PLENARY SPEAKERS

Morning Plenary: Practicing Ecological Restoration within the Context of Climate Change, Trophic Cascades and Urbanization: Where Do We Go from Here?

Keith Bowers, FASLA, RLA, PWS, President and Founder, Biohabitats, Inc. *(Keith Bowers, Biohabitats, Inc., 2081 Clipper Park Road Baltimore, Maryland 21211. (843)529-3235, kbowers@biohabitats.com)*

Much of the US and developed countries around the world have extirpated large carnivores and other keystone species from ecosystems. As a result, we are witnessing top down cascades (trophic cascades) of the food web where the abundance of the prey that was being suppressed by these keystone species is now released, causing extreme pressure on the next trophic level down. A classic example is the extirpation of wolves, the corresponding spike in deer, and the extreme herbivory of forest understory (we are also seeing this take place in the oceans). With this example, the question becomes; how can we effectively restore eastern deciduous forest if we don't reintroduce the wolf? And do we understand all the cascading effects from this trophic cascade enough to be able to predict or counteract, with any confidence, a trajectory of success? I don't find many restoration ecologists or restoration practitioners wrestling with (or accounting for) this dilemma.

Biography: For nearly three decades, Keith Bowers has been at the forefront of applied ecology, land conservation and sustainable design. As the founder and president of Biohabitats (www.biohabitats.com), Keith has built a multidisciplinary organization focused on regenerative design – the blurring of boundaries between conservation planning, ecological restoration and sustainable design. Using living-systems as the basis for all of its work, Biohabitats applies a whole-systems approach to all of its projects. Keith has applied his expertise to more than 600 projects throughout North America. His work has spanned the scale from site-specific ecosystem restoration projects involving wetland, river, woodland and coastal habitat restoration to regional watershed management and conservation planning, to the development of comprehensive sustainability programs for communities and campuses throughout the country. Keith is also president and founder of Biohabitats' sister company: Ecological Restoration and Management, Inc., (www.er-m.com). ER&M provides professional installation and management services for restoration projects throughout North America. Keith currently serves on the Board of Directors for the Wildlands Network (http://www.twp.org), a national organization focused on restoring, protecting and connecting North America's best wild places and is the Theme Lead for Ecological Restoration under IUCN's

Commission on Ecosystem Management. Keith served on the Board of Directors for the Society for Ecological Restoration (www.ser.org), twice as its Chair. He is a Fellow of the American Society of Landscape Architects and is a Professional Wetland Scientist. He holds a B.S. in Landscape Architecture from West Virginia University and an honorary degree from the Conway School of Design.

Afternoon Plenary: Wastewater and Sea Level Rise: Cape Cod's Biggest Environmental Problems as Ecological Restoration Opportunities

Dr. Christopher Neill, Director, The Ecosystems Center, Marine Biological Laboratory at Woods Hole (*Dr. Christopher Neill, Marine Biological Laboratory, 7 MBL Street, Woods Hole, MA 02543. (508) 289 7481, cneill@mbl.edu)*

Many US coastal waters have been severely degraded by high nonpoint nitrogen loading from land. On Cape Cod, meeting federally-mandated (but up to this point unenforced) nitrogen loading targets will require billions of dollars of investment in new water treatment infrastructure. This infrastructure will likely be a novel mix of traditional centralized sewage treatment plants and "green" wastewater treatment options in coastal watersheds and estuaries, such as constructed treatment wetlands, phytoremediation, and shellfish aquaculture. These projects have potential to restore habitats and ecosystem functions that were lost with suburbanization. Because both traditional and non-traditional approaches are likely to be first implemented in some watersheds and not others, rigorous monitoring of estuarine ecosystem responses to infrastructure projects conducted as ecological restoration "experiments" coupled with clear before and after measurements would provide new information and potentially identify thresholds for successful restoration that could be applied elsewhere.

As sea level inevitably rises, Cape Cod will have to modify both natural and engineered infrastructure to prevent ecological and monetary damages. Ecological restoration opportunities for adapting to higher sea levels include restoring salt marshes into low-lying coastal cranberry bogs, removing hard coastal structures, and "creating" biodiversity-rich coastal grassland and heathland plant communities inland of their current locations. Careful site selection, design and implementation of these studies as experiments, with appropriate comparisons of a variety of ecosystem functions (habitat, nutrient removal, carbon storage, recreation) between restored and control (non-restored) settings, can advance restoration science and provide a vital "toolbox" for maintaining biodiversity and ecological functioning for Cape Cod and other regions in an increasingly climate-altered world.

Biography: Christopher Neill is an ecologist, Senior Scientist and Director of the Ecosystems Center and Director of the Brown-MBL Partnership. Neill's research investigates the ecological consequences of deforestation in the Brazilian Amazon, including how clearing alters runoff and the hydrologic cycle, soil fertility, emissions of carbon dioxide and other greenhouse gases from soils to the atmosphere and the biodiversity and ecological health of streams. He also works on the ecology and restoration of terrestrial and aquatic ecosystems in coastal Massachusetts, including coastal ponds and sandplain grasslands and shrublands, where rapid increases in residential development threaten ecosystems that contain high and unique biological diversity. Neill was a Fulbright Scholar at the University of São Paulo in 2007 and received a Harvard University Bullard Fellowship in Amazon Ecology in 2010.

MORNING SESSIONS

SESSION A: COASTAL RESTORATION & MANAGEMENT (1)—SEA LEVEL RISE, SALT MARSHES, OYSTER RESTORATION (EAST LECTURE HALL)

Modeling Sea Level Rise in the NY-NJ Harbor Estuary Using a Coastal Vulnerability Index

Zachary Lehmann, Lauren Alleman, and Timothy Hoelzle, Great Ecology; Kate Boicourt, NY-NJ Harbor Estuary Program *(Zachary Lehmann, Great Ecology, 2231 Broadway Suite 4 New York, NY 10024. sstevens@greatecology.com.)*

The impacts of climate change on global sea levels poses a particular risk to coastal communities. In response to concerns about projected sea level rise (SLR), and increasing pressures on public access, the NY-NJ Harbor & Estuary Program partnered with Great Ecology to launch Case Studies in Sea Level Rise Planning: Public Access in the NY-NJ Harbor Estuary, focusing on sites in the Raritan River in New Jersey. Great Ecology conducted a GIS analysis of the vulnerability of public access infrastructure and natural resources (e.g., parks) to SLR at three public access sites within the harbor estuary. Great Ecology used LiDAR data, publicly-available GIS data, and information gathered during site assessments to create a geospatial composite overlay and a Coastal Vulnerability Index (CVI) model (adapted from Tallis et al. 2011) to assess SLR impacts for these three sites. The CVI model considered six main criteria: geomorphology, relief, low-lying areas, natural habitats, soil type, and projected sea level rise. By including recommendations at the site-scale, the case studies provide practical insight into techniques to minimize potential ecological and public access infrastructure damages caused by SLR. The CVI model demonstrates a relatively simple and rapid method that provides coastal communities with the information needed to plan for SLR. By focusing on vulnerability to SLR and potential resiliency options at the site scale, the project complements larger scale vulnerability assessments by providing site-specific recommendations for towns, counties, and landowners.

Biography: Zachary Lehmann has over six years of experience as a field biologist and GIS specialist in New York City and the surrounding wetlands. Zachary leads Great Ecology's team of GIS technicians, constructing habitat suitability models, performing geospatial analysis, hydrologic models, and graphic outputs. Most recently, Zachary used GIS analysis to model site specific sea-level rise vulnerability in the NY-NJ Harbor Estuary. He specializes in wildlife and plant inventory and monitoring, with a focus on bird and mammal species. He brings his diverse experience in ecological sciences to various projects relating to biological assessment and habitat restoration, including habitat studies and avian management in Jamaica Bay. Zachary holds a Bachelor's degree in Wildlife Conservation and Forestry from Unity College.

Salt Marsh Migration in Anthropogenic Coastal Landscapes

Katharine Gehron, Shimon Anisfeld, and Alexander Felson, Yale School of Forestry & Environmental Studies; Andrew Kemp, Tufts University *(Katharine (Kate) Gehron, Yale School of Forestry & Environmental Studies, 140 Alston Avenue, Rear House, New Haven, CT 06515. 612-889-9966, katharine.gehron@gmail.com.)*

Salt marsh migration is a process associated with sea-level rise. In response to gradual increases in the elevation of mean high tide, the plant communities of New England salt marshes have been found to be migrating inland when uplands are available for colonization. This is an important process because, when marshes cannot migrate, they may drown, and this habitat--as well as the coastal flooding protection it provides and the stunning amount of primary production that takes place in salt marshes (a major nutrient source for coastal fisheries and a significant carbon sink)--may dwindle. Coastal areas are highly developed, and turf landscapes--golf courses, parks, backyards, and the like--are ubiquitous along shorelines and marshes. My research looks into (1) whether mowing lawns that abut marshes affects marsh migration, (2) whether the cessation of mowing permits migration, and (3) whether this migration is more successful (rapid and robust) than it is in natural--or high-shade, woody-plant-dominated--landscapes. This research may inform restoration and habitat preservation efforts in developed areas and change private and public landowner behavior. I have finished collecting data and am developing my preliminary statistical results, which I will be ready to share by the conference. Developing marsh plant palettes suitable for designed landscapes and creating a demonstration garden for homeowners and private property owners are planned outreach aspects of my work.

Biography: I am a second-year master's student at the Yale School of Forestry and Environmental Studies. I am working towards a master's of environmental science under the direction of Shimon Anisfeld, PhD, and Alexander Felson, PhD, RLA. I also hold a master's in landscape design from the Conway School of Landscape Design and a bachelor's degree in English literature and American studies from Cornell University.

Vegetation Response to Tidal Restoration in Long Marsh, Harpswell Maine.

Shri N. A. Verrill and Curtis C. Bohlen, University of Southern Maine *(Shri Verrill, University of Southern Maine, 9 Fore Street. (207)515-0733, andrea.verrill@maine.edu.)*

Sea Level Rise (SLR) creates challenges for coastal management. Tidal restoration provides opportunity to understand how salt marsh ecosystems respond to SLR. Maine Department of Transportation (MDOT) is replacing an undersized culvert beneath Long Reach Lane early in 2014. The larger sized culvert is expected to restore 80% of the tidal flux in Long Marsh. Last summer, the Casco Bay Estuary Partnership MDOT and I collected detailed vegetation, elevation, and hydrology data. Together, these data provide the baseline for a field-based observational study and a field experiment scheduled for this coming summer. The objective of this study is to understand how the characteristic hydrology of this fluvial minor marsh influences the shift in vegetation after tidal restoration. Twelve transects were established perpendicular to the tidal creek and upland borders. Vegetation, salinity, and inundation data were collected as outlined in tier one of the Gulf of Maine Salt Marsh Monitoring (GPAC) protocol. Elevation along transects that contain *Typha angustifolia*, Narrow Leaved Cattail was recorded with a Total Station and mapped in ArcGIS. Statistical analysis of vegetation data was completed using ordination (non-metric scaling) in Systat 12. I will present the first year's data from this two year study and discuss implications for the spatial distribution of brackish vegetation and hydrology of fluvial minor marshes in the high marsh transitional zone dominated by *Typha angustifolia*.

Biography: Shri N. A. Verrill, MS. expected Dec. 2014, Sigma Xi Research Fellow, Department of Biological Sciences University of Southern Maine, Portland. Casco Bay Estuary Partnership, Intern, Muskie School of Public Service, University of Southern Maine. Salt Marsh Restoration Ecologist, Maine Wetland Community Mapping under Maine Natural Area Program (MNAP) classifications, Wetland Vegetation Identification and Biological Inventory, Native Plant Restoration & Invasives Management, ArcGIS, Digital Mapping, Restoration Needs sAssessment, Grant Writing, Team Leader, Graduate Assistant, University Teaching, Community Ecosystem Education, Traditional Ecological Knowledge (TEK) advocate, Herbalist, Organic Gardener, Watershed Monitoring, Etho-Botany.

Defining Ecological Baselines and Suitability for Oyster Reef Restoration

Steven Brown and Kevin Ruddock, The Nature Conservancy, Rhode Island; Bryan DeAngelis, The Nature Conservancy, North America Program *(Steven Brown, The Nature Conservancy, Rhode Island. (860) 271-3535, dsbrown@tnc.org.)*

Reef formations of the oyster (*Crassostrea virginica*) provide significant ecological goods and services including denitrification, water clarity enhancement, and fisheries production. Nonetheless, oyster reefs have been poorly managed and overfished since the 19th century. Population declines continue to this day with a 97% decrease in spatial extent in Rhode Island and 85% nationally. In the last ten years, restoration and enhancement of wild oyster populations has become a major focus of conservation and resource management programs. The task of reestablishing oyster reefs can be costly, labor intensive, and there is no guarantee that restoration efforts will be successful. Despite recognition as a critical restoration target and increased effort to rebuild sustainable populations, oyster population demographics and supporting baseline conditions have been poorly inventoried and studied. A critical challenge in defining restoration goals is that neither current baseline conditions nor those that preceded restoration activities are well understood. Without definable baselines or targets, it is extremely difficult to select appropriate indicators and performance metrics needed to evaluate restoration success. To address these concerns, we developed a life-stage habitat suitability index (HSI) model to inform restoration programs. The model was field validated using data collected from wild and restored populations in Rhode Island. The results of our modelling and field validation study are currently used by our partners to inform restoration and shellfish sanctuary programs. This presentation will discuss the importance of ecological baselines and habitat suitability in oyster restoration.

