HRES HUDSON RIVER ENVIRONMENTAL SOCIETY

Conference Program

2013 Hudson River Science Symposium:

“The State of Hudson River Science”

State University of New York at New Paltz

Student Union Building

April 24, 2013

Conference Sponsors & Collaborators:

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2013 Hudson River Science Symposium:
"The State of Hudson River Science"

State University of New York at New Paltz
Student Union Building
Wednesday April 24, 2013
8:00AM - 5:30PM
Talks start at 9:00 – Poster Session at 3:45

The State of the Hudson River Science will present our latest scientific understanding of the Hudson River and environs, discuss the drivers behind the science, identify future challenges, and provide an opportunity for scientists, resource managers, educators and students to share ideas. The Hudson River Environmental Society working in partnership with the Hudson River Foundation invites you to hear from regional scientists and view scientific posters. Invited speakers will give presentations on the following themes:

The State of Hudson River Science –*Dr. Jeffrey Levinton*
Long-term Ecological Changes – *Dr. David Strayer*
Climate change, Sea-level Rise, and Episodic Events – *Dr. William Solecki*
Ecosystem Restoration Science– *Dr. Stuart Findlay*
Hudson River Fish – *Dr. Karin Limburg*
Sediment Transport and Deposition – *Dr. David Ralston*
Contaminants: Old and New – *Dr. Isaac Wirgin & Dr. Emma Rosi-Marshall*
Historical Ecology and Archaeology – *Dr. April Beisaw*
Meeting the Challenges – *Dr. Dennis Suszkowski*

A contributed poster session and reception will follow the oral presentations. This will provide for a great opportunity to make and renew connections and share ideas.

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2013 Hudson River Science Symposium:
"The State of Hudson River Science"
State University of New York at New Paltz,
Student Union Building
Wednesday April 24, 2013

Agenda

8:00-9:00 - Registration and Light Breakfast

8:45 – Announcements and general instruction

9:00 – Welcome

9:15 – 9:45 – "Hudson River Science: Scanning the Rearview Mirror While Looking Forward"
Dr. Jeffrey Levinton, SUNY- Stony Brook

9:45 - 10:15 – "Decadal-scale Change in the Hudson Ecosystem"
Dr. David Strayer, Cary Institute of Ecosystem Studies

10:15-10:45 – "System Transitions and the Urban Environment: Lessons from the New York Metropolitan Region and Hurricane Sandy"
Dr. William Solecki, CUNY Institute for Urban Systems

10:45 – 11:15: Coffee Break

11:15 – 11:45 – "Is the State of Hudson River Science Sufficient to Support Restoration Planning?"
Dr. Stuart Findlay, Cary Institute of Ecosystem Studies

11:45 – 12:15 – "Status of Hudson River Fishes: Local and Regional Perspectives"
Dr. Karin Limburg, SUNY-College of Environmental Science and Forestry

12:15-1:15: Lunch – Remarks on the State of Hudson River Science
Mr. James Tierney, Assistant Commissioner for Water Resources, New York State Department of Environmental Conservation

1:15 – 1:45 – "Sediment transport and deposition: salinity fronts and storm events"
Dr. David Ralston, Woods Hole Oceanographic Institute

1:45 - 2:15 – "Ecological Effects of Hudson River PCBs"
Dr. Isaac Wirgin, New York University School of Medicine

2:15 – 2:45 – "Occurrence and ecological effects of pharmaceutical and personal care products in the Hudson River Basin and beyond"
Dr. Emma Rosi-Marshall, Cary Institute of Ecosystem Studies

2:45 - 3:15 – "Historical Ecology of the Hudson Valley: How Environmental Decisions of the Past Affect those of the Future"
Dr. April Beisaw, Vassar College

3:15 - 3:45 – "Providing Science in Support of Continuing Stewardship of the Hudson River: Are we up to the Challenge?"
Dr. Dennis Suszkowski, Hudson River Foundation

3:45 – 5:30 – Poster Session and Reception

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Abstracts for Symposium Presentations

(Presented in the same order as on the symposium agenda)

Hudson River Science: Scanning the Rearview Mirror While Looking Forward

Jeffrey Levinton
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In the past 25 years, tremendous progress has been made in understanding the basis of a broad range of phenomena and fields that now constitute Hudson River science. In some ways the Hudson is complex, originating (at least by definition) as a mountain stream, becoming a freshwater river obstructed by one major dam, and terminating in a peculiar two-directionally hybrid of river and estuary. We have learned the impact of a dynamic system of varying river discharge and geomorphology on a series of biological, sedimentological, and chemical phenomena that are themselves dynamic. Layered on top of these responses are impacts from almost unimaginably large concentrations of toxic substances, very high nutrient inputs from human influences and natural river processes, alterations of physical habitats and invasive species. But thanks to strong efforts in learning mechanisms and producing habitat descriptions we have managed to gain a general understanding of this complex system. This is an impressive triumph given that is was achieved in mainly responses to a hodge podge of individual and often titanic environmental problems, such as industrial waste pollution, sewage, highly altered fisheries, diversions of water flow, and alterations of the watershed landscape.

Are we done? Not at all. We still face a number of scientific challenges. Certain major habitats, such as tributaries, riparian zones and the general Hudson River watershed still need to be understood in integration with a series of chemical and water movement processes. Some work has been done to establish priorities for habitat restoration but implementation and the scientific understanding of the effects of implementation remain to be elucidated. Unfortunately, we are not yet done with understanding the details of effects of toxicants such as individual congeners of PCBs, the distribution and uptake of toxic metals such as mercury, and even the introduction of novel potential toxicants such as pharmaceuticals. It is also time to have a better integration of modern technologies for monitoring physico-chemical variables, water flow, and mobile organisms in the river. Finally, we have not an elephant but a dinosaur in the room, namely climate change. We don’t know enough about regional long-term expectations, but temperature has increased and rainfall has increased to the degree that increased river discharge may have strong impacts on everything from lower trophic level ecosystem structure to the dispersal and survival of larvae of oysters and fishes.

Decadal-scale change in the Hudson ecosystem

David L. Strayer
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Jonathan J. Cole, Stuart Findlay,Michael L. Pace, Emma Rosi-Marshall
Cary Institute of Ecosystem Studies

Like many modern rivers, the Hudson is subject to long-term change from both natural and anthropogenic causes. We will show examples of such decadal-scale change in the Hudson as a result of species invasions, climate change and extreme weather, changes in harvest, and biological evolution, as well as some long-term changes of unknown cause. These changes affect many parts of the Hudson River ecosystem, from water chemistry to fish populations, and many are large. Both the drivers of change and the changes themselves are highly varied, including pulse, press, and ramp drivers, which led to responses that included long-term trends, step-changes, and abrupt spikes and dips. These long-term changes pose serious challenges to understanding and managing large-river ecosystems.

System Transitions and the Urban Environment: Lessons from the New York Metropolitan Region and Hurricane Sandy

Dr. William Solecki
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Hurricane Sandy, which heavily impacted the New York City Metropolitan Region, is now defined as one of the most damaging disaster events in U.S. history. Sandy revealed stresses and potential crisis points within a variety of urban environmental systems, such as electrical grid failures, transportation disruptions, and loss of water supply. Local and national response to Sandy is particularly important because post-Sandy recovery and redevelopment is now interfused with questions of climate change and how to best create disaster risk reduction strategies with an increasingly dynamic climate. To help our understanding of these events and activities, it is important to reflect on the past urban environmental system crises and transitions. The lens of critical transition theory and writings on urban system resilience can be used to sharpen our analytical capacity to study such issues.

Is the State of Hudson River Science Sufficient to Support Restoration Planning?

Stuart Findlay
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A variety of restoration activities are feasible for improving conditions in the Hudson River estuary but selection and implementation pre-supposes a scientific basis for what should be done to accomplish a specific goal. Fortunately the Hudson is one of the best-studied and well-understood river/estuarine ecosystems so there is a solid knowledge base to select among alternative actions and assess effectiveness. This talk will review several of the commonly proposed restoration activities and consider the adequacy of data and understanding of the system to make good decisions. For example, restoration of tidal wetlands pre-supposes there is information on reference condition and ecosystem functioning to set realistic targets for restoration. Other proposed activities have less of a contemporary reference, for instance effort to restore fish habitat would be done at a time of historic low abundance for many species and so it is more difficult to assess the magnitude of change that might be achieved. Science is a necessary but certainly not the only component of solid restoration planning and public/political support, funding will weigh equally into these impending decisions.

