Morning Plenary: Restoration in Times of Climate Change and Environmental Instability

Andre Clewell

We have recently emerged from a period of prolonged environmental stability, when it seemed possible to restore ecosystems to a prior state of biodiversity with relative ease. Now with climate change, sea level rise, and increasing land use impacts, we are scrambling to find out how we can restore and still retain a historical perspective in our work. The SER Primer (www.ser.org) reminds us that ecosystems are dynamic, and that our job is to reestablish the continuation of a temporarily interrupted historic ecological trajectory. This way of thinking requires that we pay more attention to the preparation of the ecological reference and not just use reference ecosystems as templates. It also means that we must heed performance standards in a more sophisticated manner. This talk explores how this altered way of considering restoration can be implemented.

Biography

Andre Clewell has practiced ecological restoration since 1979. He has also been engaged in research, policy development, and the advancement of restoration as a profession and conservation strategy. For 22 years, Clewell owned and operated A. F. Clewell, Inc., specializing in the design and implementation of ecological restoration projects. His clients include private corporations (mostly mining companies), NGOs (The Nature Conservancy, etc.), public U.S. agencies (U.S. Fish & Wildlife Service, etc.), national governments (Saudi Arabia), and transnational organizations (Inter-American Development Bank). He conducted ecological inventories of potential project sites and natural ecosystems to serve as baseline reference sites. He is currently implementing projects on the Tibetan Plateau of SW China to reconnect fragmented forests as habitat for Giant Pandas.

Clewell is a founder and past-President of the Society for Ecological Restoration (SER). Among his many writings, he is the author of the internationally acclaimed book Ecological Restoration: Principles, Values, and Structure of an Emerging Profession, and the primary author of SER’s principle foundation documents: The SER Primer on
Afternoon Plenary: Biodiversity in the Concrete Jungle: Restoring Nature in Cities for a Resilient Future

Myla F.J. Aronson

The majority of humanity now lives in urban areas, with this proportion expected to continue increasing for the foreseeable future. Because the majority of the world’s cities and towns are in areas of high biodiversity, the rapid urbanization of the world has a profound effect on global biodiversity. Although ecologists have made great strides in recent decades at documenting ecological relationships in urban areas, much remains unknown, and we still need to identify the major ecological and environmental factors, aside from habitat loss, that drive ecological communities in cities and towns. Understanding these factors will provide a basis for successful ecological restoration in cities. Here I will discuss: 1) the status of biodiversity in the world’s cities and towns; 2) drivers of biodiversity in cities; and 3) restoration of ecological communities in cities. While the world’s cities and towns are certainly hotspots of species loss, they are also surprisingly biodiverse, supporting native plant communities as well as threatened and endangered plant species. Ecological restoration in cities is beset by many challenges, but can lead to enhanced biodiversity and resilient ecological communities. Understanding ecological processes in cities and towns is increasingly important and offers unique insights into the science of ecology. Furthermore, an understanding of the factors affecting biodiversity in cities is necessary to inform scientists, city planners, and managers to best conserve and restore urban biota.

Biography

Myla F.J. Aronson is a plant ecologist whose interests focus on the conservation, restoration, and maintenance of biodiversity in human dominated landscapes. She received her B.S. in Natural Resources from Cornell University and a M.S. and Ph.D. in Ecology and Evolution from Rutgers, The State University of New Jersey. She is currently the Associate Editor-in-Chief of the journal Ecological Restoration and a Research Scientist in the Department of Ecology, Evolution and Natural Resources at Rutgers University. She also co-directs, with Charles Nilon at the University of Missouri-Columbia, UrBioNet: A Global Network for Urban Biodiversity Research and Practice (http://urbionet.weebly.com/). Dr. Aronson’s research focuses on the patterns and drivers of biodiversity in urban landscapes, in particular to understand community assembly and biotic homogenization in cities at local, regional, and global scales. She
also focuses on dynamics of species invasions and the ecological function of restored communities. Finally, she studies long-term change in intact and restored vegetation communities in urban and agricultural landscapes in order to better understand and manage plant community dynamics over time. Dr. Aronson has used the results from her research to direct decisions regarding the restoration and management of degraded habitats, such as wetlands and woodlands in New York, New Jersey, Minnesota, and Iowa. She is currently the chair of the Urban Ecosystem Ecology section of the Ecological Society of America and has served on the board of directors of the Friends of Hempstead Plains, the board of directors of the Long Island Native Plant Initiative, and the Fire Island National Seashore Science Advisory Team. In addition to her applied restoration work, she has taught at the undergraduate and graduate levels at Rutgers University, Luther College, and Hofstra University. Website: https://mylaaronson.wordpress.com/

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**MORNING BREAKOUT SESSIONS**

**SESSION A: SETTING APPROPRIATE TARGETS FOR RESTORATION**

**The Myth of the Free-Flowing River: Natural Dams and the Baseline Condition**

**Denise Burchsted**, Assistant Professor, Keene State College (dburchsted@keene.edu; 603-358-2176)

Although many river restoration targets and management guidelines idealize the free-flowing condition, rivers without direct human intervention are highly structured by natural dams. These "natural dams" in postglacial New England include blockages such as beaver dams, log jams, and sediment dams created by landslides. The impoundments and subsequent marshes created by these dams fundamentally differ from the free-flowing condition and from dams constructed by humans. The aquatic organisms of the northeast have evolved within this patchwork of habitats, and different life stages of many species depend on the different components of this mosaic. This talk presents an overview of results from GIS and field studies to describe some of the key characteristics of natural impoundments and meadows. These characteristics are contrasted with the condition in free-flowing rivers and human-created impoundments. Recommendations for management are provided, focusing on restoration of the baseline condition of heterogeneity and patchiness.
Biography

Denise Burchsted is an Assistant Professor of Environmental Studies at Keene State College and a licensed Professional Engineer. Her research focuses on the shape and function of rivers and wetlands without modern human modification in order to improve restoration targets. Her research is funded by agencies such as the EPA and National Science Foundation, and she publishes her research in journals such as Geomorphology and BioScience. She studies aquatic systems across disciplines, based on formal training in engineering (BS), aquatic ecology (MFS), and fluvial geomorphology (PhD). In addition to her academic research, she has designed dam removal and other fish passage projects, designed salt marsh and freshwater wetland restoration projects, evaluated restoration alternatives in the Everglades, and led non-profit watershed conservation planning efforts.

A Statewide Proactive Approach to Dam Removal in Massachusetts

Kristopher Houle, Massachusetts Division of Ecological Restoration
(kris.houle@state.ma.us; 617-626-1543; 251 Causeway St, Suite 400, Boston, MA 02114)

Authors: Kristopher Houle, MA DER; Beth Lambert, MA DER

Massachusetts has 3,000 dams, many of which no longer serve their original intended purpose and now pose a risk to nearby infrastructure and public safety during storm events. Many dams are in disrepair and are subject to increasing stress as storms increase in magnitude and frequency. These dams impede natural riverine processes and limit access to critical spawning habitat for migratory and resident fish. The Massachusetts Division Ecological Restoration (DER) works with public and private land owners to restore and protect the Commonwealth’s rivers, wetlands, and watersheds for the benefit of the people and the environment, and has recently begun a proactive, systematic approach for achieving this goal.

Using the Massachusetts Office of Dam Safety's database and DER's (Ecological) Restoration Potential Model, DER has identified the dams in the Commonwealth that pose the highest risk to people and the built environment and whose removal will provide the greatest aquatic ecosystem benefit. This analysis has yielded a prioritization of potential dam removals in Massachusetts that optimizes community climate change resiliency with ecological restoration. This presentation will highlight the methodology used to identify the highest ranking dams in the Commonwealth, discuss the challenges encountered in developing a successful proactive outreach process, and outline the steps DER is taking to prioritize these dam for future removal.
Biography

Kris serves as an ecological restoration specialist for the Massachusetts Division of Ecological Restoration (DER). Kris has nine years of practical experience leading and designing watershed and aquatic habitat restoration projects and currently manages dam removals projects throughout the Commonwealth. He is a registered professional engineer and holds M.S. and B.S. degrees in civil engineering. Kris joined SER in 2014 and currently serves on the SER-NE Chapter Executive Committee.

Flood Resiliency Planning in Vermont: Two Tools to Screen Areas for Flood, Erosion, and Deposition Potential

Roy Schiff, Milone & MacBroom (802-882-8335; rschiff@mminc.com; 1 South Main Street, Waterbury, VT 05676)

To assess natural resources on the working lands it conserves, VLT uses GIS-based screening tools and field-based assessments. Recently VLT developed and added a flood resilience screening tool to the mix, allowing assessment of river corridors for their erosion and deposition potential, and conservation assets related to flood resilience. This tool is in use by VLT to incorporate flood resiliency into decision-making that is often in perpetuity.

The damage to Vermont’s transportation system caused by Tropical Storm Irene flooding in 2011 illustrated the magnitude and scale of the system’s vulnerability to river erosion and flooding. Furthermore, Vermont experiences frequent local floods that damage smaller road segments, bridges, and culverts. Flood recovery along the transportation system is a major expense for the State of Vermont, and an activity that often leads to repeated impacts to river and riparian habitat. VTrans and its project partners are developing a new tool to assess and mitigate risks to Vermont’s transportation system to save cost and avoid repeat river impacts.

Biography

Roy is a Water Resource Scientist and Engineer with Milone & MacBroom, Inc. 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, crossing structures, bank stabilization, and river corridor assessment.
Comparing Sediment Contamination, Regulatory Responses, and Sediment Management Approaches among Dam Removal Projects in the Northeastern US.

Paul Woodworth, Fluvial Geomorphologist, Princeton Hydro

Authors: Allison Roy, U.S. Geological Survey, Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts Amherst; Keith Nislow, Northern Research Station, U.S.D.A. Forest Service, University of Massachusetts Amherst; Benjamin Letcher, U.S. Geological Survey, S.O. Conte Anadromous Fish Research Center, Leetown Science Center; Beth Lambert, Massachusetts Division of Ecological Restoration; Kristopher Houle, Massachusetts Division of Ecological Restoration; and Christopher Smith, U.S. Environmental Protection Agency, Region 1

Many dams that are no longer serving an economic purpose and are no longer being maintained are being removed to reduce liability, to ensure public safety, and to restore river ecology. The management of impounded sediments is one of the greatest challenges to the removal of dams, presenting a potentially costly and complicated situation. A comparison of multiple dam removal projects across the northeastern US reveals that (1) many impoundments, regardless of size or geographic location, have low concentrations of contamination that represent potential ecological effects according to established ecological screening criteria, and that (2) the wide-spread low-level contamination, which may eclipse the most protective ecological screening criteria (i.e. threshold effect levels), appears to represent ambient or background conditions.

Regulatory concerns have also focused on sediment quantity and minimizing potential impacts to wetlands on-site. Response and guidance from agencies regarding sediment quality, quantity, and wetland impacts has varied widely among states and agencies. Balancing these concerns has produced dam removals that involved passive sediment release, re-location of sediment on-site, or, less frequently, excavation and off-site disposal of impounded sediment. These trends within the region based on the varied regulatory responses and resulting sediment management approaches provides valuable insight and guidance to dam owners, regulators, and dam removal practitioners when analyzing alternatives for a dam, and developing engineering designs for permitting a dam removal project.

Biography

Paul is the primary fluvial geomorphologist at Princeton Hydro and applies his expertise to a range of projects involving the assessment, management and restoration of streams, large rivers, floodplains, and wetlands. As of 2015, Paul has been involved with over 50 barrier removals while at Princeton Hydro. He has completed detailed
studies that demonstrate dam removal feasibility and identify project constraints and special considerations for engineering designs including bank erosion and infrastructure protection. In the planning and design phases, Paul assesses and anticipates channel adjustment processes, samples substrates and impounded sediments, conducts topographic survey of channels, and supports bathymetric survey of impoundments. Paul applies field data, geomorphologic principles, analytical techniques and hydraulic modeling to assess and design for sediment stability and mobility, and the potential for channel adjustments (degradation, aggradation) following dam removal or other significant disturbances.

Session B: Working with People for Restoration 1

Schoolyard Habitats - Opportunities for Ecological Restoration and Civic Engagement

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

Many schools throughout the region possess underutilized natural areas that are often prime opportunities for ecological restorationists. Often degraded, these sites could include wetland, upland, and riparian areas that could be restored to benefit fish, wildlife, pollinators, and native plant communities. In addition to these benefits, these projects are an excellent opportunity to create outdoor classrooms and living laboratories that can be utilized frequently by teachers and students and built into curriculum to cover lessons and help to connect the next generation to the natural world and the value of ecological restoration. The U.S. Fish and Wildlife Service’s Partners for Fish and Wildlife Program in Vermont implements schoolyard habitat projects for the benefit of fish and wildlife and to connect people with nature. This presentation will discuss how to identify sites, create a team, and implement projects while engaging students in real restoration work. Several case studies will be presented to illustrate this process.

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.

Valuing Blue-Green versus Grey Infrastructure for Coastal Planning in Response to Climate Change

Derek Pelletier, Ramboll Environ (dpelletier@ramboll.com)

Authors: Derek Pelletier, Ramboll Environ; Greg Reub, Ramboll Environ; Gretchen Greene, Ramboll Environ

Typical climate change adaptation for coastal areas are often focuses on “grey infrastructure” options (e.g. engineering approaches like dams, levees, sea walls and channels). Incorporation of “blue-green infrastructure” options (e.g. allowing the conversion of agricultural land to wetlands) can be as cost effective, especially if the value of ecosystem services are recognized. This approach has been adopted in a variety of geographies, including this study as part of The Nature Conservancy’s Coastal Resilience Ventura (CRV) project.

Working with input from local stakeholders, two alternative adaptation scenarios were developed. One alternative was focused on grey infrastructure and the other incorporates blue-green infrastructure alternatives. This presentation will focus the incorporation of a Net Ecosystem Services Analysis approach used to combine financial metrics with environmental metrics for decision making. We used Habitat Equivalency Analysis (HEA), an environmental annuity model developed as a tool for Natural Resource Damage Assessments, to scale the value of ecosystem services provided over time under each climate change adaptation alternative. HEA provides an effective way to weigh climate change adaptation alternatives by blending environmental gains and losses with traditional monetary metrics in a theoretically consistent manner. The results show that nature-based approaches to climate change adaptation can provide benefits in terms of reduced damages that are comparable to coastal armoring approaches. Conclusions address the benefits and costs for the coastal armoring approach, the benefits and costs for the nature based approach, and how the value of ecosystem services contribute to the question of the preferred approach to climate change adaptation.
**Biography**

Derek Pelletier is an aquatic ecologist with 14 years of experience in environmental consulting. He specializes in water quality issues, ecological risk assessments and natural resource damage (NRD) assessments related to contaminated sediments and groundwater. Derek has expertise in using habitat equivalency analysis for estimating natural resource damages; scaling ecological risks and injury to biologic resources based on habitat quality; identifying and prioritizing restoration projects; modeling food web transfer/bioaccumulation and chemical fate and transport; managing data; understanding biogeochemical cycling of nutrients; and developing screening levels, toxicity reference values and species sensitivity distributions for evaluating potential effects or injuries to aquatic life.

