2007 MEADOWLANDS SYMPOSIUM II: FEATURING SESSIONS ON RENEWABLE ENERGY AND URBAN WETLANDS

BOOK OF ABSTRACTS

GROUND WATERS QUALITY IN POTENTIAL ZONE OF INFLUENCE OF ASH DISPOSAL SITE AT THE THERMAL POWER PLANT

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Kosovo Thermal Power Plant which is situated near Prishtina presents major industrial capacity production in our country. From their production capacity after coals is burned a huge amount of ash is obtained, which is disposed near of the thermal power plant. The ash dump site of the thermal power plant Kosovo "B" which is situated among settlement, presents one of the most serious problems in the environment and is one of the potential danger on underground water carrier layers. Before the ash dump site location was determined a numerous examination were carried out of physical-chemical and biological parameters of ground waters which were continuous also after the exploitation of the dump site. As object study in the paper has been examined the influence of ash disposal site of thermo electric power plants of Kosovo B in ground water quality. On purpose to determine the physical and chemical parameters were taken the sampling of the water of fifteen wells. Sampling places were defined in that manner which allows assessing the impact of landfill in ground water quality. The increased concentration of ammonia, nitrate, and nitrite, total phosphorous and bacteriological impurity in village's well waters are the indicators of the faecal contamination and they are related to the proximity cesspools and stables. Increased values of manganese, iron, calcium and magnesium are the consequence of the chemical composition of the soil which is determined in initial zero state and during the exploitation of ash disposal site. The heavy metals and sulphate ion, as the relevant parameters, moves the fastest in ground waters and it serves to follow the influence of the ash dump site of the underground water quality. The variability of their concentration indicates the emphatic changes of the water quality to compare with the initial zero. The hydro mix disposal of the ash with water, contain a considerable amount of sulphates which contribute in ground water pollution of this area. For all water wells under impact zone of the ash disposal site characterizes with high mineralization. In order to avoid the negative effects of the ash disposal site in ground water quality is still needed to keep in control the landfill which means working in protection system of drain boreholes. At same time is necessary to continue with regular control of chemical and biological parameters of ground water.

DEVELOPMENT OF A DYNAMIC ENERGY BALANCE TO ASSESS OPERATING EFFICIENCY OF THE BURLINGTON COUNTY BIOREACTOR LANDFILL IN NEW JERSEY (USA)

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Bioreactor landfill technology has been extensively employed to enhance biodegradation and stabilization to decrease long-term environmental risks and landfill operating and post-closure costs. However, recovering the more abundant amounts of biogas has not achieved the same priority that facilitating waste stabilization itself has. In fact, many leachate-recirculation and biogas-collection strategies employed in modern bioreactor landfills in the United States are designed and operated to merely meet regulated environmental standards rather than to achieve maximum biogas production and energy recovery. While meeting environmental standards is of vital importance to bioreactor landfill operators, additional national and international focus on energy concerns has now forced the concept of viewing municipal solid waste (MSW) as a necessary biofuel as well. Previously published studies have utilized life-cycle analysis and linear models to generate theoretical energy balances for various waste-management schemes. While these models are useful for considering the design of new systems, immediate energy use and biogas production augmentation measures for existing bioreactor landfill systems need to be evaluated by an appropriate energy balance to assess the operating efficiency of the specific system of interest. The objective of this study is to develop a dynamic energy balance for the bioreactor landfill in Burlington County, New Jersey (USA). Development of a dynamic system-specific energy balance is important as it will provide the means by which energy conservation and biogas production enhancements can be quantified over time. Additionally, the research will seek to not only provide additional academic understanding of bioreactor landfill systems, but will also provide a tool for operators to assess and control energy efficiency.

The Burlington County bioreactor landfill started operation in 1999, covers 28 ha, and has a maximum height of 35 m. Leachate from the bioreactor landfill, leachate from an adjacent conventional landfill, and leachate from a biofilter from a sewage sludge composting facility are introduced as liquids. Excess liquids are hauled off-site to a wastewater treatment facility. MSW collection and placement, leachate removal and treatment, and most importantly biogas generation (collected and lost) are within the system boundary of the energy balance. A simplified balance can be expressed by Equation 1.

$$operationouttransprortintransportbiogasEEEEdtdE−−−=)()(\quad \text{Equation 1}$$

Existing operating data, which are continuously updated as new data become available, are used to develop the dynamic energy balance. Biogas energy generation (collected and lost), E_{biogas}, is a function of the deposited MSW as well as the rate of biodegradation. Biogas generation is predicted with a simple decay model and collected biogas is quantified by measuring actual biogas recovery rates. Incoming and exiting waste stream transportation energy requirements, $E_{transport(in)}$ and $E_{transport(out)}$ respectively, are equated to the sum of the necessary fuel used by the transport vehicles to move the waste from collection sites to the bioreactor facility and to move leachate from the bioreactor site to the wastewater treatment facility (including energy used for leachate treatment). Energy expended during waste placement and landfill operations, $E_{operation}$, is the sum of placement fuel expenditures and facility electricity usage.

The results of the energy balance from the start of the operation of the bioreactor landfill until the end of 2006 will be presented. Attention will be given as to how bioreactor landfill operators can utilize energy balances to minimize energy consumption and maximize energy outputs. Measures affecting the energy balance will be discussed and technical constraints that can be mitigated in future designs will be highlighted.

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IS FLOODING GETTING WORSE IN THE PASSAIC-HACKENSACK WATERSHED? A HISTORICAL, EMPIRICAL ANALYSIS OF TEMPORAL TRENDS IN FLOOD FREQUENCY AND MAGNITUDE

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Flooding is a severe and reoccurring problem throughout New Jersey, including the Hackensack and Passaic River basins. There seems to be a popular perception that flooding is getting worse, that is, flooding is becoming more frequent and/or more extreme. To see if this is indeed true, we calculated flows associated with various frequencies of occurrence (i.e., the 2, 5, 10, 20, 50 and 100-year flows) for 18 USGS-operated stream flow gages in the basins (with periods of record ranging from 50 to 108 years) for successive 30-year blocks of measured annual peak discharges, starting from the beginning of each record. Out of the 18 gages, the number and percent of gages that showed a statistically significant linear increase (F-test p-value <0.05) in flow through time were as follows: 14 (78%) for the 2-year and 5-year flow; 13 (72%) for the 10-year and 20-year flow; 12 (67%) for the 50-year; and 10 (56%) for the 100-year flow. Three of the gages that did not show significant increases are located immediately downstream of reservoirs, which are well known to decrease flood flows. Only one station showed a statistically significant decrease and for only one return period -- the 100 year flow on the Passaic River at Little Falls. The median rate of increase for stations with significant increases (relative to the flow for the corresponding return period for a gage's entire record) was 1.1% per year for the 2-year flow and 0.7% per year for the 100-year flow. According to this analytical method, it appears that flood flows have indeed increased through time at a majority of stream flow gages in the Passaic-Hackensack Watershed.

CHIRONOMID HEMOGLOBIN PROTEIN AS A MOLECULAR BIOMARKER FOR SPECIES IDENTIFICATION AND GENETIC DIVERSITY USING WILD LARVAE FROM KEARNY MARSH, N.J.

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Chironomids, aquatic larvae of midge fly (Diperta: Chironomidae), are abundant, widely distributed, sediment-dwelling organisms that should be used more often for field studies. One major challenge to their use is distinguishing between species based on morphological characteristics. In this study, hemoglobin protein detected by SDS-PAGE gel was evaluated for its ability to discriminate between species collected at Kearny Marsh, an oligohaline wetland that is part of the New Jersey Meadowlands. Hemoglobin protein is highly polymorphic in chironomids and important for their ability to survive in organic, suboxic wetland sediments. Genetic diversity of hemoglobin protein was also evaluated by comparing larvae collected from different sites in the marsh. In one study (May to August 2004), one site had higher concentrations of heavy metals than the other. In a second study (May to November 2006), the sediments were either capped or uncapped with AquaBlok, an aggregate clay-based technology. Proteins were separated by SDS-PAGE based on weight (kilodaltons). Hemoglobin profiles from individual larvae were distinguished by the presence or absence of bands as well as band intensities. Band profiles were compared to larval head capsules, which are commonly used to identify species. Results showed unique hemoglobin profiles that corresponded with three different species. One species was identified as *Glyptotendipes lobiferus* (five profiles) and another as *Endochironomus nigricans* (two profiles). The third species appeared to be a *Glyptotendipes lobiferus*/*Chironomus riparius* hybrid (three profiles). In the first study, *G. lobiferus* was more abundant and had more polymorphic hemoglobin profiles than the other species found, *E. nigricans*. Hierarchical clustal analyses of data found that hemoglobin diversity could not discriminate between levels of sediment metal contamination using either species. During the second study only *G.lobiferus* and the hybrid were found. The abundance of hybrid individuals increased over time particularly at uncapped sites. There was little hemoglobin diversity in *G. lobiferus* regardless of season or capping treatment. Hemoglobin diversity in the hybrid was more variable in summer than fall and more variable in uncapped than capped sites. Water quality measurements suggested that dissolved oxygen might have influenced hybrid abundance and hemoglobin diversity. Findings of this study indicated that hemoglobin protein polymorphisms can assist with species identification of chironomids and may serve as a biomarker of changing ecological conditions.

EXPERIMENTAL METHOD TOWARD IN-SITU BURIAL AND FLORAL RESTORATION OF CONTAMINATED SITES IN SUBMERGED WETLANDS.

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Empirical data indicate that AquaBlok - a patented, bentonite composite-aggregate technology, can serve as a benthic substrate for aquatic vegetation while simultaneously acting as a physical barrier between contaminated sediments and overlying biological receptors. The objectives of this research is to 1) evaluate the effectiveness of AquaBlok pellet (SubmerSeed) to sink the incorporated seeds below the surface and become integrated into the soil and/or hydrated AquaBlok cap, 2) evaluate the ability of plants to utilize AquaBlok as an alternative to sediment, 3) determine if adding organic matter improved AquaBlok's suitability as a substrate, 4) evaluate the effectiveness of AquaBlok as a physical barrier between contaminated sediments and plant tissue. Preliminary green-house study results have demonstrated that successful herbaceous emergent wetland plant establishment and growth from deposited and specially treated seed stock occurs within a hydrated AquaBlok substrate.

BEHAVIOR AND CONDITION RESPONSES OF YOUNG-OF-THE-YEAR BLUEFISH (*POMATOMUS SALTATRIX*) TO CONTAMINANTS ACCUMULATED VIA EXPERIMENTAL TROPHIC TRANSFER

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Newly recruited young-of-the-year (YOY) bluefish, *Pomatomus saltatrix*, from relatively pristine Great Bay were fed daily to satiation for about three months with menhaden and mummichog from Great Bay (control treatment) and Hackensack River (exposed treatment). Amount of prey consumed and consumption rates for the exposed fish was significantly less than that for the control fish. Exposed fish also displayed a significant decrease in the swimming activity compared to the control fish during the non-feeding periods. There was no statistical difference in the condition index, but both the length and weight of the control fish were significantly larger. PCB concentrations in exposed YOY bluefish were greater than the field-caught specimens. PCB fingerprints in the exposed fish were nearly identical in the individual YOY bluefish. These fingerprints matched most closely to that of mummichog probably because this was the sole prey species used during the last month of the feeding experiment. PCB concentrations in menhaden and mummichog found in the bluefish guts were higher than the field-caught specimens. As certain PCB congeners can exert adverse neurotoxic, endocrine, or immunological effects, prey with higher PCB body burdens may become less agile and thus easier to capture. If it is assumed that YOY bluefish preferentially foraged on such prey species due to higher capture success, greater amounts of PCBs can be trophically transferred. Decreased feeding, activity level and growth in the exposed YOY bluefish observed in the present study can have detrimental effects on migration fitness and recruitment success in feral populations exposed to similarly contaminated regimes. Further research is being conducted to investigate the physiological and biochemical changes resulting from contaminant exposure that may have caused the changes observed in the behavior and growth of YOY bluefish.