Status of Hudson River Fishes: Local and Regional Perspectives

Karin Limburg
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Kathy Hattala, Amanda Higgs, Andy Kahnle,
Hudson River Fisheries Unit, NYSDEC

Robert Schmidt
Simon's Rock of Bard College

John Waldman
Biology Dept., CUNY Queens College

The Hudson River once supported vibrant fisheries of iconic species such as shad, sturgeon, striped bass, river herring, and eels, among others. Today most of these fisheries are closed and all but striped bass are at worrisome, historic or near-historic lows. At the same time, non-native predatory fishes as well as other non-native species are on the increase in the estuary and watershed. We review these trends and provide a broader, regional perspective on the status of diadromous species.

Sediment transport and deposition: salinity fronts and storm events

David Ralston
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The classic conceptual model for estuarine sediment transport holds that a convergence in near-bottom circulation at the landward limit of the salinity intrusion leads to high concentrations of suspended sediment and high rates of deposition – an estuarine turbidity maximum, or ETM. Recent results from a combination of field observations and numerical modeling indicate that the sediment transport processes in the Hudson are more complex, and that sediment trapping and temporary deposition occur simultaneously at multiple locations along the estuary and in the tidal river. In the estuary, bottom salinity fronts form tidally at locations of bathymetric transition. Intense gradients in density and stratification at the fronts locally trap suspended sediment and lead to enhanced deposition, particularly at lateral fronts between the main channel and adjacent shoals. The frontal trapping produces local maxima in suspended sediment concentrations that vary with the position of the salinity intrusion, including ETMs at intermediate salinities near the George Washington Bridge and at lower salinities in Haverstraw Bay. Due to the efficient trapping, little of the sediment delivered to the estuary escapes south of the Battery, even during high discharge events. Tropical Storms Irene and Lee in the summer of 2011 produced record precipitation in the Hudson watershed and extremely high discharge and sediment loads. Model results and limited observations indicate that of the approximately 3 million tons of new sediment introduced by the storms, roughly 1/3 was trapped in the estuary. The surprising corollary was that the other ~2/3 of the new sediment remained trapped in the tidal river, upstream of the salinity intrusion. The processes leading to the high rates of sediment trapping in the tidal freshwater region are not well understood and are the subject of on-going research. The results suggest that residence times for sediment in the Hudson are much longer than previously thought, with important consequences for issues like contaminant transport and carbon fluxes.

Ecological Effects of Hudson River PCBs

Isaac Wirgin
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Nearly 200 miles of the Hudson River have been contaminated with PCBs for over six decades. Many surveys have demonstrated that burdens of total PCBs in the edible portions of Hudson River resource species were at one time exceedingly high but have decreased greatly in recent decades. There are far fewer data on the ecotoxicological effects of PCBs on the Hudson River biota. In this presentation, I will present the results of recent studies in four taxa; American mink, Atlantic tomcod, Atlantic sturgeon, and shortnose sturgeon that demonstrate likely toxic effects of Hudson River contaminants. For mink and both sturgeons, toxic effects were observed in controlled laboratory studies. The offspring of ranched mink fed a diet of graded doses of PCB-contaminated Hudson River carp exhibited a variety of dose responsive toxicities in their early life stages including reduced survivorship of kits, reduced growth of kits and an elevated incidence of jaw deformities. Larvae of both sturgeons when treated in the laboratory as embryos with a single PCB or dioxin congener exhibited a variety of morphological alterations that are probably incompatible with successful existence in natural populations. These sturgeons proved to be among the more sensitive of fishes to PCBs toxicities reported to date. Finally, the Hudson River Atlantic tomcod population has developed a dramatic resistance to PCBs induced early life stage toxicities. It is likely that this rapid evolutionary change was due to intense natural selection for the resistant phenotype. In total, these studies demonstrated that PCBs, often at concentrations found in Hudson River biota, can elicit toxic responses and most likely during early life stages.

Occurrence and ecological effects of pharmaceutical and personal care products in the Hudson River Basin and beyond

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Pharmaceutical and personal care products (PPCPs) are ubiquitous in surface waters throughout the world, but their effects on ecological function and structure is not well understood. I will review the concentrations of PPCPs measured throughout the Hudson River basin and discuss potential hotspots of PPCPs in aquatic ecosystems. In addition, I will discuss recent findings that demonstrate the effects of common pharmaceuticals (caffeine, cimetidine, ciprofloxacin, diphenhydramine, metformin, and ranitidine) on ecosystem functions ranging from primary production, community respiration and bacterial community dynamics. These data demonstrate that PPCPs, alone or in combination, could have consequences for important ecological functions. Finally, I will explore the potential consequences for the occurrence of PPCPs in the Hudson River and will highlight future research needs.

Historical Ecology of the Hudson Valley: How Environmental Decisions of the Past Affect those of the Future

April Beisaw
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Numerous environmental histories of the Hudson Valley have been compiled. While each has its own focus, together they help us envision the natural and cultural changes that have taken place over the past few hundred years. A next step is to integrate these data under a uniform paradigm such as historical ecology. Historical ecology takes a longer view than environmental history and sees the world as composed of landscapes, not ecosystems. Landscapes are forever altered by the human actions associated with them, they cannot return to a pre-altered state for no such thing exists. Landscapes are also much smaller than the regions of environmental history. Humans interact with local geology, hydrology, and biology to create distinctive landscapes,through the selective harvesting or alteration of native resources and the addition of non-local resources. Anthropological approaches, especially archaeology, provide a means for studying past environmental decisions at the local level and throughout time. Elsewhere, such historical ecology research has shown how seemingly minor differences in landscape use produce significant environmental impacts over time. With a more holistic understanding of Hudson Valley landscapes we can consider the lessons and legacies of the past when making environmental decisions for the future.

Providing Science in Support of Continuing Stewardship of the Hudson River: Are we up to the Challenge?

Dennis Suszkowski
Hudson River Foundation
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The Hudson River has been called one of the best studied rivers of the world. Since the application of scientific understandings about natural systems is generally thought to be a necessary ingredient in the successful stewardship of them, the Hudson has benefited from an abundance of science produced about it. This presentation will review the quality and quantity of scientific information generated about the Hudson, the producers of it, the sources of support and its application toward management. The economic downturn over the past decade along with the growing complexities of managing the River's resources in light of climate change, extreme events, and greater public interest throughout the watershed, present serious challenges to the acquisition of science to support and inform decisions in the future. This presentation will further elucidate these issues and offer some opinions about whether we are up to the challenge of continuing to provide science in support of future stewardship of the river.

Abstracts for Symposium Poster Session

(Listed in alphabetical order by presenter's last name)

Current assessment of fish passage opportunities in the tributaries of the Lower Hudson River

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Lisa Rosman - NOAA NOS, Assessment and Restoration Division

The Hudson River estuary supports numerous diadromous and potamodromous fish. Tributaries to the Hudson River provide critical spawning and nursery habitat for these migratory fish. Previous studies made recommendations for fish passage but were limited to determining the upstream fish movement at the first and second barriers on each of 65 tributaries to the tidal Hudson River (e.g., dams, culverts, and natural falls/rapids) or to multiple barriers for a small subset of tributaries. Our effort expands the spatial coverage beyond the first two barriers on 65 tributaries and assesses the current state of passage using a variety of available tools. Our findings demonstrate the importance of re-evaluating field conditions and study objectives to meet present day and future restoration goals.