**Understanding Stakeholder Preferences for Flood Adaptation Alternatives with Natural Capital Implications**

Shannon Rogers, PhD, Plymouth State University (shrogers@plymouth.edu; 603-535-2216; 17 High Street, MSC 63, Plymouth, NH 03264)

Authors: Shannon Rogers and Jonathon Loos, Plymouth State University Center for the Environment

Inland flood risks are defined by a range of environmental and social factors, including land use and floodplain management. Shifting patterns of storm intensity and precipitation, attributed to climate change, are exacerbating flood risk in regions across North America. Strategies for adapting to growing flood risks and climate change must account for a community’s specific vulnerabilities, and its local economic, environmental, and social conditions. Through a stakeholder-engaged methodology, we designed an interactive decision exercise to enable stakeholders to evaluate alternatives for addressing specific community flood vulnerabilities. We used a multicriteria framework to understand what drives stakeholder preferences for flood mitigation and adaptation alternatives, including ecosystem-based projects. Results indicated strong preferences for some ecosystem-based projects that utilize natural capital, generated a useful discussion on the role of individual values in driving decisions and a critique of local environmental and hazard planning procedure, and uncovered support for a river management alternative that had previously been considered socially infeasible. We conclude that a multicriteria decision framework may help ensure that the multiple benefit qualities of natural capital projects are considered by decision makers. In this session, we will discuss the method we developed, our findings, and how it can be used in many types of natural resource management decisions and by a variety of decision makers.

Nick Wildman, MA Division of Ecological Restoration (617-626-1527; nick.wildman@state.ma.us; 251 Causeway Street, Boston, MA 02114)

Authors: Nick Wildman, Tim Purinton, MA Division of Ecological Restoration

Scientists have demonstrated that carbon sequestered in coastal wetlands is significant and offers a newly recognized climate mitigation benefit. The restoration of coastal wetlands can jump-start carbon sequestration, reduce methane emissions and help governments and other entities achieve their climate change mitigation and adaptation targets. The carbon sequestered in coastal wetlands (sea grasses, mangroves and salt marshes) is commonly called "blue carbon". Massachusetts is a nationwide leader in wetland restoration having restored approximately 2,000 acres of coastal wetlands and the state's Division of Ecological Restoration, together with its partners, have thousands of acres of wetland restoration in planning and design, making it potentially a prime state for developing a blue carbon market. The presenter will explore the role of blue carbon in assisting Massachusetts meet its climate change targets and how to calculate, using the best available science, the green house gas budget (methane and carbon) for a wetland or river restoration project using the new "Blue Carbon Calculator". The "Blue Carbon Calculator" is an innovative tool developed by industry experts for estimating an important ecosystem service associated with ecological restoration.

Biography

Nick Wildman is a Restoration Specialist with the Massachusetts Division of Ecological Restoration. As part of this work, Nick is the Division’s lead on eight restoration projects across the state and serves on the Management Committee of the Narragansett Bay Estuary Program. Since 2010, he has co-led the Division’s work examining the
economic effects of restoration. Nick has a decade of private and public sector experience directing river and wetland projects in the northeast. He holds a Master of Environmental Management degree from Duke University.

Session C: Restoration of Native Plants

Applying Decision Support Tools to Weed Management: A Retrospective Analysis of Garlic Mustard (Alliaria petiolata) Control

Jeffrey Corbin, Associate Professor, Union College (corbinj@union.edu; 518-926-0374; Dept of Biological Sciences, Union College, Schenectady NY 12308)

Authors: Jeffrey Corbin, Matthew Wolford, Union College; Christopher Zimmerman, The Nature Conservancy; Brendan Quirion, Adirondack Park INvasive Plant Program

Given the difficulty that habitat managers face in controlling invasive species, assessing a project’s feasibility before implementation can be a useful exercise. We describe efforts to eradicate a population of garlic mustard (Alliaria petiolata) from an area of the Adirondack Park, USA. We applied a retrospective assessment of the feasibility of the project using two different decision support tools, the Invasive Plant Management Decision Analysis Tool (IPMDAT) and WeedSearch. We modeled several scenarios in each tool by varying parameters related to the effectiveness of control in order to test the sensitivity of project success to particular assumptions. Except for a small decline between 2007-2009, the population increased during the control period. The number of surveyed transects with at least one garlic mustard individual increased, as did plant density within transects. IPMDAT and WeedSearch analysis confirmed that eradication of the garlic mustard population at this site was unlikely. IPMDAT discouraged proceeding with the goal of eradication, and only recommended containment if control of seed production could be effective and subpopulations (e.g. transects) could be eliminated. WeedSearch estimated that time required to achieve eradication would range from 11 years if control was 100% effective to more than 50 years if control was only 90% effective. The application of tools such as IPMDAT or WeedSearch can aid project planning by giving invasive species managers a more realistic picture of the commitment that may be required in order to achieve specific restoration goals.

Biography

Associate Professor, Union College. I study the effects of invasive species on community and ecosystem processes, and strategies to restore invaded habitats.
Restoring an Old Growth Urban Forest

Jessica Schuler, Director of the Thain Family Forest, The New York Botanical Garden (914-329-6395; jarcate@nybg.org; 2900 Southern Blvd, Bronx NY 10458)

Authors: Jessica Schuler, NYBG; Todd Forrest, NYBG

The Thain Family Forest (Forest) at The New York Botanical Garden is the largest remnant of old-growth forest in New York City. Though the forest has remained intact since the last ice age, it has undergone many disturbances both natural and anthropogenic. This 25 hectare stand is an old growth urban forest (Loeb, 2011).

A long-term study is being conducted to observe vegetation change over time (Rudnicky and McDonnell, 1989). In 1895, the Forest was known as the “Hemlock Grove” because the stand closest to the Bronx River was dominated by the Canadian hemlock (Tsuga canadensis). In 1923, the regeneration of T. canadensis was less abundant in the Forest when compared to northern forests dominated by T. canadensis (Britton, 1926). This was the first indication that T. canadensis was declining in the Forest. In 1985, Hurricane Gloria introduced the hemlock wooly adelgid (Adelges tsugae), leading to further decline of hemlock. Today, less than 100 individuals of T. canadensis remain in the Forest.

Hemlock decline is one change in forest composition that has been documented in Forest inventories 1937, 2002, 2006, 2011, and 2016. These surveys have observed the dynamics of forest composition change over time and inform current forest management. Increases in invasive plant species, particularly, Amur corktree (Phellodendron amurense), Japanese angelica tree (Aralia elata), and Amur honeysuckle (Lonicera maackii) initiated a forest restoration program to actively managing invasive plant species (Schuler and Forrest, 2016). Since the last inventory in 2011, Hurricane Sandy greatly impacted the Forest and the viburnum leaf beetle (Pyrrhalta viburni) has taken hold. The 2016 data set will have much to show in terms of forest change.

The future of the Forest has shifted away from a trajectory of invasive plant species to native species. Data driven management for the long-term is successful in meeting the goal of managing for a dominantly native Forest for future generations.

Biography

Jessica is responsible for the management of the 50 acre, old growth urban Forest including ecological restoration and the development of education and research programs. She teaches about urban forest restoration, invasive species, and native plants. Jessica earned a BS in plant science with distinction in research from Cornell
University and is an ISA-certified arborist. Jessica is an advocate for native plant conservation and ecological restoration.

**Hardy Kiwi (Actinidia arguta) Control Project at Kennedy Park and Pleasant Valley Sanctuary, Lenox, Massachusetts**

Jessica Toro  (413-358-7400; nativehabitatrestoration@gmail.com; PO Box 582, Stockbridge, MA 01262)

Hardy Kiwi vine (*Actinidia arguta*) is one of the newest species to be reviewed by the Massachusetts Invasive Plant Advisory Group and listed as Likely Invasive. Hardy Kiwi vine can grow over 20-35 feet/year and forms dense mats of intertwining vines that can overwhelm other vegetation, including trees. The weight of the vines during the growing season in addition to snow and ice loading on the vines breaks down the tree canopy, creating “amphitheaters” of only kiwi vine.

One of the largest known infestations in New England is found on two adjacent properties. Kennedy Park is a 360-acre property owned and managed by the Town of Lenox, MA and Pleasant Valley Wildlife Sanctuary in Lenox is a 1,140-acre property owned and managed by MassAudubon. A large-scale control project was initiated through partnership of the Town of Lenox, MassAudubon and the Mass Natural Heritage and Endangered Species Program in 2015 focusing treatment of 100 acres of patches of kiwi vine across 450 acres. Native Habitat Restoration was hired as the contractor for the control efforts in 2015. Initial results from the treatment efforts will be presented as well as considerations for future management of this species.

**Biography**

Jessica Toro is the co-owner of Native Habitat Restoration based in Stockbridge, Mass. She has designed and implemented many invasive control and restoration efforts over the past 18 years. Prior to starting Native Habitat Restoration, Jessica worked for 11 years at the Nature Conservancy as the Conservation Program Manager of the Berkshire Taconic Landscape. Both at The Nature Conservancy and at Native Habitat Restoration, Jessica designed the restoration of floodplain forests, woodlands, and riparian areas as well as specializing in projects to improve rare wetlands and critical habitat for federally listed species.
Evolving highways: Fostering Native Habitat and Conserving Funds through Passive Roadside Restoration

Sara Wigginton, MS, The University of Rhode Island (sarawigginton@gmail.com; 270-769-8547; 61 Janna Ct., North Kingstown, RI 02852)

Authors: Sara Wigginton and Laura Meyerson, The University of Rhode Island

Roadside ecosystems are the managed areas adjacent to roads that are undervalued for their ecological functions. Reducing roadside mowing can create habitat, lower management costs, and reduce fragmentation. However, reducing mowing raises concerns invasive plants may proliferate. Our goal was to quantify whether decreasing mowing would increase invasive plant cover. Using Modified-Whittaker plots at roadside sites under three types of vegetation management— Never Mowed (N=5), Reduce Mowed (N=5), Fully Mowed (N=5) — we compared plant diversity and percent cover. Never Mowed sites had higher total species richness than Fully Mowed sites (P=0.046), the highest native species richness at the two largest spatial scales (1000-m² P=0.0001, 100-m² P<0.0001), the lowest introduced species richness at three spatial scales (100-m² P=0.003, 10-m² P=0.003, 1-m² =P<0.0001), and the lowest introduced species percent cover (P=0.0001). We did not observe differences in invasive species richness or percent cover under any management type. Reducing mowing roadsides facilitates biodiversity and maintains habitat important for rare and endangered wildlife.

Biography

Sara Wigginton is a Research Associate at The University of Rhode Island, in the Meyerson Invasion and Restoration Laboratory. Sara completed her Master’s Degree in Ecology and Ecosystem Sciences at The University of Rhode Island in 2015 where her work focused on monitoring the effects of roadside restoration on stormwater filtration and invasive species colonization. Currently, Sara is involved in studying the genetics and ecology of the wetland invader Phragmites australis as a study species to gain understanding of invasion ecology and the repercussion of invasion on restoration efforts.
Fish Passage and Movement Behavior at a Tide Gate Prior to Restoration

Derrick Alcott, University of Massachusetts Amherst (dalcott@umass.edu; 856-294-8696)

Authors: Derrick Alcott, UMass Amherst, and Theodore Castro-Santos, U.S. Geological Survey

Anadromous river herring (Alosa spp.) must migrate into freshwater streams and ponds each spring to spawn. River herring movement behavior and passage success was studied at a tide gate structure and culverts on the Herring River of Wellfleet, MA (Cape Cod). The study used a combination of Passive Integrated Transponder (PIT) and acoustic telemetry to assess fish passage and movement behavior around the current tide gate structure. Over 1,000 acres of historic salt marsh were lost after the construction of the tide gate at the mouth of the Herring River in the early 20th century. A full restoration of tidal flow by removal of the tide gate is scheduled to begin by ~2018. These data serve as a pre-restoration baseline to assess to what extent removal has met fish passage management goals.

Biography

Derrick is a Ph. D. candidate at the University of Massachusetts Amherst and the U.S. Geological Survey S.O. Conte Diadromous Fish Research Center. His research focuses on river herring movement behavior around anthropogenic obstacles.

A Hostile Takeover in the Salt Marsh: Invasive Snail Threatens Essential Plant Species

Devin Batchelder, University of New Hampshire (dkb2001@wildcats.unh.edu)

Authors: Devin Batcheldor, UNH, David Burdick, University of New Hampshire, Durham, NH; Gregg Moore, University of New Hampshire, Durham, NH; Jenn Dijkstra, University of New Hampshire, Durham, NH; Megan Tyrrell; U.S. Fish and Wildlife Service, Hadley, MA.

Surveys and experiments improved our understanding of the interactions occurring between two ecosystem engineers, Littorina littorea and Spartina alterniflora, in a
fringing salt marsh along an eroding shoreline (York ME). The common periwinkle (*L. littorea*) is an invasive snail that destabilizes surface sediments and will often climb *Spartina alterniflora*, creating radulations as it grazes, which can weaken and kill the plant. Due to its ability to withstand regular inundation, *S. alterniflora* is the cornerstone species responsible for sediment trapping and marsh establishment, making it critical for coastal zone protection from erosion and sea level rise. As a result, the outcome of *L. littorea* and *S. alterniflora* interactions could have consequences for intertidal shorelines across New England. Snail densities reached 616 snails per m² at our research site and tended to be greater in vegetated areas. Research questions for this study include: What is the maximum number of snails the average stand of *S. alterniflora* can sustain before experiencing significant biomass loss? Can N enrichment stimulate plant growth to overcome the snail driven biomass loss? What are the best plant protection strategies? Initial results show that the presence of snails reduced new shoot growth by 54%, while N enrichment increased new shoot growth by 48%. Since sea level rise and human encroachment both impact coastal marshes, preservation and restoration of remaining marshes is a priority and better understanding of community dynamics could improve restoration methods and management strategies to support healthy salt marsh ecosystems where *L. littorea* is present.

**Biography**

Devin Batchelder is a graduate student at the University of New Hampshire in the Natural Resources and the Environment department and her advisor is Dr David Burdick. Her research interests include wetland conservation, restoration and invasive species management. Prior to UNH she attended Franklin Pierce University and obtained a B.S. in Environmental science and a B.S. in Anthropology.