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POLYCHLORINATED BIPHENYL CONGENERS AND ORGANOCHLORINE PESTICIDES IN YOUNG-OF-THE-YEAR BLUEFISH FROM SEVEN NURSERY ESTUARIES WITHIN THE NEW YORK BIGHT AND THE ASSESSMENT OF SITE FIDELITY BASED ON CHEMICAL FINGERPRINTS

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Concentrations of polychlorinated biphenyl (PCB) congeners and organochlorine pesticides in young-of-the-year (YOY) bluefish, *Pomatomus saltatrix*, from seven nursery estuaries within the New York Bight correlated well with the known or anecdotal contamination histories of the respective habitats. Contaminant concentrations were highest in YOY bluefish from Newark Bay, and followed in the decreasing order in YOY bluefish from Hudson River, Sandy Hook Bay, Great South Bay, and Navesink River. YOY bluefish from Great Bay and Delaware Bay were relatively uncontaminated. YOY bluefish from Hudson River displayed the best condition factors while YOY bluefish from Newark Bay displayed the worst condition factors. Despite the small sample size, this observation suggested that chemical contaminants might not be the sole determinants of the condition of YOY bluefish. Body burdens of PCBs and p,p'-DDE increased with the weight of YOY bluefish. PCB and p,p,-DDE concentrations did not increase proportionate to the body weight probably due to the dilution effects related to the rapid growth of YOY bluefish during their estuarine residence. Low to moderate intraestuarine homogeneity of PCB patterns in YOY bluefish was indicated by decrease in relative standard deviations in the concentrations of PCB congeners after PCB 153 normalization. Different patterns of prominent PCB congeners in YOY bluefish from Newark Bay and Hudson River suggested different sources of contamination in these relatively contaminated and geographically adjacent nursery estuaries. Principal component analyses of PCB and pesticide fingerprints using non-normalized and normalized data segregated various New York Bight subestuaries, including resolving adjacent nurseries with a distance of less than 15 kilometers. Bioenergetically profitable site fidelity behavior of YOY bluefish, as suggested by the results of the present study and the results of tagging experiments reported in the literature, can have management implications.

FUTURE SEA LEVEL RISE AND THE MEADOWLANDS

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The tidal fringe brackish marshes of the Meadowlands were formed as a result of post-glacial sea level rise. Continued sea level rise, no matter the cause, will continue to affect the distribution, structure and function of these coastal ecosystems. These marshes maintain their stability relative to the tide through a combination of the accumulation of organic matter and periodic inputs of sediments from storms. However, even under accelerated sea level rise, research has shown that this type of coastal ecosystem will be able to maintain suitable conditions for vegetative growth if hydrologic conditions allow natural sediment accretion processes to continue.

One of the foremost steps needed to successfully manage and protect the environmental, recreational, and economic resources and investments along the shorelines of the Meadowlands is to recognize and understand the complex causes and dynamic processes related to sediment accretion, including the ensuing ecological change in state and function in the face of sea level rise. However, sediment accretion processes within the Meadowlands have yet to be modeled and are not well understood.

This presentation will describe a theoretical model developed as a decision tool to evaluate potential impacts of sea level rise on sedimentation patterns and sediment accretion across a variety of vegetative coastal habitats in the Meadowlands. The model is applied to a potential restoration site in the Meadowlands to investigate the potential effects of restoration efforts on future sea level rise changes.

ANALYSIS OF THE SEDIMENT DATA FROM THE LOWER HACKENSACK RIVER

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The New Jersey Meadowlands Commission's Meadowlands Environmental Research Institute (MERI) has collected metals data in sediments from 24 sampling sites in the Lower Hackensack River estuary and its major tributaries during 1987-88 and 2003. During both of these time periods, data were collected on the following metals in the sediments: Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni), Zinc (Zn). The 2003 study also included data on the following metals: Arsenic (As), Mercury (Hg), Iron (Fe) collected from 26 sampling locations with three replicates per each location with the total of 78 samples. Area subjected to observation is the river mile stretch between Newark Bay to the Bergen Turnpike and mouth of the Overpeck Creek in Ridgefield.

This paper describes the results of a comparison of the average levels of metals between the two time periods as well as the differences between different locations of the sampling sites. Since all sampling units were not uniform in volume, we normalized the units by using "percentage of fines in silt and clay" as the variable of interest. We also report the models fitted to describe each metal as a function of other metals for each of following 3 groupings: (i) overall, (ii) by part (river or tributary), (iii) by location (lower, middle, upper or tributary).

To test whether levels of metals were significantly different between studies done in 1987-88 and 2003 we have used paired t test. The justification for using the paired t experimental design is the methodology of having samples collected at approximately the same geographical locations where the only factor is the time in between collections. What is more, samples of metals in sediments were taken using 23cm x 23cm Ponar grab same for both studies. Paired t test was done in three levels of analysis. First we looked for the overall difference in concentration of metals in sediments for each of the metals. Second level of analysis grouped samples by allocation to the main river stream and tributaries. For the last level of analysis we sought for the difference in levels of metals when we grouped samples by location (lower, middle, upper and tributaries).

We have used general linear model to measure the relationship between each of the metals as independent or predictor variables and other metal as dependent or criterion variable. We have presented significant model equations for each of the metals. We found that there is a strong interaction between some of the elements.

In the last part of the analysis we have used analysis of variance (ANOVA) test with Tukey's pairwise comparison to look for the difference in concentration of metals in sediments between four locations for the data collected only in 2003. We wanted to analyze the average levels of Arsenic (As), Iron (Fe) and Mercury (Hg) relative to their position in the upper, middle and lower sections of the river.

THE RELATIONSHIP BETWEEN SOIL METAL CONCENTRATIONS AND ENDEMIC VEGETATIVE ASSEMBLAGES IN AN URBAN BROWNFIELD

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Anthropogenic sources of toxic elements have had serious ecological and human health impacts. Analysis of the soil samples, from a brownfield within Liberty State Park, Jersey City New Jersey showed that arsenic (As), chromium (Cr), lead (Pb), zinc (Zn) and vanadium (V) exist at concentrations above those considered ambient for area. The accumulation and translocation features were characterised for the dominant plant species of four vegetative assemblages. *Betula populifolia* and *Populus deltoides* were found to be accumulating Zn in leaf tissue at extremely high levels. *B. populifolia*, *P. deltoides and Rhus. copallina* accumulated Cr primarily in the root tissue. A comparison of soil metal maps and vegetative assemblage maps did not indicate any significant relationship. Attenuation rates of these metals within the soils appear to correlate well with translocation into the plant tissue.

In many areas throughout the world, activities associated with the industrial revolution have resulted in the contamination of urban landscapes. While many severely contaminated sites have been identified and addressed, less contaminated sites or brownfields have proven more difficult to appropriately remediate. As the result of industrial land uses, brownfield soils typically contain high concentrations of trace metals such as cadmium (Cd), copper (Cu), zinc (Zn), lead (Pb) (Dudka et al., 1996) and others. These elements are often adsorbed or occluded by carbonates, organic matters, iron (Fe)-magnesium (Mg) oxides and primary or secondary minerals (Adriano, 1986; Ross, 1994). However, despite considerable advances in contaminated land exposure assessment in recent years, there are still obvious difficulties in identifying whether or not and under what conditions soil contamination should be a matter of concern (French et al., 2006). Many studies addressing metal contamination focus on hot spots (Ramsey and Argyraki, 1997; Sastre et al.) offering engineering solutions which can be relatively expensive. Phytoextraction or phytostabilization offers low cost and effective although long-term solution (Canell, 1999), and the vegetated assemblage provides aesthetic improvement and economic benefits (Paulson et al., 2003). However, if these green methods are to be employed an understanding of the ecological risk associated with contaminate assimilation is critical.

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SPRINGTIME ATMOSPHERIC NITROGEN OVER THE MEADOWLANDS

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Nitrogen oxides (NO, NO_2) are highly reactive gases in the ambient air, which are precursor molecules for the production of ground-level ozone (O_3). The O_3 production rate strongly depends on the concentrations of NO and NO_2. High concentrations of O_3 in the ambient air can trigger serious respiratory and other health-related problems. Therefore, an adequate knowledge of the characteristics of NOx in the ambient air is crucial for the assessment of O_3 pollution and air quality. On the other hand, particulate nitrate and gaseous nitric acid also affect air quality, in particular acid rain, and their deposition may affect certain sensitive aquatic ecosystems. To characterize atmospheric nitrogen over the Meadowlands district, the measurements of nitrogen oxides and O3 in the ambient air are undertaken through the use of a chemiluminescent NO-NO2-NOx analyzer and O_3 analyzer, housed in the Meadowlands Environmental Research Institute. Additional measurements of particulate nitrate and gaseous nitric acid will also be carried out at the same location. In this presentation, we will focus our discussions on the springtime characteristics of these atmospheric species in the ambient air over the Meadowlands, in particular their concentrations and relationships.

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INTEGRATING ENVIROINFORMATIC AND BIOINFORMATIC APPROACHES FOR THE SYSTEMATIC ANALYSIS OF ENVIRONMENTALLY RELATED HUMAN HEALTH RISKS

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In the past, assessing the human impact on the environment, and the subsequent impact of environmental change on human well-being, was typically performed on a "stressor by stressor basis," e.g. for groups of "related" chemical compounds, present in a given environmental medium (e.g. atmosphere, groundwater, etc.) and typically associated with a single exposure route (e.g. inhalation, ingestion, dermal absorption, etc.). Although this practice has evolved over time to allow considerations of multimedia contaminants, the focus has primarily remained on contaminant- and route-specific risk characterizations. In recent years, however, a major change has been taking place, through the development of "person-oriented" (i.e. anthropocentric) approaches and models, that aim to account for total ("cumulative" and "aggregate") exposures of individuals (or of populations consisting of such individuals), to co-occurring stressors (i.e. mixtures of chemical, biological and radiological agents.

These new integrated, "systems-based," approaches focus on individual humans, real or "virtual", with well defined physiological, socioeconomic, behavioral, etc. attributes, and take into account how the detailed activities of these individuals in space and time affect (a) their "personal microenvironments," and their corresponding exposures to stressors, and (b) the physiological and biochemical processes determining biologically relevant dose and eventually biological effect (e.g. uptake rates; metabolic rates and pathways; toxicodynamics). Proceeding a major step further, person-oriented approaches currently aim to take advantage of information on genetic and other factors that determine the highly variable individual susceptibility to environmental stressors. Current advancements in toxicoinformatic (genomic, transcriptomic, proteomic, metabonomic etc.) technologies and data are successfully used to provide quantitative understanding of the intra- and inter-individual variability in responses to various environmental factors, thus eventually giving rise to "personalized" risk assessments.

The US Environmental Protection Agency (USEPA) has established a multifaceted "university partnership" with EOHSI, that supports a continuing research effort to develop, evaluate and apply an integrated modeling and database framework for probabilistic analyses of the complete "environmental health sequence". This effort, over the past seven years, has resulted in the evolution of two complementary software "systems of model and data components," operating on customized Linux clusters: the Modeling ENvironment for TOtal Risk studies (MENTOR), that addresses the "source-to-dose" steps, and the DOse-Response Information ANalysis system (DORIAN), for the biological "dose-to-effect" steps.

Various problem-specific implementations of this framework have been developed and applied to a wide range of environmental issues in the USA, including: regional/multiscale ozone and airborne particulate matter (PM) control; urban/local scale inhalation exposures to complex mixtures of co-occurring ozone, PM, and air toxics; contaminant releases from forest and urban fires; groundwater contamination; multimedia and multipathway exposures to mixtures of metals/metalloids (Hg, Cd, Cu, As, etc.) and their compounds, to pesticides, to organic solvents, to water chlorination by-products, etc. Special focus has been on novel methods for systematic simplification of complex models and for uncertainty analysis and reduction. Up-to-date information on publications and on scientific developments related to the above efforts, is posted regularly on the web site of the Computational Chemodynamics Laboratory of EOHSI (www.ccl.rutgers.edu) and at www.EnvironmentalBioinformatics.org.

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KEARNY MARSH SEDIMENT ABOVE AQUABLOK CAP SHOWS INCREASED BACTERIAL DIVERSITY

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Single Strand Conformational Polymorphism (SSCP) of 16s rDNA was used to compare bacterial diversity in, above, and below a layer of Aquablok. Aquablok is a clay-based capping technology deployed over contaminated sediment in experimental plots in Kearny Marsh, Kearny, NJ. Preliminary results, based on cores taken from two sites, showed that 16s rDNA amplified from DNA extracted from sediment on top of Aquablok produced the greatest number of SSCP bands, followed by the Aquablok itself. Sediment below the cap appeared least diverse. Bacterial diversity in Aquablok amended with 2% peat moss was not different from that in Aquablok by itself. Data suggest that active capping technologies such as Aquablok promote creation of more bacterial niches than Kearny Marsh sediment alone.

BRONX RIVER PILOT OYSTER REEF RESTORATION: METHODS, MONITORING AND COMMUNITY PARTICIPATION

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Eastern Oysters (*Crassostrea virginica*) were once plentiful in the estuarine waters of the NY/NJ Harbor. Due to disease, over-harvesting and poor water quality, the eastern oyster population of the harbor declined to nearly zero in the early 1900's. Oysters are still located in small pocket populations around the harbor today, including at the confluence of the Bronx and East River where oysters are growing on hard rock substrate as well as debris. We tested clamshell as a substrate for oyster spat settlement at this Bronx River location. The study site was the intertidal water off the south side of Soundview Park, where there is a tide difference of 7.5 ft and an average salinity of 24 ppt. We placed 205 plastic mesh bags of clam shell at the project site in two layers as a pilot reef environment covering a basal area of 16.5 m^2. Four monitoring trays were placed at the site and filled with two bags of clam shell each. The reef was monitored for oyster spat settlement and size and for invertebrate, fish, and algae colonization. Two comparison plots 15 m^2 each (an intertidal rocky outcrop exposed at low tides and rocky shoreline) were monitored for live oysters of all sizes and for oyster shells. The number of oyster spat found on the pilot reef was compared to the number of oyster spat found on the substrate at the comparison plots. Preliminary results from the initial season of monitoring show that the oyster larvae favored the clam shell substrate over the substrate available in the comparison plots. A diversity of 16 species of organism were located during the monitoring of the site showing that the bagged clam shell substrate created a community reef environment. Benthic invertebrate and sediment trap samples were collected at the project site and a control site pre and post reef placement to gather information about the change the reef structure has on the benthic environment. Community participation was important for all stages of the reef creation, placement and monitoring. Bronx River community groups participated in over 1000 hours of work on this project with NRG staff. Further monitoring work, systematic shell placement and community participation is needed to gather more information about this project site and to inform future oyster restoration projects at this and other NY/NJ estuary sites.