Impacts of invasive-plant management on nitrogen-removal services in freshwater tidal marshes

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Stephen B. Baines - Stony Brook University
Stuart Findlay - Cary Institute of Ecosystem Studies

Management of invasive plant species such as *Phragmites australis* in order to conserve native plant diversity is a major management goal in the Hudson River Estuary. Substantial changes in plant community composition resulting from species invasions and the removal of invasive species may drastically alter sediment characteristics and processes, including permanent removal of nitrogen from these systems via microbial denitrification. The Nature Conservancy conducted small-scale removals of *Phragmites* from Ramshorn (also Catskill) Marsh in September 2010 using glyphosate herbicide. Here we present results from a four-year monitoring project, including two years of pre-treatment monitoring, of sediment characteristics and potential denitrification rates for three herbicide-treated *Phragmites* patches, three untreated *Phragmites* sites, and adjacent sites dominated by native *Typha angustifolia*. Sediment ammonium increased following the removal of vegetation from treated sites, likely as a result of decreases in plant uptake and nitrification. Denitrification potentials were lower in removal sites, relative to untreated *Phragmites* sites, a trend that persisted two years following removal as native plant species began to re-colonize treated sites. With the exception of measurements conducted following Hurricane Irene in September 2011, denitrification measurements were consistently highest in *Phragmites*-dominated sites. This result suggests the potential for a trade-off between invasive-plant management and nitrogen-removal services. However, our results also reveal considerable interannual and interseasonal variation in denitrification, highlighting a need for more frequent intra- and interannual monitoring efforts in order to fully understand the dynamics of plant-sediment interactions, and their impacts on nitrogen cycling, in tidal marshes of the Hudson River.

Community Flood Resilience in the Hudson River Estuary: Assessing the Decision-Making and Educational Needs of Municipal Officials

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Gretchen Gary - Cornell University

Climate change is expected to cause increases in extreme weather events, changes in precipitation patterns and sea level rise, which likely will increase local flooding in some areas. Land-use planning can be a mechanism with which to increase resilience to flooding. With a deeper understanding of extreme weather, flooding, land-use planning and stream management, municipal officials can increase the resilience of their communities to flooding. The purpose of this study is to aid in the understanding of the decision-making processes and educational needs of municipal officials in regards to local flooding. The results will allow educational programs on climate change, flood resilience, and stream management in the Hudson River watershed to be tailored to the specific needs of municipalities. The programs are expected to encourage changes in behaviors of municipal officials that benefit the people and the environmental conditions of the watershed. A literature review was conducted on local government decision-making as related to extreme weather events and climate change, flood resilience, and floodplain management. Semi-structured interviews were conducted with municipal officials in the Hudson River estuary and coded and analyzed using Atlas, TI software. Preliminary data from the interviews will be presented along with a theory-based framework describing factors related to municipal decision making.

The New York Master Watershed Steward Program: Empowering Volunteers in Watershed Stewardship

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Maureen Mullen - Cornell University
Carolyn Klocker - Cornell Coop. Extension, Dutchess County
Liz LoGiudice and Terri Mayhew - Cornell Coop. Extension, Columbia & Greene Counties
Gretchen Rae and Brent Gotsch - Cornell Coop. Extension, Ulster County

Human-induced threats to New York State's water bodies include pollution from urban and agricultural runoff, municipal wastewater, stream bank erosion, inadequate on-site septic treatment, increasing development, and much more. Community-based watershed planning and management is an approach designed to address these issues by combining public and private efforts. However, local watershed organizations face many challenges, including recruitment and retention of trained volunteers and staff, sustaining funding, continued skill development, community outreach and organizing, understanding the complexities of watershed science, and dealing with community and social dynamics. A seven-member team of Cornell University Cooperative Extension faculty and staff piloted an educational program (Master Watershed Steward) designed to help address these issues in the Hudson Valley. The mission of the Master Watershed Steward Program is to strengthen local capacity for successful management and protection of watersheds by empowering volunteers. The training combines in-person and distance learning educational strategies, and also includes completion of an independent, hands-on project. The curriculum is comprised of a number of lesson modules, some elective, some mandatory. The elective modules allow for the tailoring of the program to the needs of the individual. The in-depth learning projects also allow the stewards to pursue what interest them, whether it is focused on watershed assessment and management, community engagement, or municipal decision-making. Pre- and-post test evaluation survey results from the pilot year of the program will be presented. These results include measures of the program impact on Steward awareness and capacity for watershed stewardship.

Testing a Novel Low Cost Eel Ladder and Determining Optimal Locations for Future Eel Ladders

Max Bernstein
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The *Anguilla rostrata* (American eel) population has declined by approximately 84% in the last few decades, raising concerns for the health of the species. One reason for this

decline is anthropogenic barriers (man-made dams), which prevent upstream migration. This research deployed a novel low cost eel ladder that is designed restore this obstructed habitat for the eels. Eel ladders can cost up to $10,000; however this ladder only costs approximately $400. It was placed at the base of an over 15ft high dam in Furnace Brook, a tributary of the Hudson River, and checked twice per week to determine the number of eels that used it. The eel ladder was effective, with 1470 eels using it over the 2011 season and 308 eels using it over the 2012 season. In order to make the most effective use of any future ladders of this design that may be deployed, a watershed analysis was conducted using GIS software on 30 dams on six different tributaries of the Hudson River. The watershed analysis determined the stream length, and thus habitat, that each dam blocks. The six dams out of those 30 that blocked the most stream length are recommended for future eel ladder installations in order to make the most effective use of conservation resources. This study demonstrated that a low-cost eel ladder design can be used effectively, and determined which dams should be given highest priority for future eel ladders to be placed at to allow for maximum effectiveness.

The Eel Monitoring Project: Studying the Glass Eel population in the Quassaick Creek

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Lynn Maelia, Briana Barbato, Anastasia Cintula, Jordyn Catapano, Kasey Edwards, Roy Forster, Anastasia Frank, Melanie Hofbauer, Dharamhet Khangura, Monica Shea, Ilci Velarde - Mount Saint Mary College

The American eel is a migratory fish that undergoes several physical and habitat changes during its lifetime. Starting as eggs in the Sargasso Sea, the eel larvae drift with the Gulf Stream and other currents, taking about a year to reach the Atlantic coast. Known as "glass eels" at this stage because of their translucent, pigment free bodies, the young eels migrate into the North American tributaries such as the Hudson River where they stay and mature into full grown eels before returning to the oceans to spawn. Relatively little is known about the migratory habits, habitat preference and biology of the eels.

Freshman honors students from Mount Saint Mary College, in conjunction with the New York State Department of Environmental Conservation (NYSDEC) Hudson River Estuary Program and National Estuarine Research Reserve participated in a six week citizen science juvenile eel monitoring program to observe the number of juvenile eels at the Quassaick Creek in March/April 2012/2013. Results from our 2012 study suggest that the Quassaick is a choice habitat for the eels. 22, 875 glass eels were caught at this site during the 2012 study period. The catch was significantly higher than that reported from other sites along the Hudson. The reason for this habitat preference remains to be understood and is the subject of our current study in which we studied additional parameters such as water pH, conductivity, and flow rate in addition to counting the eels.

The Changing Hudson Project: Bringing Local Ecology to High School Classrooms

Kali Bird
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Cornelia Harris, Alan Berkowitz, Alan Strayer, Stuart Findlay –
Cary Institute of Ecosystem Studies

A vibrant, dynamic ecosystem, the Hudson River estuary is historically one of the most inspirational and best-studied rivers in the United States. But after decades of pollution, declining fisheries, and cultural shifts in recreational pastimes, local residents are becoming increasingly distanced from this iconic feature of the Hudson Valley. In an effort to reconnect students to the Hudson River and teach about the health, resources, and threats to this national treasure, Cary Institute scientists and educators created the Changing Hudson Project. Engaging lessons bring cutting-edge research about our river valley to students' fingertips. Topics include invasive species, climate change, water quality, and the cycling of matter and energy, among others. Visuals, background readings, data sets, and lesson plans are resources for educators throughout the region who desire to teach ecosystem concepts using the Hudson River. More than 250 teachers have enriched their curriculum with our freely-available materials, reaching thousands of students throughout the watershed. The lessons meet science and math standards for New York State and the AAAS national benchmarks, and include specific indicators for courses such as Living Environment and AP Environmental Science.