**Removing Legacy Effects of Ditching from Salt Marshes Increases Resilience to Sea Level Rise**

**David Burdick**, Associate Research Professor, Jackson Estuarine Laboratory, University of New Hampshire ([david.burdick@unh.edu](mailto:david.burdick@unh.edu); 603-862-5129; 85 Adams Point Road, Durham, NH 03824)

Authors: David Burdick, Gregg Moore, Chris Peter, Jackson Estuarine Laboratory; Susan Adamowicz, US Fish and Wildlife Service; Geoff Wilson, Northeast Wetland Restoration

Tidal marshes have developed at the interface of marine and terrestrial systems where physical and biological processes interact. Feedback between saltwater flooding, plant productivity, and the oxidation / storage of the reduced plant carbon allows marshes to
grow with sea level rise. Mosquito ditching, once a widespread practice across New England, results in over-draining and oxidation of the marsh foundation - peat, but it also leaves spoil piles that can impound small marsh areas, resulting in loss of vegetation caused by waterlogging. By ditching, human interference with the natural marsh hydrology has left managers with a paradox: both drained areas and impounded areas subside in elevation and serve to reduce resilience as sea levels rise. At Parker River National Wildlife Refuge, our team has been piloting and documenting new techniques that use natural hydrologic forcing to cause ditches to become shallow and re-vegetate panels of high marsh. Our results suggest that our approach will rebuild some of the natural capital lost due to ditching in the Great Marsh.

Biography

Dr. David Burdick is Research Associate Professor of Coastal Ecology and Restoration in the Department of Natural Resources at the University of New Hampshire, where he has taught wetlands courses over the past eighteen years. In 1988, he received a doctorate in Marine Sciences at LSU in Baton Rouge. His study of coastal science spans 35 years, concentrating on coastal ecosystems, assessing human impacts, and planning, implementing and assessing habitat restoration at the Jackson Estuarine Laboratory, where he serves as Interim Director. In 2012 he won the Susan Snow-Cotter Visionary Award from the Gulf of Maine Council for the Marine Environment for his efforts to restore vitally important habitats and reconnect people to benefit from them. He recently published a book with Charles Roman to translate and extend lessons learned from tidal restoration of salt marshes in the Northeast US and Canada.

Vegetative and Salinity Changes Associated with the Restoration of Bass Creek. Marshfield, MA

Steven Riberdy, Senior Ecologist, GZA GeoEnvironmental (413-237-6860; Steven.Riberdy@gza.com; 1350 Main Street, Suite 1400 Springfield, MA)

Authors: Steven Riberdy, GZA; Greg Robbins, GZA; Steve Lecco, GZA; Paul Davis, GZA

Bass Creek, tributary to Green Harbor River (Marshfield, MA) was a tidally influenced stream, prior to tide gate failure, followed by years of sedimentation and vegetative infilling. Riparian wetlands shifted from *Spartina alterniflora* to *Phragmites australis*. A 2008 Town / MA CZM project repaired the tide gate, increasing tidal flow and salinity from 11.1 ppt to 25 ppt, 6,700 feet upgradient of the tide control structure. However, the years of *Phragmites* channel occlusion impeded restoration of the upgradient tidal creek. In 2014 GZA designed, permitted and monitored a Bass Creek restoration effort to
remove *Phragmites* via dredging of the channel, allowing tidal influence to channel areas 4,000± feet further upgradient. Project goals included tidal creek and salt marsh restoration, storm flow conveyance, reduced flooding, and improve wildlife habitat.

GZA has been involved in the monitoring of Bass Creek Restoration Project since 2014. Prior to restoration efforts salinity values in this portion of Bass Creek ranged from 0.0 to 0.2 ppt. Initial post dredging salinity monitoring in Bass Creek showed a dramatic change in salinity from ≤0.2 ppt to >18.1 ppt ~9,500 feet upgradient of the tide gate, and significantly increased salinity values and tidal influence an additional 500 feet upgradient (> 5.0 ppt). Further, the 2014 restored tidal areas showed significant browning and poor growth of *Phragmites, Scirpus cyperinus, Typha latifolia* and other freshwater wetland species up to 10,000 feet upgradient of the tide gate. In areas where restored tidal influence yielded salinity <12 ppt, there was no detectable effect on *Phragmites* or other freshwater wetland species since 2014. Concerns for a new, further upstream zone where salinities will favor the incursion of *Phragmites* have thus far not materialized.

**Biography**

Mr. Riberdy is a senior ecologist at GZA GeoEnvironmental, Inc. He has been working in ecological restoration for the past 15 years across the northeast. His specialties are wetland ecology, rare species surveys and management, floristic surveys and restoration projects. He holds a MS degree in wetland ecology from UMASS Amherst, is a Professional Wetland Scientist with SWS, a Certified Ecologist with ESA, a Certified Wildlife Biologist with the wildlife society and a professional soil scientist.

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**Session E: Freshwater Restoration #1 Case Studies and Guidance**

**Nissitissit River Response to the Removal of Turner Dam**

**Jill Griffiths**, Water Resources Engineer / Ecologist, Gomez and Sullivan Engineers (jgriffiths@gomezandsullivan.com; 603-428-4960; PO Box 2179, Henniker, NH 03242)

The former Millie Turner Dam was a privately owned dam on the Nissitissit River in Pepperell, MA that was about 250 feet long and 10 feet high and rated by the MA Office of Dam Safety to be in “Poor” condition with a “High” hazard potential. The Nissitissit River is home to a variety of threatened and endangered species, as well as a coldwater fishery, with approximately 20 miles of high quality habitat upstream of the dam. The dam was removed in September 2015 to decommission aging instream infrastructure while restoring fish passage, improving water quality, restoring instream
and riparian habitat connectivity, and enhancing riverine functions (e.g., sediment and organic matter transport). The project involved an instream approach to sediment management that encouraged the natural formation of the upstream channel and downstream redistribution of clean sediment over time following dam removal activities. To characterize the quantity and quality of impounded sediment prior to the removal of the dam, bathymetric mapping, sediment depth probing, and sediment contaminant analyses were conducted and a sediment management plan was developed. Combining this data with post-removal channel survey data and observations has led to valuable information about sediment transport and channel response in the restored Nissitissit River. The project was led by the Massachusetts Department of Fish and Game, Division of Ecological Restoration (DER) and supported by the dam owner, the Massachusetts Division of Fisheries and Wildlife (DFW), the US Fish and Wildlife Service (USFWS), Trout Unlimited, the Nashua River Watershed Association, and the Nashoba Conservation Trust. Gomez and Sullivan Engineers provided feasibility study, design, permitting, bidding, and construction support services.

**Biography**

Jill Griffiths, PE is a water resources engineer and ecologist with Gomez and Sullivan Engineers in Henniker, NH. She is a certified floodplain manager (CFM) with B.S. degrees in both civil engineering and biology. Her background is in hydrology and hydraulics with a focus on ecologically sustainable stream restoration. She has a wide range of experience with projects to restore riverine environments, such as dam removals, fish passage and habitat restorations, and culvert replacements. She is experienced with stream geomorphic assessments, flood inundation and fluvial erosion hazard zone mapping, and river corridor planning. She also has a strong background in environmental studies such as sediment analyses, habitat assessments, vegetation surveys, and water quality monitoring. Through this work, she has been involved with all aspects of water resources projects including management, data collection, modeling, alternatives analyses, reporting, public outreach, design, permitting, bid and construction phase services, and post-construction monitoring.

**A Cranberry Farm Transformation: Initial Outcomes and Lessons from the Tidmarsh Wetland Restoration Project (Plymouth, Massachusetts)**

**Alex Hackman**, Restoration Specialist, Massachusetts Division of Ecological Restoration (alex.hackman@state.ma.us; 617-626-1548; 251 Causeway Street, Suite 400, Boston MA 02114)
Authors: many partnering organizations (will be outlined in talk)

In October 2015, comprehensive ecological restoration began on Tidmarsh Farms, a 577-acre commercial cranberry operation in southeastern Massachusetts. Since that time, completed restoration actions (~$2.7 million total cost) have included removal of seven dams/dikes, re-construction of 3.5 miles of stream channel, creation of deep and shallow ponds, installation of thousands of pieces of large wood, ditch plugging, surface roughening, extensive earthwork, and native seed bank reactivation, and selective planting. As a result and within <1 year, much of site has transitioned from retired cranberry farm, to heavily disturbed and bare soil, to wet and heavily re-vegetated wetlands.

We present an overview of wetland and stream restoration work performed, observations from the field, and initial lessons learned. We will discuss the work of Living Observatory and partners - the learning collaborative developed in concert with the restoration project – and initial findings from ‘time zero’ on site. We will also discuss future related work within the watershed, and how efforts at Tidmarsh may provide a template for conservation and restoration for future retiring cranberry farms (over 12,000 acres in MA). This talk is a follow-up to a presentation at the 2014 SER NE meeting, which focused on the use of a practical, process-based approach for linking theory to practice, and succinctly conveying project design and intentions.

Project partners: Tidmarsh Farms, Inc. (landowner), Living Observatory (and partnering institutions), USDA NRCS, USFWS, NOAA, Mass Audubon, Town of Plymouth, Salicicola, Massachusetts Division of Ecological Restoration (project manager), Division of Fisheries and Wildlife, and Division of Marine Fisheries, American Rivers, Gulf of Maine Council on the Marine Environment, Massachusetts Environmental Trust, Inter-Fluve, Inc. (project engineer), and SumCo Eco-Contracting (construction contractor)

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. Over the past 20 years, he has held a variety of environmental protection and research positions in private, public, and academic settings. Alex is currently managing numerous dam removals and wetland restoration projects (including Tidmarsh Farms) in Massachusetts. He lives happily with his sweetheart in Medford, bikes to work in Boston, and considers himself the most fortunate public servant in the world.
It was never about the fish...The Maxwell Pond Dam Removal and Black Brook Restoration Success Story

Stephen Landry, Supervisor, Watershed Assistance Section, New Hampshire Department of Environmental Services (stephen.landry@des.nh.gov; 603-271-2969; 29 Hazen Drive, Concord NH)

A century-old dam across Black Brook created an impoundment called Maxwell Pond, which was a site for ice harvesting, fishing, swimming and other recreation. Over time, sediment accumulated in the pond, which became stagnant and shallow. As a result, Maxwell Pond was added to the 303(d) list of impaired waters. Stakeholders collaborated for seven years to remove the dam in 2009. Once Black Brook returned to its free-flowing condition, the dissolved oxygen level rebounded and the brook could once again support its aquatic life designated use.

Funds for this $685,000 restoration project were derived from a diverse portfolio of stakeholders that included the City of Manchester, EPA, DES, NH Fish & Game, NH State Conservation Committee, NH Corporate Wetlands Restoration Partnership, American Rivers/NOAA, Gulf of Maine Council, Fairpoint Communications, National Grid, Aggregate Industries, Amoskeag Fishways, Dubois & King, Inc., Sumco Ecological Services, and Trout Unlimited. Thanks to the incredible collaboration and innovative funding strategies to restore Black Brook, this project was accepted as a Section 319 Nonpoint Source Program Success Story by EPA in 2011.

In addition to the local community accolades for flood relief and elimination of a public safety hazard, the project also garnered national attention. American Rivers selected this project as one of three in the United States to be featured in their Restoring America’s Rivers – Preparing for the Future DVD that focused upon flooding, community decision makers, and restoration of vital habitats for fish and wildlife.

This presentation will provide attendees with an overview of the dam removal process on Black Brook, the project partnerships and funding collaborations that led to success, pre and post-dam removal data, the return of state and federally listed fish species to Black Brook, and an opportunity to view the nine minute chapter from the American Rivers DVD.

Biography

A graduate of the University of Massachusetts with an Environmental Science degree, Steve started his professional career with the New Hampshire Department of Environmental Services in the Limnology Center managing diagnostic feasibility studies, and coordinating paleolimnological and bioassessment projects for lakes. Steve transitioned to the Watershed Assistance Section to manage U.S EPA Section 319
funded Watershed Assistance Grant projects for high quality and impaired waters. Currently, Steve is the Watershed Assistance Section Supervisor where he works with the best Nonpoint Source Pollution staff on the planet. He prides himself on working with stakeholders to complete environmental legacy projects including river restoration through selective dam removal. Steve volunteers on the Upper Merrimack River Local Advisory Committee, and with the New Hampshire Volunteer Lake Assessment Program. Free time is spent training for the Boston Marathon, enjoying the outdoors with his wife, or fulfilling the needs of their four cats.

Nature-like Fishway Design Guidance: Application to the Northeast Region

James Turek, Restoration Ecologist, NOAA Fisheries Restoration Center (401-782-3338; James.G.Turek@noaa.gov; 28 Tarzwell Drive, Narragansett, RI 02882)

Authors: James Turek, NOAA Restoration Center; Alex Haro, USGS S.O. Conte Anadromous Fish Research Center; and Brett Towler, USFWS Fish Passage Engineering

In 2016, the National Marine Fisheries Service (NMFS), the U.S. Geological Survey (USGS) and the U.S. Fish and Wildlife Service (USFWS) developed and released federal interagency fish passage design guidelines for use by engineers and other restoration practitioners planning and designing nature-like fishways (NLFs). The primary purpose of the guidelines is to provide safe, timely and effective passage for 14 diadromous fish species and life stages using Northeast Region and other Atlantic Coast rivers and streams, and at passage sites where preferential full barrier removal and river reach restoration is not feasible. We present seven key physical design parameters in the design of NLFs based on the biometrics and swimming mode and performance of each target species, and to address passage of one or an assemblage of migratory fish species. The parameters include six dimensional guidelines recommended for minimum weir passage opening width and depth, minimum pool length, width and depth, and maximum channel slope, along with a maximum flow velocity criterion for each species. Maximum fish species body length and depth as well as morphologic body type form the basis for the metrics presented. While these guidelines are targeted for the design of step-pool NLFs, this information may also have application in the design of roughened channel NLF types being considered at passage restoration sites, and in assessing performance at passage sites. Examples of constructed NLFs are presented with relevance to the design guidance. Information is also presented in use of these guidelines as input to a SMath model (Towler et al. 2015) for developing and advancing preliminary step-pool NLF design.
Biography

James Turek is a Restoration Ecologist with over 30 years of experience in fishery biology and aquatic ecology. He has worked with the NOAA Fisheries Restoration Center in Narragansett, RI for the past 17 years and previously worked for 13 years as an environmental scientist at consulting firms in MD and RI. His fish passage experiences include the assessment, design and implementation of dam removals, nature-like fishways and structural fishways, as well as aquatic restoration and creation sites. He is responsible for managing or providing technical assistance on coastal habitat and migratory passage restoration projects in Narragansett Bay, Long Island Sound, Buzzards Bay and contributing Southern New England watersheds.