Biography: The overall objective of my work is to better understand, conserve and restore the ecological integrity of estuarine environments. Restoration and management of estuarine systems require a multidisciplinary approach and understanding of bio-physical and socio-economic controls on management actions. As such, I take a collaborative and hypothesis-driven approach to addressing present-day management problems. I'm a coastal ecologist and geospatial analyst with extensive experience in restoration ecology and ecosystem-based management. I attribute much of my passion for estuaries to my upbringing on a family owned marina in Noank, Connecticut, where I spent much of my time fishing and exploring the coastal landscape.

Water Quality Results from a Two-Acre Oyster Restoration Pilot Project, Wellfleet, MA

Curtis Felix, Town of Wellfleet; Anamarija Frankic, UMass Boston; Amy Costa, Provincetown Center for Coastal Studies *(Curtis Felix, Town of Wellfleet, 415 Chequessett Neck Road, Wellfleet, MA. 603-209-6000, cfelix@planktonpower.net.)*

Wellfleet Harbor is a designated "Area of Critical Environmental Concern", and Cape Cod and Massachusetts' coasts are highly exposed and have experienced increasingly severe storm events, hurricanes and coastal nor'easters which pound the sandy shorelines and harbors on a regular basis. Until the early to mid-1800's these shorelines featured extensive oyster reefs and saltmarshes which provided living barrier protection and enormous food resources. Approximately 95% of oyster habitat and 65% of former saltmarsh have been lost. Massachusetts coastal regions have experienced a near catastrophic loss of historic fish stocks, according to NOAA, EPA,TNC and State DMF, DER and DEP. In addition to the benefits of restoration on coastal resiliency and fishing, these habitats have become an important aspect of the Cape Cod Commission's "208 Wastewater Management Plan" to reverse eutrophication and increase estuary water quality to meet EPA Clean Water Act standards. Preliminary estimates show that a modest acreage of restoration could save potentially billions in wastewater infrastructure and produce immediate water quality benefits that are broader than just nitrogen reduction from TMDL's. A 2 acre, NOAA/USDA NCRS/Barnstable County sponsored pilot project has won two prestigious awards: Mass Recycle: "Municipal Innovation" and American Council of Engineering Companies: "Engineering Excellence" 2013 Silver Award. Located in Duck Creek, Wellfleet, Ma, it has produced a population increase from a few thousand oysters to nearly 4.5 million within two years. In addition, wider cultch application in Wellfleet Harbor, outside the pilot site, has increased population by an estimated 40 million oysters, 15 times the current annual harvest. Extensive monitoring of nitrogen levels in the pilot area showed a surprising reduction of 70% due to the oyster population increase.

Biography: Curtis S. Felix is the Vice-Chair of the Comprehensive Wastewater Planning Committee in Wellfleet, Wellfleet Representative to the Cape Cod Water Protection Collaborative and the County 208 Technical Advisory Committee. He has helped spearhead the Town's Oyster Restoration and Shell Recycling Project that includes support from USDA, NOAA, Mass Oyster Project, Barnstable County and SPAT. The project is restoring 140 acres of oyster habitat and supporting large scale salt marsh restoration in Wellfleet Harbor. In 2008 he founded Planktonpower to develop algae for renewable feedstocks. In 1995, he developed what was the largest Compressed Natural Gas (CNG) refueling facility in the country at Logan Airport. His 25 years of experience in the energy industry also includes roles in utility planning at the former Boston Edison Company, utility strategic management consulting and helping to create what is now a $14.2 billion renewable and energy efficiency lending program at the World Bank. He is a graduate of the University of Vermont with degrees in Economics, Political Science and Biology.

SESSION B: ECOSYSTEM SERVICES AND HUMAN ECOLOGY (WEST LECTURE HALL)

The Three R's of an Academic Stewardship Plan

John Lepore, Future Lands - Ecological By Design *(John Lepore, Future Lands - Ecological By Design, P.O. Box 608. (413) 648-9485, ask@future-lands.com.)*

Covering 90 acres, a small, regional school claims the largest landholding of any non-vocational institution in Massachusetts. Challenges facing the school today include large lawns where meadows once supported rich habitat, historically unmanaged forest areas that have experienced a severe decline in biodiversity due to an insurgence of invasive plants, and more than eight million gallons of water drain annually from impervious surfaces into critical natural landscape.

The recently adopted and highly endorsed Pioneering Stewardship Plan identifies the extent of the site's decline, analyzes existing conditions, and prioritizes key areas of the land where restoration, reuse, and repurposing can be initiated using the school's limited resources.

Biography: As a retired educator, I enrolled in the intensive 10-month ecological restoration master's program at the Conway School (www.csld.edu). The experience nurtured diverse strategies necessary in supporting positive adaptations to economically and ecologically vulnerable communities. Today, I am a restoration ecologist and design professional with Future Lands, LLC. Through it, I endeavor to synchronize collaboration, sound ecological practices and local culture. My designs combine scientific and local knowledge to assure long-lasting resilience to ongoing social, economic and ecological challenges. For more information, please view: issuu.com/johnlepore/psp_full; My personal web page: johnlepore.info; Portfolio projects: issuu.com/johnlepore

Teaticket Park: Public Access and Restoration of Sensitive Wetland Habitat

Alexander Etkind and Jessica Whritenour, The 300 Committee Land Trust *(Alexander Etkind and Jessica Whritenour, The 300 Committee Land Trust, 157 Locust Street, Falmouth, MA 02540. 508-540-0876, aetkind@300committee.org, jwhritenour@300committee.org.)*

The 300 Committee Land Trust (T3C) purchased the 10.7-acre Joe's Driving Range in 2011. Located in the heart of Teaticket, Falmouth's most developed commercial corridor, the property operated from the 1950's until 2011 as a commercial driving range and miniature golf facility. Acquisition of this parcel presented a unique opportunity to convert commercial land into a publicly accessible park, while also restoring the ecological function of the land.

Teaticket Park's 1.8-acre freshwater wetland is severely degraded as it was part of the active driving range activity. Covered largely with turf grass growing in saturated soils, the wetland for decades received runoff from uphill parking and turf areas without any filtering or vegetative buffer. T3C's restoration plan focuses on enhancing existing wetland habitat, reducing storm water runoff, increasing the natural recharge of rainfall, and decreasing sources of nutrient pollution.

The park's wetland is a link in a larger system that feeds into Little Pond, a priority estuary for the Massachusetts Estuary Project. Eliminating the possibility of future development at Teaticket Park helps protect Little Pond's long-term water quality. In addition, restoration of the wetland will create wildlife habitat and serve as an educational site for schoolchildren and other park visitors.

In restoring the wetland, T3C is first utilizing a passive approach that will allow existing native plants to re-vegetate. T3C will also monitor for invasive plants and take active measures to prevent invasive plants from propagating. The conservation restriction (recorded 5/31/12) allows planting of native trees and other vegetation in order to implement and maintain restoration of the wetland habitat. With the planned installation of a boardwalk and observation platform, active mitigation will moderate disturbance and support restoration. T3C will monitor the health of these restoration plantings on a regular basis and evaluate the progress of its restoration efforts.

The 300 Committee is a private, non-profit land trust dedicated to protecting and preserving open space for the citizens of Falmouth, Massachusetts. Founded by a small group of volunteers to commemorate the Town of Falmouth's 300th anniversary in 1986, The 300 Committee has helped protect more than 2,300 acres throughout our community for conservation, recreation and water protection. Our important land preservation work is made possible by the support of our 1,200 annual members.

Biography: Alexander Etkind is the Stewardship Coordinator and Jessica Whritenour is the Administrator of The 300 Committee Land Trust in Falmouth, Massachusetts (2010 – present). The 300 Committee Land Trust is a non-profit organization dedicated to permanently protecting open space in Falmouth through acquisition, education, and management. She previously worked for the Town of Falmouth as an Assistant Town Planner / Community

Preservation (2006 – 2010) focused on the implementation of the Community Preservation Act and administration of the Falmouth Historical Commission and Historic Districts Commission. Jessica has a B.A. degree in Communication and Graphic Design from Buena Vista University (Storm Lake, Iowa) and a M.A. degree in Urban and Environmental Policy and Planning from Tufts University (Medford, Massachusetts). She is a certified planner affiliated with the American Institute of Certified Planners, and serves on the Board of Directors for AmeriCorps Cape Cod and the Falmouth Housing Corporation.

The Balancing Act: Walking the Line between Ecological Restoration and Dense Human Development on Cape Cod.

Theresa Sprague and Amy Wolfson, BlueFlax Design *(Theresa Sprague, BlueFlax Design, PO Box 615. (774)678-8677, theresa@blueflaxdesign.com.)*

Restoring ecological integrity in areas of dense residential and commercial development requires the restoration designer to carefully consider and balance the needs of the environment, wildlife, and property owners. According to the Cape Cod Foundation, 42% of the 396 square miles that make up Barnstable county are developed. The Cape Cod Commission reports in their 2012 Cape Wide Buildout Analysis to Support Regional Wastewater Planning that at build-out an additional 28,000 dwellings could potentially be added to the existing 153,000 residential units. Without the support of property owners, land managers, and the community, sustainable, long-term success of restoration projects in this densely developed region is not possible. How can we design these projects to meet restoration goals, win the support of stakeholders, and ensure long-term project success? In this talk we will study a small-scale habitat restoration project on a residential property on Cape Cod, and consider techniques used for finding equilibrium between habitat for wildlife and habitat for people-life in this densely developed region.

Biography: Theresa Sprague is the owner of BlueFlax Design in Mattapoisett, Massachusetts. Blending her background in communication and education with more than 20 years experience in horticulture, landscape planning and ecological design, Theresa merges science with the fine art of landscape design to create beautiful and sustainable landscapes, restoring ecological function and integrity to the built environment while thoughtfully creating habitat that supports the needs of both people and wildlife. Theresa holds a Masters Degree in Ecological Design from The Conway School of Landscape Design.

Temperature Regime of a Cape Cod Groundwater River Influenced by Impoundment and Cranberry Agriculture

Christopher Neill, The Ecosystems Center, Marine Biological Laboratory *(Dr. Chris Neill, Marine Biological Laboratory, 7 MBL Street, Woods Hole, MA 02543. 508 289 7481, cneill@mbl.edu.)*

Water temperature is an important control on the community structure and ecological function of small streams and is therefore an important consideration in the design of efforts to restore stream ecosystems. Water temperatures in small streams are controlled by a variety of factors including the rate and location of ground water inputs and adjacent riparian vegetation that controls the amount of sunlight reaching the stream channel. I examined the annual temperature regime in the Coonamessett River, a small ground water-dominated river on Cape Cod in southeastern Massachusetts that once supported brook trout but is now degraded by impoundment and cranberry agriculture adjacent to the river channel. I logged temperatures at ten points along the river's length that were influenced in different ways by ground water inputs and the effects of impoundment and agriculture. In the upper Coonamessett, mean daily water temperature in summer increased in reaches passing through active cranberry bogs but remained relatively constant in a wooded reach. Summer mean daily water temperatures increased dramatically downstream from the largest impoundment on in the river system, and in the lower Coonamessett, mean daily temperature increased as the river passed through the large open areas of bogs. Differences in temperature among reaches were lower during fall, winter and early spring compared with summer. Summer temperature in the lower Coonamessett River ranged from 1^{o}C to 8^{o}C higher than in the similar-sized Quashnet River and Red Brook that have both been restored from cranberry agriculture and now support native brook trout. Both dam removal and restoration of streambank vegetation will be required to restore temperatures suitable for coldwater fishes in the lower Coonamessett, but restoration of streambank vegetation alone would be sufficient in the upper portion of the river system.

Biography: Christopher Neill is an ecologist, Senior Scientist and Director of the Ecosystems Center and Director of the Brown-MBL Partnership. Neill's research investigates the ecological consequences of deforestation in the Brazilian Amazon, including how clearing alters runoff and the hydrologic cycle, soil fertility, emissions of carbon dioxide and other greenhouse gases from soils to the atmosphere and the biodiversity and ecological health of streams. He also works on the ecology and restoration of terrestrial and aquatic ecosystems in coastal Massachusetts, including coastal ponds and sandplain grasslands and shrublands, where rapid increases in residential development threaten ecosystems that contain high and unique biological diversity. Neill was a Fulbright Scholar at the University of São Paulo in 2007 and received a Harvard University Bullard Fellowship in Amazon Ecology in 2010.

SESSION C: FRESHWATER WETLAND RESTORATION (CLASSROOM 107)

Restoration of a Wetland and Stream System at an Upland Glacial Till Site in Northwestern CT

Michael S. Klein and James.R. Cowen, Environmental Planning Services *(Michael Klein, Evironmental Planning Services, LLC, 89 Belknap Road, West Hartford, CT 06117. 860-236-1578, michael.klein@epsct.com.)*

The proposed re-development of a 17 acre site in northwestern CT provided an opportunity to restore a perennial stream and wetland that had been incrementally channelized and filled over a ca. 35 year period. We discuss the data collection, design, permitting, construction oversight, monitoring, and adaptive management required to convert a landscape contracting yard, nursery, and single family residence containing fragmented, highly degraded wetlands into integrated retail uses,a stormwater wetland, a restored stream channel, and a floodplain wetland.

Biography: Michael Klein, a biologist and soil scientist, holds a B.A. in Biology from the University of CT and a M.S. in Marine Environmental Sciences from SUNY Stony Brook. James Cowen, a botanist, landscape designer, and soil scientist, holds a B.A. in Biology from the University of California at San Diego and an M.A. in Landscape Design from the Conway School. Both are registered soil scientists and certified Professional Wetland Scientists with Environmental Planning Services, LLC. EPS has provided biological and wetland surveys, impact assessment, mitigation design, permitting, and third party reviews to private and municipal clients since 1983.