SEA-LEVEL RISE IMPACTS AND SALT MARSH CHANGE IN THE NEW YORK CITY VICINITY

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Sea level in New York increased by 2.77 mm per year (22 to 39 cm overall) during the 20th century, nearly double the global mean rate. Projections based on climate model simulations and historic tide gauge data suggests that regional sea level could rise by another 24 to 108 cm by the 2080s. Resulting coastal flood levels from future storms would be higher, cover a broader area, and occur more frequently. The 100-year flood could have a likelihood of recurring as frequently as approximately once every 20 years by the 2050s and every four years by the 2080s.

We analyzed salt marsh change at Marshlands Conservancy, a wildlife sanctuary in Rye, New York. A comparison of historic aerial photographs and field observations revealed several trends, including: 1) complete submergence or "drowning" of marsh segments, 2) marsh loss along tidal inlets terminating in enlarged pools 3) gradual slumping of peat, marsh retreat and fragmentation, and 4) die-back of *Spartina alterniflora* vegetation.

Many of New York's wetlands have experienced large-scale anthropogenic modifications that could have initiated marsh deterioration. Unrelated to dredge and fill activity, reduction in marsh size of 20% to 60% has been found in the region particularly where inland migration of salt marsh extent is severely limited by urban infrastructure such as in the marshes of Jamaica Bay, Queens, NY.

Work is in progress to determine if marsh submergence has occurred at other selected New York City salt marshes using comparisons of historic and current aerial photographs. Policies are also being explored to better monitor and manage salt marsh resources through city, state and federal initiatives. While the exact causes remain unknown, relative sea-level rise may thus far be simply exacerbating other anthropogenic effects; however, given the future rate of rise, and limitations on the rate of accretion known to occur in marshes, sea-level rise may be the predominant cause of marsh loss in the next decades. Future sea-level rise combined with stronger storm surges will likely increase the vulnerability of urban intertidal marshes. In order to ensure marsh survival, salt marsh preservation will increasingly not be a sufficient policy, but will need to be accompanied by monitoring, management and enhancement of these valued wetland resources.

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TRACE MONITORING OF NEW AND EMERGING POLLUTANTS VIA MICROSCALE MEMBRANE EXTRACTION TECHNIQUES

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In recent times, increasing amounts of everyday consumer products have found their way into our water supplies. Unused medications, fluorinated surfactants that make our clothes stain and water resistant, pesticides, lotions and makeup all contain these "emerging" pollutants that are now being found in trace quantities in water. Limited data exists on the toxicology of these compounds but what is available suggests that these compounds may have toxic effects on human as well as wildlife. Since they are present in trace amounts, their detection is difficult and so techniques must be developed that allow for their extraction and concentration.

Typical methods currently in use include solid phase extraction (SPE) in conjunction with LC/MS/MS, LC/ESI/MS or GC/MS. SPE is a time consuming, costly procedure that requires the use of substantial amounts of organic solvents. SPE cartridges are expensive and the procedure may involve several washings and elutions with an organic solvent, drying with an inert gas such as helium and then reconstitution. Membrane extraction on the other hand requires only microlitres of solvent, is inexpensive, and can be done in relatively short times. Another advantage of membrane extraction is the ability to interface directly with instruments such as GC, HPLC or AAS. This brings with it, the advantage of facilitating real time monitoring which allows for speedier responses to anomalies and hence better management of our resources.

Of these emerging pollutants, pharmaceuticals are receiving increased interest in recent times since many are specific biological toxins. Antibiotics have surfaced in waters in USA, Canada and Europe and the fear of the possible development of bacterial resistance is fueling the movement to quantify these compounds and assess their effects. The present research involves the use of microscale membrane extraction as a simple and fast method for the extraction and analysis of these compounds. We show the extraction and monitoring of acidic and neutral pharmaceutical compounds, such as, ciprofloxacin, sulfamethoxazole, clarithromycin and trimethoprim. These antibiotics are used to treat a wide range of common ailments including upper and lower respiratory tract infections, pneumonia, tonsillitis, gonorrhea and sinusitis. Analysis and detection were done with HPLC-UV and enrichment factors as high as 1200 were obtained. RSDs ranged between 1.5 and 2.0% and detection limits as low as 92 ppt were obtained.

CONTINUOUS WATER QUALITY DATA MODELING FOR LOWER HACKENSACK RIVER

Jain, Aridaman[1]**;Johnson**, Ken[1]; **Hobble**, Christine[2]

The New Jersey Meadowlands Commission's Meadowlands Environmental Research Institute (MERI) monitors water quality by continuously collecting the water quality data in the Hackensack River and its tributaries. In 2004, the New Jersey Meadowlands Commission established three continuous water monitoring stations and one weather station within the Hackensack River Estuary. There are 8 variables of interest within a site (collected at the continuous water quality monitoring stations) and 8 variables external to a site (collected at the continuous weather monitoring station). The variables within a site are: Depth of Water, Conductivity, Dissolved Oxygen, Dissolved Oxygen Percent Saturated, Salinity, Turbidity, pH, and Water Temperature. The variables external to the site are Air Temperature, Barometric Pressure, Rainfall, Relative Humidity, Solar Radiation Watts, Wind Direction Degrees, Wind Speed, and Battery Park Water Depth.

This paper describes Phase I of the analysis of the water quality data and the development of time series models for forecasting each of the 7 site variables at Kearny and Mill Creek stations based on 2 and 7 months of data for Kearney and Mill Creek, respectively. The process of forecasting the water quality by using these models and identifying unusual measurements that are outside the control limits was mechanized by developing an Excel-macros program. When an observed value turns out to be outside the 95% tolerance interval, it would be investigated to determine if it occurred due to an instrument problem along with the causes of such a malfunction of the measuring instrument.

Since Phase I data did not capture the normal seasonal variation for spring, summer and fall, now additional data are being collected to cover a full one-year period. This one-year data will be used in Phase II to develop comprehensive models that incorporate the seasonal variations and the new models will be used to recalibrate the Excel-macros program.

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URBAN AEROSOLS CHARACTERIZATION IN NEWARK NJ

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Newark is the largest city in New Jersey, and it represents a unique metropolitan area that is heavily influenced by extensive industries, large population, massive transit, main airport, and port facilities. To characterize urban particulate air pollution in such environment, air particulate sampling was conducted in Newark during the month of July 2006. A PM2.5 low-volume air sampler was used for sample collection that took place on the roof of a 23 m building at Rutgers University Newark campus located in the heart of Newark. Samples were taken at different diurnal times. An inductively coupled plasma mass spectrometer (ICPMS) was used to determine the concentrations of selected trace elements associated with air particulate matter. Ion chromatography (IC) was used to determine concentrations of the selected ions in air samples. This presentation will focus on the discussions of the ambient levels of selected air particulate pollutants over Newark and their possible sources.

PHENOLICS-OXIDIZING ENZYMES OF ROOTS OF NON-NATIVE AND NATIVE PLANTS

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Phenolic compounds are allelopathic signal molecules exuded by the roots of many plants and detected by the roots of other plants. Invasive plants – plants that often were introduced from far-away regions - may not respond appropriately to these coevolved interspecies signals. Root enzymes that destroy phenolic compounds may be involved in the process of permitting an invasive plant to (a) ignore the signal molecules exuded by plants in the native community and (b) to render such allelopathic compounds ineffective. We screened and assayed roots of a wide range of invasive and native grasses for phenolic oxidase and peroxidase enzymes. An analysis of our assembled grass data base suggests that only members of the genus *Bromus* display elevated levels of phenolics-oxidizing enzymes. Species from that genus are known to be problematic invaders in many parts of North America; there are several non-native *Bromus* species in the Hackensack Meadowlands. Other grass genera, regardless of their life form and tendency to invasion, typically have lower levels of these enzymes. Current research is aiming at identifying the ecological function of elevated enzyme activities. Phenolic degrading enzymes have broad specificity. Phenolase and laccase, enzymes widely distributed in the plant kingdom, have been shown capable of degrading chlorophenols and other xenobiotic phenolics. Phytoremediation of xenobiotic chlorophenolics has been demonstrated. Thus knowledge of which plants in the ecosystem possess these enzymes in their roots should be useful in remediating contaminated sites.

MULTIVARIATE STATISTICAL ANALYSIS OF PHYTOPLANKTON POPULATIONS IN THE LOWER HUDSON RIVER

Kim, E-W[1]; **Park**, M. [2]; **Levandowsky**, M. [3]; **Wang**, Zhaoyan[4]; **Vaccari**, David A[4]

An 8-year series of weekly phytoplankton samples from surface water at two lower Manhattan sites in the Hudson River was analyzed using Multivariate Polynomial Regression (MPR) and Canonical Correspondence Analysis (CCA). The 2 sites were Pier 26 on the Hudson River and Piers 15-16 on the East River. Presence-absence data were collected on 29 taxa, readily identifiable with the light microscope from living material, along with measurements of temperature, salinity, pH, Secchi depth and dissolved oxygen.

The CCA analysis used presence-absence data of all 29 taxa at both sites. The Hudson sample points formed distinct clusters with respect to salinity and temperature, whereas the East River samples, involving the same taxa, did not. The data suggest significant differences in organization of phytoplankton at these two sites: the lower Hudson River phytoplankton community appears to be much more structured than that of the East River. This may be due to hydrodynamic differences: the Hudson is typically highly stratified, whereas the East River is dominated by turbulent mixing. The contrasts in the data appear to reflect the high degree of hydrologic stratification of lower Hudson, and the extreme turbulence of the East River. Distributions of individual taxa in the ordination plane were also studied, allowing a characterization of them with regard to hydrographic variables.

MPR models were developed to predict the probability of presence or absence of 3 of the phytoplankton taxa at the Hudson River site: *Actinoptychus undulata, Rhizosolenia setigera*, and *Scenedesmus quadricauda* from the physicochemical measurements. The MPR model can describe interactions and nonlinear behavior in complex systems with an explicit equation. The MPR model significantly improved the accuracy of prediction over multivariate linear models, and could describe complex behavior such as nonlinearities and interactions. A probability response surface can be described using the model. This was used to identify the physical parameter space corresponding to various probabilities of occurrence for the taxa that were modeled.

These analyses demonstrate that meaningful statistical information can be obtained from such categorical (presence/absence) data. This information includes identifying correlations between sets of population and water quality variables, and being able to predict the probability of finding a particular species given independent physical and chemical water parameters.

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MEADOWLANDS BIODIVERSITY: WHAT DO BUTTERFLIES, ODONATES, AND FROGS TELL US?

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Biodiversity can indicate environmental quality and its change over time. There are few published studies of American urban biodiversity. In 2006 I sampled butterflies, odonates (dragonflies and damselflies), and frogs in the Meadowlands to address MERI's interest in a long-term monitoring program. These animals are useful for comparing urban and rural areas and and monitoring temporal change.

I performed frog call surveys at two freshwater sites, Teterboro Airport Woods and Guarini Tract, counting calls for 2.5 hours beginning about dusk, once each in April, May, and June. I detected only southern leopard frog, in modest numbers (ca. 15 calling males per site). Several other species have been reported but probably only American toad, green frog, and bullfrog persist. Southern leopard frog has disappeared from Long Island thus a population in the Meadowlands is noteworthy. Frog diversity in the Meadowlands is limited by the distribution of freshwater of good quality and combinations of wetland and undeveloped upland habitats. Despite low diversity, long-term frog surveys are worthwhile because frogs are sensitive to local and global ecological change. I recommend continuation of frog surveys by remote recording.

James Barbour and I performed strip transect surveys for adult odonates and butterflies in late June, once each at five sites (Kearny Marsh West, Disposal Road, Laurel Hill, Kane Natural Area, and Merhof Pond). On each 100 min survey we counted insects in 5 m of vegetation either side of a dirt road 1000 m long and divided in 10 equal segments. We identified flora and ranked abundance of trees, shrubs, vines, and selected nectar plants by segment along the transects. We recorded 25 species of butterflies and 24 species of odonates on overall. All odonates and all but two butterfly species are native. We detected a mean of 82.8 insects per transect. Damselflies were common on two transects with abundant nearly-fresh water and virtually absent from the other three transects. Dragonfly abundance and species richness were negatively correlated with rank sums of woody vegetation, probably because adult odonates need sunny open areas. We found two possibly rare odonates, Needham's skimmer and big bluet. There were no strictly stream-associated odonates. Butterflies were mainly common species of open areas, a few common woodland species, and one possibly rare skipper. We observed butterflies nectaring at a variety of introduced and native flowers.