Alex Haro is a Research Ecologist at the S.O. Conte Anadromous Fish Research Laboratory in Turners Falls, MA, and serves as a Principal Investigator and Section Leader of the Fish Passage Engineering Section. His work involves migratory fish behavior, design, engineering, and evaluation of fish passage structures, fish swimming performance, and ecology and management of American eels. Dr. Haro is also an Adjunct Associate Professor at the University of Massachusetts, Amherst and serves as an advisor to graduate students and instructor of courses in fisheries biology.

Brett Towler is a Hydraulic Engineer with the USFWS Fish Passage Engineering in Hadley, MA. Dr. Towler is also an Adjunct Assistant Professor at the University of Massachusetts, Amherst, Department of Civil and Environmental Engineering.

Session F: Field Studies & Models of Ecosystem Services

Using and Interpreting IRIS Tubes to Assess Wetland Mitigation Success in Created Wetlands

Gillian Davies, Senior Ecological Scientist, BSG Group (gdavies@bscgroup.com; 508-792-4500; 33 Waldo Street, Worcester, MA 01608)

Often, the success or failure of a wetland mitigation area is not identified until years after project completion, at which point, the remedy may be elusive, time consuming and costly. In this case study, the success of a newly constructed wetland mitigation area (WMA), which was proximate to a significant topographic cut, was evaluated during the construction phase of a MassDOT highway safety improvements project by using Indicator of Reduction In Soil (IRIS) tubes in conjunction with groundwater elevation monitoring wells. The WMA appeared to have been constructed as designed, but appeared to lack a seasonal high water table in some areas, particularly near the
topographic cut. IRIS tubes were installed during the spring 2015 and 2016 seasons, according to M.C. Rabenhorst methodology (2008), for several weeks. After removal, they were evaluated using Photoshop software, and hydric soil status was determined according to National Technical Committee on Hydric Soils IRIS tube criteria.

In 2015, three out of four IRIS tube nests documented redoximorphic processes within the top 12 inches of soil. All four IRIS tube nests were consistent with groundwater elevation monitoring well data. The nest that indicated upland soil was most proximate to the topographic cut. In 2016, IRIS tube nests were installed in areas thought to be unsuccessful in establishing a groundwater table within the top 12 inches of the soil. All three nests documented a lack of redoximorphic processes within the top 12 inches of soil, and were consistent with groundwater elevation monitoring data.

This monitoring led to timely verification of flaws and assessment of the impact of the topographic cut. Results are being used in identification of appropriate approaches for redesign and functional success, as well as compliance with regulatory agency requirements for multi-parameter data, while avoiding potentially problematic visual assessment of recently installed soils.

**Biography**

As a senior ecological and soil scientist, Ms. Davies provides innovative solutions, scientific and regulatory consulting to public and private sector clients, as well as expert witness testimony. Her consulting expertise encompasses ecosystem-based climate change resiliency and mitigation assessment and planning, state and federal permitting, wetland delineation, impact analysis, wetland mitigation and restoration planning, design and monitoring, difficult wetland soils evaluations, vernal pool evaluations, construction monitoring, and peer reviews for Conservation Commissions. She also teaches numerous workshops relating to wetlands, particularly with regard to climate change, soils and regulations. She is additionally the current president of the Society of Wetland Scientists.

**Sediments can Represent an Alarming Source of GHG Emissions in the Decommissioning of Dams**

**Simone Pereira de Souza**, PhD, Postdoctoral Researcher, University of New Hampshire (603-767-7765; sp.souza@yahoo.com.br; 35 Colovos Road, Gregg Hall, UNH)

Authors: Simone P Souza, Environmental Research Group, University of New Hampshire; Kevin Gardner, Environmental Research Group, University of New
The trapped sediments in reservoirs is a matter of concern in the decommissioning of dams: the flux of sediment during and after removal, increase in availability of potential toxic contaminants, the influence of deposited sediments on downstream habitat and other site-specific considerations. The significant volume of sediments accumulated over the years and the carbon content can also lead to methane emissions, potentially contributing to climate change and influencing the life cycle greenhouse gas emissions from hydroelectric power. Many factors can affect the greenhouse gas (GHG) emissions from trapped sediments, such as sedimentation rate, rate of mineralization, CO2:CH4 ratio, carbon content, among others. The behavior of these parameters for different conditions are still unknown, especially in a dam removal scenario. However, by using a Monte-Carlo analysis applied to published studies evaluating the life-cycle impacts of hydropower plants and methane emission from decomposition of sediments, we found that even in an optimistic scenario with low rates of sedimentation and mineralization, the carbon emissions from the decommissioning of dams may represent 20% of the GHG life-cycle of hydropower plants; in the worst scenario it may account for up to 90%. Such variation is the consequence of a wide range, 10-60 million tons of CO2e, in the dam decommissioning stage. These results demonstrate the need for further analysis to identify the conditions that drive the methanogenesis process post-removal and for strategies to reduce this impact. Best practices for sediments management could be a strategy to reduce the GHG emissions from dam removal, especially when anoxic conditions may be dominant.

Biography

Simone is a postdoctoral researcher at Environmental Research Group, University of New Hampshire, working on a project regarding "The Future of Dams". Her duties include apply an integrated analysis in different scenarios of dam removal. Simone has also worked on sustainability science of bioenergy systems focused on identifying pathways to reduce the GHG emissions and the energy consumption by applying quantitative analysis.

Using a MODFLOW Groundwater Model to Evaluate Water Management Alternatives in Order to Restore Streamflow and Fish Passage in the Jones River, Southeastern Massachusetts

Neal Price, Senior Hydrogeologist/Senior Project Manager, Horsley Witten Group (508-833-6600; nprice@horsleywitten.com; 90 Route 6A, Sandwich, MA 02563)
Silver Lake, located in southeastern Massachusetts, is the primary water supply for the City Brockton as well as the headwaters of the Jones River. Water supply in Silver Lake is augmented by water diverted directly into the Lake from two other ponds in different watersheds (Monponsett Pond in the Taunton River watershed and Furnace Pond in the North River watershed). The Jones River historically supported prolific runs of diadromous fish, which spawned in Silver Lake, but water supply management, reduced streamflow, and downstream dams have significantly reduced their population in this system. This study evaluated potential water supply management alternatives intended to help maintain water levels in Silver Lake that would allow for sufficient streamflow to support fish passage in the Jones River. Water supply management in Silver Lake can be altered by changing the rate and/or timing of diversions into the lake, and by changing the rate of withdrawals from the Lake.

While the major components of the study are all surface water resources, the hydrology of the Tri-basin area is dominated by groundwater influence. After initially, and unsuccessfully, evaluating the use a surface water model (Water and Evaluation Planning, WEAP) linked to a groundwater model (MODFLOW) for this study, the MODFLOW model was ultimately used alone to conduct the transient water budget analyses at the heart of the study. Because it is a groundwater model that does not simulate stormwater runoff, the MODFLOW-computed flow rates for the Jones River constitute the groundwater component of streamflow and were therefore compared against monthly average baseflow conditions to evaluate management alternatives. This approach proved a fruitful and informative way to compare different water supply management strategies against each other in comparison to big picture impacts to Lake level and streamflow.

**Biography**

Neal is a Senior Hydrogeologist and Senior Project Manager at Horsley Witten Group, bringing over 20 years of professional experience in the fields of hydrology and hydrogeology. He has an M.S. in Geology from the University of Massachusetts, Amherst. Neal has led the majority of the water resources restoration projects at HW, including salt marsh and fresh water wetlands restoration. The nature and extent of the work that he conducts includes river restoration, culvert replacements, dam removal, pond and estuarine water quality studies, groundwater and surface water modeling, watershed and drinking water protection studies, water supply development, sediment quality and dredging assessments, wastewater disposal feasibility studies, and environmental permitting.
Assessing the Potential for Dam Removal to Restore Natural Thermal and Dissolved Oxygen Regimes

Peter Zaidel, Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts Amherst (pzaidel@umass.edu; 860-878-1291)

New England has nearly 15,000 dams, most of which are small, surface-release structures that no longer function to meet anthropogenic needs, yet still negatively impact the structure and function of stream ecosystems. Removing such dams has successfully restored many river systems, although the potential for ecosystem improvement depends on the extent to which a dam alters a river’s physical habitat, water quality, and biota. We quantified the impacts of small, surface-release dams on stream temperature (31 sites) and dissolved oxygen (DO; 12 sites) in Massachusetts (MA). Of the 15 sites that had upstream reference temperatures, 87% (13 sites) had elevated downstream temperatures (0.07–5.76°C increase) relative to upstream temperature. Twenty-two of 27 sites showed a linear decline in temperature for 200–1765 m downstream of the dam, with the rate of decline varying among sites. We observed six sites with significantly lower downstream DO than upstream. Of the remaining six sites, three had significantly higher downstream DO, and three had no significant difference between the upstream and downstream conditions. These results are consistent with past research showing varying effects of dams on temperature and DO, and suggest that restorative success following dam removal may be dependent on the magnitude of the dam-induced disturbance. One of the sites, Turner Dam on the Nissitissit River (Pepperell, MA), was removed in September 2015. Turner Dam had clear effects on both temperature (downstream averaged 0.74°C warmer than upstream during August 2015) and DO (downstream DO was consistently lower than upstream), and its removal will allow us to compare before and after conditions in the river. At the other sites, the differences between upstream and downstream reaches suggest locations where dam removal will most improve water quality and alleviate likely seasonal stress experienced by aquatic organisms as a result of these dam-caused impacts.

Biography

Peter Zaidel is a second year Master’s student at the University of Massachusetts Department of Environmental Conservation and the Massachusetts Cooperative Fish and Wildlife Research Unit. Following his graduation from the College of the Holy Cross in 2012, he worked for Olympic National Park and the Connecticut Department of Energy and Environmental Protection before arriving in Amherst to pursue his graduate studies. His current research investigates the impacts of dams and dam removal on stream temperature and dissolved oxygen concentrations in Massachusetts under the direction of Dr. Allison Roy.
"The Price of Everything and the Value of Nothing": What Economists Can (and Can’t) Tell Us About Ecological Restoration

Rachel Bouvier, Lead Consultant, rbouvier consulting (rbouvier.consulting@gmail.com; 207-272-8692; 5 Fellows St, Portland ME, 04103)

A recent article in the Journal of the American Water Resources Association was entitled, "Is Urban Stream Restoration Worth It?" As any economist worth her salt will tell you, the answer is "it depends" - on how the goals of restoration are measured, on the assumptions that are made about "worth," and on whose values matter. In this presentation, Dr. Bouvier will review what ecologists need to know about economics - to be able to recognize a "good" economic study from a bad one, to reveal the hidden assumptions within an economic study, and to make sure that the "right" values are included. Like it or not, there is power in economic arguments and measures. Using economic language helps ensure that ecological restoration is on equal footing with other, more marketable services.

Biography

Rachel Bouvier is founder and principal of rbouvier consulting, a consulting firm specializing in environmental and natural resource economics. Rachel earned her PhD in Economics from the University of Massachusetts at Amherst, where she focused on the relationship between economic development and environmental quality. She also holds a Master’s degree in Resource Economics and Community Development from the University of New Hampshire. She is keenly interested in demonstrating the economic value of environmental protection and conservation.

AFTERNOON BREAKOUT SESSIONS #2

Session G: Landscape-Scale Models for Restoration and Resiliency

Hydraulic and AOP Characteristics of Problem Culverts

Tom Ballestero, Director, UNH Stormwater Center University of New Hampshire (tom.ballestero@unh.edu 6038621405 238 Gregg Hall)

Authors: Tom Ballestro, UNH and Joel Ballestero, Streamworks
Tens of thousands of culverts are past their retirement age and were typically hydraulically designed for the hydrology of the mid-twentieth century. Detailed study of each and every culvert will be time consuming, however at the same time, many states have embarked on asset management strategies that take rudimentary field information at each culvert in order to define these assets. These field data provided the input to a code to perform hydrologic, hydraulic, and aquatic organism passage (AOP) characteristics. The code was written into an EXCEL spreadsheet that accommodates either user input or input from a GIS database. The code can also provide assessments in a batch mode (multiple culverts at once). Code input includes the culvert geometric data and latitude/longitude coordinates. The coordinates locate the watershed and thereby all watershed characteristics may be found in GIS databases (land use, hydrologic soil group, runoff travel paths, watershed slope, etc.). Runoff computations are performed either by the NRCS method for watershed areas less than 2 mi² or USGS regression equations for larger watersheds.

As a test of the code, a current project funded by NOAA and NHDES studied 105 culverts selected by ten seacoast New Hampshire towns. These culverts were identified by the towns as “problem” culverts: often meaning undercapacity. Watershed areas to each culvert were generally less than 3 sq. mi. These culverts were modeled with the FHWA HY8 code as well as the EXCEL code. The comparisons were extremely similar, as both codes are based on the same fundamental equations. Hydraulic analyses built into the code include 10-, 25-, 50-, and 100-year floods. AOP assessment employs the Vermont protocols. Some of the more interesting results include: the majority of culverts are under outlet control, only 9% provide full AOP, yet 2/3 provide reduced AOP.

**Biography**

Thomas P. Ballestero, University of New Hampshire. Tom is a hydrologist and water resources engineer with four decades of national and international experience in stream systems, stormwater management, and groundwater hydrology. He is a licensed Professional Engineer, Professional Hydrologist, and Professional Geologist. Areas of expertise include: stream restoration, stormwater management, stream crossings, fish passage, geomorphic assessments, dam removal, hydrology, hydraulics, sediment transport, and coastal engineering. Aside from teaching undergraduate and graduate courses he performs all aspects of projects including field data collection, project management, design, alternatives analysis, data analysis, public outreach, construction supervision, permitting, and monitoring. Tom was a lead author for the technical aspects of the Stream Crossing Guidelines for the State of New Hampshire. Tom is a member of the Scientific Resolution Panel to arbitrate technical disagreements between communities and FEMA regarding riverine, lacustrine, or coastal flood insurance studies.
Down Along the Binnekill: Using Flood Inundation Mapping and Stream Power to Identify Risks and Set Conservation Priorities

Mark Carabetta, Environmental Scientist, Milone & MacBroom (mcarabetta@mminc.com; 845-633-8153; 231 Main Street, Suite 102, New Paltz, NY 12561)

Authors: Mark Carabetta, Milone & McBroom, Catherine Gibson, The Nature Conservancy; Chris Zimmerman, The Nature Conservancy

A collaborative project was undertaken to set conservation priorities and identify risks along two watercourses in Orange County, NY. Digital flood inundation mapping, which depicts estimates of the spatial extent and depth of flooding corresponding to select river flows and water surface elevations, was produced for 14.2 miles of the Neversink River and 4.2 miles of its tributary, the Basher Kill. Analysis of stream gauge records and regression equations were used to determine hydrology and estimate flow return intervals. Using HEC-RAS modeling software, one-dimensional hydraulic modeling was employed to determine water surface elevations and calculate specific stream power along both watercourses for a range of flow conditions ranging from the estimated 2-year to 500-year recurrence interval, and including flows recorded during the April, 2005 flood of record. Inundation mapping for the more frequent flow events (the 2-year, 5-year, and 10-year recurrence interval floods) was used to identify opportunities for ecological restoration, prioritize areas for protection, evaluate floodplain connectivity, and identify remnant stream channels, or binnekills. Maps representing the larger and less frequent flow events (the 2005 flood, and the 100-year and 500-year recurrence interval floods) were used to assess risk to inhabited areas resulting from flooding, and combined with stream power calculations to create a coarse-screen measure of potential erosion and channel migration. The resulting products from this study will be combined with other available data such as land cover, soil mapping and field observations, to further refine conservation prioritization and risk assessment. River reaches were identified where an understanding of complex flow conditions is required, and the application of more powerful, two-dimensional hydraulic modeling may be warranted.