Baselines for Restoration: Calculating a Water Budget for a Small Urban Wetland

Catherine Kuhn, Yale School of Forestry & Environmental Studies *(Catherine Kuhn, Yale University, 261 View Street, New Haven CT 06511. 773-343-7887, catherine.kuhn@yale.edu.)*

The purpose of this research project is to calculate a water balance for the Yale swale, a 5 acre forested urban wetland adjacent to the Yale School of Forestry. Students and faculty have collected data on this local living lab including information on bird habitat, soil quality, invasive species and tree species and distribution. The project was driven by a need for a quantitative hydrologic profile to inform feasibility studies for green infrastructure. This project provides baseline data towards the larger goal of leveraging wetland restoration to increase ecosystem services for campus storm water management.

The swale land parcel features a steeply forest slope which slants to an ephemeral stream/wetland. Developed impervious areas in the swale complicate the budget because precipitation onto these areas is routed into storm water infrastructure instead of through the swale. Instrumentation was installed to monitor local climate conditions, soil moisture and surface water. These tools included level loggers and v-notch weirs to measure stream discharge, a water quality monitor, soil moisture profile probes, a radiometer and a Hobo Rainwise tipping bucket to measure precipitation. Two v-notch weirs installed at the top and bottom of the swale stream captured inflow and discharge hydrography. The following basic mass balance equation was used with an assumed negligible change in storage: Precipitation (P) + Surface Inflow (Si) –Evapotranspiration (ET) –Surface Outflow (SO) = Change in Storage (ΔS).

Precipitation was calculated from both regional meteorological data and on-site measurements. In order to account for impervious areas precipitation was multiplied by the current estimated pervious area of the swale (4.68 hectares). Preliminary results indicate surface inflow composes 20% of outflow, suggesting significant contributions from groundwater. Initial trend analysis shows that 2013 seasonal surface flow ceased from July until mid-November with a lag between the first fall precipitation and observed outflow. Further data analysis will evaluate water balance sensitivity to local variation in climate conditions by comparing local and regional meteorological data impacts to discharge calibration.

Biography: Catherine is a first year Master of Environmental Science candidate at the Yale School of Forestry and Environmental Studies, where she focuses on using modeling to inform riparian restoration and management. Before coming to Yale, Catherine, as an Oakland Teaching Fellow, taught biology and environmental science to urban youth. After engaging in local stream restoration and citizen science monitoring projects with her students, Catherine became interested in hydrologic responses to land use changes.   At Yale she hopes to continue translating research for the public to help diverse groups address environmental challenges together. She is passionate about public involvement in urban resource conservation, especially watershed monitoring and management. As a research assistant at the Hixon Center for Urban Ecology she is collaborating on a wetland restoration plan to improve habitat, enhance storm water management and promote public access to the Yale swale wetlands.

Design and Implementation of Floodplain Wetland Restoration in Vermont

Ryan Crehan, U.S. Fish and Wildlife Service *(Ryan Crehan, U.S. Fish and Wildlife Service, USFWS, 11 Lincoln St, Essex Junction, VT 05452. (802) 872-0629 ext 24, ryan_crehan@fws.gov.)*

Wetland restoration is a priority practice employed by many individuals, agencies and groups due to the multiple functions and values that wetlands provide. While specific goals of wetland restoration may include providing wildlife habitat, increasing sediment and nutrient removal, and flood-flow alteration, combining efforts of interested parties can accelerate and improve the implementation of wetland restoration projects. Over the last 6 years, an innovative and collaborative effort has developed to restore wetlands along Otter Creek, Vermont's longest river and a major tributary of Lake Champlain. The Otter Creek target area includes notable wetlands and natural communities that harbor rare plants and provide important breeding and stopover habitat for waterfowl, wading birds, and songbirds. The target area also includes extensive acreage where wetlands and riparian habitats have been cleared, leveled, bermed, ditched and drained for agricultural use. Working in partnership with the Natural Resource Conservation Service, the Vermont Agency of Natural Resources, and Ducks Unlimited, the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program has implemented wetland restoration projects on over 25 parcels encompassing over 2,100 acres for the benefit of wildlife, water quality and floodplain function. This presentation will discuss how resources and technical expertise have been pooled and explore the many "moving parts" that are needed to put a successful wetland restoration project on-the-ground and conserve wetlands for the long-term. Specific topics to be covered include how to identify potential wetland restoration sites, create designs, navigate permitting requirements, and implement the restoration work while avoiding potential pitfalls.

Biography: 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. His work focuses largely on the assessment, design, permitting, and implementation of restoration projects that strive to restore the lost functions and values of wetlands. He received his Bachelor's degree from Prescott College in Arizona and his M.S. from the University of Vermont where he examined using constructed wetlands to treat wastewater. 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.

Long-Term Development and Ecosystem Functions of Restored Wetlands

Kate Ballantine, Mount Holyoke College; Johannes Lehman and Rebecca Schneider, Cornell University; Peter Groffman, Cary Institute of Ecosystem Studies *(Professor Kate Ballantine, Mount Holyoke College, 325 Clapp Laboratory, Mount Holyoke College. (413)230-1897, kballant@mtholyoke.edu.)*

Field-scale manipulations were used to investigate the impact that soils amended with organic materials of differing lability have on soil and vegetative development and on desirable and undesirable biogeochemical functions in restored wetlands. Experimental plots were established in four newly restored depressional freshwater wetlands in central New York. Amendments ranged along a continuum of decreasing carbon lability (straw, topsoil, straw/biochar mix, and biochar). Three years after restoration, the addition of soil amendments to wetland plots stimulated the development of a suite of key structural and chemical properties (e.g., soil carbon, soil nitrogen, cation exchange capacity, bulk density) and biological properties (e.g., microbial biomass and activity, nitrogen cycling) indicative of wetland functions. Straw and Biochar had minimal influence on key wetland functions, whereas most properties associated with desirable functions were highest in topsoil-amended plots. Potential methane emissions were primarily driven by differences in hydrology among sites, and were significantly higher in amended plots than control plots. Despite improvements, soil properties did not reach levels of comparable natural wetlands within three years of restoration. In contrast, plant biomass recovered quickly, and had reached levels of comparable natural wetlands within two years. Results of this research reveal that addition of organic amendments to soil during wetland restoration can improve key properties indicative of wetland functioning and highlight the importance of site selection in restoration design. More research is required, however, to determine what level of amendment application will be sufficient for meeting functional goals within an acceptable time frame.

Biography: Dr. Kate Ballantine is an Assistant Professor of Environmental Studies at Mount Holyoke College in South Hadley, MA. Dr. Ballantine's research interests center on the long-term development and ecosystem functions of restored and created ecosystems. She is currently investigating soil and vegetative development of restored wetlands, the mechanisms that underlie water quality and climate change functions, and the influence of environmental variability on these functions.

You want to do what? Theory and practice used to design one of the largest freshwater wetlands restorations in Massachusetts (Tidmarsh Farms, Plymouth)

Alex Hackman, Massachusetts Division of Ecological Restoration *(Alex Hackman, Massachusetts Division of Ecological Restoration, 251 Causeway Street. 617-626-1548, alex.hackman@state.ma.us.)*

Retired cranberry farms have been referred to as 'blank canvases' in terms of possible restoration options. In our experience, however, such sites impaired by multiple stressors present unique challenges and are rarely straight-forward. These restoration opportunities demand disciplined and structured thinking to focus limited resources on beneficial actions. Furthermore, an approach that focuses on ecological processes guides useful intervention and helps avoid less-effective or counter-productive efforts.

We present Tidmarsh Farms as a case study for using ecological theory to assess multiple interacting stressors and plan a coordinated response to address the root sources of impairment. Tidmarsh Farms is a 577-acre commercial cranberry farm located in a small coastal watershed of southeastern Massachusetts. The farm comprises 10% of the total watershed land area and includes over 50% of the total stream length. 120+ years of farming rendered native wetlands and forested headwaters into simplified and managed agricultural cells and supporting lands. The Massachusetts Division of Ecological Restoration (DER) is leading a partnership of over twenty organizations in planning, design monitoring, and funding its restoration. On-the-ground restoration actions will begin in late 2014, with a long-term (20-30 year) monitoring study to in development.

We demonstrate a simple and practical approach for providing transparency concerning restoration intentions. Explaining what you want to do – and why – is critical for project design, feedback along the way, and monitoring of outcomes. Such transparency can help practitioners avoid pitfalls including single or limited species focus, or over-emphasis on structural responses that only provide short-term relief without addressing underlying drivers of stress.

Biography: Alex Hackman is a Restoration Specialist and Project Manager for the Massachusetts Department of Fish and Game's Division of Ecological Restoration. He holds a Master's Degree in Aquatic Ecology and Watershed Science from the University of Vermont, where his research focused on whole-stream metabolism and nutrient spiraling in impaired urban streams. A self-proclaimed "stream nerd" and "dam removal junky," he currently is managing numerous restoration projects in Massachusetts. Alex happily lives in Somerville with his sweetheart Keri-Nicole, bikes to work, and considers himself to be the most fortunate public servant in the Commonwealth.

The Long History of Instream Structure Use in River Restoration

Douglas Thompson, Connecticut College *(Dr. Douglas Thompson, Connecticut College, 270 Mohegan Ave, Box 5585. 860-439-5016, dmtho@conncoll.edu.)*

The use of engineered devices, often called instream structures, to modify river environments began on private estates in the 1880s in the United States, but became institutionalized by the 1930s with academic and federal involvement. Few changes in the design or implementation methods occurred in the subsequent 80 years. In the 1930s, a variety of man-made geometric designs were used in attempts to improve on nature, following an assumption that natural systems are inefficient. Federal government practitioners learned methods to install instream structures in a series of week-long training sessions, and then supervised crews of untrained workers. Although project designers claimed a scientific management approach, projects were rarely studied, and lacked data collection and hypothesis testing fundamental to the scientific method. Restoration projects relied heavily on an aesthetic appeal of geometric structures that reflected a desire to bring order to natural systems. Today, practitioners learn methods in short courses, and often describe projects as experimental despite the lack of hypothesis testing. Designs used for modern instream structures are almost unchanged from the 1930s, but now use more rounded features and natural materials as part of a new aesthetic valuation that hide the underlying structure. However, the more natural appearance does not ensure successful incorporation of natural processes. Static instream structures designed to prevent natural channel change still ignore the long-term sustainability of ecosystem function dependent on erosional and depositional patterns. A review of river restoration through time reveals that the value of river restoration has never been demonstrated with enough scientific merit to justify the current widespread use of instream structures. A new effort focused on independent monitoring and evaluation of each and every restoration project is needed to ensure that all projects feed our scientific understanding of these complex ecosystems to avoid the pitfalls of our past failures.

Biography: Douglas Thompson is the Karla Heurich Harrison '28 Director of the Goodwin-Niering Center for the Environment, and Professor of Geology, Connecticut College. Thompson studied geology and geography at Middlebury College before obtaining his MS and PhD in Earth Resources at Colorado State University. He is a fluvial geomorphologist, one of the world's foremost experts on pools and riffles, and a leading authority on the history of river restoration. He has written more than 30 scientific articles and book chapters, and presented more than 50 papers. He recently published the book, The Quest for the Golden Trout. Thompson won a prestigious CAREER award from the National Science Foundation in 1999, the G.K. Gilbert Award for excellence in geomorphic research from the Association of American Geographers in 2000, and was a participant in the Third Annual Chinese-American Frontiers of Science Symposium sponsored by the National Academy of Sciences in 2000.

Stream Processes, Stream Power, and Stream Restoration

James G. MacBroom, Milone & MacBroom, Inc. *(James G. MacBroom, Milone & MacBroom, Inc. 203-271-1773, jimm@miloneandmacbroom.com.)*

The recent series of large floods in the Northeast have reshaped many of our stream channels and riparian corridors in addition to causing well-publicized community damages. The floods are a powerful reminder that alluvial channels are subject to active lateral and vertical geomorphic adjustments that surprised some floodplain communities. Observations during the immediate flood recovery period and subsequent analysis have identified relationships between the rivers computed unit stream power and corresponding geomorphic processes that may be useful as an affordable method of predicting future river behavior and mitigating floodplain hazard risk. River reaches with high stream power due to flood discharges combined with steep slopes or lateral confinement had several feet of bed degradation or valley widening via terrace removal and slides, while reaches with lower stream power were observed to have channel aggradation, several feet of floodplain deposition, plus lateral avulsions.

Large scale fluvial processes that create channel patterns and forms are driven by watershed hydrology and sediment transport. As a result, many smaller-scale stream restoration and habitat modification projects based upon simple bankfull discharge relations have short lifespans and limited ecological effectiveness. Most channels disturbed by the floods should be allowed to heal and adjust on their own, but some had to be repaired to protect infrastructure or enable further natural restoration. Although geomorphic rehabilitation does not ensure ecological restoration, ecological restoration can be prolonged without geomorphic rehabilitation.

Rehabilitation and restoration efforts should consider the entire watershed and have clear realistic goals and objectives. They should identify the river corridor zones for water and sediment sources, transport, and deposition continuity, plus focus upon helping the river help itself thru natural processes. One evolving approach is to identify and stratify river corridor zones by investigating specific stream power thresholds and being aware of corresponding management options and limitations. Several examples will be discussed with dam removal, stream restoration, and stream-road crossing applications.

Biography: Jim earned BS and MS degrees in Civil Engineering from the University of Connecticut and is a registered Professional Engineer in five states. He is Vice President of Milone & MacBroom Inc, a Civil and Environmental Engineering consulting firm located in Cheshire, Connecticut, and he developed and teaches graduate courses in River Processes & Restoration and Applied Hydrology at Yale University.