Many butterfly and odonate species are strong dispersers thus able to reach suitable habitats in urban areas. Butterfly diversity in the Meadowlands is limited by habitats and host plants, among other likely factors. Odonate diversity is limited by distribution of low salinity waters of good quality, and the absence of minimally-altered stream habitats. Butterfly and odonate diversity depends on proximity of wetland and undeveloped upland habitats. I recommend continuation of butterfly-odonate surveys using a larger number of transects and repeated surveys of individual transects. Improvement of wetland quality and protection of undeveloped uplands will help ensure future diversity of frogs and insects.

ON-LINE MEMBRANE EXTRACTION FOR REAL-TIME WATER MONITORING

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The increasing need for inexpensive, real-time monitoring devices has added new impetus to developing chemical analysis systems that integrate sampling, sample preparation and detection. One way to enhance sensitivity in these measurements is to provide concentration, and/or extraction along with other functionalities. The goal is to integrate these components to develop total analytical systems for on-line, real-time analysis.

This presentation covers some recent developments including membrane sampling and microconcentration techniques. The water monitoring devices developed here can be used as, laboratory instruments, field analytical and as on-line monitoring devices. Applications in the monitoring of different classes of compounds are covered that include volatile organics, semi-volatile organics, haloacetic acids, pesticides, pharmaceutical products and metals. Microfabricated devices using MEMS technology have also been developed, which can lead to miniaturization.

DECHLORINATION OF NATIVE PCBS IN KEARNY MARSH SEDIMENTS

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The Kearny Marsh is an approximately 311 acre freshwater impoundment wetland located within the New Jersey Meadowlands. The marsh is a receiving body for landfill leachate and urban surface runoff, resulting in low levels (approximately 2 mg/kg) of polychlorinated biphenyls (PCBs) in the marsh sediment.

Preliminary microcosm studies using Kearny Marsh sediment showed that stimulating the native bacterial population with pentachloronitrobenzene resulted in dechlorination of historical PCBs. The chlorine ions removed from the PCBs were mainly from the para- and meta- positions, suggesting that biological processes were responsible for the dechlorination.

Follow-up microcosm studies are being performed to identify which treatments are most effective in stimulating PCB dechlorination. The microcosms consist of 200 mL of marsh sediment, amended with one or more of the following treatments:

1. A mixture of four organic acids (lactic, propionic, acetic, and butyric acids) to serve as electron donor.
2. A mixture of solvents (methanol, acetone, and 1-butanol), to increase bioavailability
3. tetrachlorobenzene to stimulate dechlorinating bacteria, and
4. Spiking with a non-naturally occurring PCB congener (PCB116) to evaluate the capability of the native microbial community to dechlorinate this model compound

These studies will be followed up by field testing in Kearny Marsh during the spring/summer of 2007. Nine two-foot diameter enclosures were installed in marsh sediments to form "mesocosms" for testing the combined effects of capping with AquaBlok® and the most promising treatments identified in the microcosm studies. The experiments will address the logistics of adding a treatment to sediments beneath a cap, and evaluate the effectiveness of some treatments to enhance *in situ* biotransformation of the native PCBs.

BIOTIC AND PHYSICAL RESPONSES TO REHABILITATION ALONG THE BRONX RIVER IN THE BRONX: EVALUATING SUCCESS & MONITORING APPROACHES

Larson, Marit[1]; **Yackulic**, Charles[2]

Rehabilitation efforts along the Bronx River for the past 10 years have been aimed at controlling invasive species, increasing the extent and diversity of native vegetation, increasing aquatic habitat diversity, and reducing erosion and other sources of non-point source pollution. Relatively few of the rehabilitation actions have been systematically evaluated, but beginning in 2002, we began three summers of benthic invertebrate and vegetation monitoring to try to assess the measurable effects of the rehabilitation actions. Benthic invertebrate sampling was conducted at eight sites along the river. Vegetation monitoring plots were established primarily in the northern freshwater section of the Bronx River in areas where invasive plant removal and re-vegetation efforts were focused. Basic hydrological and channel morphologic impacts of the rehabilitation measures were also assessed.

The benthic invertebrate data was used to determine the values of water quality indices at each site. The most common taxonomic groups in the river as a whole were moderately to very tolerant of pollution, and the majority were collector gatherers. A lack of data prevented comparison of change over time at several freshwater sites where most rehabilitation activity had occurred. In general, the northernmost freshwater section of river in the Bronx had the most diverse benthic community, while downstream sites showed greater water quality impacts or a downward trend over time. Rehabilitation efforts to date have not had a significant impact upon the flood hydrograph, and channel cross-sections have shown trends towards pre-project conditions, as well as the stability of constructed pools.

The vegetation data was categorized and assessed in relation to reference invasive-dominated and native dominated riparian vegetation communities. The results suggested that differences in treatment, management, and position in the landscape resulted in a continuum of responses ranging from complete reversion of a site to invasive species, to a trend towards fewer invasive and more dominant native species. The only significant trend across the data appeared to be a greater trend towards reference conditions following restoration in the southern end of the floodplain forest, potentially as a result of the greater riparian buffer, more canopy, and more use of rooted plantings.

Our vegetation monitoring results suggested that invasive species management is not sufficient to ensure greater native species recruitment and also pointed to potential challenges in using bioengineering. However, the monitoring was not designed to discern between different environmental or management factors in the trends we observed. Benthic monitoring, although not a direct measure of the performance of the riparian rehabilitation measures, served as useful diagnostic tool and provided an indication of the restoration potential of a stream system over a longer timeframe. Channel morphologic and hydrologic parameters monitored were also not necessarily sensitive to the scale of the projects or the short time frames. Monitoring efforts along the Bronx River underscore the need to target monitoring towards the specific parameters that one intends to impact through rehabilitation efforts, including educational and recreational characteristics and functions of a site.

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HISTORY OF INDUSTRIALIZATION AND LAND USE CHANGES IN THE BERRY'S CREEK WATERSHED AND THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN MAPPING OF RESTORATION OPPORTUNITIES

Laska, Mark S.; **Dvorett**, Dan; and **Stanich**, Serge; Great Eastern Ecology, Inc., New York, NY

The New Jersey Meadowlands have undergone over 400 years of extensive land development and industrialization that have resulted in extensive damages to natural resources from land modification and discharges of industrial wastes. Determining the sources and extent of damages to natural resources is often difficult without a comprehensive understanding of the historic ecological setting and anthropogenic influences causing their degradation. Utilizing Geographic Information Systems (GIS) based technology, records of industrial activity can be spatially analyzed over current and historic aerial photography providing a view of potential contaminant sources and their migration. Overlaying multiple data sources within GIS allows for the disentanglement of responsibility for multiple-party Comprehensive Environmental Response, Compensation and Liability (CERCLA) actions. CERCLA serves to provide remedies to industrial contamination of natural areas and includes provisions to compensate the public trust for loss of services through Natural Resource Damage Assessment (NRDA) claims. Incorporating biological and ecological data, including faunal surveys and habitat type delineations, within GIS provides empirical data to establish baseline ecological conditions as well as measure the extent of lost service for NRDA and identify opportunities within the watershed that would benefit from restoration activities.

NATURAL RESOURCE DAMAGE ASSESSMENTS IN URBANIZED AND CHANGING HABITATS – BERRY'S CREEK, NJ

Laska, Mark S.[1]; **Galloway**; Richard W.[2]; **Guest**, Daniel T.[3]

Natural Resource Damage (NRD) penalties follow from Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Oil Pollution Act (OPA) actions where a release into the environment has resulted in a loss of ecological services. Habitat Equivalency Analysis (HEA) is a model that is used to estimate the extent to which the PRPs are required to reimburse the public for the injury, payable in the form of cash or equivalent habitat enhancements on site or elsewhere. The HEA analysis is based on the presumption that before the release a baseline level of habitat services existed. The habitat of the New Jersey Meadowlands has changed dramatically in the last 150 years. The remaining habitat in Berry's Creek, the location for a recent CERCLA action, was formerly freshwater Atlantic white cedar forest, and then it became brackish *Spartina alterniflora* marsh, and is now primarily *Phragmites*-dominated marsh. Wetlands have been drained and filled for navigational and developmental uses diminishing habitat value. We examine the difficulties and complexities in establishing a HEA protocol when baseline habitat values are changing over time and are due to multiple influences, releases and non-release events. In addition, we discuss the strategies and challenges of analyzing NRD in the Berry's Creek Watershed.

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RETROFIT PATH TO NET-ZERO ENERGY BUILDINGS

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Stabilizing climate change will require an 85% reduction in current greenhouse gas (GHG) emissions. Buildings consume directly nearly 40% of the energy supply. Newer technologies such as geothermal, wind and photovoltaic systems have more recently been applied to housing. The challenge is to achieve cost-effective, simple net zero-energy housing with no GHG emissions in cold northern climates where solar insolation is available only 12-16% of the time. This paper focuses on a retrofit approach to an existing low energy building using only solar energy to achieve net-zero energy.

The current building (built 1998) integrates 5 approaches to achieving low energy use: site, spatial design and orientation; efficient house envelope; efficient appliances and lighting; renewable energy systems; and occupant conservation behavior. The house is a 2400 ft2 two-story cantilevered ranch oriented south, with a length/width ratio of 2. The house is partly bermed, with R values of 40, 27, 3.3, 6 and 16 for the roof, walls, windows, doors and slab, respectively. Tight house construction provides 0.05 air changes per hour (ach). An 80% efficient heat recovery ventilator provides fresh air at 0.3 ach. The calculated heat loss value for the house is 3 Btu/ft2/DD, with an envelope heat loss of 45 million Btu's in a 6500 DD climate All appliances are Energy Star rated. Most lighting in the house is highly efficient T8 fluorescent bulb valence lighting or CF bulb fixture lighting. Overall electrical consumption averages 280 kWh per month. The current backup system is a 90% efficient sealed-combustion oil-fired boiler with a 40-gallon indirect fired hot water tank. Heat distribution has 5 heating zones and includes basement radiant heating and baseboard heating upstairs. Solar heat is collected from 200 ft2 of south facing windows, and an 8 ft. by 12 ft. south facing greenhouse (installed 2002), totaling about 27.5 million Btu's. 75% of the hot water load is provided by 64 ft2 of solar collectors (installed 1999) with an 80-gallon storage tank that feeds into an indirect-fired 40-gallon hot water heater. A 2.5 kW grid-connected photovoltaic solar electric system (installed 2003) provides about 4000 kWh per year, including 600 kWh of excess electricity. Occupant behavior includes reducing thermostat settings to 60 degrees F at night, minimal use of the electric clothes dryer, and occasional cold water clothes washes. Backup oil use has decreased from an initial value of over 250 gallons per year in 1998 to an (estimated) under 120 gallons for the 2006-2007 season.

A detailed analysis of the energy budget and cost effectiveness of each component of the overall design will be presented, with modifications that will achieve net-zero energy use. These include: use of movable insulation, added insulation, 1 kW of additional photovoltaic panels, electric heat for the solar backup tank, and replacing the oil-fired boiler with an electrically heated source of hot water.

COUPLING TOP-DOWN AND BOTTOM-UP RESTORATION PARADIGMS TO ENHANCE BIOGEOCHEMCIAL CYCLING, ECOSYSTEM SERVICES, AND BIODIVERSITY IN THE HACKENSACK MEADOWLANDS

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Ecosystems organize themselves around flows of matter and energy, - all the more critical for the Hackensack Meadowlands, which serves as a major center for ecosystem services and biodiversity in the densest metropolitan region in the country. While management of the Meadowlands has taken large steps forward in recent years, two essential features of ecosystem growth and development could favorably contribute to its sustainability:

1) the enhancement of habitat and structural diversity of landward, intertidal, and benthic environments;
2) maximizing biogeochemical filtration through a zero-discharge stormwater policy, as well as creation and extension of marshes, mudflats, mussel beds and oyster reefs.

While not fully understood, structural diversity of landscapes, waterbodies, intertidal and benthic environments regulates biological diversity, including the length and complexity of food chains. Habitat types from low and high marsh to reed-grass meadow provide some diversity, but could be well augmented by hypothesis-driven, properly scaled restoration of Atlantic white cedar, wild rice, shrub-scrub, swamp forest, and other native plant communities.