Biography

Mark Carabetta, PWS, CFM is a senior environmental scientist responsible for an array of ecological inventory, river and wetland restoration, and flood mitigation projects. He has led numerous conservation, restoration and flood mitigation projects in New York, New England, and southern Ontario. Mr. Carabetta has degrees in botany and natural resources management and engineering, and is a certified wetland scientist and
floodplain manager with over 20 years of experience in the environmental field. Mr. Carabetta manages Milone & MacBroom's regional office in New Paltz, New York.

Preserve Management Planning to Improve Climate Resilience

Karen Lombard, Director of Stewardship and Restoration, The Nature Conservancy (klombard@tnc.org; 413-923-3174; The Nature Conservancy, The Felt Building, 136 West St., Northampton, MA 01060)

Authors: Karen Lombard, Mark Anderson, Angela Sirois-Pitel, Jessica Dyson, The Nature Conservancy

The Schenob Brook Preserve (2072 acres) is The Nature Conservancy’s (TNC) largest preserve in Massachusetts and protects a large calcareous wetland complex surrounding Schenob Brook, a lowland stream system in the southwest corner of the state. During recent management planning effort, we recognized the need to consider not just the current conditions within the Preserve, but also strategies to make the site more resilient to inevitable changes driven by climate change. We investigated what changes we might expect from climate change, how we could maintain the quality of the underlying geophysical and chemical environment, and how we could increase options for species to move and find suitable habitat. We used both a spatial analysis of resilience as well as recommendations from the literature to identify a suite of possible management actions focused on limited interventions that would increase connectivity or improve the condition of the physical stage.

Biography

Karen Lombard has been working in stewardship and restoration for The Nature Conservancy since 1999. She currently leads a TNC team that manages over 6000 acres of TNC fee land and monitors over 2,500 acres in conservation easement land in Massachusetts. She is the current chair of the MA Invasive Plant Advisory Group and is also involved in the startup of the Sandplain Grassland Network, a new partnership focused on improving collaboration on sandplain grassland and heathland restoration efforts. Past projects have included management of long-term Phragmites invasive plant removal project on Cape Cod; starting and co-leading a cooperative invasive species management area in Western MA, and co-authorship of "A Guide to Invasive Plants in MA." She has an M.S. in Natural Resource Management from the University of Michigan and a B.A. from Williams College.
No Management is Active Management: A (Re) Evaluation of New Hampshire Salt Marsh Restoration and Conservation Opportunities in a Changing Climate

Rachel Stevens, Stewardship Coordinator and Wildlife Ecologist, Great Bay National Estuarine Research Reserve and NH Fish and Game Department (603-778-0015; rachel.stevens@wildlife.nh.gov; 89 Depot Road, Greenland, NH 03840)

Authors: Rachel Stevens, Great Bay National Estuarine Research Reserve and NH Fish and Game Department and Katie Callahan, NH Fish and Game Department.

Rising sea level is likely the dominant driver of coastal wetland change in New Hampshire and much of the northeastern United States. Consequently the present day suite of tidal flow restoration opportunities is dynamic and likely to change over time. To assess what future conditions might look like, the Sea Level Affecting Marshes Model was run for coastal New Hampshire under multiple time and sea level rise scenarios. From this, supplemental “decision support” mapping layers were developed to help identify the most strategic restoration opportunities that will likely be sustained for the longest duration and maximize coastal resiliency. An assessment of current salt marsh condition and adaptation potential, identifying areas of resilient salt marsh and pathways for migration, allows us to consider the relative benefit of restoration verses land protection when trying to maximize coastal resiliency in the face of unprecedented change. A synthesis of statewide results and highlights at the community level will be presented.

Biography

Rachel Stevens is a Wildlife Ecologist for New Hampshire Fish and Game and the Stewardship Coordinator for Great Bay National Estuarine Research Reserve. She has been involved extensively in coastal wetland ecology and conservation.

Session H: Freshwater Restoration 2: Instream Habitat & Structure

Restoring Instream Habitat and Improving Floodplain Resiliency Using Large Wood

Joel DeStasio, NH Field Manager, New England Culvert Project, Trout Unlimited (jdestasio@tu.org; 54 Portsmouth Street, Concord, NH 03301), and Colin Lawson, New England Culvert Project Coordinator, Trout Unlimited (clawson@tu.org).
Beginning in 2014, Trout Unlimited has been working with the USDA Natural Resource Conservation Service (NRCS) to monitor and restore instream fish habitat at 23 NRCS Wetlands Reserve Program (WRP) conservation easements in southern New Hampshire. The goal of these restorations is to reintroduce large wood into sections of stream where the natural recruitment of large instream wood becomes limited. Our restoration projects aim to improve instream habitat & structure for fish and also influence spawning potential by improving sediment transport, pool/riffle runs, and stream cover. Throughout the summer seasons, streams at each easement have had water parameters recorded and samples collected to analyze nutrient content. This has allowed us to establish the current water quality & habitability of streams for each easement. This information will serve to better identify the value of large wood additions in smaller order streams and understand the intrinsic value instream wood has on restoring fish habitat.

Biography

Colin Lawson: I joined the TU team in 2010 and spend most of my time heading up the New England Culvert Project. I work on instream connectivity issues across Massachusetts, New Hampshire (where I live) and Vermont. The work we are doing includes assessing road stream crossings for both aquatic organism passage (AOP) as well as hydraulic capacity. Where we find problems, we engage with a diverse group of partners to remove problem crossings and replace them with structures which allow for the natural movement of water and critters during most high flow events.

Using Large Wood to Restore River Function

John Field, President, Field Geology Services ([field@field-geology.com; 207-491-9541; P.O. Box 985, Farmington, ME 04938])

River function has been greatly compromised throughout New England as the result of a legacy of log drives and other activities that led to widespread channelization in the 20th century and earlier. Channelization included artificial straightening and the removal of logs and boulders that has degraded geomorphic and habitat function. River restoration projects using large wood can be used in multiple ways to restore habitat complexity, provide structure in the channel to accelerate the reformation of meanders and other natural features, and stabilize eroding banks. Along steep mountain channels where no infrastructure concerns are present, the "chop and drop" technique can be used to directionally fell trees into the channel where subsequent floods can reorganize the wood into log jams and steps that create deep pools, store sediment, and improve floodplain connectivity. Such upper watershed projects do not only improve habitat locally but can also attenuate flood peaks and sediment loading downstream. Along
valley-bottom systems, marginal log jams can be constructed along straightened channels to encourage the reformation of meanders and divert flow away from eroding banks while single logs can be used to scour pools, trap gravel useful for spawning, and improve flow complexity. In valley-bottom settings where wood movement could potentially threaten infrastructure, wood can be anchored by driving logs into the bed and banks without the use of boulders or steel cables to ensure the constructed log structures appear natural even in sandy environments. While trees falling into stream channels can often exacerbate flooding and erosion problems during storm events, large wood can actually be used in restoration projects to reduce threats to human infrastructure while simultaneously improving geomorphic and habitat function degraded by historic channelization.

Biography

Dr. John Field, President of Field Geology Services, LLC, received a Ph.D. in 1994 from the University of Arizona with concentrations in fluvial geomorphology and hydrology. During eight years as a university professor, Dr. Field received two excellence in teaching awards and was active in training teachers and government agency personnel on techniques for identifying flood and erosion hazards and assessing the stability and habitat conditions of rivers. Dr. Field has over 20 years of professional experience related to river restoration and has designed and installed numerous projects throughout New England utilizing large wood to improve river function and aquatic habitat. As an award-winning teacher, Dr. Field is able to present and explain complex concepts in a clear and concise manner.

Use and Effects of Self-stabilizing Wood on Channel Processes and Aquatic Habitat

Jim MacCartney, River Solutions, LLC (jim@riversolutions.com; (603) 491-8766; 54 Portsmouth Street, Concord, NH 03301)

Wood historically was removed from river channels to reduce flooding and improve transport of timber and other products. Wood removal in many river systems still continues in attempts to protect infrastructure after large flood events, reduce bank erosion, and improve recreational boating. Meanwhile, river restoration practitioners increasingly are adding large wood into rivers and streams to restore natural channel processes and aquatic habitat degraded by wood removal. Most of these restoration projects use the materials in a static manner by anchoring large wood in place. The use of self-stabilizing wood additions—a restoration approach where whole trees including roots are added to the stream and allowed to transport at high flows—is being implemented at Nash Stream in northern New Hampshire. While both methods are
effective, implementation and subsequent monitoring at Nash Stream shows that self-stabilizing wood more closely mimics natural recruitment to, and transport and accumulation within, river systems, and provides a cost-effective method of increasing large wood volumes in hard-to-reach locations or with limited stands of riparian trees.

**Biography**

Jim MacCartney is Principal and owner of River Solutions, LLC, a New Hampshire-based environmental consulting firm. He has over twenty years’ experience working nationally on river restoration projects such as large wood structures, channel reconstruction, stream crossing remediation, habitat enhancement, and dam removal.

Before starting River Solutions, Jim was Director of River Restoration for Trout Unlimited where he worked on restoring natural channel process and coldwater fish habitat. Jim also worked for the NH Department of Environmental Services where he administered the NH Rivers Management and Protection Program, and led development of the state’s instream flow policy. He earned his M.S. in Resource Management from Antioch University, with concentration in water resources and geomorphology.

In addition to being Principal of River Solutions, Jim also works for the National Park Service on Wild and Scenic Rivers. He is an avid fly fisherman and whitewater boater.

**Large Wood Controls on Channel Morphology and Use of Wood Additions for River Restoration**

**Douglas Thompson**, Rosemary Park Professor of Geology  (860-439-5016; dmtho@conncoll.edu; 270 Mohegan Avenue, Box 5585  New London CT 06320)

Large wood (LW) distributed in rivers as either single logs or multiple log jam accumulations can influence flow patterns, sediment transport and channel morphology. A study on Blackledge River in Connecticut documents the formation and maintenance of a major pool-riffle couplet with associated habitat complexity. The new pool-riffle couplet is a major site of storage for fine sediments and organic material along the study reach. The site highlights the value of LW additions in restoration projects. A model to estimate the role of LW additions to river reaches is briefly introduced. The Monte Carlo simulation was developed to predict pool-riffle formation, spacing and the percent length covered by pools, riffles, scour holes and plane-beds based on input data that include channel width, slope, the number of small and large boulders, and the number of 10-30 cm, 30-60 cm and >60 cm pieces of LW. The statistical-empirical model is founded on the principle that boulders, bedrock outcrops and LW provide a physical framework that
then controls local water-surface slopes, velocity patterns and the channel morphology. The total number and spacing of pools, riffles and scour holes thus reflects the number and locations of obstructions and characteristics of the pool-riffle couplet. Preliminary details are also provided of a monitoring plan for a LW addition project in the Narraguagus River in Maine. The role that LW plays in mobilizing embedded sediments will be analyzed using cross-section surveys and tracking of PIT-tagged particles.

Biography

Douglas Thompson is the Rosemary Park Professor of Geology at Connecticut College, where he has taught for 19 years. 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, an expert on pool-riffle morphologies and the history of river restoration. He has authored dozens of articles and the book The Quest for the Golden Trout. Thompson is a fellow in the Geological Society of America.

Session I: Working with People for Restoration 2

Community Engagement in Ecological Restoration: Working with Volunteers in Stewardship and Citizen Science

Malin Clyde, Extension Specialist, Community Volunteers (malin.clyde@unh.edu; 603-862-2166; Nesmith Hall, 131 Main Street, Durham, NH 03824)

Authors: Malin Clyde, UNH and Alyson Eberhardt, UNH Cooperative Extension and NH Sea Grant

A collaborative project was undertaken to set conservation priorities and identify risks along two watercourses in Orange County, NY. Digital flood inundation mapping, which depicts estimates of the spatial extent and depth of flooding corresponding to select river flows and water surface elevations, was produced for 14.2 miles of the Neversink River and 4.2 miles of its tributary, the Basher Kill. Analysis of stream gauge records and regression equations were used to determine hydrology and estimate flow return intervals. Using HEC-RAS modeling software, one-dimensional hydraulic modeling was employed to determine water surface elevations and calculate specific stream power along both watercourses for a range of flow conditions ranging from the estimated 2-year to 500-year recurrence interval, and including flows recorded during the April, 2005 flood of record. Inundation mapping for the more frequent flow events (the 2-year, 5-year, and 10-year recurrence interval floods) was used to identify opportunities for ecological restoration, prioritize areas for protection, evaluate floodplain connectivity,
and identify remnant stream channels, or binnekills. Maps representing the larger and less frequent flow events (the 2005 flood, and the 100-year and 500-year recurrence interval floods) were used to assess risk to inhabited areas resulting from flooding, and combined with stream power calculations to create a coarse-screen measure of potential erosion and channel migration. The resulting products from this study will be combined with other available data such as land cover, soil mapping and field observations, to further refine conservation prioritization and risk assessment. River reaches were identified where an understanding of complex flow conditions is required, and the application of more powerful, two-dimensional hydraulic modeling may be warranted.

Biography

Malin Clyde, Extension Specialist, Community Volunteers, UNH Cooperative Extension. Since 2013, Malin has been the project manager during the launch of the Stewardship Network: New England, and effort to mobilize and train volunteers to care for and study lands and waters in New Hampshire and beyond.

Alyson Eberhardt, Extension Specialist, Coastal Ecosystems, UNH Cooperative Extension/NH Sea Grant. Alyson coordinates the Coastal Research Volunteers, an innovative citizen science program that trains community volunteers to collect data and implement restoration projects on a wide variety of coastal research and stewardship projects including wildlife habitat, water quality, and coastal dune restoration.

