herbivores, detritivores and predators. Results of recent new research suggest that reduced plant species diversity results in altered insect abundance and diversity. This is especially true for specialist insect species – and most insect species are specialists. Since herbivorous insects are the largest taxon of primary consumers, a shift from native to nonnative plants can clearly result in bottom-up reductions of energy available to higher trophic levels in food webs. Those of us old enough to remember the high "bug splat" density on vehicle windshields ~40 years ago can confirm that insect abundance appears much reduced today, though increases in nonnative plants are likely not the only cause.

Loss of specialist insects is but one example of a widespread "replacement" of specialist species by generalists in many taxa and in many contexts as a result of disturbance and global change. This loss of functional diversity results in functional homogenization (FH) of natural communities. Consequences of FH are likely a loss of ecosystem resilience, stability, and ecosystem services at a landscape scale. We can't wait for evolutionary time and the resilience of nature to fully restore functional ecosystem diversity from the bottom up. As species become increasingly rare, dispersed or extirpated, we are losing the diverse genetic material needed for evolution and adaptation to change. You can't evolve if you are extinct.

So what do we do about novel ecosystems altered by introduced species? We must prioritize scarce resources and use a triage approach to management and restoration of novel ecosystems. Sometimes it will be important and possible to restore native species and communities, and sometimes (most times?) we will accept novel ecosystems and work with them. Novel management strategies developed using a "whole ecosystem" approach, and tailored to suit different ecoregions, microclimates, land uses, and socioeconomic settings will be needed in order to maximize the conservation value and ecosystem services provided by these altered ecosystems. Above all, we need a deeper understanding of novel ecosystems in order to manage them flexibly, innovatively, in ways that will promote ecosystem services and resilience to change while still protecting our native evolutionary biological capital.

Dr. Marilyn Jordan is a Senior Conservation Scientist for The Nature Conservancy on Long Island. She received her Ph.D. in plant ecology and soil science in 1971 from Rutgers University. She did research in forest ecology, microbial ecology, aquatic ecology, nutrient cycling and land application of wastewater before moving to Long Island in 1992 to work for The Nature Conservancy. Her work for The Nature Conservancy has included invasive plant science, fire ecology, ecological monitoring, atmospheric deposition and conservation planning. She has assisted The Nature Conservancy and partner agencies in carrying out ecologically sound land management, and development of threat abatement strategies needed to ensure the continued health of lands and fresh waters on Long Island and beyond. One of her recent accomplishments has been co-authorship of a system for ranking nonnative plants for invasiveness in New York State.

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