He has 40 years of experience in watershed management, open channel hydraulics, flood control, dam repair and removal, computer modeling, fluvial morphology, stream restoration, and tidal systems. Jim is a member of the ASCE Stream Restoration Committee, American Rivers Technical Advisory Committee, and a speaker at the annual University of Wisconsin continuing education course on dam removal.

Jim has planned, designed, and inspected numerous river restoration and flood control projects with a special interest in sediment management, stream classification and assessments, channel evolution, and design of natural-like channels. He has participated in many post flood damage assessments and developed emergency river recovery plans.

Natural Dams and the River Dis-Continuum

Denise Burchsted, Keene State College *(Prof. Denise Burchsted, Keene State College, 229 Main Street, MS2001, Keene, NH 03435-2001. (603) 358-2176, dburchsted@keene.edu.)*

Within the river restoration industry, a common perception is that rivers should be free-flowing. This talk addresses ways in which that perception—and corresponding projects—could be improved to generate additional ecosystem services in restored rivers. In particular, I will present field research on the impacts of "natural dams," especially wood jams and beaver dams, which create river systems that are patchy and discontinuous. These patchy systems have much greater variation in habitat than purely free-flowing systems, which increases their resilience to disturbance and which also increases support for all life stages of critical species such as anadromous fish. I will conclude by suggesting research and restoration directions based on a baseline condition that includes these natural dams.

Biography: Denise is an Assistant Professor of Environmental Studies at Keene State College and a licensed Professional Engineer in Connecticut. She studies rivers and wetlands, with formal training in civil engineering (BS, UConn), aquatic ecology (MFS, Yale), and fluvial geomorphology (PhD, UConn). She uses this training to apply academic rigor to water resources management and design. Previously, as a water resources engineer with Milone and MacBroom, Inc., and as a hydrologic engineer at Everglades National Park, she has designed dam removals and other fish passage projects, designed salt marsh and freshwater wetland restoration projects, and evaluated restoration alternatives in the Everglades. Her multidisciplinary research currently focuses on the baseline condition of river systems. This research is funded by agencies such as the EPA, which funded Denise's dissertation as a STAR Fellow, the Geological Society of America, and the New Hampshire EPSCoR research grant for Ecosystems and Society, among others. Her research is published in journals such as Geomorphology and BioScience. Denise serves as the New Hampshire state director for the board of SER-NE.

"Engineered Dam Failure": An Approach to Aquatic Habitat Restoration

Michael Chelminski and Robin MacEwan, Stantec Consulting Services Inc. *(Michael Chelminski and Robin MacEwan, Stantec Consulting Services Inc., 30 Park Drive, Topsham, Maine 04222. 207-837-2937, michael.chelminski@stantec.com, robin.macewan@stantec.com.)*

This presentation presents a perspective on the "engineered dam failure" approach to dam removal and related aquatic habitat restoration, including discussion of appropriate applications and project examples. Dam removal can be an effective means to restore aquatic habitat and to eliminate infrastructure that no longer serves its intended purpose. Processes and approaches for dam removal projects in New England, including project prioritization, permitting, and design, are continually evolving. Two factors common to most dam removal projects are funding constraints and the need to balance short-term construction-related impacts with long-term benefits.

Funding for dam removal projects is typically limited for aquatic resource restoration projects, and dam removal proponents seek dam removal approaches that minimize total project costs, including those costs associated with design, permitting, and construction. Regulatory requirements for dam removal vary substantially by project and state in New England. Advances in environmental regulatory requirements for ecosystem restoration projects in Massachusetts and New England have the potential to decrease the time and cost associated with regulatory compliance, while maintaining an appropriate balance between protection and restoration of natural resources.

"Blow-and-go" is a term used to describe a simplified approach to dam removal, whereby the dam is removed with a minimum of additional activity. Blow-and-go may be conceptualized as "engineered dam failure." Design materials and permits are required for this simplified approach, but the project design focuses on removal of the dam structure and relies largely on natural processes to advance post-removal restoration of aquatic habitat.

The applicability of this approach must be evaluated on a project-specific basis and may not be appropriate at a given site due to factors such as impacts to adjacent infrastructure or elevated concentrations of environmental contaminant. Where appropriate, this approach may minimize construction-related impacts and reduce project costs and time, while meeting project restoration goals. Peace.

Biography: Michael is an environmental consultant and Principal at Stantec Consulting Services Inc. in Topsham, Maine. His work is focused on fisheries habitat restoration through improved upstream fish passage. The current focus of his work is decommissioning of legacy infrastructure (i.e., dam removal) as a means to improve access for indigenous fish to their historic habitats. Michael's work includes assessment, scoping, evaluation, and design of fish passage and habitat restoration projects in the United States and Canada. He is the engineer-of-record for six completed dam removal in Massachusetts, where he has performed approximately 50 preliminary dam removal reconnaissance studies. He is a member of the ASCE-EWRI/AFS-BES Ad Hoc Committee on Fish Passage, a fisherman, has a MS in engineering from Utah State University and a BS in engineering from the University of Connecticut, and is a licensed professional engineer.

Robin is an environmental consultant and Associate at Stantec Consulting Services Inc. in Northampton, Massachusetts, and has substantial expertise in the design and permitting of aquatic habitat restoration projects in Massachusetts, include dam removal projects. She specializes in restoration ecology and wetland science, including environmental regulatory compliance; development of restoration, mitigation and resource management plans; and project management. Robin manages multidisciplinary teams that completed five dam removals in Massachusetts in 2012 and 2013. Much of her recent work has involved dam removal projects conducted on behalf of the Massachusetts Department of Fish & Game, Division of Ecological Restoration. Robin is a graduate of Hampshire College and has an MS degree from Antioch New England Graduate School and an MA degree the Conway School of Landscape Design.

AFTERNOON SESSIONS

SESSION E: COASTAL RESTORATION & MANAGEMENT (EAST LECTURE HALL)

Effects of Vegetation Removal, Seed Limitation and Soil Chemistry on Sandplain Grassland Creation on Former Agricultural Fields

Megan Wheeler and Christopher Neill, The Ecosystems Center, Marine Biological Laboratory; Elizabeth Loucks, The Nature Conservancy, Martha's Vineyard; Annalisa Weiler, Department of Biology, University of Central Florida *(Megan Wheeler, The Ecosystems Center, Marine Biological Laboratory, 7 MBL St., Woods Hole, MA, 02543. 619-248-9802, mwheeler@mbl.edu.)*

Restoring native-species rich grasslands in the place of abandoned agricultural fields can be an important strategy for supplementing the area of grasslands, which are in decline across the United States. In the northeastern US, sandplain grasslands support a highly diverse plant community and several rare plant, bird, and insect species that are disappearing largely due to reductions in historical disturbances such as fire and grazing. We designed an experiment on the coastal plain of Martha's Vineyard to test methods of restoring a native species-rich sandplain grassland on former agricultural land. We compared different methods for: (1) removing existing and dominant non-native established vegetation, (2) introducing seed to increase the pool of desired natives, and (3) amending soil to reverse the agricultural legacy of elevated pH and nutrient levels. We sampled soils and vegetation before treatment and for five years following treatment to determine effects on soil chemistry, species richness and the proportion of native and non-native species cover. Reduction of the established vegetation by herbicide spraying and tilling increased native cover. The combination of seeding and tilling increased total and native species diversity on average by 8 species compared to the original field, and was more effective than either seeding or tilling alone, which increased diversity by fewer than 5 species on average. Sulfur addition decreased soil pH and nitrogen levels, but did not have a significant effect on the vegetation. From these results we concluded that native species establishment in this former agricultural field was limited by seed and microsite availability but not by agriculturally altered soil chemistry. Restoration of this field into a native species-rich sandplain grassland is a feasible goal and best accomplished by a single season of tilling and seeding. This experiment can serve as a model for creating species-rich eastern grasslands on old agricultural sites.

Techniques for Restoration Planting in Dynamic Coastal Wetlands

Seth Wilkinson, Wilkinson Ecological Design, Inc. *(Seth Wilkinson, Wilkinson Ecological Design, Inc., 11 Rayber Road, Orleans, MA 02653. 508-241-0125, seth@wilkinsonecological.com.)*

In highly productive habitat areas such as salt marshes the plant community is often anchored in place by a peat layer which can take centuries to develop. Given the realities of accelerated sea level rise, coastal adaptation dictates that many coastal plant communities will be and are experiencing rapid migration into areas without the proper substrate to anchor these plant communities. In the absence of a peat layer, Coconut fiber (Coir) and other biodegradable bioengineering materials can be very effective at securing restoration plantings in dynamic coastal wetlands where periodic inundation and wave action can challenge the fastest growing plants. This presentation will include specific techniques to realize effective results in restoration plantings. Case studies in the restoration of salt marshes, coastal banks and coastal dunes will be used to illustrate how effective these techniques can be to meet some of the most challenging restoration goals.

Biography: Considered one of the regional experts and a frequent instructor in the field of invasive plant management and ecological restoration, Seth Wilkinson has been a leader in hundreds of ecological restoration projects for land trusts, conservation commissions and private individuals for over a decade. Whether through the use of innovative equipment to manage invasive species or the inspired blending of bioengineering products with native plants, Seth and his team at Wilkinson Ecological Design continue to improve the practice and integrity of ecological restoration. In addition to serving as the lead designer on numerous inland wetland restoration projects, Seth Wilkinson has also designed numerous innovative coastal restoration projects throughout Cape Cod, the Islands and as far North as Kennebunkport, Maine. Projects have ranged from restoring heavily degraded wetlands dominated by invasive *Phragmites australis* to innovative techniques of pre-vegetating coir products to serve as a growing medium for plants in coastal areas.

Managing Emergent *Phragmites* to Bring Back the Natives to Rhode Island Coastal Ponds

John Berg and D. Steven Brown, The Nature Conservancy, Rhode Island *(John Berg, The Nature Conservancy, 159 Waterman Street , Providence, RI 02906. (401) 331 7110 x 22, jberg@tnc.org.)*

Rhode Island Sound is bordered with highly functioning coastal lagoon ecosystems that contain critical biological resources and which support activities that provide for significant economic benefit. These coastal features are remarkable for their collective variation, their individual characteristics, and the diversity of their aquatic, emergent and shoreline habitats.

The Nature Conservancy of Rhode Island has been fortunate to be primary steward of a number of these coastal features, beginning in 1968 when it received a salt marsh for safekeeping. The Conservancy has since developed approaches for managing for biodiversity across a continuum of coastal ponds, tidal creeks, and coastal barriers which together contain a myriad of native shoreline communities. A living expression of soils, salinity, water regimes and disturbance, endemic plant communities provide sustenance for much of this biodiversity.

In recent years, it has become apparent that shoreline colonization of these coastal lagoons by Common Reed (*Phragmites australis*) has potential to displace the diversity of native shoreline habitats, replace site specific plant communities with monoculture, and convert shallow open water lagoons into emergent grasslands. Loss of biodiversity aside, local objection to the appearance of this invasive plant has led to rogue management practices, some of which cause known harm to the denizens of these coastal features.

With a goal of maintaining biodiversity in these coastal lagoon ecosystems, and mindful of the need for safe, efficient practices, The Nature Conservancy in Rhode Island has been partnering with landowners, consultant ecologists, agency staff and coastal zone regulators since 2008 at several locations to devise methods and oversee efforts to combat *Phragmites australis* and foster its succession by endemic plant communities. A sustained commitment is planned in these locations, but our results to date are encouraging.

Our proposed talk will explore the rationale, methods, and findings of work to date which is largely centered in Little Compton, Rhode Island. Central to this talk will be sharing our techniques, but it will be critical to consider together the temporal nature of these natural communities in this era of climate change.

Biography: John W. Berg is the Sakonnet Landscape Program Manager for The Nature Conservancy. *About Me*: Saving places, repairing systems, public work. I've been at this for 25 years; since 2001 with the Rhode Island Chapter in the special corner of our state named after a goose call. Before this, I was open space guy & landscape architect for Boston's Neighborhood Development Agency, which was rebuilding the City around gardens, schoolyards, parks and 'urban wilds'. Before that, I was with a private landscape architectural practice in Fairfax County.

Expertise: project management & oversight, real estate negotiation, community development, building partnerships, coaching volunteers, designer & translator, donor relations & fundraising, grant administration, land planning, habitat restoration; *Degree Type*: MLA; *Field of Study*: Landscape Architecture; *Schools*: Middlebury College, University of Pennsylvania; *Memberships*: Rhode Island Land Trust Council; *Honors/Awards*: Boston Municipal Research Bureau, Boston Soc'ty of Landscape Architects; *Interests*: my kayak & all things coastal, gardening, good music, and walking with our red hound dog. *Further information*: http://www.linkedin.com/profile/view?id=44771830&trk=nav_responsive_tab_profile

Determining Abundance and Molluscan Prey Preferences of the Invasive European Green Crab (*Carcinus Maenas*) in East Harbor, Truro, MA

Heather Conkerton and Rachel K. Thiet, Antioch University New England; Megan Tyrrell, National Park Service, Cape Cod National Seashore *(Heather Conkerton, Antioch University New England, 380 Brush Brook Road, Peterborough, NH 03458. (603)924-9657, hconk73@yahoo.com.)*

To make room for industrial progress, tidal flow to New England salt marshes has historically been restricted by dikes, impoundments, and roads. East Harbor, a 720 acre coastal lagoon located in Truro, MA, is a system undergoing restoration after being tidally restricted from Cape Cod Bay in 1868. The introduction of culverts has significantly improved animal and plant communities with increased seawater exchange, yet foundation species such as bivalve mollusks have continued to decline in both species richness and abundance since partial restoration began in 2002. Various ecological stressors may be attributed to this decline, but a potentially new and devastating threat to restoration is the invasive European green crab (*Carcinus maenas*).