Since the highest predator strongly affects food web structure, raven reintroduction in the Meadowlands is a substantial step in ecosystem restoration. To carry this forward, habitat restoration for insectivores, for example, could favorably contribute to both human and ecosystem health. Textured surfaces under bridges to attract nesting swallows, bat houses, and nesting boxes for phoebes and other insect eating birds could create habitat for some of the species only recently absent in meadowlands and surroundings. Hawk and owl platforms and boxes, and tree copses planted away from human contact to provide future heron rookeries, directed by specific hypotheses on habitat features attractive to targeted species, can help to develop integral management tools.

Human built structures including warehouses and parking lots presently provide no ecological value. Greenroofs on such structures could provide protected zones for native plant meadow and shrublands, as well as a refugia for ground-nesting and other birds species vulnerable to raccoon, cat and other terrestrial predators adapted to life near human habitation. Parking lots and roadways outfitted with below-grade cisterns could capture a million gallons of stormwater/acre, decreasing pollutant loads, charging local water tables and increasing plant survival, primary productivity and base flow into the Hackensack and its tributaries.

Discharges from seven wastewater treatment plants, nearly seventy industrial facilities, and thirty two combined sewers put the Hackensack at risk. Opportunities exist to both decrease inputs and increase the scale of filters in the estuary to remove pollutants and increase habitat. Salinity, flow, bacteria and plankton content, and potential fish habitat maps may be used to site oyster reefs for filtration and biodiversity enhancement. About a hundred acres of oyster reef would, conservatively estimated, filter the full 400 cubic foot per second base flow of the Hackensack. Marsh, eelgrass, and mussels beds could be used with oyster reefs to create a habitat mosaic, adding value which could be measured in terms of water quality enhancement and biodiversity impacts.

MARINE ELECTRICAL RESISTIVITY IMAGING OF SHALLOW-WATER WETLANDS

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Continuous marine electrical resistivity imaging (ERI) using floating electrodes was conducted from a paddleboat to predict spatial and temporal patterns of pore-fluid conductivity within Kearny freshwater marsh soil. Resistivity measurements were obtained with marine-acquisition software and a multi-channel resistivity instrument at 6 times over a four month period, covering a 10,000 m^2 grid. A set of 10 simultaneous reception channel measurements were continuously recorded every two seconds yielding an average of 13,000 measurements per survey. Three dimensional inversion was carried out to determine the conductivity distribution of the subsurface using the smoothness-constrained least-squares optimization method. The continuously recorded surface water conductivity and average depth were entered as known information in the three dimensional (3-D) inversion and measurement error (for constraining the inversion) estimated from tie points. Pore-fluid conductivity was constrained using surface conduction measurements obtained from laboratory experiments on soils extracted from the wetland and a correction for temporal and spatial temperature variations using direct surface water temperature measurements.

The study demonstrates that: (1) continuous ERI is an ideal method for determining the resistivity structure of wetland sediments covered by a shallow surface water layer such as those in the New Jersey Meadowlands, (2) temperature variations must be considered in such shallow monitoring studies as they may otherwise have the most significant influence on the results, and (3) surface conduction is significant in marsh soils and must be accounted for if subsurface conductivity models are to be reliably interpreted in terms of pore-fluid chemistry. In this study, changes in pore-water conductivity estimated from inverted models suggest that migration of contamination from marginal landfills into the Kearny marsh accompanies rainfall events.

BRIDGE CREEK – TIDAL WETLAND RESTORATION IN AN URBAN SETTING

Maresca, Susan I.[1]; **Albrecht**, Sherri[2]

The 22-acre Bridge Creek wetland restoration site is located in northwest Staten Island, Richmond County, New York. The site is owned by NY State Department of Environmental Conservation. Hydrology is provided by Bridge Creek, a tidal tributary of the Arthur Kill. Pre-restoration conditions that contributed to selection of this site for restoration included: flow restrictions along Bridge Creek; a dominant monoculture of invasive *Phragmites australis*; historic filling and ditching; and exposure to multiple oil spills. Opportunities for wetland restoration at the Bridge Creek site consist of addressing one or more of these conditions, with the goal of restoring the area to a fully functional marsh system.

Desirable attributes of the Bridge Creek site that made it an attractive choice for restoration include proximity to other natural systems on Staten Island, including the adjacent Goethals Pond site. Goethal's Pond is owned by NYSDEC and is part of a larger system on Staten Island known as the Harbor Herons Complex, a state designated Significant Coastal Area recognized for its importance as habitat for migratory and breeding birds.

Implementation of the Bridge Creek Wetland Restoration was a multi-faceted project which involved multiple agencies and funding sources. In addition to the NYSDEC, the following agencies were involved to varying degrees: New York City Parks, the Port Authority of New York & New Jersey, the New York State Office of General Services, and the National Oceanic and Atmospheric Administration.

The first phase of the restoration included a hydrology study and modeling effort to identify specific restrictions to tidal flow and associated opportunities for improvement. Vegetation mapping and a topographic survey were also conducted to establish baseline conditions.

The hydrology study identified tidal flow impediments within Bridge Creek between the Arthur Kill and the Western Avenue culvert in the area where the creek flows through the Howland Hook Container facility, owned by the Port Authority of New York & New Jersey. Improvements to Bridge Creek to reduce these flow restrictions were conducted by a New York/New Jersey Port Authority project which modified the channel bottom and side slopes as it runs through Howland Hook and removed sediment shoals that obstructed tidal flow.

Based on the hydrology study, NYSDEC implemented a design that enlarged the Bridge Creek channel within the restoration site and constructed new or improved existing side channels throughout the site. Important pre-design considerations included protection of existing areas of desirable vegetation, pre-treatment of invasive vegetation, on-site disposal options for excavated material, off-site disposal of contaminated soil, protection of utilities and coordination with adjacent property owners. The final design included lowering of the marsh plain to remove invasive species and create an environment more conducive to the establishment of native salt marsh vegetation, which was planted throughout the site. Maintenance and adaptive management, including herbivory control, micro-topography adjustments to facilitate drainage, re-planting, and follow-up herbicide application were also important to the project success.

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A RAPID APPROACH TO CHARACTERIZE NATURAL ORGANIC MATTER IN WATER

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Natural organic matter (NOM) in the environment today does not only come from humic sources, but also from non-humic or synthetic sources. The typical total organic carbon (TOC) analysis has been typically used as an aggregate measure of NOM in water. NOM from New Jersey (U.S.A) surface water sources were isolated and fractionated by resin adsorption techniques into hydrophobic acid, hydrophobic neutral, hydrophobic base, hydrophilic acid, hydrophilic neutral and hydrophilic base. The Spectral Fluorescent Signatures (SFS) technique through a database of spectral characteristics specific to each fraction was developed for the identification of the six NOM fractions. Among the main advantages of the technique are high sensitivity and rapid identification. The potential use of the technique for the rapid qualitative and quantitative identification of the NOM fractions, including the problematic ones, for point/non-point source water assessment and impact on water quality is presented.

LOOKING AT THE NEW JERSEY MEADOWLANDS: A HISTORICAL OVERVIEW

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Satellite images and scientific monitoring reports using on-site inspection, sampling and laboratory analysis are the latest manifestation of a centuries-old practice of observing and reporting on the New Jersey Meadowlands. The first sources of information about the Meadowlands were intermittently-published travelers' accounts during the 17th and 18th centuries. The first maps showing any recognizable portions of the Meadowlands were produced during the American Revolution to assist and record military operations. The first maps showing the wetlands' precise boundaries (as well as the routes of the newly-constructed Morris Canal and two railroads) were published in the 1830s and 1840s by public and private mapmakers. Detailed topographical maps were produced several decades later, first by the N.J. Geographical Survey and later by the U.S. Geological Survey. State and federal agencies also later made more detailed maps and studies of the Meadowlands, with the goal of facilitating its "improvement" (i.e., its transformation from wetland into upland). Technological innovations in photography and aviation in the early 1900s led to the development of aerial photographs, a new medium for observing and recording conditions and changes in the Meadowlands. This was supplemented by the development of satellite imaging at the end of the century. The development of video technology also provided another method of observing and recording conditions at the Meadowlands. Until late 1900s, almost all studies and records of the Meadowlands focused upon its physical characteristics (e.g., elevation, boundaries between upland and wetland, and water depth). Growing awareness of the environmental benefits of wetlands and increasing concern over (legal and illegal) waste disposal led to detailed studies and reporting of pollution history and current ecotoxicology of the Meadowlands. Much of this work was institutionalized in a new state agency created in 1969, the Hackensack Meadowlands Development Commission (since 2001, the New Jersey Meadowlands Commission [NJMC]). Most recently, computers have assisted the storage, retrieval and presentation of data about the Meadowlands, via database management systems, Geographic Information Systems (G.I.S), and NJMC websites.

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TOXICOLOGY ANALYSIS FOR *VULPES VULPES*

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In ecological risk assessment, metals, like any other contaminate, are not considered a potential hazardous chemical toxic unless it reaches an active site in the target species at a sufficiently high concentration to generate adverse reactions. Therefore, the bioavailability of these compounds and their risk leads to establish the relationship of contaminants in the environment with wildlife contamination and other key environmental parameters.

For wildlife studies, heavy metals, PCB's and Pesticides have been studied by measuring chemical residues in tissues or fluids of animals living in appropriate aquatic or terrestrial habitats. Many different species can be used to estimate the impact of toxic chemicals on aquatic organisms, but the choice of suitable terrestrial indicators is more problematic. Several wild animal species, such as chamois, moose, red deer, reindeer, or roe deer, have been proposed for biomonitoring studies. All these herbivorous species occupy very large territories and may not be helpful in localizing specific sources of toxic hazards. The Meadowlands District is a wetlands environment bounded by urban development. Red foxes adapt to a variety of environmental conditions and in urbanized areas, occupy territories up to 0.5 km^2 making them suitable for the study of specific contaminants in specific locations. The use of red foxes for biomonitoring purposes has been proposed before, but previous reports were limited to the analysis of foxes living in rural habitats.

This study presents a statistical comparison of contaminants concentration for each of the target organs studied from a 3 years old female compared with NOAEL and other toxicological benchmarks. Special considerations are made in the case of Mercury contamination since The Meadowlands District is the highest concentration of mercury of any fresh-water sediment in the world.

OVERCOMING CHALLENGING SOIL CONDITIONS IN THE MEADOWLANDS TO ENHANCE A DEGRADED, URBAN WETLAND

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The Secaucus High School Wetland Enhancement Site, located in Secaucus New Jersey, is currently being enhanced by the New Jersey Meadowlands Commission (NJMC). The project will enhance an approximately 31-acre degraded tidal marsh located adjacent to the Secaucus High School on the Hackensack River. The enhancement will improve tidal flow and re-establish a diversity of high and low marsh wetland plants to provide habitat for a variety of wildlife. The work generally includes isolating the site from the Hackensack River, changing the surface elevations by excavation and fill, creating new channels, planting of various wetlands vegetation, constructing approximately 1,470 feet of pile supported wooden boardwalk and restoring the connection of the site to the River.

During the design phase, the NJMC collected detailed data on site soils, hydrology, vegetation, and wildlife use. During the field work, it became evident that the site contained many areas of "soft-soils" that could prevent earthwork activities on the site. To identify the location and depth of these problematic soils, the NJMC conducted extensive borings using a hand-held Russian peat borer. This chambered-type corer collects undisturbed samples, which are not compressed or shortened during recovery, from very soft and mucky soils. The borings identified multiple locations with unconsolidated mucky soils at or near the surface. The depth of the soils ranged from a few inches to almost three feet.

Since excavation in the low-marsh portions of the site could be compromised by these challenging soils, the design requires several unique projection measures. A timber mat road will be used to move equipment and material across the marsh. The installation of the road will be such that the load from crossing vehicles is less than 2 pounds of bearing pressure per square inch of mat area. The Contractor shall excavate the marsh plain section by section with one pass of the heavy excavating equipment. Once the wetland and stream design grades are established, the Contractor will avoid additional heavy equipment traffic in these areas. In areas where the muck is encountered, the use of heavy equipment will be avoided and/or minimized. In any areas where excavation exposes greater than 100 square feet of this unsuitable planting substrate, coir fiber biomats will be installed to stabilize the area prior to the introduction of tidal waters.

Construction of this wetland enhancement project is scheduled to begin in March 2007. Marsh excavation and planting will be completed in June 2007.