Evaluating carbon flux from wetland soils under anthropogenic nutrient loading conditions

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Gregory O'Mullan, Jeffrey Bird - Queens College

Hudson River Estuary wetland systems in proximity to urbanized regions receive significant inputs of carbon (C) and nitrogen (N) due to fertilizer runoff from agricultural land and sewer overflow during storm events. Nutrient deposition on microbial communities may induce increased utilization of stored C pools found in recalcitrant soil organic matter and the subsequent increased production of greenhouse gases via enhanced microbial decomposition. The loss of soil carbon via enhanced microbial decomposition has also been postulated to result in destabilized root systems which may consequently facilitate wetland soil and habitat loss. We hypothesized that the additions of both C and N will stimulate anaerobic microbial communities indicated by increased production of greenhouse gases. To test this hypothesis, soil cores were removed from Piermont Marsh (Piermont, NY) and incubated for at least two weeks under anaerobic conditions in two separate incubation experiments. Both incubation experiments demonstrated that readily degradable C (acetate) but not inorganic N additions stimulated the production of methane (CH_4) and to a lesser degree carbon dioxide (CO_2). Acetate additions on wetland soils resulted in 30X increase in peak CH_4 production approximately one week after nutrient addition started compared to the negative controls. Further, the addition of acetate produced 2X greater CO_2 production for experiments #1 and #2 for a four day period approximately one week after nutrient addition. The high efflux of CO_2 and CH_4 observed compared with the level of acetate added indicates that nutrient additions stimulated C mineralization of native soil organic matter.

Mysterious Migrants: Investigating the When, Where, and Why of Juvenile *Anguilla rostrata* Populations in the Hudson River

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Amanda Bernstein - Ossining High School, NYSDEC

American eel populations have declined by 90% in the past few decades in the North Atlantic Coastal region; the reason for this decline remains unknown. This study monitored juvenile American eel populations in tributaries of the Hudson River, and examined environmental factors that may impact juvenile *A. rostrata* populations through the examination of biotic indicators, physicochemical parameters and stream flow rate. Sheldon-type fyke nets were used to monitor eel populations daily for two consecutive years. No significant relationship between water temperature and eel abundance was found ($p=0.0788$), ($p=.164$) in 2011, and 2012 ($p\geq.05$). There was also no correlation found between conductivity, dissolved oxygen content, and pH levels and eel abundance ($p\geq.05$). Flow rate was found to have no significant correlation with eel abundance or the pigmentation level ($p>.05$). Salt front was also found to have no significant correlation ($p>.05$) with eel abundance. This research indicates that the eel ingress in not dependent on water temperature or other physicochemical properties including water quality of tributaries. Importantly, this study found that total eel abundance has increased and research is necessary to determine the reason that this trend opposes the decline reported in other regions.

The impacts of the zebra mussel (*Dreissena polymorpha*) on the feeding ecology of early life stage striped bass (*Morone saxatilis*) and river herring (*Alosa pseudoharengus* and *Alosa aestivalis*)

Grace Casselberry
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Eric Schultz - University of Connecticut

Despite numerous studies of the ecological effects of the zebra mussel (*Dreissena polymorpha*) invasion in the Hudson River, the impacts on larval and juvenile fishes have been poorly characterized. We analyzed changes in early life stage fish diets upon invasion of the zebra mussel, focusing on the striped bass (*Morone saxatilis*) and river herring (*Alosa pseudoharengus* and *Alosa aestivalis*). We quantified changes in prey diversity, frequency of prevalent prey items, and a prey habitat index from 1988, before the mussels arrived, to 2008.

Sample years bracketed a period of increasing mussel impacts, followed by a period of apparent ecosystem recovery. For the striped bass, we found that prey diversity increased during peak invasion years and then declined in 2008. A similar trend was seen with the frequency of prevalent prey. After they arrived, zebra mussels became one of the main components of the diet. Over time, bass fed increasingly on benthic prey rather than pelagic prey. Overall, the zebra mussel has changed many aspects of the striped bass diet, some in surprising ways, and although some of those aspects are returning to their pre-invasion condition others are remaining the same as they were during peak invasion years. Data analysis is still in progress for changes in river herring diet.

Eutrophication of Lake Minnewaska, Shawangunk Mountains, Ulster County, NY

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Lake Minnewaska was known as an acidic, fishless, and crystal clear oligotrophic lake on the Shawangunk Ridge, but, in recent years, the lake ecosystem has been rapidly changing. The pH has risen over the past two decades from acidic to close to neutral. The now neutral waters have allowed a minnow, the Golden shiner (*Notemigonus crysoleucas*), to successfully invade the lake. We expect ecosystem wide effects due to the fish introduction; foremost among these is eutrophication by trophic cascade. We hypothesize that the zooplankton populations have been suppressed by minnows who act as new predators; this feeding releases the phytoplankton population due to decreased grazing. Increased phytoplankton blooms and reduced water clarity pose danger to the rare aquatic life currently in the lake including the deep water bryophyte *Sphagnum trinitense* and a behaviorally unique population of two-lined salamander. Throughout 2012, we measured pH, chlorophyll *a*, total phosphorus (TP), secchi depth, conductivity, and dissolved oxygen at both the lake surface and in profile to indicate major ecosystem changes in Lake Minnewaska. We also monitored nearby Lake Awosting which remains fishless and similar to the condition of Lake Minnewaska prior to the pH increase and fish introduction. Chlorophyll *a*, TP, secchi depth, and anoxia throughout the summer and fall months indicate that the primary productivity of the lake has risen to mesotrophic levels.

Does urban riparian habitat support mainly urban birds?

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Riparian corridors are known to be havens of biodiversity in urban areas. But do urban riparian corridors support mainly urban wildlife, or do they equally support non-urban species? We compared distributions of urban specialist birds and non-urban birds in the riparian corridor of the Fonteynkill, a small urban/suburban stream in Poughkeepsie, NY, and in surrounding landscapes with varying degrees of woodland and urban land use. Although the riparian zone was small, usually < 200 m wide, it was distinctive in having relatively high counts, species diversity, and abundance of species that were not urban specialists, such as wood thrush, rose-breasted grosbeak, and great-crested flycatcher. While these birds tolerate urban surroundings in the landscape, they avoided more thoroughly developed landscapes such as open lawns. Urban specialists, however (e.g. European starling, house sparrow, house finch) occurred almost exclusively in developed settings and did not dominate the small riparian zone. Habitat type and structure evidently explain the importance of riparian corridors: shrub thickets, snags, and other non-manicured land cover types occurred mainly in the riparian corridor in our study area, and these were the vegetation types occupied by non-urban species. Urban species occurred mainly in or near open lawns, or in mature trees. Our findings show that even small amounts of undeveloped riparian cover, including understory shrubs and canopy tree cover, provide disproportionate habitat for species that otherwise would find little suitable habitat in an urban environment.

Where did all the trees go? Urban stream monitoring before streamside construction

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In January 2013 Vassar College began the site clearing and construction process for a new science building bridging the Fonteynkill stream in Poughkeepsie, New York, an indirect tributary to the Hudson River. Landscaping plans associated with the new building call for installation of green infrastructure such as bioretention ponds to manage stormwater entering the Fonteynkill. To record construction and green infrastructure impacts on the Fonteynkill, we began continuous monitoring of the stream's discharge, specific conductance, turbidity, and temperature in January 2012 using YSI sondes and HOBO water pressure loggers. We also began biweekly measurements of chloride, nitrate, and fecal coliform levels in June 2012. We sampled benthic macroinvertebrate communities along the Fonteynkill twice during the summer of 2012. *E. Coli* counts above 1000 CFU/100 mL indicate sewage leakage into the Fonteynkill. At four out of five sites sampled for BMIs, at least 75% of the BMI community was composed of pollution tolerant species. These results indicate that the sewage leakage and other pollutant entry into the Fonteynkill is a serious concern.

Concrete and storm sewers: baseline study of an urban stream

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The Fonteynkill in Poughkeepsie, New York is a classic example of a stream affected by the Urban Stream Syndrome. Over sixty percent of the Fonteynkill's watershed is covered in impervious surface. In addition to groundwater, many stormwater sewers draining the southeast portion of the City of Poughkeepsie provide water to the stream. Approximately a third of the aboveground Fonteynkill forms Vassar Lake. As part of a long-term stream monitoring project, we conducted a baseline study of ion concentrations in the stream and Vassar Lake sediments. Cores taken from the Vassar Lake bed indicate high calcium values, possibly leached from concrete via acidic rain and flooded into the stream. We also found high levels of chloride and sodium, both indicative of road salt runoff. The high values were significant because we sampled in the summer following a relatively mild winter during which little salt was used. High levels of sulfate could be attributed to road salt or sewage leakage. Another study found that *E. Coli* levels were 6-7 times the bathing limit. This project evaluated multiple methods of sample collection and data analysis and supplied baseline data on the Fonteynkill's health. Our results indicate multiple stream impacts from a highly impervious watershed.