The focus of this study was to establish baseline data of *Carcinus maenas* and its feeding preferences through a combination of both laboratory and field studies. Mesocosm studies showed that of three bivalve mollusk species found consistently throughout East Harbor in 2007, 2008, 2011 and 2013, that *Mya arenaria*, a valuable commercial shellfish was most often preferred and consumed first. Using pit traps and transect sampling, abundance of *Carcinus* was found to be most significant in Moon Pond, the region of East Harbor that has direct access to incoming tides and the highest salinity, which is also the area of highest abundance and diversity of mollusks. Through gut analysis, plant material, *Neridae*, and bivalves were found to be present, but it was *Crustacea* and unknown material that dominated gut contents. These findings suggest that *Carcinus maenas* could indeed be exerting pressure on mollusk populations and could be yet another reason for slow recovery.

Biography: I am a conservation professional with more than 10 years of experience spanning research, direct animal care, fundraising, education and community outreach. Some days you'll find me out in the forest banding owls, and on others, you'll find me on a small research boat in the ocean, helping to collect killer whale 'poop' for hormonal studies.

I'm a Master's candidate in the Environmental Studies department at Antioch University New England, and my concentration is Conservation Biology. My thesis research was conducted in East Harbor, a salt marsh lagoon within Cape Cod National Seashore that is undergoing restoration after human degradation. Field and laboratory research was focused on determining whether the invasive European green crab (*Carcinus maenas*) is affecting valuable shellfish recovery.

Wetland and Habitat Restoration in a Challenging Residential and Regulatory Environment

Michael Talbot and Thomas Bienkiewicz, Environmental Landscape Consultants, LLC *(Michael Talbot, Environmental Landscape Consultants, LLC, P.O. Box 187, Mashpee MA 02649. 508-539-1912, info@talbotecolandcare.com.)*

In 2010 the owner of a residential property on Cape Cod approached our firm to explore options to restore an isolated vegetated wetland and upland areas within the relatively small property on Cotuit Bay. Reconstruction of the house and ornamental landscape was nearly complete after permitting by the Barnstable Conservation Commission. However, remaining areas of the property under strict jurisdiction of the Conservation Commission were choked with vines and dense shrubs. The owner wanted a more attractive landscape that would also be safer for people driving and walking along the property to a town beach, and he knew he needed an environmental consultant that could develop a plan acceptable to the Conservation Commission—the busiest Commission in the Commonwealth that strictly regulates its Town Wetland Protection Bylaw as well as the Wetland Protection Act. . In addition the street along the wetland flooded after every significant rain event, and there was interest in options for stormwater management to reduce the severity of flooding, as the Town had no plans to manage stormwater in the near future. Thus, the project also required consultation and approval by the Town Engineer.

The approved conservation plan contrasts with the landscape architect's ornamental landscape and included extensive invasive species management, restoration of native wetland, grassland and shrubland habitats, and low impact design that included enhanced management of stormwater—with an eye to providing aesthetic value to the owner and surrounding community. The restoration was completed in 2012 and includes an intensive three year management program. The reaction of neighbors has been fascinating, as many are pleased with the results, but others have complained that “mosquitoes will breed” in the restored wetland—a wetland that was not visible for decades because of dense stands of shrub honeysuckle and other invasive species that hid the wetland.

Biography: Michael Talbot, MCH, ISA; Environmental Landscape Consultants, LLC (ELC), and Talbot Ecological Land Care; restoration ecologist, landscape designer, consulting arborist, lecturer, author and educator. With over three decades of experience developing, practicing and teaching sustainable landscape design, restoration and management, Michael combines native habitat restoration and ornamental horticulture in both residential and commercial projects in eastern Massachusetts with projects from Maine to Connecticut. As principle consultant for ELC, he leads a team that plans, permits and carries out wetland, salt marsh, dune, grassland, woodland and other restoration projects. He is the author of dozens of articles in various magazines and newspapers and is an appointed member of the Environmental Oversight Committee. He was vice-chair of the Mashpee Conservation Commission and in 2008 received the "Environmental Champion Award" from the Association to Preserve Cape Cod for his work promoting sustainable, native landscapes, organic and ecological land care and low impact design.

Flow-Based TMDLS: Retrofitting Your Way Out of an Impaired Situation

Kristopher Houle, Horsley Witten Group, Inc. *(Kristopher Houle, Horsley Witten Group, 30 Green St, Newburyport, MA 01950. 978.499.0601, khoule@horsleywitten.com.)*

Restoring stream habitats in urban areas typically necessitates management of stormwater flows. In an effort to address aquatic life impairments attributed to stormwater, the Vermont Department of Environmental Conservation (DEC) set hydrologic restoration targets for a dozen stormwater-impaired streams, including a 23% increase in low flows and a 63% decrease in high flows for Centennial Brook—an impaired stream in a small, yet highly urbanized watershed that drains to the Winooski River and, ultimately, Lake Champlain. DEC issued an MS4 permit requiring the four regulated entities (Burlington, South Burlington, University of Vermont and the Vermont Agency of Transportation) to develop and implement a plan to meet the Centennial Brook TMDL flow targets, and by extension, improve in-stream conditions.

In coordination with the Chittenden County Regional Planning Commission and the four MS4s field investigations were conducted to identify and conceptually design over 40 stormwater retrofits with the potential to manage over 90% of total watershed impervious cover and improve stream conditions of highly impacted reaches. Flow reductions were modeled using a GIS-based hydrologic model—the VTBMPDSS as required by DEC. Under no modeling scenario was the 63% flow reduction target of the TMDL achieved using stormwater retrofits alone.

These results raise some interesting technical and regulatory questions that may influence how stream restoration objectives can be met using a flow-based TMDL. Do existing channel protection stormwater requirements result in sustainable, non-erosive flows? How do warm and cold-water fisheries standards for surface detention structures constrain flow restoration? How do small green infrastructure practices impact downstream conditions? Using the Centennial Brook effort as context, this presentation will address these questions and outline the process DEC and regulated MS4 communities are using to develop Flow Restoration Plans.

Biography: Kristopher Houle, P.E., is a Project Engineer at the Horsley Witten Group supporting civil engineering, stormwater management, and ecological restoration projects. He has over seven years experience in water resources design, research, and monitoring. Most recently, Kris has led the design of a two-mile long stream restoration project at an urban park in Wellesley, MA. Prior to joining Horsley Witten, Kris served as a research assistant at the highly regarded University of New Hampshire Stormwater Center where he participated in the evaluation of over twenty innovative stormwater technologies. Kris is a registered professional engineer in Massachusetts and holds a Master of Science degree in civil engineering from UNH and a Bachelor of Science degree from Worcester Polytechnic Institute.

Watershed Management and Modeling as Tools in the Restoration of Pearly Pond, Rindge NH

Catherine Owen Koning, Franklin Pierce University, Rindge, NH; Rebecca Balke and Benjamin Lundsted, Comprehensive Environmental Inc. *(Dr. Catherine Koning, Franklin Pierce University, Franklin Pierce University, 40 University Drive, Rindge, NH 03461. 603-899-4322, koningc@franklinpierce.edu.)*

Pearly Pond, a 191-acre lake in Rindge, NH, is classified by EPA as impaired by total phosphorus, chlorophyll-a, dissolved oxygen (DO), pH and Cyanobacteria hepatoxic microcystins. These parameters reflect the health of the pond, with higher concentrations of phosphorus contributing to increased algal blooms, including potentially toxic cyanobacteria. These conditions create low DO levels in the pond, creating harmful conditions for fish.

A coalition of scientists, engineers and local landowners are developing a watershed management plan to restore the lake water quality to levels that will eliminate harmful algae blooms. The basis of the plan is a computer model that simulates water and nutrient loads entering the pond from the watershed and predicts an in-pond phosphorus concentration. The model is then used to determine the nutrient load reductions needed to achieve specific water quality goals and how changes in the watershed (e.g., nutrient controls, build-out scenarios) will impact the pond's water quality. This information is used to develop a long-term restoration plan intended to improve overall water quality in Pearly Pond. Preliminary investigations and model runs show the major sources of phosphorus in the Pearly Pond watershed are stormwater runoff from roadways and developed areas, water fowl, lawn maintenance, erosion from steep slopes and gravel roads, wastewater from septic systems and a historic wastewater treatment plant discharge. The restoration plan outlines a 10-year program to reduce phosphorus loads from the watershed and improve water quality, including the installation of stormwater best management practices (BMPs) and educating watershed residents. A long-term modeling program is also proposed to refine phosphorus sources, including background contributions from groundwater, which was an area of uncertainty in the model.

The next step in this project is to work with local landowners to prioritize the suggested best management practices (BMPs) to control non-point source pollution.

Biography: Catherine Owen Koning is Professor of Environmental Science at Franklin Pierce University in Rindge, NH. She received her B.A. in Biology and Environmental Studies from Bowdoin College, her M.S. in Ecology from the University of California at Davis, and her Ph.D. in Environmental Studies from the University of Wisconsin. Dr. Koning's interests are in wetland ecology, watershed management, conservation biology and sustainability. She has conducted research in wetland ecology, hydrology, water quality and plant ecology in Maine, New Hampshire, California and Wisconsin, publishing in Environmental Management, Journal of Hydrology, and Wetland Ecology and Management, and Wetlands. Dr. Koning has received research grants from the National Science Foundation, The Nature Conservancy, Audubon Society, Sigma Xi, EPA, and others. She has served on the Board of the New England Chapter of the Society of Wetland Scientists, and is currently an Associate Editor for the Natural Areas Journal.

Bioengineering: Green Infrastructure for Climate Adapted Urban Planning and Design

Wendi Goldsmith, The Bioengineering Group *(Wendi Goldsmith, BioEngineering Group, 18 Commercial Street, Salem, MA 01970. (978)224-3107, wgoldsmith@bioengineering.com)*

Green Infrastructure has been defined as ecologically functional measures designed to handle stormwater, such as green roofs, bioswales, rain gardens, treatment wetlands, and similar elements. These measures have been used with increasing frequency to address water quality while allowing separation of combined sewers without requiring dedicated pipes to convey stormwater. A new scale and type of Green Infrastructure measures have begun to enter professional practice in relation to storm surge and flood impacts, especially for climate change adaptation solutions. While current science substantiates many limitations to purely "green" measures, successful applications have been documented where "green" components have performed well, especially hybrid measures featuring structural and vegetative elements in various combinations. On the micro scale, such systems can shield and buffer "hard" structures that could otherwise not withstand direct open water exposure forces. On the macro scale, wetlands, oyster reefs, dunes, and other natural systems support regional quality of life, contribute to the stable equilibrium of fragile or dynamic landforms, and host economic systems based on fisheries, forestry, and tourism. A combined approach is both necessary and also highly desirable for communities facing threats related to sea level rise, land subsidence, increased storm intensity, aging infrastructure, and other factors.

Two detailed case studies will outline how site scale and regional scale infrastructure systems can yield measurable, reliable, and cost-effective flood risk reduction with significant Green Infrastructure components, combined with hard infrastructure. The Lexington DPW project applied a variety of measures to manage stormwater on site up to the 100-year storm event, thereby identifying and addressing potential problems related to local flooding, while preventing increased off-site flood risk. Methods replicated pre-development hydrology and included water harvesting as well as infiltration and evapotransporation. The Greater New Orleans Hurricane Storm Damage Risk Reduction System(HSDRRS) formulated a robust and resilient regional scale infrastructure system after Katrina that factored in trends and uncertainties surrounding climate change, sea level rise, and land subsidence. Recognizing that no hard infrastructure could perform well in the long term without being surrounded and shielded by healthy coastal wetlands and protective landforms such as barrier islands, these functions were considered as core functional elements. Together, the natural landforms, healthy ecological communities, built structures, and operating procedures were capable of mitigating storm damage based upon multiple lines of defense, delivering a sustainable infrastructure solution that can be emulated in many coastal cities facing the need for climate change adaptation.

Biography: Wendi Goldsmith is founder and CEO of Bioengineering Group, a Salem, MA-based firm whose mission statement is "Building Sustainable Communities on an Ecological Foundation." She has been a pioneer in the field of ecological restoration and the application of sustainability principles to site planning, development, and public infrastructure. Wendi has led R&D programs for DOD developing methods for evaluating and optimizing renewable energy and efficient infrastructure and building and site design. Her roles span planning of large scale climate adaptation projects, multi-state watershed management and restoration projects, and science and design research. She facilitates interdisciplinary collaborative design teams in adopting effective climate change adaptation strategies, serving as co-convener of NATO Advanced Research conferences on the topic, hosted in Europe. Notably she led key aspects of the planning, engineering, and oversight of the $14 billion program for Greater New Orleans Hurricane Storm Damage Risk Reduction System, the first regional scale climate adapted infrastructure system in the US, incorporating hard and green elements for resilient and multi-functional performance. Recognized with many awards for business success, for promoting STEM to girls and women, for sustainable design, and for environmental engineering, the firm is recognized for 20 years of leadership in sustainable design. A hallmark of its projects is stewardship and creative use of onsite resources, delivering triple bottom line value. Wendi is a Yale graduate in Geology & Geophysics and Environmental Studies. She holds two Master's in Sustainable Design from the Conway School Plant and Soil Science from the University of Massachusetts.