Living Observatory: Documenting Ecological Change over time across the Tidmarsh Farms Restoration Project

Glorianna Davenport, President, Living Observatory (gid@media.mit.edu; 617-642-7934)

Large-scale ecological wetland restorations, such as the Tidmarsh Farms Restoration Project in Massachusetts, generate an unusual opportunity to further the science of ecological restoration and shape public perception of the value of restored wetlands. This talk will introduce Living Observatory (LO), a non-profit 501(c)3 interdisciplinary learning collaborative of scientists, artists, engineers, practitioners. Goals of LO include: to observe, document and interpret change to ecosystem functions as they evolve pre, during and after specific restoration actions; to develop metrics to help agencies and the public evaluate the success of fresh-water ecological restorations; and to support public understanding of relationships between ecological processes, human lifestyle choices, and climate change adaptation. Future researchers submit project proposals to the LO community that articulate goals, methods, and expected outcomes of the particular
endeavor. LO welcomes projects that include novel instrumentation; current and past projects have employed low-power environmental sensing, distributed temperature sensing over fiber optic cable (DTS), multi-track audio streaming, infra-red drone photography/video resolved to GIS. LO’s growing community of learners are encouraged to meet, share ideas, and evolve research synergies. Every other year, LO researchers share their ideas and their progress at a bi-annual LO Summit. All LO participants agree to LO’s shared data policy.

Biography

Glorianna Davenport is a Trustee of Tidmarsh Farms, Inc. and co-founder of Living Observatory, a non-profit (501(c)3) collaborative organization focused on telling the long-term story of the Tidmarsh Farms Wetland Restoration in order to advance scientific knowledge and public understanding of wetland ecology. Trained as a documentary filmmaker, Davenport is co-founder of the MIT Media Lab where she researched innovations in the construction, editing and shared use of video throughout the 1990’s and 2000’s. Today, in building Living Observatory, Glorianna champions project based learning for science and media innovation in the belief that, working together, we can create experiences that will allow people, individually and collectively, to better understand relationships between ecological processes, human lifestyle choices, and climate change.

A Framework for Coastal Ecology: Sculptural Forms as Infrastructure for Coastal Resilience and Education

Emily Vogler, Assistant Professor, Rhode Island School of Design (505-977-0652; evogler@risd.edu; 98 Reed Rd, Westport MA, 02790)

Authors: Scheri Fultineer, Rhode Island School of Design; Emily Vogler, Rhode Island School of Design; Marta Gomez-Chiarri, University of Rhode Island; Breea Govenar, Rhode Island College; Dale Leavitt, Roger Williams University

In 2012, Rhode Island NSF EPSCoR funded an interdisciplinary studio course at Rhode Island School of Design in which sculpture and landscape architecture students worked with scientists from the University of Rhode Island, Roger Williams University, and The Nature Conservancy to research and design sculptural shellfish habitat forms with the objective of creating proposals for a highly visible coastal restoration project at an urban waterfront site in Providence, RI. Since then, the research team has moved forward to develop one proposal through material and formal studies into three prototypical forms. Materials and forms were tested in the hatchery and in the field and monitored for successful bivalve larval settlement. The forms can be deployed individually or in
aggregations, creating new models for urban coastal edges that contribute to the restoration of critical ecological systems and enhance their resiliency to withstand the impacts of rising sea levels and climate change.

This summer 9 forms were installed at an urban park in Providence, RI. The park was chosen with the support of local stakeholders both for its public visual access and also for its ecological conditions. The forms will remain in the water for three years and will be monitored for shellfish settlement and other ecosystem services. Through presentations at local schools, community involvement in the construction of the forms, ongoing citizen-science to monitor shellfish settlement on the forms, and the high visibility of the forms, this project uses the sculptural forms as a platform for public outreach and education about coastal ecosystems.

**Biography**

Emily Vogler is a landscape architect whose work negotiates ecological and urban systems, aesthetics and performance, design and research to create a more just, creative and resilient land use system. She is an assistant professor at the Rhode Island School of Design where she teaches studio and elective courses in representation, ecological systems and design foundations. Vogler's teaching and professional practice support her research into multi-scale projects that address regional hydrological, ecological, and agricultural systems at the site scale. This has resulted in research into the irrigation ditches of the Middle Rio Grande Valley of New Mexico, decision making processes around dam removal in New England, the installation of sculptural forms as infrastructure for coastal habitat and education, and efforts to reintroduce small-scale grain production into Southeastern of Massachusetts. These projects have allowed Vogler to investigate topics surrounding the aesthetics of restoration, the use of representation for outreach and decision making, and the design of multi-functional infrastructural systems.

Vogler received a Master's degree from the University of Pennsylvania, where she was recipient of the Ian L. McHarg Prize for Excellence in Ecological Design, an ASLA Honors Award recipient and the 2010 National Olmsted Scholar. Following graduation, she worked at Michael Van Valkenburgh Associates, where she was the project designer for the winning entry of the ARC Wildlife Crossing Design Competition and the Bloomingdale Trail.
Floating to Recovery: Can Artificial Islands Provide Nesting Habitat for Saltmarsh Sparrows?

Bri Benvenuti, Graduate Student, University of New Hampshire
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Tidal marsh birds are severely threatened by the impacts of rising sea levels on salt marsh ecosystems. Changes in vegetation, loss of nesting habitat, and increased tidal inundation will reduce, if not eliminate, the reproductive ability of marsh-nesting birds, such as the Saltmarsh Sparrow. Conservation actions are needed in the very near-term to identify solutions to mitigate nest flooding and maintain breeding populations until habitat is created in the longer term by accelerated marsh migration or other habitat restoration efforts. We designed a short-term management experiment for maintaining flood-free high marsh nesting habitat for Saltmarsh Sparrows through the use of artificial habitat islands. We installed four 4 ft x 8 ft floating island rafts, vegetated with Spartina patens and Spartina alterniflora in a marsh pool on Rachel Carson National Wildlife Refuge in Wells, Maine. Islands were monitored through the breeding season and winter. The islands remained free of tidal inundation and supported vegetation growth and expansion, suggesting that floating habitat islands hold promise as a method for mitigating nest flooding in tidal-marsh-nesting birds.

Biography

Bri Benvenuti is in the second year of her Master’s Program at the University of New Hampshire.

Population Structure and Spawning Habits of the American Horseshoe Crab (Limulus polyphemus) in East Harbor, Massachusetts after Partial Tidal Restoration

Jodi Curtin, Antioch University New England (jcurtin@antioch.edu; 508-237-5957; 143 Beacon St Lawrence, MA 01843)

Authors: Jodi Curtin, Krystal House, Rachel Thiet Environmental Studies Department, Antioch University New England Keene, NH, MJ James-Pirri Graduate School of Oceanography, University of Rhode Island Narragansett, RI, Kelley Mediros Cape Cod National Seashore, National Park Services Truro, MA
East Harbor is a 291-ha back-barrier salt marsh lagoon located within Cape Cod National Seashore in N. Truro, MA. East Harbor was artificially isolated from Cape Cod Bay in 1868 when the original 300-m wide inlet was diked. The resulting tidal restriction caused a decline in salinity and dissolved oxygen levels, which led to a variety of ecological problems, including extirpation of native estuarine flora and fauna. Partial restoration of East Harbor began in 2002, after which native estuarine flora and fauna re-established quickly. In 2006, the American horseshoe crab (*Limulus polyphemus*) colonized East Harbor, and its population structure and spawning behavior in the system had not been studied until now. Horseshoe crabs are an essential part of marine ecosystems and a significant natural resource in coastal national park units, as their eggs are used as a food source by migratory shorebirds, minnows, and young sport fish. The importance of this species and concern that its numbers are dwindling have prompted demand for research on horseshoe crab populations along the eastern seaboard for management and conservation purposes. Previous studies have shown that individual populations adapt to the unique systems where they are found. The overall goal of this study was to characterize the population structure, spawning habits, and preferred habitat of horseshoe crab adults and juveniles within East Harbor. The baseline data provided by our study will be used to understand how horseshoe crabs are affecting restoration outcomes in this system, and to inform future management and conservation efforts.

**Biography**

I am a master’s of science candidate in conservation biology at Antioch University New England. I am currently working on my thesis on the American Horseshoe Crab (*Limulus polyphemus*) in East Harbor on the Cape Cod National Seashore. I received my undergraduate degree in Environmental Studies from Harvard University Extension School in 2014. I interned at the Great Bay National Estuarine Research Reserve this past spring. My projects included a species list with photo identification, tree identification, and recovering vegetation plots for the summer field season. I volunteered at Massachusetts Association of Conservation Commissions from July 2014 until April 2015. I also volunteered at the New England Aquarium in various capacities in the Animal Care Center, Live Blue Service Corp, and helping out with the sea turtles in the Rescue and Rehab. My career interests are in coastal ecology and restoration with an affinity for salt marshes.
Distribution and habitat associations of the Common Garter Snake in wetland habitats of Southeastern Massachusetts

Emily Donahue, Bridgewater State University (edonahue@student.bridgew.edu; 508-846-0699; 85 Bayberry Circle, Bridgewater MA)

Authors: Emily Donahue, Jackie Toomey, Sarah Jones, Thilina Surasinghe, Bridgewater State University

Behavioral thermoregulation is a critical behavioral act that alters the metabolism of reptiles. Long-term reproductive success, efficient foraging, and growth are functions dependent on thermoregulation. Most reptiles maintain their thermal optima by basking or retreating beneath cover objects. Efficient thermoregulation is critical for aquatic snakes, as their aquatic foraging efforts inevitably result in heat loss. The objective of this research was to investigate the influence of body weight and sex on thermoregulation of Common Garter Snakes (CGS). We conducted visual encounter surveys (visual scanning and search under cover objects) across wetland habitats of southeastern Massachusetts. For each snake captured, sex, body weight, cloacal temperature, and substrate type were documented. Throughout our survey, we captured 19 individuals (10 females, 2 males, and 7 juveniles) in five habitats. All snakes were found on brown, shallow (10-20 mm depth) leaf litter under thick canopy cover. We did not find any correlation between sex/body weight and cloacal temperature. Egg production and incubation by females require elevated body temperatures. Thus, lack of intersexual differences in body temperature is surprising. Increased body weight alters the surface:volume ratio, which substantially influences metabolism. Therefore, lack of correlation between body weight and internal temperature is also unexpected. The CGS may have evolved a lower thermal optima to allocate more energy on non-thermoregulatory activities, such as mating and foraging. Since extensive basking may expose CGS to predators, evolution of life histories with reduced basking needs and lowered thermal optima are tenable. CGS’s association with closed canopy may also be an anti-predatory adaptive behavior. We intend to continue this survey until late Fall. Our research may provide useful information for understanding ecological requirements and ecophysiology of CGS, and thus help manage and restore wetlands landscapes to create the optimal biological conditions for persistent populations of CGS.

Biography

Emily is attending Bridgewater State University where she is pursuing a Bachelors degree in Biology. She is currently a tutor in introductory biology courses at that university. After graduation, she plans to attend graduate school and pursue a career in conservation ecology.
Effects of Salinity and Metals on Denitrification across Restored and Reference Wetlands in Urban Landscapes

April Doroski, Department of Natural Resources and the Environment, University of Connecticut (april.doroski@uconn.edu; University of Connecticut, Unit 4210, Bldg 4 Annex, 3107 Horsebarn Hill Rd, Storrs, CT 06269)

Authors: Ashley Helton, Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT, USA, and Center for Environmental Sciences and Engineering, University of Connecticut, Storrs, CT; April Doroski, Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT, USA, and Center for Environmental Sciences and Engineering, University of Connecticut, Storrs, CT, USA; Timothy Vadas, Center for Environmental Sciences and Engineering, University of Connecticut, Storrs, CT, USA, Department of Civil and Environmental Engineering, University of Connecticut, Storrs, CT, USA

Tidal flow wetland restoration in Connecticut has historically been completed to improve habitat, but the response of ecosystem functions to restoration is not well studied. The objectives of this study are to 1) determine how tidal flow restoration affects ecosystem functions and 2) quantify patterns of ecosystem function (denitrification) in restored and reference wetlands. We examined the effects of restoration on ecosystem functions, nutrient, and metal concentrations in 32 tidal wetlands (17 restored; 15 reference) along the coast of the Long Island Sound. Soil cores were collected in July 2015 from freshwater to saltwater tidal wetlands and analyzed at 0-5cm (top layer) and 5-10cm (bottom layer) depth intervals. We found in the top layer, ammonium and carbon mineralization rates were significantly higher in restored wetlands, while denitrification potential (DEA) was significantly lower in restored wetlands in the bottom layer. In restored wetlands, substrate-induced respiration (SIR), DEA, and Mn concentrations increased with time since restoration. This suggests restoration for habitat improvement may restore ecosystem function as an added benefit. Additionally, we examined the effects of soil electrical conductivity (EC), organic matter content, SIR, ammonium, and metal concentrations on DEA across the 32 tidal wetlands. Results of a multiple linear regression model selection for DEA in the top layer include EC, SIR, copper, and lead in the best fit model (r² =0.43; p<0.05). DEA was positively related to SIR (p<0.05) and copper (p<0.05), and negatively to EC (p<0.05) and lead. Results for DEA in the bottom layer include manganese and iron in the best fit model (r² =0.24; p<0.05). DEA was positively related to manganese (p<0.05) and negatively to iron. The results suggest a potential suppression of DEA with elevated salinity and enhancement with copper, particularly at the oxic-anoxic interface and potential enhancement of DEA with increasing manganese in deeper anoxic soils.
Biography

April Doroski is a Master’s student in the Department of Natural Resources and the Environment at the University of Connecticut (UConn). Her research focuses on how sea level rise affects the biogeochemical function of coastal wetlands in urban landscapes. She is interested in understanding wetland ecosystem function to improve strategies for wetland preservation, construction, and restoration. April is an Associate Professional Soil Scientist (APSS) and Wetland Professional in Training (WPIT). Prior to attending UConn, she worked as an environmental scientist for Sovereign Consulting Inc. April earned a BS in Environmental Resource Management with a concentration in Soil Science from Pennsylvania State University.