The Influence of Water Quality on Air Quality in the Hudson River Estuary

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Urban water bodies such as the Hudson River Estuary (HRE) often support high levels of microbial contamination through the release of untreated sewage to surface waters. Aerosol particle production from these contaminated waters provides the mechanism for degraded water quality to influence urban air quality. Despite this air-water connection, the production, transmission, and end fate of bacterial aerosols originating from polluted surface waters remain largely uncharacterized. To address this, we have quantified and characterized the bacterial contribution of water surfaces to urban waterfront aerosols at several sites in the Lower HRE. Our work has confirmed the aerosol transfer of aquatic surface bacteria to the

waterfront through various mechanisms, including high onshore winds and aeration remediation of contaminated waters. Molecular characterization of the 16S rRNA gene diversity of bacteria from HRE aerosols and surface waters revealed a similar species-level bacterial composition, with over 25% of the total sequence library represented by operational taxonomic units detected in both aerosols and surface waters at a NY Harbor pier. This bacterial connection between water and air quality was strengthened at wind speeds above 4 m s^{-1}, with similar temporal patterns for coarse aerosol concentrations, bacterial fallout rates, and presence of aquatic and sewage-associated bacteria in near-shore aerosols. These findings have important ecological and public health implications. The delivery of viable bacteria from water to air and land represents an inter-system geochemical connection not usually considered. Furthermore, the aerosolization of contaminated HRE waters into urban airspace greatly increases the potential human health impact of degraded water quality.

Surface Elevation Tables (SETs) in the Tivoli Bays: Analyzing the Impact of Superstorm Sandy

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To measure the relative elevation of sediments within the freshwater tidal marshes of the Tivoli Bays, Surface Elevation Tables (SETs) were installed. The SET provides a nondestructive method for making highly accurate measurements of sediment elevation over long periods of time relative to a fixed elevation benchmark. The Tivoli Bays were divided into study segments including Outer Tivoli North (OTN), a reference site, Inner Tivoli North (ITN), a site of potential marsh migration, and Tivoli South Bay (TSB), a site impacted by invasive *Trapa natans*. Three SETs were installed in each study segment, for a total of nine SETs.

SET data were collected in the late spring (May), late summer (September), and fall (November) of 2012. The last SET reading was taken after the impacts of Superstorm Sandy, which made landfall in New Jersey on October 29, 2012. The upper Hudson River Estuary experienced minimal wind (15 mph) and rainfall (1 inch), but received a storm surge approximately 6.5 feet above a normal high tide. In ITN, there was a significant elevation increase of 2.85 cm before Sandy, but no significant change after. In TSB, there were only significant elevation changes in one of the three SET stations. However, in OTN, the marsh elevation significantly increased by an average of 1.87 cm in the period before Sandy, then significantly decreased by an average of 2.03 cm immediately after Sandy. The Superstorm Sandy storm surge seemed to cause a slight sediment compaction event. However, as this is only the first year of a long term study, natural variability in the data still needs to be assessed.

Vegetation Monitoring in the Tivoli Bays

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The focus of this study is to assess the impact of climate change stressors, specifically sea level change and increased storm surges, on emergent tidal marsh within the Hudson River National Estuarine Research Reserve (HRNERR) site at the Tivoli Bays, a freshwater tidal system. In the Hudson River Estuary, the anticipated increase in water level of about 50 cm by the end of this century is close to the existing elevation difference between the vegetated lower intertidal community and the *Typha angustifolia* high marsh community. With sea level rise, a conversion of *Typha angustifolia* high marsh to vegetated lower intertidal community is anticipated. There are differences in plant productivity, organic matter dynamics, and biogeochemical processes among these vegetation classes, so changes in cover may affect overall wetland function. The Tivoli Bays were divided into study segments including Outer Tivoli North (OTN), a reference site, Inner Tivoli North (ITN), a site of potential marsh migration, and Tivoli South Bay (TSB), a site impacted by invasive *Trapa natans*. Vegetation transects were established along an elevation gradient from open water to high marsh. Baseline differences detected in the year one results include: 1) In OTN, the percent cover of *Typha angustifolia* within plots absent of the invasive *Lythrum salicaria* was higher than where *Lythrum salicaria* was present; 2) In ITN, plots adjacent to the wooded swamp had the highest species diversity across all study segments; 3) In TSB, there was no difference between the average percent cover of *Acorus calamus* and *Typha angustifolia.*

Upper Hudson Unremediated PCBs:
Impacts on the Recovery Time of Lower Hudson Fish

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Remedial decision-making at large sediment sites often relies on complex models to make future projections about bioaccumulative contaminant concentrations for comparison of natural recovery and active remedial alternatives. Temporal projections of biota concentrations provide a basis for estimating the time to reach risk-based thresholds when evaluating remedial alternatives. As part of the assessment process, EPA developed mathematical models to predict future levels of PCBs in Upper Hudson River (UHR) sediment and water. These models were linked to Lower Hudson River (LHR) models to

predict PCBs in fish in the upper portion of the LHR and to estimate the number of years to reach risk-based target thresholds. PCB concentrations in fine-grained surface sediment collected during remedial design exceeded the upper bound model projections under Monitored Natural Attenuation (MNA) and were estimated to be 5-fold higher than expected post-remediation in two of three river sections in the UHR. The objective of this paper is to apply a simplified modeling approach to evalute the impact of these higher sediment concentrations on the time to reach risk-based target thresholds in fish in the LHR under MNA and the selected remedy

PCBs Unremediated by the Hudson River Remedy and Implications for Restoration

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The Hudson River PCB Superfund Site encompasses approximately 200 miles from Hudson Falls to the Battery in New York City. The 2002 dredging remedy was estimated to remove 2.65 million cubic yards of sediments from River Sections 1, 2 and 3 between Fort Edward and the Federal Dam in Troy (40 miles). Characterization of sediment during remedial design (2002-2008) found higher and more widespread PCB concentrations in the surface and much slower natural recovery than models predicted for the 2002 remedy.

The first phase of the remediation commenced in River Section 1 in 2009; Phase 2 began in 2011. To date, more than 1.3 million cubic yards of sediment have been dredged from River Section 1. Phase 1 and Phase 2 combined will remediate at least 493 acres and remove 95% or more of PCBs from within the dredge footprint. However, an estimated 136 acres of surface PCBs exceeding 10 ppm Tri+ (25-30 ppm total) PCBs will remain outside of the dredge footprint and the average PCB concentration in the surface of River Sections 2 and 3 will be five times higher after remediation than predicted by the 2002 remedy. Our analyses evaluate the degree and extent of contamination remaining outside the areas designated for dredging and the potential for impacts of remaining PCB contamination on recovery and restoration of the Hudson River.

Collaborative Research and Education on Freshwater Tidal Marshes of the Hudson River

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Understanding the benefits provided by tidal marshes-from harboring biodiversity to removing pollutants- and the challenges they face from climate change means exploring them in the classroom and field. Over the past five years, researchers and educators from the Cary Institute of Ecosystem Studies have been working with teachers throughout the region to gather fine-scale data about the impact of vegetation types on water quality. These data provided additional details about how tidal freshwater wetlands function, and were used to support the findings of a large-scale investigation of various Hudson River wetlands. Teachers were challenged to incorporate their experience into the classroom in some way, and we now have several instructional modules that can be shared with other educators in the region. Created by fourteen teachers, the modules include both middle and high school materials, and focus on topics such as wetland ecology, biodiversity, nutrient pollution, and climate change.

Decline of eastern hemlock and other vegetation changes over a 35 year period in a rare, old-growth mixed hardwood forest

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Old-growth forests are not only cultural assets, but also provide valuable insights into developing restoration and management practices for ecosystems in response to anthropogenic change. The invasion of the hemlock wooly adelgid (HWA), *Adelgis tsugae*, has led to the significant decline of the eastern hemlock, *Tsuga canadensis,* a foundation species in many northeastern U.S. forests. The loss of a foundation species can result in alterations to community composition, and this process is still not well understood. In this study, we utilized a unique opportunity to investigate changes in an old-growth forest where hemlocks are in decline. Our forest stand was sampled in 1976, prior to HWA invasion, and in 2011. We documented changes in forest stand density, basal area, and understory composition. Relative density of hemlock decreased significantly from 68.9% to 38.7% while sweet birch, *Betula lenta*, and striped maple, *Acer pensylvanicum*, increased in relative density. Species richness increased and in 2011 included several non-native species not observed in 1976. Our results provide a unique example of hemlock decline and replacement in a rare old-growth forest.
*Received bachelor’s degree in Spring 2012.