SESSION G: NATIVE, INVASIVE, AND RARE PLANTS (MAIN LECTURE HALL)

Plant Conservation and Restoration in a Changing World: Observations from Native Plant Horticulture and an Ongoing "Assisted Colonization" Experiment

Jesse L. Bellemare, Smith College *(Prof. Jesse Bellemare, Smith College, 44 College Lane, Smith College, Northampton, MA 01063. 413-585-3812, jbellema@smith.edu.)*

Climate change threatens many species with declines or extinction in coming decades, and is likely to upend traditional distinctions between non-native vs. native species due to rapid shifts in species geographic ranges. Conservation and ecological restoration efforts in the 21st century will be faced with difficult choices related to the preservation of rare species that may be on the verge of extinction within their native ranges. For example, might it be appropriate to establish new populations of threatened species in regions outside their historical ranges if such areas represent the only possibility for continued survival in the wild? Or does such " assisted colonization" or "managed relocation" risk triggering new biological invasions and further disrupting ecological communities already impacted by environmental change? This talk will review evidence on the risks and potential of unconventional approaches to conservation and restoration in the face of rapid climate change, like assisted colonization, with a particular focus on forest plants native to the eastern United States. The results of an ongoing experimental transplant study investigating the relationship between the distribution of a rare plant species, Umbrella-leaf (Diphylleia cymosa), and climate will be discussed. In addition, horticultural data on a broader set of forest plant species will be reviewed to assess species tolerances to novel climatic conditions and prospects for conservation and restoration.

Biography: Jesse Bellemare is a plant ecologist based in the Department of Biological Sciences at Smith College. His research focuses on the biogeography and ecology of plants native to the forests of eastern North America, with a focus on species responses to climate change and prospects for conservation.

In Situ Growth and Rapid Response Management of Flood-Dispersed Japanese Knotweed (*Fallopia japonica*)

Brian P. Colleran; Katherine E. Goodall, Wellesley College Botanic Garden *(Brian Colleran, NA, 19 Harvard St., Apt 1 Natick MA, 01760. (203)561-5010, brian.p.colleran@gmail.com.)*

The objective of this talk is to improve the understanding and control of Japanese knotweed propagules distributed by high-water events. Along four river systems in Vermont, we collected and measured Japanese knotweed propagules that had been distributed by flooding approximately 1 yr earlier. Results indicate that the size of the emergent shoot may be determined by the extent of underground growth late in the growing season, although initially it is linked to the size of the propagule. Our results show that 70% of new plants originated from rhizome fragments, and 30% from stems. This proportion is similar to regeneration rates shown in laboratory studies. We suggest that the best way to prevent the spread of Japanese knotweed along rivers is to focus control efforts on those stands most susceptible to erosion and propagule dispersal. We also suggest that an early detection and rapid response management approach can be effectively utilized to eradicate these propagules, and effectively suppress the spread of Japanese knotweed. Our data-collection method also provides evidence that control of newly distributed propagules can be effectively accomplished without the use of herbicides or heavy mechanical tools.

Biography: Brian Colleran, no current affiliation. Recently the State of Vermont's Invasive Species Ecologist, Brian led the Rapid Response to Japanese Knotweed in that State following tropical storm Irene. Prior to that position, he has worked on invasive species issues in California's Central Valley, the Great Basin and Sonoran deserts, and the Great Lakes region.

Population Restoration of Sandplain Gerardia in Massachusetts

Bryan Connolly, Massachusetts Natural Heritage & Endangered Species Program, Division of Fisheries and Wildlife *(Bryan Connolly, Massachusetts Natural Heritage and Endangered Species Program, 100 Hartwell St. Suite 230, W. Boylston, MA 01583. 508-389-6344, bryan.a.connolly@state.ma.us.)*

Agalinis acuta (Orobanchaceae) Sandplain Gerardia is a federally endangered plant species. The taxon is known from Maryland, New York, Connecticut, Rhode Island, and Massachusetts.

This plant occurs in sand plain habitats, the species is hemi-parasitic drawing nutrients from the roots of other plants, primarily little blue stem (*Schizachyrium scoparium*). Historically the plant was known from 51 populations range wide. When placed on the federal endangered species list in 1987, only 12 locations were known to support plants. In Massachusetts, the plant was historically known from 24 populations, though not rediscovered until 1980. Three native sites are known, two of which are active cemeteries. The Massachusetts Natural Heritage and Endangered Species Program has engaged with conservation partners to monitor the *A. acuta* populations, enhance known natural populations, and create restoration populations. This conservation program has been generally successful but is complicated by the high fluctuations in population numbers. Natural populations with initial individual numbers of 40, 73, and 378 plants have at their highpoints reached 4,700, 4,000, and 5,100 plants respectively. Introduced populations have been very successful reaching highpoints of 164,000, 64,900, and 22,000 plants. All sites have been managed to some extent with either controlled fire, removal of invasive species, or carefully coordinating mowing times with the cemetery caretakers. In recent years population numbers have been lower, but with state totals still in the thousands of individuals. The reasons for the recent declines are unclear but may have to do with the annual life cycle of the plant, increased thatch at some sites, and precipitation patterns. An additional complication to the conservation of *A. acuta* is based on molecular genetic findings: it has been recommend that this species be combined with *A. decemloba*. It appears that even as a combined entity this group of plants deserves federally listing.

Biography: Bryan Connolly is the Massachusetts state botanist for the Natural Heritage & Endangered Species Program, Division of Fisheries and Wildlife. He is also currently serving as the Vice President of the New England Botanical Club. Bryan is a co-author of "The Vascular Plants of Massachusetts: A County Checklist, First Revision". His professional experience includes being a botanical consultant for the Connecticut Chapter of The Nature Conservancy, surveying rare plant populations for the Connecticut Department of Environmental Protection, coordinating a volunteer invasive plant survey at the New England Wild Flower Society, and instructing botany classes at Connecticut College and the University of Connecticut.

Monitoring Riparian Habitat Restoration Projects: Lessons Learned and Adaptive Management in Vermont

Leah Szafranski, U.S. Fish and Wildlife Service, Vermont *(Leah Szafranski, U.S. Fish and Wildlife Service. 802-872-0629 x 28, leah_szafranski@fws.gov.)*

It is well known that forested riparian areas throughout the United States have been drastically altered and reduced by human activities. Forested riparian buffers are important components of our landscape because they have proven to reduce runoff and filter nutrients and pollutants, stabilize river banks, improve water quality, and provide valuable habitat for both terrestrial and aquatic species.

Many organizations are working to restore riparian buffers through various treatments and practices such as changes in land use and the planting of trees and shrubs. Over the past 20 years, approximately 300 miles of riparian habitat has been restored in Vermont, including the planting of more than 200,000 trees and shrubs. While there has been great emphasis and resources directed towards the development and restoration of riparian buffers, monitoring the results and opportunities for adaptive management have been limited.

In 2008 the USFWS in Vermont took the lead on developing a monitoring program to assess riparian restoration projects statewide. Monitoring has focused on tree and shrub survivorship, health, and growth; while taking into consideration variables such as: species, plant material types, plant protection devices (mats and tubes), and site specific variables. In addition this study has included annual avian point count surveys to monitor changes in bird abundance and diversity at restoration sites throughout the State. After more than five years of monitoring restoration sites our data and field observations have begun to contribute to the decisions we make throughout the planning process. This talk will highlight the main findings our monitoring results, how this information will change the way we plan our projects, and discuss areas where we see the need for further monitoring and research.

Biography: Leah Szafranski is a graduate of the University of Vermont with a B.S. in Environmental Studies with a focus in Ecological Restoration and a minor in Plant and Soil Science. After graduation, Leah served as manager for the Intervale Conservation Nursery in Burlington, VT, growing and selling native trees and shrubs for restoration projects. In addition to propagating and growing plants, managing the day to activities of the nursery, Leah lead planting crews and collaborated with resource professionals on restoration projects. Since 2010 Leah has worked for the U.S. Fish and Wildlife Service (USFWS) monitoring the success of restoration projects through vegetation and avian surveys. Leah has also provided technical planning assistance for the USFWS and its partners, developing and implementing riparian habitat restoration projects.

Integral Invasive Plant Management Practices for Ecological Restoration Projects

Chris Polatin, Polatin Ecological Services, LLC *(Chris Polatin, Polatin Ecological Services, LLC, 334 Mountain Road Gill, MA 01354. 413-367-5292, chris@polatineco.com.)*

Well planned and implemented ecological restoration projects can easily be undermined by invasive plants if due consideration is not paid to their management. This talk will discuss invasive plant management strategies within the planning, control and maintenance phases of a project. Case studies from various New England natural communities will be used to demonstrate invasive plant management principles. Planners and practitioners alike will walk away with a heightened awareness of how to successfully consider invasive plant management in their projects.

Biography: Chris Polatin is an ecological restoration practitioner involved with habitat restoration, conservation planning, and land stewardship through his company Polatin Ecological Services. He and his crew regularly perform all aspects of invasive plant management and revegetation including planning, mapping, monitoring, implementing various control activities and encouraging in-situ native plant establishment. He has a master's of science degree in conservation biology and has been involved with environmental work for fourteen years.

SESSION H: RIVER RESTORATION (2): APPROACHES AND CASE STUDIES (CLASSROOM 107)

From Stone to Wood: 20 Years of Riverbank Restoration on the Connecticut River

Mickey Marcus, New England Environmental, Inc. *(Mickey Marcus, New England Environmental, Inc., 15 Research Drive Amherst, MA 01002. (413)658-2050, mmarcus@neeinc.com.)*

This paper discusses the restoration techniques used to re-vegetate eroding riverbanks of the Turners Falls Impoundment of the Connecticut River in Massachusetts, Vermont and New Hampshire during the past 20 years. In this time frame over four miles of eroding riverbank has been successfully restored. Initial restoration work including the use of large diameter stone at the water's edge with soil bioengineering treatments on the higher bank elevations. The restoration techniques have evolved to "soften" the armoring by using smaller diameter stone and by using wood in place of stone. Over the past 5 years I have designed and implemented engineered log structures, coarse woody debris, soil bioengineering, and tree stumps to stabilize approximately 6300 linear feet (1920 meters) of eroding river bank. The goal of this work was to provide near natural riverbank restoration using coarse woody debris and bioengineering techniques, without the use of stone or other hard armor. The Connecticut River has a watershed area of 11,000 square miles (2,848,987 ha) and has a bankfull width of over 800 feet (244 meters). Annual flows exceed 100,000 cubic feet/second (2,831,685 liter/second) causing significant bank failures and soil erosion. One of the goals of using the woody debris was to capture sediment during high flow storm events. The sediment deposition was monitored using bank pins, scour chains and staff gauges, and have been monitored for four years to measure the rate of bank erosion and the sediment deposition which was captured by the woody debris.

Engineered woody debris log jams were built at a spacing of approximately 120 feet (36.5 m) on center and secured into the bank. Native willow shrubs and emergent and aquatic vegetation were planted between the log jams to help in the retention of sediment, and to provide wildlife and fisheries habitat. Staff gages, and scour chains were installed vertically along the project's aquatic bench to measure accretion or deposition. To measure bank erosion, bank pins were installed horizontally into the banks. During the first year of monitoring, the woody debris structures accumulated as much as 30 inches (76 cm) of new sediment by reducing water velocity along the shoreline during flood events. Tropical Storm Irene on August 28, 2011 was a bankfull event which exceeded 110,000 cfs (3,114,853 lps), and submerged the bank and woody structures for over two weeks. Following the storm significant sediment was deposited and retained by the wood structures; there was no measured horizontal bank erosion. The accumulated sediment has permitted emergent vegetation to become established, further protecting the adjacent river banks.

Biography: Mickey Marcus is a Senior Scientist and Principal of New England Environmental, Inc., Amherst, MA. Mickey received his B.S. from Marlboro College, and M.S degree from the University of Maine at Orono. He has been working in the field of wetland science since 1981 where he got his feet wet conducting biological inventories of Maine peat bogs. His present areas of interest are in the fields of soil bioengineering, river morphology and restoration, watershed management, wetland restoration and innovative sediment and erosion control techniques and stormwater compliance and management.

Mickey is currently the Vice President of the Northeast Chapter of the International Erosion Control Association. He is a Board member of the New England Chapter of the Society of Ecological Restoration and the Vice Chair of the New England Chapter of the Soil and Water Conservation Society. Mickey is also a member of the Executive Board of Envirocert International Storm Water Council. Mickey is currently a Senior Wetland Scientist and Principal with New England Environmental, Inc. in Amherst, MA. He is a Professional Wetland Scientist, a Certified Professional in Storm Water Quality, and a Certified Profession in Sediment & Erosion Control.

Performance of the Sucker Brook Channel Avulsion Stabilization Design

Matthew Murawski, DuBois & King, Inc; Mary Nealon, Bear Creek Environmental, LLC; Jessica Andreoletti, Town of Williston *(Matthew Murawski, DuBois & King, Inc, 28 N Main St, Randolph VT 05060. 802-728-3376, mmurawski@dubois-king.com.)*

Sucker Brook is a relatively small stream (14-foot bankfull width, 2.5 sq mi drainage area) in the Lake Champlain Watershed in Williston, Vermont. Following a night of heavy rains in 1985, the channel avulsed through an adjacent sand pit, returning to the original channel approximately 700 feet downstream. The abandoned channel was largely stone-lined and included a 20-foot waterfall. Over the next 20 years, the energy formerly dissipated at the waterfall instead attacked a path through highly erodible sands and gravel, sending an estimated 35,000 CY of material downstream. In 2004, an armored channel with vegetated floodplain was designed to stem the production of sediment and associated phosphorous, and construction followed in 2005. The design was an early attempt to incorporate natural channel design features, but the gross disconnect between the erosive forces and the on-site material required importing material to construct an erosion-resistant, immobile channel bed. Eight years of post-construction observation and measurement suggest that the primary objective of the project – namely sediment reduction – has been achieved, but aspects of the original design did not perform well and conditions at the site continue to evolve. The lessons learned on this project can inform the design of future channel avulsion stabilization projects.