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EFFECTS OF VARIATIONS OF A CLAY-BASED CAP ON THE ABUNDANCE OF MACROINVERTEBRATES AND WATER QUALITY IN KEARNY MARSH

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Due to landfills that were uncapped in the past, the water and sediments of Kearny Marsh are contaminated with heavy metals and other contaminants. In an attempt to cap the contaminated sediments and decrease the presence of contaminants on the bottom of the marsh and the water column, a clay-based cap, with a variety of treatments, was installed in Kearny Marsh during the summer of 2005. To determine the effect of the cap on the abundance of macroinvertebrates and on the water quality of the marsh, sediment cores and Hester-Dendy collectors were used to collect macroinvertebrates, and salinity, pH, DO, eH and temperature of the water was measured with a Hydrolab datasonde meter in September of 2005 and May and August of 2006. Before the cap was in place there were few macroinvertebrates in the cores. Salinity and pH were constant in all plots while DO, eH and temperature were higher on the west side of the marsh than on the east side. After the installation of the cap and in September of 2005, macroinvertebrates in the cores were still very few. Many more macroinvertebrates were collected on the Hester-Dendy collectors but there was no significant difference between the plots. DO was significantly lower in the uncapped plots than in the capped plots, salinity was significantly lower in the uncapped plots than in the capped plots, pH was significantly higher in the capped plots than in the uncapped plots, and eH in the plots that lacked peat moss was significantly higher than it was in the uncapped plots. In both May and August of 2006, macroinvertebrates in the cores remained few but diversity increased. The abundance of the macroinvertebrates collected on the Hester-Dendy collectors was significantly higher on capped plots that contained aquatic vegetation seeds and peat moss than on uncapped plots with aquatic vegetation seeds. There were no significant differences in salinity. In May, one of the two control plots with aquatic vegetation seeds had significantly higher pH than the other treatments but in August this plot had significantly lower pH than the other plots. Also in May, one of the two plots with a cap that contained peat moss and aquatic vegetation seeds had significantly higher DO than the other plots. However in August, one of the two control plots that contained aquatic vegetation seeds had significantly lower DO than one of the two uncapped and capped plots that lacked peat moss. The results suggest that capping material that contains aquatic vegetation seeds and peat moss increases the abundance of macroinvertebrates on Hester-Dendy collectors and increases DO of the water. The abundance of macroinvertebrates in the sediment may increase over a longer time period.

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ASSESSMENT AND TREATMENT OF CONTAMINATED DREDGED SEDIMENTS FROM PASSAIC RIVER

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Navigable waters including Hackensack and Passaic Rivers are dredged regularly to maintain and sometimes extend water depths. Dredged sediments are often highly contaminated and their disposal is not only expensive but also unsustainable. If effectively stabilized, dredged sediments have potential for beneficial reuse in the construction industry as an alternative to disposal. In this study, metal contaminants (Zn, Mn, Pb, Cd, Ba, and Se) in sediments from Passaic River and from Dampremy, Belgium were assessed using a suite of complementary analyses including the U.S. EPA toxicity characteristic leaching procedure (TCLP), synthetic precipitation leaching procedure (SPLP), sequential extraction, x-ray diffraction (XRD), and x-ray absorption spectroscopy (XAS). Interestingly, sediments from both locations showed similar levels of metal contaminants. For Passaic River sediments, Zn was the most abundant contaminant (1136 mg/kg) followed by Mn (476 mg/kg), Ba (296 mg/kg), Pb (118 mg/kg), Cd (30 mg/kg), and Se (< 20 mg/kg). Using linear combination and principal component analyses, XAS data showed Zn in untreated sediments was adsorbed to hydrous iron oxides (41.3%), precipitated as hydrozincite (37.9%), and adsorbed to montmorillonite (20.8%). Stabilizing of the contaminated sediments was examined using phosphate addition and thermal treatment at 700 ^{o}C to form sparingly soluble metal hydroxylapatites and mineralize organics. Leaching of the metal contaminants as determined using TCLP was reduced in the treated sediments by as much as 89%. XAS analyses of treated Dampremy sediments showed the Zn speciation as the crystalline phases: temperature induced, gahnite ($ZnAl_2O_4$) at 46.5%; phosphate mineral, hopeite ($Zn_3(PO_4)_2 \cdot 4H_2O$) at 36.2%; and $ZnSO_4$ at 17.3%. Thermodynamic analyses confirmed stability of the mineral phases in the treated sediments.

PROFILING BIOAVAILABLE METALS IN URBAN SALT MARSH SEDIMENTS

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The Arthur Kill is a severely polluted urban waterway within the vicinity of the New Jersey Meadowlands District that adjoins many wetland areas along the shores of New York and New Jersey. In the past various manufacturing and industrial facilities have discharged contaminated effluents into these receiving waters, and subsequently subjected these areas to intensive metal loadings that has compromised the water quality of the region. The exposure of estuarine biota to heavy metal pollution is related to the concentration of metals that are biologically available through water or sediment. In estuarine environments bioavailable metals are correlated with easily extractable fractions, rather than with total metal contents. Previous studies have demonstrated that partial extraction techniques, like a weak-HCl procedure, are useful to release biologically relevant fractions of metals from sediments. The focus of our study was to quantify bioavailable metals (Cd, Cu, Zn) in sediments of salt marshes adjoining the Arthur Kill, in Staten Island, New York. Chronologies of metal concentrations in marsh sediments illustrate temporal contamination at each site and show that locations adjacent to the Arthur Kill Proper contain high levels of bioavailable Cd, Cu and Zn. Results indicate that concentrations of extracted metals at Lemon Creek, a site external to the Arthur Kill and the least contaminated, are slightly higher than (at the surface) or comparable (at depth) to background levels. Surface and subsurface sediments at sites near the Fresh Kills landfill were found to contain metals markedly elevated above regional background concentrations. Metal concentrations in sediments near a former smelting facility contained the highest Cd, Cu, and Zn levels in the area. Obvious subsurface peaks are indicative of past pollution activities and consequent metal loadings. In general, subsurface concentrations (2-20cm) were found to be higher than surface concentrations (0-2cm). This implies a decrease in metal loadings to the region and greater vulnerability of metal exposure to subsurface deposit feeders compared to surface deposit feeders. Future studies will assess the toxicity of these metal-contaminated sediments to organisms inhabiting these wetland habitats and examine the role of the Arthur Kill as a source of metal pollutants to neighboring creeks and salt marshes. Ultimately, this will aid in assessing the success of current and future remediation and restoration efforts in this significantly impacted waterway.

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GEOPHYSICAL MONITORING OF MICROBIAL ACTIVITITY WITHIN A WETLAND SOIL

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We performed Induced Polarization (IP) and Self Potential (SP) measurements to record the geoelectrical signatures of microbial activity within a wetland soil. The experiment was conducted in laboratory, utilizing an open flow column set up. Soil samples from Kearny Marsh (KM), a shallow water wetland, were collected and stored at 4^{o} Celsius prior to the start of the experiment. Two columns were dry packed with a mix of KM soil and sterile Ottawa sand (50% by weight). One column was sterilized and used as a control while the other column retained the biologically active soil sample. Both columns were saturated with a minimal salts medium capable of supporting microbial life; after saturation, a steady flow rate of one pore volume per day was maintained throughout the experiment. Ambient temperature and pressure changes (at the inflow and outflow of each column) were continuously monitored throughout the experiment. Common geochemical parameters, such as Eh, pH, and fluid conductivity were measured at the inflow and outflow of each column at regular intervals. IP and SP responses were continuously recorded on both columns utilizing a series of electrodes along the column length; additionally for the SP measurements we used a reference electrode at the inflow tube. Strong SP anomalies were observed for all the locations along the active column. Black visible mineral precipitant also formed in the active column. The observed precipitation coincided with the times that SP anomalies developed at each electrode position. These responses are associated with microbial induced sulfide mineralization. We interpret the SP signal as the result of redox processes associated with this mineralization driven by gradients in ionic concentration and mobility within the column, similar to a galvanic cell mechanism. IP measurements show no correlation with these visual and SP responses. Destructive analysis of the samples followed the termination of the experiment. Scanning electron microscopy (SEM) and Energy Dispersive Spectrometry (EDS) were used to identify and quantify the presence and composition of the mineral precipitation in the control and active columns. Further geochemical measurements are currently being performed in order to confirm and more accurately quantify the mineralization and associated processes.

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CHARACTERIZATION OF HIGHLY CONTAMINATED SEDIMENT FROM THE GOWANUS CANAL, BROOKLYN, NEW YORK

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The Gowanus Canal is a 3 km long industrial waterway dating from the mid-19th century, constructed on the site of a natural tidal channel draining into New York Harbor. The canal received waste effluents from nearby industries (including oil refining, coal gasification, soap making and tanning) as well as input of domestic sewage. After some years of operation, in spite of the fact that the tidal range is about 2 m, it became apparent that tidal flushing was insufficient, leading to accumulation of noxious contaminants in the sediments. In 1911, to help remediate this problem, a flushing tunnel and pumping station were constructed at the head of the canal and operated for a half century. It was recently repaired and is back in operation. Even though much of the industrial activity along the canal has ceased, its sediments remain highly enriched in organic and inorganic contaminants, with combined sewer outfalls continuing to transport pollutants into the canal.

As part of a program of continuing sediment quality monitoring, a series of 10 grab samples were collected along the length of the canal. Standard environmental chemical analyses were performed (volatile and semi-volatile organics, PCBs, metals). For comparison, dried sediment samples were also analyzed by pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS) and thermodesorption-gas chromatography/mass spectrometry (TD-GC/MS). Samples were quantitatively evaluated for the presence of benthic organisms.

Industrial metals (Cr, Cu, Pb, Zn) are present in elevated concentrations (several hundred mg/kg) in the samples. PCBs, however, were not detected. Parent (i.e., non-methylated) PAHs tend to be very abundant, up to several hundred mg/kg in one sample. Compared to most benthic sites of similar nature (depth, salinity, etc.) the samples are all low in biological diversity, low in numbers, and dominated by pollution tolerant organisms. These include capitellid polychaetes, particularly *Capitella* cf *capitata*, and the spionid polychaete *Streblospio benedicti.*

Py-GC/MS analysis permits a more complete characterization of the sedimentary organic matter, including biomass as well as the semi-volatile contaminants. The resulting data indicate that the sediments are strongly contaminated, to the point that signals from natural organic matter are overwhelmed. Three to five ring PAHs predominate in most samples, with parent and alkylated (up to C_4) compounds of the phenanthrene, pyrene and chrysene series, in distributions characteristic of creosote. The dibenzothiophene and benzonaphthothiophene series attest to a significant organosulfur component. Abundant sterenes and fatty acids in sediment pyrolyzates indicate the presence of raw or partially treated sewage. Long chain normal alkanes are relatively minor constituents, in distributions that suggest fresh crankcase oil input to some samples. In spite of the recent reopening of the flushing tunnel, it is evident that acute sediment pollution persists in Gowanus Canal sediments.

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NITRATE REMOVAL IN URBAN WETLANDS: EXAMINING THE ROLES OF VEGETATION, SOILS, AND HYDROLOGY IN THE CREATION OF 'HOT SPOTS' AND 'HOT MOMENTS' OF DENITRIFICATION

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Metropolitan development increases the extent of impervious surface and thus increases the volume of surface runoff entering urban waterways. Urban wetlands are therefore characterized by flashier hydrographs, elevated concentrations of nutrients and contaminants, altered bank morphology and stability, and reduced biotic richness. In recent decades, interest has increased in restoring ecological functions to urbanized wetlands. However, managers often lack quantitative, predictive models relating wetland processes to specific combinations of biological communities, flooding patterns, and soils. Nitrogen (N) removal is commonly cited as a rationale behind wetland restoration projects, since riparian zones have demonstrated the ability to prevent movement of excess N from upland areas into streams. A recently developed paradigm has been adopted by restoration projects that aim for higher N removal across wetland landscapes; this paradigm involves "hot spots" and "hot moments" of N removal within patches of wetland. NO_3^- removal via denitrification is a process mediated by the transport of materials via water flowpaths. Denitrification is limited by the availability of carbon (C) and NO_3^-, and occurs under anaerobic conditions. "Hot spots" of NO_3^- removal therefore tend to be created by intersecting flowpaths supplying these materials and conditions. "Hot moments" of N removal are mediated by wetting and drying cycles. The scale at which "hot spots" and "hot moments" of denitrification occur has not been well-defined, and there has been little work relating plant biology, hydrologic regime, and soils with N removal function in wetland restoration efforts. My study examined the factors mediating "hot spots" and "hot moments" of denitrification at a well-defined spatiotemporal scale in an urban wetland ecosystem located in the meadowlands of Bergen County, New Jersey. At Teaneck Creek Conservancy in Teaneck, NJ, monospecific stands of *Phragmites australis* are located on adjacent patches of clayey, silty, and organic soils. The presence of these adjacent patches enabled me to isolate the effects of soil type and soil-generated differences in hydrology on the spatial and temporal distribution of "hot spots" and "hot moments" of NO_3^- removal. Soil properties (redox potential, soil moisture, soil chemistry, plant surface litter biomass, texture) and denitrification rates were characterized over three seasons in different soil profile types. Two replicate patches of each soil type (clay, organic, silty) were identified for sampling, and two replicate plots were used in each patch. A "hot spot" of N removal was thus restricted to two spatial levels: between-soil patches and within-soil patch. To identify differences in denitrification rates between soil profile types over time, soil cores were collected from each plot every day for 10 days following a saturation event from rainfall. Cores were collected during at least one saturation event in each of three seasons when temperatures are sufficiently high enough for denitrification to occur: spring, summer, and fall. A "hot moment" of N removal was thus restricted to two temporal levels: within a 10-day soil wetting and drying cycle, and within a given season. In this poster, the N dynamics and soil characteristics of each soil type at Teaneck Creek will be discussed.