USGS Hudson River Watershed Suspended-Sediment Monitoring Network

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The United States Geological Survey, in cooperation with the New York State Department of Conservation, New England Interstate Water Pollution Control Commission, and EPA's Harbor Estuary Program, operates a network of nine near-real time suspended-sediment monitoring stations across the Hudson River Watershed. Eight of these stations, located near the mouths of the Mohawk, Upper Hudson (above the Mohawk), Normanskill, Catskill, Kinderhook, Roeliff Jansen, Rondout, and Schoharie watersheds, monitor the export of suspended-sediment from 77 percent of the contributing watershed to the tidal Hudson River. The ninth station, located on the tidal river near Poughkeepsie, is near the downstream limit of freshwater and downriver of the other monitored watersheds. The 8 watershed stations constitute 88 percent of the watershed above the Poughkeepsie station allowing a comparison between the mass of suspended-sediment input from the watersheds and exported from the freshwater tidal river.

Each of the stations record turbidity as a surrogate for suspended-sediment concentration (SSC) and have the capacity to collect water samples automatically. Discharge rating curves are being developed or maintained for each of the sites to allow the computation of suspended-sediment discharge (water discharge x SSC = suspended-sediment discharge). Information from this network helps quantify the movement of sediment in the watershed to assist resource managers and stakeholders reduce dredging costs, identify areas that contribute to sediment-related damage to the ecosystem, and direct resources to mitigate soil loss. A web site with further information and links to network data is available here: http://ny.water.usgs.gov/gmaps/HudsonSedNet.html

PCB Contamination of the Hudson River Ecosystem

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PCBs released from General Electric (GE) facilities on the Upper Hudson River present a serious and long-term threat to the health of the Hudson River ecosystem. As part of the ongoing Natural Resource Damage Assessment, the Hudson River Natural Resource Trustees have conducted studies to quantify the extent of PCB contamination of the Hudson River. Living resources at every level of the Hudson's aquatic, terrestrial, and wetland-based food chains are contaminated with PCBs. PCB contamination is found in aquatic insects, amphibians, reptiles, birds, and mammals such as mink, otter, bats, mice, shrews, and voles. PCB concentrations in much of the wildlife tested exceed effects thresholds from the scientific literature. Concentrations of PCBs in surface water, groundwater, sediments and floodplain soils of the Hudson River exceed regulatory standards and criteria for their quality and use.

Serious adverse effects are likely occurring to living organisms exposed to the PCB contamination of the Hudson River region. The Trustees will use this information on the extent of the contamination to document injuries to natural resources and inform the restoration work needed to compensate the public for natural resource injuries from GE's release of PCBs in Hudson Falls and Fort Edward, New York. Restoration planning is underway.

Hudson River Water Quality: Microbial monitoring and policy implications

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The improving water quality of the Hudson River Estuary is an environmental success story in the making. Following more than a century of neglect and rampant pollution, recent decades can be characterized as a period of renewal for the Hudson ecosystem with measurable improvements in water quality. However, in order to reach the goals of the Clean Water Act continued progress in management is required. Over the last seven years, samples have been collected from 74 locations spanning the tidal Hudson River Estuary as part of the Riverkeeper water quality sampling program. Intermittent problems with sewage contamination persist in all regions of the estuary and approximately one quarter of all water samples collected had unacceptable levels of the sewage indicating bacterium, *Enterococcus*, in comparison to EPA guidelines for recreational water quality. Levels of sewage indicators were significantly higher in the near shore environment compared to the mid-channel, and tributaries were a large source of contamination to the river. While rain is an important determinant of water quality at many locations, some sites also display persistent pollution even during dry weather. The results from this monitoring program will be presented in the context of policy and management opportunities including updating of New York State recreational water quality criteria in accordance with new EPA guidelines released in 2012.

When it rains, it pours: Salt and nutrient inputs in a stream in rainy and dry weather

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Impacts of climate variation on stream systems are a question of concern as we anticipate climate change in the Northeast. Drier summers and stormy winters are likely in this region. Warmer winters should reduce road salt use, and thus salinity in streams; drier summers could reduce runoff and increase aeration in upland areas, potentially reducing nutrient concentrations in streams. We tested these effects by examining responses of chloride and nitrate concentrations and turbidity to precipitation and to season, in the Fonteynkill, a small urban stream in Poughkeepsie, New York. We used data gathered as part of a long-term monitoring study of green infrastructure impacts on the stream. We used instream sondes and pressure loggers, as well as bi-weekly grab samples, to monitor discharge, specific conductance, turbidity, and temperature for over a year (January 2012-February 2013). Turbidity levels in the stream varied from 0 NTU to greater than 500 NTU. Turbidity peaks occur both in the first flush following precipitation and during dry spells. Dry-spell turbidity peaks may represent phytoplankton blooms. Specific conductivity levels in the depend on road salt applications in winter and on ground-water discharge in summer. Chloride concentrations frequently peaked above 230 mg/L. Seasonal variation in concentrations was slight, although the response of concentrations to precipitation varied between seasons. Our findings point to higher concentrations of chloride and nitrate, rather than lower concentrations, if ongoing changes in weather patterns continue.

Determination of Chemical Contaminants in Soils in Areas Flooded by Superstorm Sandy

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On Monday, October 29, 2012, Superstorm Sandy hit the east coast with a surge of up to 13 feet. Thousands of people were affected by flood waters which brought sediment (mud, sand, and dirt) into homes and businesses. The wind and flood waters of Hurricane Sandy left extensive physical damage to coastal communities; it also raised concern about the potential exposure to harmful materials. Routes of exposure could be via the movement of sediment from areas of known contamination and new sources of pollution from submerged vehicles,

underground fuel tanks, and flooded industries. From a chemical perspective, concern is for materials such as heavy metals, polycylic aromatic hydrocarbons (PAHs), and polychlorinated biphenyl (PCBs). In the immediate aftermath of the storm, a project called SUDS (Send Us your Dirt from Sandy) was launched. The premise of the study was to conduct a survey of the affected areas by analyzing dirt samples collected by citizens from places that were flooded for a variety of organic and inorganic chemicals. The objectives are to discover areas of interest for future studies and learn as much as possible about contamination mechanisms occurring as a direct or indirect result of the storm. This poster will tell the story of the SUDS project and provide some preliminary results including lead, arsenic, PCB and PAH levels.

The State of the Hudson-Raritan Estuary: A look at the estuary's environmental health and trends

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The State of the Estuary is a periodic report of the New York-New Jersey Harbor & Estuary Program on the status and trends of a number of environmental indicators for the Hudson-Raritan Estuary (also known as the New York-New Jersey Harbor Estuary). Speaking to the Symposium's goal to provide a common knowledge base, this report aims at extending available information to the broader community. It is intended to serve as an educational tool and to increase awareness of the issues affecting the river and estuary and promote stewardship of the estuary's shared resources among the general public. Thus, the report not only presents data but provides a narrative context for this information, including ongoing and planned actions to preserve and improve the estuary's health, making clear connections between the health of the estuary and our everyday lives, and providing tips on simple actions we can all take to contribute our part. While the report focuses on the harbor side of the estuary, it also includes data from its tributaries, including the Hudson River. Data concerning the Hudson River in particular includes, most notably, fish populations and peregrine falcons. The poster will summarize data and information concerning the Hudson River, point to some of the knowledge or data gaps remaining, and highlight the approach taken to make this information accessible and to garner attention from a wide audience.