Biography: Matthew Murawski, PE is a consulting Water Resources Engineer with DuBois & King in Randolph, Vermont. He has 16 years of experience with water resource planning and engineering with an emphasis on the protection and restoration of natural resources. His work includes scores of stream restoration and stabilization projects where rivers and the built environment share cramped quarters, dam removals, and the sizing and design of culverts and bridges to address hydraulic, geomorphologic, and AOP concerns. Prior to consulting, Matt worked for EPA Region III developing nonpoint source pollution control plans and a short stint with the Vermont DEC developing and testing geomorphic assessment protocols. Matt has a BS in Watershed Science from Colorado State University and a MS in Agricultural Engineering from Texas A&M University.

Oak Hill Stream Channel Restoration

Mary Nealon, Bear Creek Environmental, LLC; Matt Murawski, DuBois & King, Inc., Jessica Andreoletti, Town of Williston *(Mary Nealon, Bear Creek Environmental, LLC, 149 State Street, Suite 3, Montpelier, VT 05602. (802)223-5140, Mary@BearCreekEnvironmental.com.)*

Gully erosion in headwater streams is a common problem that plagues infrastructure and water quality. Located south of Interstate 89 in Williston, Vermont, the Oak Hill project is an example of a small tributary (drainage area of 0.4 sq. miles) that was straightened and lined with rock during highway construction. Below the rock-lined portion, the channel incised losing access to its floodplain and was eroding laterally threatening a major road and contributing excessive sediment downstream.

In 2006, an alternatives analysis was conducted to evaluate options to arrest an active headcut and to improve channel stability. The selected design involved excavation of highly-erodible material adjacent to the channel to restore floodplain access and to reduce mobilization of sediment and phosphorus downstream. The transition to the restored channel included armoring to prevent upstream migration of the head cut. The design blended hydraulic engineering, fluvial geomorphology, bioengineering, and natural channel design principals. Construction took place during a particularly dry period in summer 2007, and the newly formed stream banks crumbled due to the erodible soils and site conditions. Following an emergency meeting with the project team and regulators, coir mat was selected and installed to hold the banks intact. Streamside plantings using native plant species including live willow and dogwood stakes followed construction in fall 2007. After the spring high flow period, concern about the channel incising further was voiced, and log structures were installed to add structure to the channel to help resist further incision. The project was successful in restoring floodplain function, reestablishing a high quality riparian zone, and reducing sediment discharges. Important lessons were learned about construction in highly erodible soils and providing sufficient in-channel structure.

Biography: Mary Nealon is the principal of Bear Creek Environmental, LLC, an environmental consulting firm located in Montpelier, VT. She earned a Master of Science degree in Wildlife and Fisheries biology from the University of Vermont, and has received training in applied fluvial geomorphology, river restoration and natural channel design. Additionally, she is a Certified Professional in Erosion and Sediment Control. During the past thirty years, Mary has worked in the environmental field, specializing in geomorphic assessments, aquatic biology, river restoration and water quality monitoring. She has designed and implemented numerous stream restoration projects in Vermont. Mary is passionate about working with organizations and municipalities to protect and restore surface waters in their communities, and has been responsible for preparing more than twenty river corridor plans.

Ten Ways to Reduce Habitat Impacts and Future Flood Risks during Flood Recovery

Roy Schiff, Jim MacBroom, and Mark Carabetta, Milone & MacBroom, Inc., Mike Kline, Shayne Jaquith, and Barry Cahoon, Vermont Rivers Program; Evan Fitzgerald, Fitzgerald Environmental Associates *(Dr. Roy Schiff, Milone & MacBroom, 1 SouthMain Street, 2nd Floor, Waterbury, VT 05676. 802-882-8335, roys@miloneandmacbroom.com.)*

Flood recovery efforts can have severe impacts on the physical and biological integrity of river channels. In the wake of Tropical Storm Irene, Vermont struggled to move beyond traditional means of flood recovery resulting in perpetuating flood risks and increasing damages.

Flood recovery tends to be invasive, but if performed correctly, flood recovery projects can move the river toward a more stable equilibrium condition reducing the environmental and economic costs of channel management over the long term. A refined approach to flood recovery is emerging that is based on the following ideas.

1. Link flood damages to river processes for proper problem identification.
2. Consider channel condition and process locally and at the river corridor scale to obtain a comprehensive view of the flood recovery context.
3. Perform an alternatives analysis based on risk minimization, controlling habitat impacts, and limiting project cost. Consider the no-action alternative first. Move to more invasive, costly, and confining practices only as required.
4. Only perform practices that adhere to the principles of fluvial geomorphology and follow current best engineering practice. Maintain channel bedforms and hydraulic roughness.
5. Restore channel and floodplain reference geometry to minimize unnatural down-cutting or sedimentation. Evaluate stream power and resistance to erosion.
6. Restore floodplain connection where possible to reduce the future need for in-channel work and create space to store water, sediment, debris, and ice.
7. Manage channels towards a least erosive, vertically stable equilibrium condition.
8. Only dredge channels where unmovable infrastructure and inhabitable structures are vulnerable to future flood damages.
9. Properly size bridges and culverts so that they are geomorphically compatible with the channel and maintain aquatic organism passage.
10. Conserve river corridors to provide space for the river to migrate to reduce future flood risks and the need for future recovery projects.

Biography: Roy is a Water Resource Scientist and Engineer with Milone & MacBroom, Inc. MMI is based out of Cheshire, CT, and Roy manages their Vermont branch office that he helped open in 2005. He received his PhD (Aquatic Ecosystem Studies) from the Yale School of Forestry and Environmental Studies in 2005 and his M.S.Eng. (Civil and Environmental Engineering) from

University of Washington in 1996. Roy is a licensed Professional Engineer in Vermont and frequently works on applied projects including flood protection, channel and floodplain restoration, bank stabilization, and river corridor assessment. Roy regularly gives presentations on flood avoidance and mitigation where societal needs are balanced with a combination of stream restoration and hard engineering approaches to reduce risks. Roy lives in Montpelier, VT with his lovely wife, two adorable daughters, and sweet dog.

Designing for Success: Fish Passage Restoration as an Integral River Restoration Component

James Turek, NOAA Restoration Center *(James Turek, NOAA Restoration Center, 28 Tarzwell Drive. 401-782-3338, James.G.Turek@noaa.gov.)*

Dam removal is increasing in local community acceptance as a restoration practice to restore the functioning of and ecological services derived from free-flowing streams and rivers. Unimpeded fish passage is a function often considered in river restoration, but specific passage design criteria for targeted species or documentation of passage performance metrics are frequently lacking for constructed projects. Since 1996, NOAA's Restoration Center has contributed technical assistance and substantial funds to partners in advancing diadromous fish passage in Northeastern rivers and streams, including more than 90 dam removals completed or planned. While in most cases, full dam removal provides the best option for restoring river functions, project proponents often face multiple site or environmental constraints and social needs or requirements that limit or prevent full dam removal for implementation. Nature-like fishways, particularly river-wide designs, offer a viable alternative or can serve in combination with full or partial dam removals in restoring efficient and effective diadromous fish passage if properly designed, constructed, and maintained. Requiring target species passage design criteria and a sound basis for engineering design has resulted in a number of completed nature-like fishways in the Northeast, with project successes and adaptive measures discussed in this presentation.

Biography: James Turek is a Restoration Ecologist with the NOAA Restoration Center (RC), stationed at the NOAA Lab in Narragansett, RI. He has worked with the RC for 14+ years and is responsible for providing technical assistance on coastal habitat restoration projects in Narragansett Bay, Long Island Sound, Buzzards Bay and their watersheds. He has 30 years of experience in fishery biology and wetlands ecology, and his experience includes the planning, design, construction and monitoring of fish passage projects including dam removals, nature-like fishways and structural fishways. He holds a Bachelor's Degree in Zoology and minor in Geological Sciences from the University of Maine at Orono, and a Master's Degree in Marine Affairs from the University of Rhode Island. He is passionate about flyfishing, mineral collecting and other outdoor recreation and travel.

Climate Change and Assisted Colonization: The Seed Germination Requirements of a Southern Appalachian Endemic Plant May Already Be Well-Matched To Northern Areas

Emily Barbour and Jessamine Finch, Smith College; Jesse Bellemare, Smith College *(Emily Barbour, Smith College, ebarbour@smith.edu.)*

Scientists have begun to document evidence of range shifts as many species respond to anthropogenic climate change. However, some species with limited dispersal ability or long generation times may not be able to adapt or adjust their distributions as rapid climate change exceeds their migrational capacities. A controversial new conservation technique termed “managed relocation” has been proposed as one solution for protecting climate-threatened, dispersal-limited species by intentionally translocating them to new areas where they have not occurred historically, but where they are expected to survive in the future. In this study, we use the Southern Appalachian endemic plant Umbrella-leaf (*Diphylleia cymosa*) as a model to explore issues surrounding this unconventional conservation approach. In its native range in western North Carolina, *D. cymosa* is restricted to cool, high elevation forests, a habitat type that may decline in the Southeast with climate warming. To test how seed germination rates might be influenced by reduced length of winter cold stratification, we exposed *D. cymosa* seed to 0, 6, 12, 18 and 24 weeks of cold stratification at ~ 1° C and then tested their germination rates. To place these experimental treatments in a geographic context, GIS spatial analysis was also used to quantify current environmental conditions within the native range of *D. cymosa*. Results show that *D. cymosa* seeds require a minimum of 12 weeks cold stratification to germinate, and that germination rates are highest following extended cold stratification of 18 and 24 weeks: 52% and 83%, respectively. These findings indicate that *D. cymosa* seed performs best under conditions that may already be more typical of northern areas outside the species native range, and that climate warming could severely impact population dynamics. If such declines become evident, assisted colonization might be a viable conservation option for this species and similar Southern Appalachian endemics.

Biography: I am studying biology at Smith College, working on a senior thesis in plant ecology and conservation.

Application of Ecological Indices in Monitoring of Ecosystem Restoration

Ahmed A. Hassabelkreem, UMASS Amherst; Aaron M. Ellison, Harvard Forest *(Ahmed A. Hassabelkreem, UMass Amherst, 990 N Pleasant St. Apt # B-8, Amherst, MA 01002. (413)695-1059, asiddig@eco.umass.edu.)*

As we all know that the life on the earth is being surrounded by several environmental challenges such pollution, climate change, drought and desertification. Regardless the causes, the coming era of environmental conservation doesn't only need solid adaptation and mitigation plans but also needs quantitative, objective, flexible, cost-effective measures to assessing the performance of such strategies. Generally biological indices are thought to be an intuitive ways to get around this particularly when it comes to the complicated issues such as assessing a performance of certain restoration strategies on a certain ecosystem or habitat type.

This presentation is part of a literature review for my dissertation; aims to highlight the importance of biological indices in monitoring the performance (i.e. quality) of the restored ecosystems. Specifically the presentation will address the development of the concept, establishment, and effectiveness in addition to examples from the ecological literature/hypothetical case study.

The importance of this presentation is not only showing the significances of biological indices as ecosystem monitoring tool, but also pointing out some potential advantages of the approach such as the ability to (1) evaluating the performance of the restoration actions, (2) quantifying the magnitude of annual changes towards the desired conditions, and (3) intuitively summarizing the complexity of the ecosystem in one metric instead of a single measurement (e.g. diversity index).

Biography: Mr. Ahmed A. Hassabelkreem is a lecturer of forestry and wildlife ecology at University of Khartoum – Sudan where he received the BSc in Forestry and MSc in drylands ecology and desertification studies. Recently he is a PhD candidate at University of Massachusetts Amherst, dept. of environmental conservation with research focus on ecological monitoring , population dynamics and biodiversity conservation. Particularly his dissertation topic is investigating the effectiveness of amphibians as indicator species in long-term monitoring of environmental changes / ecosystem dynamics.

The Yale Swale: Assessing Ecosystem Services in an Urban Wetland

David Jaeckel, Catherine Kuhn, and Uma Bhandaram, Yale School of Forestry & Environmental Studies *(David Jaeckel, Yale School of Forestry, 78 Nash Street #2, New Haven CT, 06511. (408)674-4459, david.jaeckel@yale.edu.)*

The Yale Swale (Swale) is a 5.5-acre urban wetland located immediately adjacent to Yale's campus. The Swale drains an approximately 19.2 acre watershed area, with 46% of watershed runoff flowing into the Swale and the other 54% of runoff diverted into the City of New Haven's combined sewer system. For the past three years, researchers at the Yale Hixon Center for Urban Ecology have conducted Swale research related to: a) tree and vegetation inventories; and b) site characterizations related to hydrology, soils, and bird habitat. In addition, instrumentation has been installed throughout the Swale in order to accurately determine the site's water budget. This instrumentation includes: a) an inlet and outlet V-Notch Weir with pressure transducers; b) a tipping rain gauge; c) groundwater monitoring wells; and d) two YSI EcoNet Dataloggers.

Our research project focuses on determining how much stormwater runoff within the Swale watershed that is currently diverted into the City of New Haven's sewer system can be returned to the Swale. Specifically, we are working towards: a) determining the Swale's water budget during baseflow and stormflow conditions; b) developing a hydrologic model representing diverted stormwater to the Swale using HydroCAD modeling software; and c) identifying areas – such as adjacent downspouts – where stormwater can be diverted to enter the Swale. This research addresses the current lack of information related to determining maximum volumes of stormwater runoff that can be managed by means of urban wetlands. By quantifying the volume of stormwater runoff that can be reintroduced to the Swale, more data will be available to inform how to restore the natural hydrologic conditions of urban wetlands.

We are using the following methodology in our Swale research: characterizing baseline hydrology, creating storm event hydrographs, conducting hydrologic modeling, and creating a stormwater capture inventory.

Biography: I am currently pursuing a Master of Environmental Management (MEM) Degree from the Yale School of Forestry and Environmental Studies. I am interested in watershed management, green infrastructure, urban ecology, and water quality. Specifically, I am studying how networks of green infrastructure projects can improve water quality.