INFLUENCE OF WETLANDS ON THE REMOVAL OF HEXAVALENT CHROMIUM

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The ability of soils to transform and retain metal ions from aqueous solution is of special interest and has significant consequences for environmental questions such as the remediation of polluted soils and contaminated water deposition. This transformation feature is closely linked to the biogeochemical reactions that occur as a result of the degradation of organic carbon by different microorganisms through a series of terminal electron acceptors. Wetland plants affect these biogeochemical processes since released organic carbon into the soil via litter, root exudates, and root turnover drives the production of reducing compounds as well as redox potential. This study focuses on the influence wetlands have on the capacity of soils to retain metals under typical diurnal cycles and organic carbon loading Chromium was selected as the target contaminant due to its widespread use and historical releases into the environment as well as it ability to undergo extensive speciation through shift in redox potential.

Four vegetated microcosms (0.66ft. by 10ft) were constructed with varying amounts of organic matter in the soil. Two microcosms (A and C) were packed with Delaware River stone and amended with commercially available peat to produce a final fraction of organic content of 0.004 by weight. The remaining two microcosms (B and D) were packed with the peat to produce a fraction of organic content of 0.41 by weight. Of these four microcosms, A and B were planted with *Typha latifolia* (Broad Leaf Cattail) and C and D with *Carex lurida* (Lurid Sedge). Two additional microcosms without plants acted as controls. The microcosms were operated as plug flow reactors under anaerobic conditions in a greenhouse under controlled temperature, light intensity and duration and humidity. For all experimental operations, steady-state mass flux conditions were maintained.

Pore water samples were collected from each reactor at different stations. TOC, being corrected for evapotranspiration, was shown to increase along the reactor corresponding to the decrease in Cr(VI). Plant activity releases organics, such as root exudates, into soil pore water, thus increasing TOC levels. This market increase in organic loading serves to increase the concentration of reducing compounds and decrease the redox potential of the soil system. This coupled effect was shown to be higher in reactors B and D, as a result of increased vegetative activity due to the higher organic content of the soil. The reduction of metals is higher in the presence of plants, indicating that redox shift driven by TOC released from the plants to the soil, enhances Cr removal. Additionally, this phenomenon was observed to be impacted by diurnal fluctuations, thus showing the detailed changes due to varying levels of TOC production.

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THE NEW JERSEY TOXICS REDUCTION WORKPLAN FOR NY-NJ HARBOR: AMBIENT LEVELS OF TOXIC CONTAMINANTS IN THE HACKENSACK RIVER

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Phase 1 of the New Jersey Toxics Reduction Workplan for NY-NJ Harbor (NJTRWP) included the collection of water quality samples at four stations in the Hackensack River, from the head-of-tide in Oradell downstream to just above its confluence with Newark Bay. The samples were collected during baseflow and wet weather events in 2000-2002. Within the Hackensack River, median concentrations of SS (4.4 mg/L), total PCBs (1.2 ng/L), total Cd (6.3 ng/L), total Hg (1.4 ng/L), total Pb (347 ng/L), total DDTs (0.51 ng/L), and total PCDD/F – OCDD (8.1 pg/L) were lowest at the head-of-tide (in Oradell). The concentrations of these seven parameters (and total PCDD/F) were also low compared to the heads-of-tide of the Passaic, Elizabeth, Rahway, and Raritan Rivers. 2,3,7,8-TCDD was not detected at the Hackensack (and Rahway) River head-of-tide, and was only rarely detected at the other tributary heads-of-tide. Within the Hackensack River, the highest median concentrations of SS (34.9 mg/L), POC (3.71 mgC/L), DOC (7.09 mgC/L), total PCBs (22.5 ng/L), total Hg (126 ng/L), and total Pb (8,000 ng/L) were observed at the upper tidal station (in South Hackensack). The concentrations of these six parameters were also elevated at the Hackensack River upper tidal station compared to the other NJTRWP tidal tributary and estuary sampling stations. However, concentrations of these parameters (as well as total PCCD/Fs, total PCDD/Fs – OCDD, and 2,3,7,8-TCDD) at the mid- and lower tidal Hackensack River stations (in Secaucus and Jersey City, respectively) were generally comparable to those found at the other NJTRWP tributary stations, but higher than at the NJTRWP estuary stations. In contrast to the other parameters, within the Hackensack River the highest median concentrations were observed at the head-of-tide and upper tidal stations for the pesticides dieldrin (1.01 and 0.77 ng/L, respectively) and total chlordanes (1.82 and 2.71 ng/L, respectively). Median dieldrin concentrations were similar at all of the tributary heads-of-tide (0.5-1.3 ng/L). However, while median concentrations of total pesticides (4.3-5.0 ng/L), total chlordanes (0.8-1.8 ng/L), and total DDTs (0.5 – 1.9 ng/L) were similar at the heads-of-tide of the Hackensack, Passaic, and Raritan Rivers, they were lower (by factors of 2 to 8) compared to the Elizabeth and Rahway Rivers. Median concentrations of total pesticides, total chlordanes, and dieldrin were similar at the Hackensack River upper tidal station and the other NJTRWP tributary stations, but were typically greater than the concentrations observed in the mid- and lower tidal Hackensack River and at the NJTRWP estuary stations. Total DDT concentrations were generally similar at all of the NJTRWP tributary and estuary stations. Comparison of the sample data to NJ State Water Quality Standards will also be made.

BALLOON IMAGERY TO ENHANCE THE ACCURACY OF HYPERSPECTRAL WETLAND VEGETATION MAPPING

Pechmann, Ildiko; **Artigas**, Francisco; New Jersey Meadowlands Commission, MERI GIS

Tidal marshes are characterized by complex patterns in both their spatial distribution and ecological function. Fragmented wetlands in urban environments are subjected to a variety of man made pressures that alter sediment biogeochemistry and species composition. In this paper we present a novel method using balloon aerial photography to measure and enhance the accuracy of vegetation maps created from supervised classifications of high resolution hyperspectral images.

Data acquired by the AISA sensor with 34 bands in the visible and NIR range, each with 5-mm spectral and 2.5-meter spatial resolution were used to generate vegetation maps for the entire New Jersey Meadowlands District (NJMC) district. The classified vegetation maps were tested for classification accuracy against true color balloon aerial photographs (0.5 foot spatial resolution) acquired with a light weight Sony DSC-V3 camera mounted on a tethered balloon at 500 feet elevation.

We show that spatially-detailed and quantitatively reliable wetland vegetation maps may be derived from AISA images using mapping techniques such as spectral angle mapper and linear unmixing to address assemblages of mixed species. Verification of the resulting classes using balloon imagery revealed an overall accuracy of 90%. Finally, and in order to achieve accurate classifications across many flight lines, we present a technique for overcoming flight line spectral differences that remain even after brightness correction.

SOIL METAL CONCENTRATIONS AND PLANT PRODUCTIVITY IN AN URBAN BROWNFIELD

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Anthropogenic sources of toxic elements have seriously compromised the ecological integrity of many green areas in urban landscapes. Analysis of soil samples from a brownfield within Liberty State Park, Jersey City, New Jersey, shows that arsenic, chromium, lead, zinc and vanadium exist at concentrations above those considered ambient for the area. We examined plant productivity applying remote sensing and geostatistical techniques at the landscape, assemblage and individual specimen level. Quickbird and Ikonos multispectral images were used to reveal the ecological processes which led to the current community pattern. During the 2006 growing season spectral readings were taken of grey birch leaves at different locations which represented various soil Zn concentration. Broad- and narrowband vegetation indices were calculated from field data in order to unfold the effect of high heavy metal concentration in the soil on photosynthetic processes.

The results suggest that differences in similar assemblages can be correlated to levels of As, Cr and Zn in the soil. Analysis of plant tissues (root stem and leaves) from the dominate species reviled the translocation features of each of metal. As and Cr interacted primarily in the root zone whereas Zn was transported to the leaf. Accumulation of Zn in the leaf tissue occasionally exceeded soil concentrations suggesting it could interfere with the photosynthetic process.

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GEOELECTRICAL SIGNATURES OF MICROBIAL STIMULATED MINERALIZATION

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Bioremediation techniques are commonly utilized to address soil and groundwater contamination due to acid-mine drainage, industrial sources, and government nuclear weapon programs. One critical component of these efforts is the real time, spatial and accurate monitoring of the remediation processes. For this reason non-invasive high resolution geophysical methods have been employed in the recent years to elucidate system transformations occurring during bioremediation. In our study, we performed laboratory column experiments to investigate the geoelectrical response of stimulated microbe-mediated iron sulfide precipitation; a common bioremediation technique for the removal of heavy metals in the subsurface. We used common soil borne bacteria that are routinely used in bioremediation projects. In order to monitor the biomineralization processes we used geoelectrical methods (induced polarization (IP) and self potential (SP)) along with conventional geochemical monitoring. The IP data showed significant anomalies associated with on going iron sulfide mineralization induced by microbial activity; the response can be considered a proxy of the amount of the mineral precipitating and the specific form of the mineralization. Additionally, strong SP anomalies developed during the mineralization as a result of the continuous redox state changes following the microbial induced mineral formation. Visible black precipitant, indicative of iron sulfide mineralization, and high H_2S content confirm the observed geochemical and geophysical data. Overall, the results suggest that the IP and SP methods can be used to monitor the progress of the microbial induced mineralization process, and indirectly monitor the microbial activity within the subsurface. These methods can be valuable tools to increase the efficiency of bioremediation techniques.

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A GIS-BASED APPROACH FOR MODELING THE EFFECTS OF SEA-LEVEL RISE IN THE NEW JERSEY MEADOWLANDS DISTRICT

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According to the Climate Impacts Group at Columbia University, sea level has risen 0.23-0.38 cm per year in the New York-New Jersey metropolitan region over the last 100 years. This is due to both ongoing geologic subsidence since the end of the last glacial period and the global warming trend observed since the 20th century. In this region it is predicted that sea level rise may increase by as much as 29.7 cm by the 2020's, 60.2 cm by the 2050's, and 108 cm by the 2080's. The threat of sea level rise is especially significant in the coastal regions of NJ, which are home to 60% of NJ's residents. The Hackensack Meadowlands District is situated in the heart of the urban industrialized center of the New York-New Jersey metropolitan region. This District is a dynamic region containing extreme degrees of urbanization, which abuts tidal wetland regions, rich with ecological abundance. Within the District, stormwater sewers, levees, pump stations, and tide gates are used to manage both the stormwater from the surrounding impervious surfaces, the tidal effects of the Hackensack River that bisects the District, and surface waters stored in the 8,400 acres of wetlands. Flooding in roads and residential areas is already a known problem within many areas of the District and a further rise in sea level would exacerbate flooding within this area. Future infrastructure planning and engineering designs should consider the impacts of sea level rise over the projected lifetime of new water control projects.

With these concerns in mind, a raster-based Geographic Information Systems (GIS) analysis was performed to visualize the general effects of sea-level rise throughout the District. Using information such as mean high water levels and 25 year surge elevations, a high-resolution digital elevation model was developed in ArcGIS to delineate potential flood zones. Land cover and parcel data sources were used to describe present flooding in the District and to characterize potential flooding associated with the sea-level rise of 25 cm projected to occur by the 2020s. Overlay analyses revealed that the total flooded areas within the District could increase by nearly 50% in the event of a 25 cm increase in mean high water levels. Serious flooding could affect the urban land uses, which comprise a large portion of the District. Flooded acreage in the urban land use category is predicted to increase by 112% (mean high water after a sea level rise of 25 cm), accounting for more than one quarter of the flooded area.

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IS MOLLUSCAN BIODIVERSITY ENHANCED IN A NORTHERN NEW JERSEY URBAN POND?

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Urban ponds are often subject to an array of environmental insults ranging from erosive run-off, to algacides, to dredging, to trash dumping. Barbour's Pond, a 55,000 m^2 pond on Garrett Mountain in Passaic County, northern New Jersey, is contained in one of the most heavily populated urban regions in the United States. This pond is found in a park that has a strong public recreational presence and the pond itself if heavily utilized for fishing. Despite its relatively small size and surrounding urban sprawl, Barbour's Pond is home to 18 species of molluscs, the most abundant being the gastropods *Amnicola limosa, Helisoma anceps*, *Physa acuta* and the small sphaeriid bivalves *Pisidium casertanum* and *Pisidium henslowanum*. Monthly samples from March 2004 through March 2006 found highest molluscan diversity in shallow waters in March and December 2004 and January 2005. Total molluscan abundance, however, was highest in July and November 2004. The relatively high number of molluscs could reflect a recruitment event, with influx of young adults from late spring and autumn population expansions. May 2004 showed the lowest diversity and abundance. There is also a strong correlation between frequency of occurrence of a particular taxon and relative abundance. Using Bray-Curtis Similarity Indices, we determined small but consistent clusters of temporal communities. *Pisidium casertanum* and *Pisidium henslowanum* were always found together and usually in the presence of the small, grazing gastropod *A. limosa*. These three taxa were found with the thin-shelled but fast moving snail *Physa acuta* about 90% of the time and all four with the common pond snail *Helisoma anceps* and the thicker shelled snail *Goniobasis virginica* over 80% of the time. *A. limosa* was found in every month except May 2004; *H. anceps* every month except February 2005. Six of the 18 species were found 90% or more of the sampling efforts .while 3 species were found 3 or fewer times. The temporal molluscan communities could reflect specific and possibly short-lived environmental changes. The overall molluscan diversity in this pond is high compared to other ponds from less urbanized areas. The high diversity and small community dominance could reflect the wide array of microhabitats in this pond or represent the high diversity that sometimes accompanies fluctuating environmental conditions as can be found in an urban pond.