A Novel Hydrogen Isotope Proxy for Paleosalinity in Tidal Marshes

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We present a calibration for a hydrogen isotope proxy for tidal marsh paleosalinity. The stable isotope ratios of continental and marine water are distinct; seawater has a δD value close to 0‰,and in the New York region, the δD of continental runoff is about -50‰. Water in marshes has a hydrogen isotope ratio reflective of the mixing of these two water types and is directly related to salinity. Further, the δD in lipids produced by marsh plants have a hydrogen isotope ratio related in a predictable way to the δD of water in the marsh, and are well preserved in sediments. We collected common members of the genera *Typha*, *Spartina*, *Phragmites*, and *Scirpus* from salt marshes along the Hudson River, and the north and south shores of Long Island to calibrate the specific relationship between marsh plant leaf wax δD and marsh water salinity. Reconstructing salinity is most important because of its relationship to regional hydroclimatic change. The salinity of the Hudson estuary is strongly linked to the amount of fresh water available in the watershed, where the water supply for New York City and much of the surrounding metropolitan area is sourced. The continued population and economic growth in the northeastern US over the last 400 years has substantially increased the demand on freshwater resources. Our new quantitative proxy for paleosalinity will fill large gaps in our understanding of the changing hydrology in this important watershed, and the northeastern US as a whole.

Sediment Organic Geochemical Investigations of the Gateway National Recreation Area using Pyrolysis - Gas Chromatography / Mass Spectrometry

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The surface layer of estuarine sediments from the Gateway National Recreation Area (NRA) was characterized using Pyrolysis – Gas Chromatography / Mass Spectrometry (Py-GC/MS) in order to map the organic geochemical characteristics. The Gateway NRA is one of the most visited National Parks in the United States and there has been much concern over the loss of marshlands in the Jamaica Bay Unit. On the islands in the center of the bay, marsh loss has averaged 38% since 1974. The ratio of two pyrolysis products, Vinyl Guiacol, from terrestrial plant lignins, and Indole, from proteins, (VG/I ratio) is moderately well correlated with the sediment C/N ratios. The VG/I ratio suggests that the primary input of organic matter along the shores of Jamaica Bay is terrestrial while the inputs are primarily marine in the areas where marsh loss has been greatest. In contrast, healthy marshes in the Sandy Hook unit had a

VG/I ratio of 0.82. The VG/I ratio could also be correlated with the Carbon Preference Index (CPI) (r2 = 0.88) and the Syringol / Vanillyl (S/V) ratio (r2 = 0.56). Increased values of the CPI indicate an organic input from terrestrial plants while increasing S/V values are often associated with greater organic matter inputs originating with grasses. Both the S/V ratio and the CPI were higher in the Sandy Hook marshes than in Jamaica Bay. Sediment polyaromatic hydrocarbon (PAH) concentrations were also measured in this study and found to be largely associated with combustion inputs.

Distribution and persistence of sewage-associated microbes in Hudson River Estuary sediments

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Despite improving water quality, high levels of Fecal Indicator Bacteria (FIB) are still observed at many locations in the Hudson River Estuary. Following precipitation, contamination from combined sewer overflows is a major source of water quality degradation. However, the correlation between rainfall and FIB is weak at some locations where contamination appears to be occurring from unidentified sources. One possibility for dry weather contamination is the resuspension of sediments that may act as a reservoir for FIB. Sediment was collected from eight HRE locations, including designated swimming beaches and urban shorelines, to determine the magnitude and spatial distribution of sewage contamination. Samples were enumerated for *Enterococc*i and *E. coli*, in parallel with analysis of grain size and organic carbon content. Consistently high FIB levels were detected at some sites, such as Flushing Bay and Piermont Pier, while other sites, including Croton Point Beach, were found to have little to no FIB present. In addition, laboratory experiments indicate that sediment FIB can persist for many weeks, unlike patterns observed in water. FIB concentration and persistence were found to be highest in samples with high organic content, and when incubated at low temperatures. Thus, muddy benthic environments, periodically exposed to sewage contamination, may pose a threat to the public even during dry weather periods if resuspension occurs. Improved understanding of the persistence of sewage associated bacteria in environment and the interaction between microorganisms, particles, and sediments will be important to development of next generation water-quality models that better predict dry weather contamination.

The Hudson River Environmental Conditions Observing System

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In 2008, the Hudson River Environmental Conditions Observing System (HRECOS) was established to provide high-frequency, real-time data that are geographically distributed across large rivers in the Hudson River watershed. HRECOS consists of water quality and weather stations operated by a consortium of partner institutions from the government and research community who collaborate to report data in real time to a public website (www.hrecos.org). HRECOS builds upon existing monitoring and observing activities on the Hudson River estuary, including the Hudson River National Estuarine Research Reserve System-wide Monitoring Program (SWMP), the U.S. Geological Survey, the NYS DEC Rotating Integrated Basin Studies, and modeling and monitoring efforts undertaken by Stevens Institute of Technology in the New York – New Jersey Harbor. The goals of HRECOS are to provide baseline monitoring data necessary for applied research and modeling, to improve the capacity of research entities to understand the ecosystem and manage estuarine resources, to provide policy makers with timely data products to guide decision making, and to support the use of real-time data in educational settings. Recently HRECOS expanded to include new stations at Pier 84 in New York City and at Utica in the Mohawk River. New software was also added to provide flood warnings for the Stockade District of Schenectady to the Schenectady Office of Emergency Management.

Human Impacts in Hudson Marsh Archives – What is Our Signature and Legacy?

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Hudson marshes provide a wealth of ecosystem services to our watershed, but understanding how those services have shifted through time have implications for future management. Marsh sediment cores collected from the Hudson River NERR sites to urban Jamaica Bay, New York at the mouth of the estuary were analyzed using pollen, plant macrofossils, C/N ratios, loss-on-ignition (LOI), and X-ray fluorescence (XRF) techniques. Major shifts in vegetation are documented at the local as well as regional scale. Increases in ragweed (*Ambrosia)* and other light-loving species demonstrate the arrival of Europeans as upland forests were cleared. At the same time, isotopic shifts in N-15 in the sediment demonstrate the effects of shifts in human and animal populations on nutrient loads within the marsh. Significant increases in invasive species such as *Typha sp.* followed by *Phragmites* result in the modern depauperate marsh flora with very little indication of its previous plant diversity. Some of the macrofossil components such as the sedge *Cladium* currently appear to be missing in the Hudson Valley. Carbon storage in the marshes continues to shift with human impact. As sea level rises and a warmer climate ensues, what can we expect of species changes in the marshes, and how will their valued services be impacted? What can we do to ensure the health of these valuable resources, particularly where they are not protected?

Patterns of growth decline in dead and surviving eastern hemlock trees infested with the hemlock woolly adelgid

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Eastern hemlock (*Tsuga canadensis*) is experiencing widespread mortality across its range in the eastern United States due to hemlock woolly adelgid infestation. Although the patterns of decline of this important coniferous species have been studied, many questions about predictive factors and characteristics of mortality remain unanswered. We used dendrochronology to investigate the declines of two different groups of trees — one group that was dead by 2002, and another group that is still alive. We found significant differences in growth, size, and age between the two groups of trees. While the hemlock woolly adelgid infestation significantly affected the growth of both groups, it did not have a different effect on the two groups. However, prior research and examination of the data suggest a possible difference in the declines of these two groups. In particular, moisture availability seemed to be a predictor of damage incurred, as did overall tree performance. We were unable to separate location and demographics as possible causative agents, so future work should focus on isolating these two factors.

Summary of Two Chinese Invaders in the Hudson Valley

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The Chinese mitten crab, *Eriocheir sinensis*, was widespread and rather abundant in the Hudson River estuary and adjoining waters in 2008. Subsequently, numbers decreased and none have been seen in 2011 and 2012. During their presence, mitten crabs reached three years old. There is evidence of recruitment failure in the Hudson estuary since 2008. The trends on the entire Atlantic Coast are similar, raising questions of whether this species failed to establish or not and what factors may be different on the Atlantic Coast compared to other places. The Oriental weatherfish, *Misgurnus anguillicaudatus*, was discovered in the Hudson Valley in 2009. Sampling indicated that this species was widespread in the Dwaar Kill in Orange and Ulster Counties and at least 7 km of the Wallkill River. This species specializes in living in soft substrates in backwater habitats. They feed on whatever small

macroinvertebrates are available. Further spread of this species in the Hudson River seems inevitable, but we do not know how well it can adapt to tidal habitats. This species is a potential competitor for native organisms in its habitat and potentially is detrimental to small macroinvertebrates, like young of freshwater mussels and rare snails.