Fish-ways and Dam Removals: A Catalyst for Competition between Anadromous and Landlocked Fish Populations

Katherine Littrell, PhD Student, Yale University (katherine.littrell@yale.edu, 518-222-3872)

One of the primary goals of river restoration projects is the re-opening of spawning habitat to anadromous fish populations. Increasing habitat connectivity as a result of dam removals or fish-way installations will increase the probability that freshwater landlocked populations will come into contact with ancestral anadromous populations. Secondary contact between anadromous and landlocked life-history forms may result in complex interactions that can alter the ecological and evolutionary trajectory of the species. One of the possible outcomes of secondary contact is competition between populations. We are studying the impacts of competition on anadromous alewife (*Alosa pseudoharengus*) populations experiencing secondary contact with landlocked alewife. The life-history forms came into contact for the first time in centuries after a recent fish-way installation at Rogers Lake in Old Lyme, Connecticut. In the summer of 2015, we conducted a mesocosm experiment to test the effects of prey size on alewife growth rate. Two populations of anadromous and landlocked alewife were fed an abundance of either large-bodied zooplankton, characteristic of anadromous lakes in early spring, or small-bodied zooplankton, representing the prey community structure in landlocked lakes year-round. A second experiment was conducted in the summer of 2016 to determine if prey biomass and size impacts growth rate. Our preliminary results indicate that anadromous and landlocked alewife within a population grow equally well on large and small-bodied zooplankton, but anadromous alewife may suffer reduced or no growth when prey abundance mimics low levels found in landlocked lakes. Anadromous alewife could be at a competitive disadvantage when entering landlocked lakes with a low biomass of small-bodied zooplankton, potentially resulting in niche displacement.
and reduced size at emigration. Competition that occurs as a result of river restoration projects may have a significant impact on the recovery and management of alewife and other threatened anadromous fish populations.

Biography

Katherine Littrell is a fourth year PhD candidate in Yale’s Ecology and Evolutionary Biology program. Her research focuses on secondary contact events between anadromous and landlocked fish populations. The goal of her work is to understand how the interactions that occur at the onset of secondary contact can maintain or generate biodiversity. Katherine works primarily on landlocked and anadromous life-history forms of alewife, a species of river herring (*Alosa pseudoharengus*), and uses fish-way installations as a natural experiment to study secondary contact as it occurs. She is currently working on projects exploring hybridization between life-history forms and the differences between their metabolic rates, growth patterns, foraging tactics, and schooling behaviors.

Comparing the Removal of the Millie Turner Dam vs. The Bartlett Rod Shop Company Dam

Andy Marion, Keene State College (andy.marion@ksc.keene.edu)

Authors: Andy Marion, Michael Lundsted, Thomas Wolters, Denise Burchsted, Keene State College

This study is being conducted on the Millie Turner Dam located on the Nissitissit River in Pepperell, MA, and the Bartlett Rod Company Dam located on Amethyst Brook in Pelham, MA. The Millie Turner Dam, built around 1750, was classified as “High” hazard potential and in “Unsafe” condition. Because of this, state fisheries and wildlife breached the dam in October 2015 to restore pre-dam ecological function, provide passage to fish, and reduce local upstream flooding risk. Unlike other dam removal projects in New England, where impounded sediment is considered environmentally dangerous and is secured before a dam removal, this project allowed the approximately 7,000 cubic yards of mobile, impounded sediment to move on its own; this provided a unique opportunity to observe sediment movement and the resulting impacts on river habitat. The Bartlett Rod Company Dam was removed under the same circumstances.

Baseline data of both stream shape and sediment size within the stream beds were monitored pre and post-removal. The baseline data varies as distance from the dams increase. The coarsest sediment and most uniform channel structure is closest to the dams and the finest sediment, widest variation in sediment size, and most complex channel form is farthest downstream. This demonstrates the impact of a barrier to
sediment transport, which causes the ecosystem immediately downstream to be starved of sediment. After the removal of the dams, we observed no significant change in sediment or channel morphology downstream of the dam site but significant movement of impounded sediment upstream. This documentation before and after the removal of Turner Dam and Bartlett Rod Company Dam allows assessment of the impacts of dams on aquatic and riparian habitat, furthering our understanding of the role and appropriate management of sediment transport in river ecosystems.

Spatial Variation in Characterized Buried Soils and Legacy Sediments of the Northeast USA

Anna Marshall, CFE/Save the Sound (amarsha2@conncoll.edu; 207-314-6592; 141 Smithfield Rd Norridgewock, ME 04957)

Authors: Anna Marshall, CFE/Save the Sound; Doug Thompson, Connecticut College; Melinda Daniels, Stroud Water Research Center

The role of historical mill dams in transforming river systems, especially throughout New England and mid-Atlantic regions of the U.S. has recently emerged as a topic of debate amongst the scientific community. The presence of large post-settlement alluvium “legacy” deposits, originating from colonial-era deforestation, agriculture, and ongoing hillslope land-use disturbances, characterize the floodplains and have been found throughout the mid-Atlantic and occasionally in New England. These legacy sediments are frequently deposited behind mill dams and overlay comparatively organic-rich, pre-colonial floodplain soils. The potential for legacy sediment to serve as a source for nutrient-rich sediment pollution and the rise of a $1 billion stream restoration industry necessitates an understanding of the nature and extent of these floodplain deposits. This study questions the ubiquity of both the interpreted pre-disturbance land surface and legacy sediment layers in modern floodplains across sites and regions. Field sampling of exposed riverbanks was carried out along tributaries to the Delaware and Connecticut Rivers to characterize the nature and spatial variation of floodplain sediments. Deposits were analyzed for thickness, organic material, grain size, and color, and were mapped in combination with known historical dams. Results indicated that floodplain deposits vary greatly within and between watersheds as well as within regions with different glacial settings. Buried soils were consistently richer in organic content than legacy sediments. Mill dams served as a source of legacy sediment preservation, but were not collectively coupled with sediment deposits. Differences in regional and glacial histories influenced the magnitude to which sediments were stored in the floodplains, but it was slope, sinuosity, and depositional environment that appeared to most significantly impact the preservation of sediments in the landscape.
The overall trends in the results suggest patchy distributions of pre-colonial floodplain conditions (e.g. grass dominated wetland, bottomland forest) as well as a patchy post-settlement depositional environment.

Biography

Anna Marshall is the Green Projects Associate at Connecticut Fund for the Environment and its bistate program Save the Sound. Her work focuses primarily on habitat restoration, fluvial geomorphology, dam removal, and green infrastructure aimed at protecting and improving the Long Island Sound watershed. Anna completed her Bachelor’s degree in 2016 from Connecticut College where her work focused on the long-term geomorphic and sediment impact of in stream structures. Anna spent the summer as a 2016 Conservation International Trott Fellow in Cambodia where she worked with communities whose sustainable fisheries and water management practices are threatened by the damming of the Mekong River. Anna has previously worked on projects related to invasive freshwater milfoil in Maine, saltwater intrusion in Tanzania, and floodplain reconstruction in Pennsylvania.

Advancing Coastal Resilience: An Institutional Analysis of Living Shorelines in New Hampshire

Trevor Mattera, UNH (tm2022@wildcats.unh.edu; 603-760-8671; G04 James Hall, UNH, 56 College Rd, Durham, NH 03824)

Authors: Trevor Mattera, UNH; Catherine Ashcraft, UNH

Despite their economic and ecological value, national attention to shorelines has been largely reactionary, neglecting proactive efforts to protect coastal areas and communities. Additional evidence suggests many of our current approaches to coastal protection, such as the use of grey infrastructure, harm coastal habitats and limit opportunities for climate adaptation. In contrast, living shorelines protect coastlines and prevent erosion, while also maintaining natural ecological processes. They are often the least environmentally damaging solutions available for coastal management and can significantly augment coastal wetland restoration. However, significant barriers impede broad implementation of living shorelines along New England’s coastline.

This research analyzes the current institutional framework for implementing living shorelines in New Hampshire (NH), identifying specific institutional barriers, as well as opportunities for addressing these barriers. Institutional analysis provides insight into structural and organizational explanations for specific outcomes in highly integrative social-ecological systems, such as coastal management. The results are based on
interviews with key stakeholders – state regulators, town and regional planning agencies, developers, etc. – case studies of two living shoreline projects in NH, and document analysis. Interviews and analysis will be conducted during summer and fall 2016. Lessons learned from NH will be of interest to other New England coastal communities and may also be useful nationally.

Preliminary findings indicate multiple institutional barriers to living shoreline implementation in NH, including insufficient technical knowledge and familiarity, a lack of ecosystem co-benefit valuation, a lack of systemic evaluation, a regulatory framework that focuses on wetland quantity over wetland quality, and a lack of prioritization of green infrastructure over grey infrastructure. Such institutional weaknesses can potentially prevent the broader use of living shorelines in the state. Regulatory opportunities to facilitate the implementation of living shorelines could potentially include a framework of adaptive management or systemic evaluation of proposed coastal management approaches.

Biography

Trevor Mattera is a graduate student in the Department of Natural Resources and the Environment at UNH and a member of the Environmental Policy, Planning, and Sustainability Lab. Trevor graduated from the University of Massachusetts – Amherst with a Bachelor’s degree in Psychology, and now studies public policy, focusing on sustainability, coastal resiliency, and living shorelines, under his advisor, Dr. Catherine Ashcraft.

This research is part of a larger project, “High Resolution Coastal Inundation Modeling and Advancement of Green Infrastructure and Living Shoreline Approaches in the Northeast,” which includes researchers from NERACOOS, state coastal programs, universities, and other partners, with funding from NOAA Regional Coastal Resilience Grants. Project goals include filling high-priority data and capacity gaps, developing tools for decision-making, and improving communication and outreach. The authors acknowledge significant contributions from NH Coastal Program and Great Bay National Estuarine Research Reserve, but take full responsibility for the analysis and any mistakes.

Species of Instream Logs and Geomorphic Function in New Hampshire

Lindsay McGinnis, Keene State College (lmcginnis@antioch.edu; 413-329-8110)

Authors: Lindsay McGinnis, Antioch University New England; Denise Burchsted, Keene State College
Large instream wood provides critical ecosystem services like fish habitat, organic matter retention, temperature regulation, and bank stabilization. In New England, the body of research includes distribution of instream logs and biogeochemical functions. However, there is a need for increased understanding of instream log movement and how logs affect channel shape and other physical functions which could inform river restoration efforts. This research examines the hypothesis that the tree species of instream wood is related to the persistence of the instream logs, and that tree species is therefore a control on the resulting geomorphic function of the instream wood. To do this, we assessed size, location, and species of logs in New Hampshire rivers, including locations in southwestern NH and the White Mountain National Forest (WMNF), including several sites in Hubbard Brook. Our assessment of geomorphic function included identification of the following conditions: creation of diversion channels, pool formation, and sediment storage, among others. Our sites span a range of geomorphic variables including: confined and unconfined channels; 1st to 4th order streams; low to high gradient; meandering, multithreaded, and straight channels; and land use such as historic logging, modern agriculture, and post-agricultural abandonment. At each study site, we located all large logs (>10cm diameter, > 1m length) and log jams (>3 accumulated logs that provide a geomorphic function) along 100m-700m reaches. We tagged each identified log and recorded species, diameter, length, orientation, GPS location, tag number, and photographs. Along each reach we measured riparian forest composition and structure and physical channel characteristics. Our analysis shows that tree species significantly affects the function of logs: yellow birch (Betula alleghaniensis Britton) is over-represented in the watercourses in the WMNF, including Hubbard Brook, and American sycamore (Platanus occidentalis L.) is over-represented in watercourses in the southwestern sites.

Biography

Lindsay McGinnis is a Doctoral Student at Antioch University New England. The goal of her research is to highlight the role of riparian ecosystem services in New England that can inform riparian forest management, river restoration and climate mitigation. Linda’s proposed research is to describe the role of instream wood as an ecosystem service proxy by identifying geomorphic function of instream logs, tracking instream log movement and persistence in New England streams.
Restoring Pine Barren Vegetation at the Albany Pine Bush Preserve

Ashley Rosa, Union College (rosaa@union.edu; 347-856-9237)

Authors: Ashley Rosa, Biological Sciences Major. Anna Doran, Environmental Science and Policy Major. Jeffrey Corbin, Associate Professor, Department of Biological Sciences, Union College

Invasive plant species often impede the growth of native plants in a community, as seen in the case of the nitrogen-fixing black locust tree (*Robinia pseudoacacia*), which has dramatically altered native pine barren habitat at the Albany Pine Bush Preserve in New York. Since 1999, the Preserve has been attempting to restore the native pine barren habitat by removing black locust trees and using prescribed fires to increase the growth of native plants and the population of the federally endangered Karner Blue Butterfly. We surveyed the vegetation in 45 different management areas throughout the Preserve in order to assess the success of the restoration efforts for the pine barren community as a whole. The management areas included native barrens that were never exposed to locust trees, areas that are currently invaded by locust, and sites that used to be invaded but have since been restored. We sampled the species composition and percent cover of all vascular plants at each site and conducted ordination analysis to compare the vegetation composition between each type of site. Successful restoration would be indicated by significant overlap (in ordination space) between native barren and restored sites; on the other hand, less successful restoration would be indicated by significant differences between native barren and restored sites. While we found that the restored sites were distinct from the still-invaded sites, we also found significant differences between the native barren and restored sites. This indicates that, while the restoration has achieved some restoration goals such as the removal of the locust trees and an increase in the population of the Karner Blue Butterfly, the ecosystem as a whole has not recovered from the locust trees’ invasion.

Building Coastal Resilience at the Neighborhood Scale

Noah Slovin, Environmental Scientist, Milone and MacBroom Inc. (nslovin@mminc.com; 508-797-8153, 157 Quaker Lane South, West Hartford CT, 06119)

There are many opinions about the most effective approach to build resilience to coastal hazards, and to mitigate coastal impacts of Climate Change (such as sea level rise and increased storm intensity and frequency). This poster explores a different question: what is the most effective scale for building coastal resilience? In the wake of recent disasters such as Tropical Storm Irene and Hurricane Sandy, coastal residents are
concerned about their property, cities must protect the residents that make up their tax base, and States are worried about public infrastructure and services.

Milone and MacBroom, Inc., has been working with coastal Connecticut municipalities to put together “Community Coastal Resilience Plans.” These plans address coastal hazards and mitigation options using a hierarchy of spatial scale. Existing institutional capabilities and the range of coastal vulnerabilities are explored at a municipal scale. The city or town is then divided into “neighborhoods” based on a combination of both existing neighborhood divisions and physical divisions between different types of coastal hazards. Mitigation alternatives are suggested at this neighborhood scale, balancing local variations in the appropriateness of different types of projects, and the necessity of implementing those projects over an area large enough for them to be effective. Finally, the impact of these neighborhood scale projects on each individual property is addressed in more detailed conceptual plans.

**Biography**

Noah Slovin is an Environmental Scientist at Milone and MacBroom, Inc., where he works on Hazard Mitigation, Coastal Resiliency, and Water Resource Planning efforts. Prior to joining the firm in 2015, he earned his masters degree at UMass Amherst working on fluvial geomorphology and community resiliency to riverine flood events (as part of the RiverSmart Project). His experience also includes science education and outreach, and community building.