The Genetic Contribution of Oyster Aquaculture and Restoration to Wild Oyster Populations, Rhode Island

Hannah Jaris, Columbia University; Steven Brown, The Nature Conservancy; Dina Proestou, USDA Agricultural Research Service *(Hannah Jaris, Columbia University, h.jaris@gmail.com.)*

The decline of oyster (*Crassostrea virginica*) populations to near extirpation has led to a renewed interest in restoration and aquaculture efforts. Population enhancement through direct seeding of hatchery-reared oysters on constructed reefs is a common practice in restoration programs. At present, the impact of using alternative genetic strains on wild populations is unknown. A collaborative project between restoration practitioners, resource managers, and conservation geneticists was formed to evaluate the genetic contribution of aquaculture and restoration on wild oyster populations in Rhode Island coastal ponds. Samples were collected from eight populations within a large coastal lagoon highly influenced by restoration activity. Three "wild" populations located varying distances from restoration and aquaculture activities were compared to two restored and three aquaculture populations. A ninth population, collected from a site free from intense human activity was included to serve as a control. Adult oysters (n=30) collected in early June from each of the nine populations, and oyster spat (n=30) collected in late September from the four wild populations were genotyped at 14 microsatellite loci. From the multilocus genotype data we measured the extent of variation within and differentiation among populations by estimating a number of genetic parameters. Assignment tests were also used to assign spat to source populations. These analyses will provide a better understanding of the factors responsible for the restoration of wild oyster reefs. Furthermore, knowledge of how specific human activities contribute to the genetic diversity can help evaluate the future success of restoration activities.

Biography: Hannah Jaris is a graduate student at Columbia University majoring in Conservation Biology and Genetics. Her research focuses on the application of molecular genetic tools in marine conservation and restoration ecology. In 2013, Hannah was a Growing Leader on Behalf of the Environment (GLOBE) fellow at The Nature Conservancy where she completed a genetic assessment of wild and restored oyster populations in Rhode Island. From 2010 to 2012, Hannah worked as a genetic research technician at Hopkins Marine Station where she studied meta-population dynamics in the acorn barnacle. In the future, Hannah plans on working on marine conservation and restoration issues.

The Schoolyard Habitat Program: An Opportunity to Connect Students with Nature and Restore Habitat

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Concerns over children's lack of connection and appreciation of the natural world have grown in recent years, as noted by researchers and the media. In addition, loss of wildlife species and their associated habitats is also a concern to the public. In response, the U.S. Fish and Wildlife Service has initiated the Schoolyard Habitat Program to try to address these concerns together while fulfilling the U.S. Fish and Wildlife Service's mission to work with others to conserve, protect and enhance wildlife habitat for the benefit of the American people. The goals of the Schoolyard Habitat Program are to engage students with the natural world, provide opportunities for outdoor learning and exploration on school grounds, and restore native wildlife habitat. A schoolyard habitat project may focus on restoring forests, wetlands or other natural habitats and may include planting of native trees and shrubs, removing exotic species, improving access to natural areas, or creating outdoor classrooms. Schoolyard habitat projects are driven by the goals of students and teachers of a school with technical and/or financial support from the U.S. Fish and Wildlife Service. These projects are ecologically sound, integrated into the curriculum and designed to encourage long-term stewardship. The U.S. Fish and Wildlife Service recently introduced this program in Vermont. Schoolyard habitat projects within the state have included riparian restoration and wetland enhancement projects coupled with educational field outings with students to study the aquatic life on their school grounds. This poster shares some success stories from the program and uses case studies to examine the process of identifying, designing, and implementing schoolyard habitat projects.

Biography: Katie Kain works for the Partners for Fish and Wildlife Program as part of the U.S. Fish and Wildlife Service in the Lake Champlain Resources Office in Essex Junction, VT.

Vegetative Analysis of a Proposed Wetland Restoration Site in Western Massachusetts

Kate Ballantine and Carey Lang, Mount Holyoke College *(Carey Lang, Mount Holyoke College, 257 Shutesbury Rd, Amherst MA, 01002. (413)687-2105, lang22c@mtholyoke.edu.)*

The Mount Holyoke College campus lakes system receives high nutrient loads from incoming streams, often leading to eutrophied lake conditions in summer months. The Spring 2013 Restoration Ecology course identified which stream carried the largest source of incoming nutrients, and proposed a wetland restoration project to help transform excess nutrients and remove them from the system before the water drained into Upper Lake. In Fall 2013, a vegetation survey using a mixture of data collection techniques such as presence-absence data and Braun-Blanquet percent coverage scores was conducted in the proposed restoration site and the surrounding area to fully characterize the location. Out of 42 plant species observed, 7 were considered invasive. Thirty-two were classified as facultative, facultative wetland, or facultative upland species, and 1 was an obligate wetland indicator. There were no species classified as threatened or rare. Based on the species composition, the survey area can be classified as a forested wetland with regions of upland deciduous forest. The survey also found that species coverage decreased dramatically with distance from the stream as the elevation increased. The results of this survey reveal that the proposed wetland site is capable of supporting the types of wetland vegetation necessary to perform the desired processes and functions.

Biography: Carey Lang is a senior at Mount Holyoke College majoring in Environmental Studies. She has a keen interest in Restoration Ecology and has been working closely with MHC Professor Kate Ballantine to learn all she can about the field. She is especially lucky to be able to work with Kate on an ongoing restoration effort on the MHC campus. Last semester she completed an independent study examining the vegetative characteristics of the proposed restoration site with Professor Ballantine as her advisor. This is her first time participating in an academic conference.

An Ecological Analysis of a Proposed Dam Removal Site

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A controversial dam removal has been proposed for the Colony Faulkner Dam, in Keene, New Hampshire, with the primary goal of restoring fish passage. Objections to this proposal cite aesthetic, recreational, and historical concerns, and an alternate proposal exists to install small hydropower on the dam instead of removing it. This poster presents an ecological assessment of the site and an alternatives analysis. The affected reach of the Ashuelot River runs through a wide, flat valley and is artificially straightened. The surrounding landscape is extensively ditched, lowering the water table throughout the city. Despite the artificial nature of the dam, the impoundment is one of the few locations in the city that retain water levels capable of supporting the riparian wetland complex. A levee bordering the eastern bank inhibits connectivity between the river and its riparian zone. Nearby oxbow lakes reveal the formerly meandering path of the river channel. This, combined with an evaluation of a comparison reach upstream, indicates that prior to dam construction, the Ashuelot was a slow-moving, warm, and sinuous river. It is unlikely that dam removal will result in the fast-moving and cold conditions favored by the salmonid species frequently targeted in dam removal. Total removal of the dam would allow fish passage, but could also lead to a drop in the water table upstream, reducing wetlands and further limiting connectivity between the river and its riparian zone. The most environmentally beneficial course of action remains unclear due to the ecological tradeoffs of either removing or retaining the dam. We recommend further study of both the site and of alternatives that could restore upstream fish passage while restoring river- riparian zone connectivity.

Biography: Sylvana Maione is an Environmental Studies student at Keene State College. Her senior capstone project was a vegetation assessment for the Harris Center for Conservation Education in Hancock, New Hampshire. Particular environmental interests include invasive species, nutrient cycling, and habitat conservation.

A Comparison of Invertebrate Herbivore Damage across American Chestnut, Chinese Chestnut, and Blight-Resistant Hybrids: Implications for Reintroduction and Restoration

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The American chestnut (*Castanea dentate*) once dominated hardwood forests in the eastern United States until the introduction of chestnut blight in 1904. In the 1970s, Dr. Charles Burnham initiated efforts to restore this foundation tree species by using a backcross breeding method to produce Chinese-American hybrids that exhibited blight resistance but were genetically mostly American chestnut. These efforts are now close to producing hybrid chestnuts that will be reintroduced to forests in the eastern U.S. Because the novel genotypes of the hybrid chestnuts could also lead these trees to be less impacted by natural invertebrate enemies of American chestnut, and thus prone to more aggressive growth and spread following reintroduction, we sought to compare levels of herbivore damage across the two parental species and the new hybrid chestnuts. In particular, we investigated the relative diversity and impact of herbivores on the foliage of American, Chinese and blight resistant hybrid chestnut trees in an established test orchard in Hawley, MA where all three varieties co-occur. We sampled 10 leaves each from 10 American, 10 Chinese and 10 fourth generation BC3 hybrid chestnut trees for a total of 300 leaves, and classified each leaf based on four herbivore damage guilds. The results of our survey demonstrate that newly developed BC3 hybrid, American and Chinese chestnut trees experienced similar levels of invertebrate herbivory, with hybrid trees suffering modestly, but not significantly, more damage. Our findings suggest that the new hybrid trees will not be prone to aggressive behavior due to “enemy escape”, as is seen in some exotic plant species. Indeed, the new hybrid trees seem to acquire a normal load of invertebrate herbivore enemies when grown under natural conditions. The results of this study provide insight into potential restoration and reintroduction strategies for chestnut in the forest of the eastern United States.

Biography: Greylin Nielsen is a student at Smith College studying conservation biology. When she is not doing school work she enjoys trail running, rock climbing, cross country skiing or otherwise spending time outside.

How to Restore In-Situ Native Plants to a Site Overwhelmed with Common Reed (*Phragmites australis*)

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Japanese knotweed (*Polygonum cuspidatum*) and common reed (*Phragmites australis*) are non-native invasive plant species that can and do have a deleterious effect on New England's natural areas. This poster will graphically demonstrate successful techniques for managing these invasive species and facilitating native plant establishment.

Biography: Chris Polatin is an ecological restoration practitioner involved with habitat restoration, conservation planning, and land stewardship through his company Polatin Ecological Services. He and his crew regularly perform all aspects of invasive plant management and revegetation including planning, mapping, monitoring, implementing various control activities and encouraging in-situ native plant establishment. He has a master's of science degree in conservation biology and has been involved with environmental work for fourteen years.

Improving Ecological Restoration of the Ipswich River Watershed: A Study of Homeowners' Attitudes about Residential Water Conservation and Green Infrastructure Implementation

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The Ipswich River, located on Boston's North Shore, is currently considered one of the most 'endangered' rivers in the U.S. High seasonal water demand in this urbanizing watershed has resulted in several low flow events and subsequent fish kills. Outdoor summer water use plays a significant role in this demand, and understanding and altering consumers' behavior may be one solution to improve the river's imbalanced water budget. USGS has studied the potential for green infrastructure to improve flows. The Massachusetts Department of Environmental Protection and local organizations have installed demonstration rain gardens, rain barrels, swales and permeable paving around the watershed to highlight the solutions available to reduce impervious surfaces and improve groundwater infiltration. However, residents appear to be hesitant to adopt these practices on their own property. Through a survey sent to watershed residents, we seek to understand homeowners' attitudes and motivations towards water conservation by understanding their current outdoor water use practices and aesthetic preferences for water-conserving landscapes.

This poster will provide a brief overview of the existing green infrastructure projects, as well as a review of the studies supporting the adoption of green infrastructure to reduce residential outdoor water use. It will also describe the development of a survey instrument that operationalized key research themes, such as aesthetics that may influence adoption of ecological restoration projects. The poster will present initial hypotheses and any preliminary research findings to date for the project.

Biography: Johanna Stacy has sought to improve the ecological functioning of landscapes and people's understanding of them throughout her career. She has worked in environmental education, wetlands consulting, and the landscape and outdoor recreation fields. She holds degrees from Mount Holyoke College and the Conway School of Landscape Design (2005). She is currently enrolled in the Masters in Regional Planning program at UMass-Amherst, where she works as a Research Assistant for Professor Robert Ryan, FASLA.

The Effect of Soil Amendments on Denitrification Potential in Restored Wetlands

Si Qi Yao and Kate Ballantine, Mount Holyoke College; Peter Groffman, Cary Institute of Ecosystem Studies *(Si Qi (Cindy) Yao, Mount Holyoke College. 718-878-0307, yao23s@mtholyoke.edu.)*

Wetlands perform important ecological functions such as improving water quality, supporting biodiversity, and providing flood protection. However, much of the world's wetland area has been lost due to agriculture and development. Wetland restoration aims to mitigate loss by replacing destroyed natural wetlands with restored wetlands, but it has been found that these restored wetlands oftentimes do not achieve the same level of function as natural reference wetlands. The aim of this study is to investigate the effect of soil amendments on denitrification in restored wetlands. Denitrification is the process carried out by anaerobic bacteria in wetland soils which reduces nitrate to nitrogen gases, thereby removing nitrate from the water. This improves water quality because excess nitrate causes eutrophication and hypoxia as well as harm to human health if consumed in high concentrations. Experimental plots in four restored wetlands within 100 km of Ithaca, NY were amended with straw, topsoil, or biochar, whereas the control plots were not amended. Samples collected from these restored wetland plots as well as from neighboring natural wetlands were analyzed using the denitrification enzyme activity assay in order to determine denitrification potential. Denitrification potentials in plots amended with topsoil and biochar were significantly higher than those in control plots. However, average denitrification potential in natural wetlands was at least 30 times higher than in restored wetlands. These results demonstrate the efficacy of amendments in increasing denitrification in restored wetlands, while also illustrating the gap that remains to be bridged between function in restored versus natural wetlands.

Biography: Si Qi (Cindy) Yao is a junior at Mount Holyoke College, majoring in chemistry with a minor in biology. Cindy takes part in wetland restoration research under the guidance of Dr.

Kate Ballantine in the Environmental Studies department. As part of this research, Cindy has collected soil samples from wetlands, processed these samples in the lab, and analyzed the data generated. She enjoys being involved in this project and is excited to share all of the fascinating results.