Biofilms Respond to Short-Term Exposure to Pharmaceuticals

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Trace amounts of pharmaceutical and personal care products (PPCPs) can be found in aquatic ecosystems from wastewater, septic systems, factory effluent, and agricultural runoff; however, the effects of PPCPs on aquatic ecosystems have not been extensively studied. We examined the effect of exposure to a low concentration (1mg/L) of ciprofloxacin (antibiotic) and diphenhydramine (antihistamine) on stream biofilms collected from a rural stream in NY and along a gradient of streams located in rural-urban areas in Baltimore. Respiration of biofilms from the rural sites (NY and MD) initially increased when exposed to ciprofloxacin for 12 hours; rural (NY) biofilm respiration was significantly suppressed after a 24-hour exposure. In contrast, urban biofilm respiration did not respond to the 12-hour exposure to ciprofloxacin. Biofilm respiration at all locations was significantly suppressed after 12-hour exposure to diphenhydramine. Biofilm activity is sensitive to short-term exposure to PPCPs, which may influence ecological function. However, urban biofilm communities that experience chronic exposure to human sewage may have gained tolerance to some pharmaceuticals but not to others.

Sediment Composition and Industrial Metal Contaminants in Hudson River Wetlands from Troy to New York Harbor

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In intensely utilized estuaries such as the Hudson estuary, it is important to understand the baseline and long-term trends of sediment composition in order to restore both structure and function. We quantified heavy metals, inorganic matter, and carbon in 20 wetlands and tributaries along a north-south transect from Troy to New York harbor, encompassing a gradient in salinity regimes, vegetation, hydrodynamic condition and history. We found: 1) Natural background levels of industrial metals, including Pb, Zn, Cu and Cr, are lower in marshes than in deltas as the metals associate more with inorganic sediment. This raises a question about restoration target values. 2) Jamaica Bay and East River sediments from New

York City were the most contaminated with industrial metals among the sites analyzed. At depth, the concentrations of these metals at many sites are elevated above EPA and NYS regulated standards. 3) Based on pollution chronologies coupled with radiometric methods, we found that cores taken from non-vegetated areas or those designated as high-energy have higher sedimentation rates than nearby sites, resulting in higher metal inventory. 4) Inorganic matter content at most sites is significantly higher than that found prior to European settlement at the same location in the last century, suggesting increased erosion and disturbance over time from anthropogenic activities. Wetland restoration can serve as a way to prevent contaminant re-suspension and reduce sediment load and the information from this study helps define a restoration target to fully restore wetlands condition and function.

Assessment of Genetic Variation in Populations of *Phragmites australis* along the Hudson River using Microsatellite DNA Markers

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Phragmites australis is a perennial grass that has invaded wetlands of the Northeastern United States over the past century. The Hudson River is no exception in that populations of *P. australis* have also spread dramatically along its shores and tributaries in the past 30 years. Recent studies have shown that genetically variable populations of *P. australis* can spread by seed dispersal in addition to clonal mechanisms. It will be important to characterize the genetic variation of Hudson River populations as part of a management strategy for this invasive species to determine its potential to spread by seed dispersal. The goals of this study were to quantify levels of genetic variation and structuring in *P. australis* Hudson River populations. A total of 273 culms of *P. australi*s were collected from eight locations ranging from Albany to Staten Island in the summers of 2004 and 2011. The samples were analyzed using eight microsatellite primers pairs developed by Saltonstall. Results indicated that each population was genetically variable and we are in the process of analyzing the data to determine population structuring. The 2011 Constitution Marsh and Tivoli Bay sites have fewer genetic phenotypes than the 2004 sample, indicating they have undergone a genetic bottleneck from recent habitat restorations. All samples were determined to be the Eurasian invasive variety suggesting that native populations are not present along the Hudson River. Future work will correlate genetic diversity with seed viability in order to determine the ability of Hudson River populations to spread by sexual reproduction.

Modeling hydrology and nutrient fluxes in the Hudson-Mohawk Basin

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Our ongoing work in the Hudson-Mohawk watershed includes modeling Hudson River hydrology and sediment and nutrient fluxes using the Regional Nutrient Management (ReNuMa) model. A major aim is to integrate data characterizing weather, land use, and watershed nutrient inputs in order to estimate variations in river flow, sediment and nutrient fluxes across the watershed over time, and the ecological response of the estuary to these variations. Comparing model estimates to monitoring data from stations within the watershed provides a means of validating model structure and reducing parameter uncertainty, and allows the synthesis of observational data into information useful for management (e.g. watershed scale fluxes instead of point estimates of concentrations). The modeling approach can be used further to estimate future fluxes in response to alternative scenarios of climate and land use change. Recent work has focused on updating our earlier work on hydrology and nutrient variability in the Upper Hudson and Mohawk, extending it over a longer historical time period as well as into the sub-basins of the Lower Hudson. Here, we report on the magnitude and variation of the modeled riverine flows and nutrient fluxes, with implications for water quality and nutrient loading to the New York Harbor/Hudson Estuary.

Hudson Valley Warming

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This presentation is based on data from sixteen long-term(> 60 years) cooperative weather stations of the U.S. National Weather Service located within the three climate divisions of the Hudson Valley watershed. The warmest years, seasons, months and days will be shown plus the trends in Heating Degree days and first and last frost of the season. Additional information will also be available from three books - Catskill Weather, Adirondack Weather and Weather History and Climate Guide to the Lower Hudson Valley that were prepared by the author.

Tracking Tributary Trees: Monitoring in the Hudson Estuary Trees for Tribs Program

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Hudson Estuary Trees for Tribs is an initiative of the New York State Department of Environmental Conservation Hudson River Estuary Program which offers free native plants and shrubs to landowners for use in replanting riparian buffers along tributaries of the

Hudson River Estuary. Vegetated riparian buffers offer various functions like filtering sediments and pollution from runoff or stabilization of stream banks which help protect stream quality. Along many tributaries of the Hudson River Estuary, the vegetation in riparian zones has been disturbed by human activity, and the beneficial functions of vegetated riparian buffers have been lost. Since its inception in 2007, Hudson Estuary Trees for Tribs with the help of over 4,800 volunteers has replanted 12 miles of riparian buffer using more than 30,000 native trees and shrubs in 11 different counties. Hudson Estuary Trees for Tribs staff monitor a subset of sites to collect data on plant survivability, growth, and vigor. This poster will summarize data gathered by the monitoring program between 2011 and 2012. Hudson Estuary Trees for Tribs hopes to use this data to enhance the program and inform planting decisions such as the choice of species selection or planting density at sites.

Vulnerability of Hudson River Atlantic Sturgeon to Bycatch in Coastal Waters

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Atlantic sturgeon are anadromous, resident in natal estuaries for 2-6 years as juveniles, after which subadults and adults undergo lengthy coastal migrations before returning to spawn many years later. At one time adult Atlantic sturgeons were the target of lucrative fisheries in many Atlantic coast spawning rivers including the Hudson. However, due to overharvest, habitat alteration and chemical pollution, all populations have severely declined resulting in the imposition of a coastwide moratorium on their harvest in 1998 and their federal designation as five Distinct Population Segments (DPS) under the Endangered Species Act in 2012. Bycatch of Atlantic sturgeon in coastal fisheries is considered one of the major obstacles to the stabilization and rebuilding of most populations. Because both the status of individual DPS and abundances in populations within them varies by orders of magnitude it is important to know the population of origin of sturgeon bycaught in coastal fisheries or disturbed in other ways distant from their natal estuaries. We used analyses of mitochondrial DNA and microsatellite DNA to characterize spawning populations coastwide and then used those same markers to assign population ancestry of individuals collected as bycatch in ocean fisheries in the U.S and the Bay of Fundy and in fisheries independent surveys along the Delaware Coast, Long Island Sound, and the Connecticut River. We were successful in assigning specimens to their DPS of origin with a high degree of certainty and also to individual populations but with less accuracy. Our results demonstrate that the stock origin of migratory sturgeon varies greatly among coastal sites and, overall, that the Hudson River population is by far the greatest source of sturgeon potentially vulnerable to anthropogenic impacts at sites distant from their natal estuaries.