**How much Greenhouse Gases (GHGs) does a Dam emit over its Life Cycle?**

**Cuihong Song**, Ph.D. student, University of New Hampshire (603-502-5315; cs1093@wildcats.unh.edu; 215 Forest Park, UNH)

Authors: Cuihong Song, Kevin Gardner, Simone P Souza: Department of Civil and Environmental Engineering, University of New Hampshire

Hydropower is traditionally considered as one type of “clean” energy, and has been heavily developed in many regions of the world. Nevertheless, this assumption is increasingly being challenged by recent findings that a large amount of methane and other GHGs are emitted during reservoir creation, turbine operation, and dam decommission. Via a critical review of existing life cycle assessments of dams, we compared the GHG emissions of various types of dams based on their structural type, size, primary function, and geographical locations during their construction, operation, and decommission phases. Means to improve dam performance and reduce related ecological and social impacts were identified. It was found that GHG emissions are
mainly generated at the construction and maintenance stages for small-scale run-of-
river dams, whereas for large-scale reservoir-based dams, decomposition of flooded
biomass and organic matters in the sediment has the highest GHG emission
contribution. Dams with attached reservoirs generally have much higher GHG
emissions than in-stream or run-of-river dams. GHG emissions of reservoir-based dams
alone also vary significantly depending on their locations: dams located in boreal and
temperate regions have much lower emissions from reservoir creation compared with
dams located in tropical regions. It was also found that although most hydroelectric
dams have comparable GHG emissions to produce one unit of electricity as other types
of renewable energy (e.g., solar, wind energy), electricity produced from tropical
reservoir-based dams could potentially have a higher emission rate than fossil-based
electricity.

Growth and Vitality of *Typha* in a Restoring Salt Marsh Over Time

Meg Thurrell, Master's Student in Biology, University of Southern Maine
(meg.thurrell@maine.edu)

Authors: Meg Thurrell, Biology Department USM, Karen Wilson, Environmental Science
Department USM

*Typha* sp. are capable of behaving like an invasive species, outcompeting other native
species, and thus reducing biodiversity within wetlands. My research focused on the
growth and distribution of *Typha* relative to pore water salinity from 2005 to 2015 in
Sherman Marsh, a 200 acre restoring salt marsh in Wiscassett, Maine. My expectation
was that increased salinity associated with hydrologic restoration would result in
decreased growth and vitality of *Typha*, and an increase in native salt marsh species.
Permanent vegetation transects were sampled on Sherman Marsh (8 transects) and on
an adjacent reference marsh (2 transects). Percent cover was determined using a
modified point-intercept method. Salinity was measured at 2-3 pore water salinity wells
along each transect. Maximum leaf height was measured for *Typha* in each plot. *Typha*
sp. spread and established in Sherman Marsh in 2006, as marsh soils were exposed.
Within Sherman Marsh, *Typha* mean height and percent cover fluctuated from year to
year and was inversely correlated to June mean salinity ($r^2 = 0.82$ and 0.88
respectively). Mean June salinity fluctuated yearly; in 2007 salinity was 11ppt ($\pm$2ppt)
and in 2010 was 16ppt ($\pm$1 ppt). *Typha* mean height peaked at 143cm ($\pm$32cm) in 2007
and reached a low of 80cm ($\pm$33cm) in 2010. *Typha* sp. mean percent cover was 26% in
2007 and 14% in 2010. Other native saltmarsh species within Sherman Marsh
consistently increased in percent cover over the ten year study and were not subject to
June salinity changes. In 2015, mean June salinity was 16ppt ($\pm$3ppt) in the reference
marsh and 12ppt (±1ppt) in Sherman Marsh. Yearly mean salinity levels on Sherman Marsh remained below those seen on the reference marsh, where *Typha* have not established (15±1ppt compared to 21±5 respectively). Salinity is too low to prevent *Typha* sp. from persisting within Sherman Marsh.

Autoecology of the Northern Water Snakes: Microhabitat Use and Habitat Associations in Southeastern Massachusetts

Jacqueline Toomey, Undergraduate Research Student, Bridgewater State University (jtoomey@student.bridgew.edu; 508-245-6841; 7 Pratt Drive, Norton MA 02766)

Authors: Jacqueline Toomey, Emily Donahue, Sarah Jones, Thilina Surasinghe, Bridgewater State University

Wetland wildlife have received much scientific attention, given their imperative roles in ecosystem functioning. However, wetland snakes have only received little attention. In this study, we investigated natural history of a semiaquatic serpent- the Northern Water Snake (NWS). We conducted visual encounter surveys at eight wetland habitats in SE Massachusetts (May 2016 onwards). Each NWS found was sexed, and cloacal temperature was measured. Several environmental variables were also measured at the site of capture. By the end of July 2016, we documented 23 snakes, and captured 14 (nine Females, four Males, one Juvenile). The abundance of snakes at forested vs suburban landscapes were similar (eleven in forested areas, twelve in suburban habitats). Throughout the survey, the activities of NWS peaked in June, and declined gradually afterward. NWS associated numerous microhabitats (chunk rock, rip rap, gravel, leaf litter, littoral vegetation); they mostly associated chunk rock and gravel. The highest cloacal temperature was recorded among snakes collected from open water, while those found on the riparian zone had the lowest cloacal temperature. The snakes were located on average 0.45m away from water. Basking was the most prominent behavior (26.09% of all snakes observed) which underscored the importance of behavioral thermoregulation for aquatic poikilotherms. Basking snakes preferred light colored rock substrates. We intend to continue this study until mid-Fall (Oct-Nov) to make inferences on seasonal variation of natural history of NWS. Our study will provide useful insights on understanding differential ecological niche dimensions (microhabitat associations, optimal basking substrates, use of riparian cover objects, relationships to structural complexity of the wetland environment, and landscape features) of NSW- a widespread active predator of wetland environments. Such information is critical in management, restoration, and conservation of wetlands.

Biography
Jacqueline Toomey is a senior attending Bridgewater State University as a Biology major with both Chemistry and GIS minors. Next fall, she plans on attending graduate school in order to further her knowledge regarding the ecological sciences. Eventually, she hopes to earn a Ph.D. in Wildlife and Fisheries Biology, or Restoration Ecology. In her spare time, she enjoys hiking, travelling, and studying native reptiles and amphibians.

**Brackish Vegetation Response to Salt Marsh Tidal Restoration in Harpswell Maine.**

**Shri Verrill,** Botanist/Field Ecologist, University of Southern Maine (USM), Casco Bay Estuary Partnership  ([shri.verrill@gmail.com](mailto:shri.verrill@gmail.com); 207-515-0733)

Authors: Shri Verrill, University of Southern Maine; Curtis Bohlen, Casco Bay Estuary Partnership

Salt marsh vegetation plays an important role in building vertical elevation on the marsh surface. As sea-level-rise (SLR) occurs, the marsh accretion process, which accumulates organic and inorganic matter on the marsh surface, must result in elevation gain at a rate greater than or equal to the rate of SLR (Morris et al., 2002). If salt marshes do not maintain elevation above sea level, salt marshes and all their associated benefits to humans, fish, and wildlife, and their contribution to the health of estuarine and marine ecosystems will drown. Salt tolerant plant species are adapted to frequent and prolonged periods of inundation with seawater and typically maintain elevation where they persist along the seaward edge of salt marshes. Brackish and freshwater species often occur along the marsh’s landward margins. It is not well understood how these brackish and freshwater species respond to SLR. Monitoring vegetation before and after tidal restoration can provide insight into how vegetation responds to hydrologic change and thus may help predict the response of tidal marsh vegetation to SLR. To better understand the biological mechanisms responsible for changes in vegetation, this study looks at the effects of increased inundation and pore water salinity on the brackish species *Typha angustifolia* and freshwater species, *Typha latifolia* one year following tidal restoration.

Long Marsh is a Northern New England salt marsh, which underwent culvert enlargement in 2014. It was monitored one year before (2013) and one year after (2014) tidal restoration to document environmental changes associated with increased tidal flux. Twelve vegetation transects from the tidal creek to the upland were established on the marsh, each with 10 to 14 evenly distributed sampling plots. One transect downstream of Long Reach Lane was used as a reference. The remaining 11 transects were located upstream of Long Reach Lane.
I conducted a descriptive study that looked at the roles salt and flood tolerance play in structuring vegetation response to tidal restoration. Results indicate that a change in pore water salinity is the primary driver of vegetation change at this site and that the significant mortality of *T. angustifolia* occurred because of increased pore water salinity, not inundation. This implies that salt exposure must be considered to effectively evaluate how vegetation may respond to SLR in the narrow coastal wetlands of Casco Bay.

*Biography*

Shri Verrill is a Botanist and Field Ecologist who most recently worked with the Maine Natural Areas Program conducting vernal pool, rare plant and community surveys and assessments. During her Graduate studies in the Department of Biological Sciences at USM she interned as a Salt Marsh Technician with Casco Bay Estuary Partnership and carried out salt marsh monitoring in several tidal restoration projects, which provides useful context for the descriptive thesis research presented in this poster. Her undergraduate research includes vascular wetland plant surveying and natural community assessment and mapping. Shri served on the Society for Ecological Restoration, New England Chapter board for three years in varying roles consisting of Student director, Maine state director, and Communications Director. She believes that in our practice of restoring ecosystems, a reverent connection with one another as well as a spiritual relationship with nature is crucial.

*Channel Response to Wood Removal*

**Thomas Wolters**, Undergraduate research student, Keene State College (thomas.wolters@ksc.keene.edu)

Authors: Thomas Wolters, Keene State College, Denise Burchsted, Keene State College, Dana Warren, Oregon State University

River networks are structurally and biologically influenced by geomorphic processes activated by the presence of wood within them. Unfortunately, they are often stripped of this resource as it presents a risk to infrastructure, and provides functions that often remain unobserved or misunderstood. As it turns out, instream wood is a critically important component of this system’s ability to change or hold shape, store or mobilize water and sediment, as well as provide healthy habitat for fish and other organisms. In 2006, Dana Warren removed wood from 100m of a stream within Hubbard Brook Experimental Forest. A decade later, we have characterized channel response above, within, and below the same treatment site, in order to assess how wood removal affected the river.
Impacts of Small, Surface-release Dams on Stream Temperature

Peter A. Zaidel, Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts Amherst (pzaidel@umass.edu; 860-878-1291)

Authors: Peter Zaidel¹, Allison H. Roy¹,², Keith H. Nislow³, Christopher R. Smith⁴, Benjamin H. Letcher⁵ (¹ Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts Amherst; ² U.S. Geological Survey; ³ Northern Research Station, U.S.D.A. Forest Service, University of Massachusetts Amherst; ⁴ U.S. Environmental Protection Agency, Region 1; ⁵ U.S. Geological Survey, S.O. Conte Anadromous Fish Research Center, Leetown Science Center)

Dams have provided fresh water to human societies for centuries, but this service has negative consequences for stream ecosystems. For example, dams can increase temperatures, which can affect biota that rely on temperature as a cue (e.g., for migration, spawning, and egg hatching) or have narrow thermal tolerance ranges. While dams have been shown to increase downstream temperatures over many kilometers, some studies observed no effect. We sought to understand how landscape factors (e.g., basin slope, impervious cover, road density, dam height, impoundment area, and total watershed impounded area) may influence differences in responses among streams. For the 15 dam sites (of 31 total) where we had upstream reference temperatures, 87% had higher downstream temperatures (0.07–5.76°C increase) relative to upstream temperature. Twenty-two sites showed linear declines in temperature for 200–1765 m downstream of the dam, with the rate of decline varying among sites. Identifying the factors influencing temperature below dams may help guide dam management or prioritize dam removal as a means of increasing ecosystem resiliency, particularly in the face of a changing climate.

Biography

Peter Zaidel is a second year Master's student at the University of Massachusetts Department of Environmental Conservation and the Massachusetts Cooperative Fish and Wildlife Research Unit. Following his graduation from the College of the Holy Cross in 2012, he worked for Olympic National Park and the Connecticut Department of Energy and Environmental Protection before arriving in Amherst to pursue his graduate studies. His current research investigates the impacts of dams and dam removal on stream temperature and dissolved oxygen concentrations in Massachusetts under the direction of Dr. Allison Roy.
FIELD TRIPS & WORKSHOPS

**Workshop: Principles of Ecological Restoration and Their Application**

Workshop leader: Andre Clewell, PhD

This workshop, provided by one of our plenary speakers, reviews the principles of ecological restoration and thoroughly illustrates them with case histories. The workshop emphasizes the importance of reestablishing historic ecological trajectories and biodiversity as we restore, not just recover the nostalgic past or improve natural services. This viewpoint recognizes that ecosystems adapt and evolve in response to environmental modification, such as climate change and sea level rise.

**FIELD TRIPS**

**Urban Watershed Restoration and Low Impact Development: Berry Brook Restoration Project**

Trip leader: Dr. Tom Ballestero, UNH Stormwater Center

The UNH Stormwater Center initiated a watershed-wide project using innovative BMPs and retrofit opportunities to reduce stormwater runoff from impervious surfaces. In addition, the brook was daylighted and restored with a geomorphic design. Verification of success is measured through water quality and runoff volume monitoring and pollutant load reduction modeling.

**Fringing Salt Marsh Creation and Shoreline Restoration in the 21st Century**

Trip leaders: David M. Burdick, PhD, and Trevor Mattera, UNH College of Life Sciences & Agriculture

Anyone who owns or manages shorefront property knows that sea level is rising and the rate in which it is rising is becoming more rapid, leading to concerns over erosion as well as solutions, many of which destroy critical habitat. This field trip will examine a variety of coastal restoration projects in the Durham and Portsmouth region. This trip will focus on living shorelines, salt marsh restoration, invasive species control, how tidal marshes respond to climate change, and how to monitor the success of restorations.

At the halfway point, we will return to Durham but along the way we will stop at Wagon Hill Farm and walk to the mouth of the Oyster River where a living shoreline has been
proposed to halt erosion. Weather permitting, here we can hold a ‘shoot from the hip’ design charrette (newsprint and markers) ending with presentation of several newly completed competing designs for the site. We will discuss site challenges and stakeholder process for choosing the final design.

Restoring Instream Habitat and Improving Floodplain Resiliency Using Large Wood

Trip leaders: Joel DeStasio and Colin Lawson, Trout Unlimited

Beginning in 2014, Trout Unlimited has been working with the USDA Natural Resource Conservation Commission (NRCS) to monitor and restore instream fish habitat at 23 NRCS Wetlands Reserve Program (WRP) conservation easements in southern New Hampshire. The goal of these restorations is to reintroduce large wood into sections of stream where the natural recruitment of large instream wood becomes limited. Additionally, large wood re-engages floodplain processes whereby improving flood resiliency. Our restoration projects aim to improve instream habitat & structure for fish and also influence spawning potential by improving sediment transport, pool/riffle runs, and stream cover.