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CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS

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The Working Group I contribution to the IPCC Fourth Assessment Report describes progress in understanding of the human and natural drivers of climate change1, observed climate change, climate processes and attribution, and estimates of projected future climate change. It builds upon past IPCC assessments and incorporates new findings from the past six years of research. Scientific progress since the TAR is based upon large amounts of new and more comprehensive data, more sophisticated analyses of data, improvements in understanding of processes and their simulation in models, and more extensive exploration of uncertainty ranges.

KEARNY MARSH SEDIMENT CONTAMINANT INVESTIGATION

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The Kearny Marsh sediments are contaminated due to historical inputs of landfill leachate, combined sewer overflows, and municipal stormwater discharges. The NJMC has identified the remediation of this ecosystem as a high priority, and successful remediation will require an understanding of the location of historical contaminant "hot spots," the potential for sequestration and/or biotransformation of historic priority pollutants, and the feasibility of various contaminant containment options. Work supporting the goal of restoration was begun with an initial assessment of the extent of sediment contamination in Kearny Marsh. Random samples from locations representing approximately 25% of the Kearny Marsh sediments were analyzed for concentrations of heavy metals, PAHs, and PCBs. Based on data from prior sediment analyses, samples were obtained from an area that is approximately 1,725 square acres, which is located in the northwestern portion of the marsh adjacent to the Gunnell Oval ball fields. Organic material was the dominant particle fraction in the sediments and total sediment organic carbon ranged from 19% to 42%. The samples had relatively high levels of water soluble extractable organic carbon material, suggesting the strong possibility of high rates of microbially-mediated biotransformation processes with respect to organic contaminants. The bioavailability and toxicity of the heavy metal contaminants will also be determined by association with this organic material. PAH concentrations in Kearny Marsh sediment are relatively high, similar to sediments of the upper New York Harbor. ΣPCBs concentrations are relatively high in many of the Kearny Marsh samples. PCBs pose a problem in disposal of the dredge material should it eventually be determined that Kearny Marsh needs to be dredged to remove contamination. Chromium, copper, nickel, lead, and zinc concentrations exceeded the Ontario sediment quality criteria used by the State of NJ. Hg concentrations were above the regulatory level in all locations sampled and a Hg "hot spot" was identified. High correlations between Cr, Cu, Fe, and Zn indicate that these metals may come from the same source. The presence of Hg was not correlated with the other metals, and it is possible that the source of Hg contamination is different from that of the other metals.

RHIZOSPHERE SEDIMENT MICROBIAL COMMUNITIES: DOES THE PLANT MATTER?

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In upland soils, microbial communities associated with plant root zones are believed to play a crucial role in the biogeochemical cycling of major elements, much less is known about the effects estuarine plant root systems have on their rhizosphere microbial communities. Our research compares the two dominant plants in the Meadowlands (*Phragmites australis* and *Spartina alterniflora*), and the sediment bacterial communities associated with these plants and with unvegetated mud flats. Samples were collected during 2001-2003 from Saw Mill Creek (SMC) and from two non-urbanized estuaries in southern NJ. Bacterial community structure was described by phospholipid fatty acid (PLFA) analyses, and microbial community functional analyses include the biotransformation of halogenated organic contaminants, enzyme activity analyses, and catabolic responses to a variety of organic substrates. Statistically significant interactions were found between the specific sites and the plants or microbes. Differences between plants, microbial community structure, and functions were significantly greater in the undisturbed sediments than in samples collected from the Meadowlands. Enzyme activity related to the cycling and storage of carbon, nitrogen, and phosphorus was lower in the SMC samples, as was sediment microbial diversity. SMC microbial response to the organic compounds was significantly different than the response of undisturbed sediment communities, and SMC microbial biotransformation of a halogenated organic contaminant occurred at a faster rate. In many analyses there were no SMC differences between the two plant species or between vegetated and unvegetated sediments. We propose that the history of multiple disturbances in the Meadowlands, including hydrological alterations, nutrient, and contaminant inputs may be overwhelming the influence of the plant rhizospheres on sediment microbial community structure and function at this point in the restoration of the Hackensack Meadowlands. Continued monitoring of sediment microbial processes can provide a bench mark for evaluating the success of restoration efforts, and we suggest that enhancing desirable biogeochemical processes should be included in setting restoration goals.

BEHAVIORAL DIFFERENCES IN TWO POPULATIONS OF BLUE CRAB IN NEW JERSEY

Reichmuth, Jessica M.[1]; **Place**, Allen R.[2] and **Weis**, Judith S.[1]

Blue crabs (*Callinectes sapidus*) were collected from Hackensack Meadowlands (HM), a contaminated site in northern NJ and Tuckerton (TK), a relatively clean site in southern NJ. Behavioral differences were found in the predator avoidance ability of juveniles and prey capture by adults in laboratory studies. Specifically, HM juvenile blue crabs were significantly more successful at avoiding an adult blue crab predator compared to TK juveniles and HM adults were less efficient at capturing juvenile blue crabs compared to their TK conspecifics. However, HM adults were just as efficient predators as TK congeners when less active species such as fiddler crabs (*Uca pugnax*) and ribbed mussels (*Guekensia demissa*) were used as prey. Since the results of behavior experiments suggest that HM adults are inefficient predators, stomach analysis was also conducted in order to determine what the crabs at the different sites are actually eating under natural conditions. Data show HM adults are "junkyard dogs" – they eat "less nutritious" food (more sediment and detritus) compared to TK adults. However, we have not seen detrimental impacts on the HM blue crab population, in that they appear to be relatively numerous and larger in size than the TK crabs. Genetic studies (using both nucleic and mitochondrial material) also indicate that there are no substantial genetic differences among the crabs from different locations. Field studies were conducted in order to determine if the environment was a cause of the behavioral differences observed in the lab. Blue crabs from each population were placed in killifish traps in their respective habitat as well as "switched" habitats in the field; TK crabs placed in HM environment (sediment, water and food) for 6 weeks became less efficient predators compared to TK crabs in TK habitat. HM crabs placed in TK habitat became more efficient predators than HM crabs kept in HM habitat. This indicates that the environmental conditions in HM (probably contaminants) are primarily responsible for the impaired predatory behavior of the blue crabs.

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UNCERTAINTY ANALYSIS OF CONTAMINANT UPTAKE FACTORS IN ESTUARINE ENVIRONMENTS

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Human health and ecological risk assessments typically rely on contaminant transfer factors to estimate tissue concentrations as part of dose- and residue-based assessments at contaminated site assessments. Even where empirical site-specific tissue data are available, forecasting analyses require that the functional relationship between abiotic media and prey tissue concentrations be understood at temporal and spatial scales relevant for decision-making. Unfortunately, this component is often one the most significant sources of uncertainty in risk assessment and can pose daunting challenges to conducting heuristic risk assessments. This is particularly the situation often found in estuarine systems that are characterized by unique physicochemical properties affecting contaminant bioavailability, widely varying patterns of contaminant inventory and seasonal biological exposures.

Using preliminary risk assessment results for 2,3,7,8-TCDD conducted for the Lower Passaic River Restoration Project, this presentation will present results of a probabilistic analysis of bioaccumulation hazards to human and ecological receptors and demonstrate relative dose model sensitivities to various factors that determine bioavailability and bioaccumulation in estuarine habitats. Difficulties associated with use of both empirical results and theoretical prediction tools to estimate biological uptake of strongly hydrophobic organic compounds will be discussed and recommendations for minimizing assessment uncertainties through the risk assessment process provided. Finally, the potential for both environmental variability and risk assessment uncertainty to contribute to selection of incorrect remedial management decisions will be demonstrated using several typical scenarios. Although the presentation will emphasize estuarine environments; other relevant case studies (Frazer River, Woonasquatucket River) will be discussed to highlight commonalities.

NEW JERSEY'S CHANGING CLIMATE

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Last year was New Jersey's second warmest since statewide averages began being compiled in 1895. Only 1998 was warmer, and 9 of the 12 warmest years in the past 112 have occurred since 1990. Clearly something is happening to our state's thermal regime, with several potential culprits to blame. These include solar fluctuations, minimal volcanic activity, decadal variability in North Atlantic circulation, simply chance, and finally, human impacts affecting our atmosphere and landscape. The vast majority of climatologists believe that natural variations alone cannot account for the recent global (not just NJ) warming, however the climate system is chaotic enough that one cannot ascribe specific numbers or percentages to a human influence.

Where things will go from here is problematic, as the climate system is replete with many positive and negative feedbacks. NJ will likely continue to warm, which is a major concern in the Meadowlands and other coastal environments for a number of reasons, particularly if sea level begins rising rather quickly due to glacial melting. Also of importance to the Meadowlands and the remainder of the region is whether major changes in the water cycle will occur as a result of human impacts on the climate system. Despite drought or drought like conditions from time to time, the Garden State is in the midst of its wettest period of the past century (since 1970). Whether there is a link between the recent warming and the greater wetness, or the possibility that our precipitation regime is becoming more variable, remains uncertain.

This presentation will bring the issue of global climate variability and change home to New Jersey and the Meadowlands, answering questions as to where we have been and where we may be headed. Our capabilities to monitor NJ's weather and climate will also be discussed, including an introduction to the NJ Weather and Climate Network operated by the Office of the NJ State Climatologist (http://climate.rutgers.edu/njwxnet).

STRUCTURE AND COMPOSITION OF THE VEGETATION AT TEANECK CREEK CONSERVANCY

Rohleder, Linda; **Ehrenfeld**, Joan; Department of Ecology, Evolution, & Natural Resources, Cook College, Rutgers University, New Brunswick, NJ

We conducted a vegetation survey within an 18.6 ha degraded wetland along Teaneck Creek at the Teaneck Creek Conservancy, part of the Bergen County Park System, in Bergen County, NJ. This wetland, a historic remnant of the New Jersey Meadowlands, was heavily impacted before and during the construction of nearby I-80 and I-95. Over the years, much of the site has been filled with construction debris, and Teaneck Creek was channelized and a berm created separating it from the wetland. We conducted a study of the vegetation of the site by dividing the property into a grid of 100x100 m (1 ha) sample units which were surveyed during the spring and fall of 2006. Each plant species was identified and its relative abundance within the unit was estimated using a five-level abundance ranking.

More than 243 plant species were identified for the site with an average of 47 species per sample unit. All units were heavily invaded by non-native species, and for most, more than 50% of the species in the unit were non-native. The most abundant invaders at the site were *Phragmites australis* (common reed), *Alliaria petiolata* (garlic mustard), *Polygonum perfoliatum* (mile-a-minute), *Polygonum cuspidatum* (Japanese knotweed) and *Rosa multiflora* (multiflora rose). Floristic quality was assessed for each sample unit by calculating the Plant Stewardship Index (PSI) using the newly available coefficients of conservatism, an index of the degree of habitat specificity of a given species, assigned to NJ plant species. PSI values ranged from a low of 3.3 (species richness=28) in an area dominated by *Phragmites australis* to a high of 14.4 (species richness= 74) in the least disturbed area. Natives found at the site that have high coefficients of conservatism include *Scirpus expansus* (wood bulrush), *Allium tricocum* (wild leek), and *Carya cordiformis* (bitternut hickory). Species associations, identified through ordination and cluster analyses, discriminate among communities on drier fill mounds, on wetter areas, and on native soil in the less-disturbed sections of the site. These results suggest that efforts to restore natural native plant communities, in addition to being dependent on the control of invasive species, may also be highly constrained by the properties of the fill material that dominates most of the site.

THE ROLE OF STORMWATER DETENTION PONDS IN THE NITROGEN CYCLE OF URBAN WATERSHEDS

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In pristine watersheds, riparian wetlands function as an important 'sink' for nitrogen, regulating the amount of this nutrient that enters streams and is potentially transported to nitrogen sensitive coastal systems. Urban development may result in disturbance of riparian zone nitrogen removal processes (eg. denitrification) resulting in increased tributary nitrogen loads and ecological degradation of downstream estuaries. This problem may be one of particular significance in the state of New Jersey in light of current trends of accelerated urban development. Our research investigates the role of stormwater detention ponds in the nitrogen cycle of urban watersheds. Detention ponds possess many of the features of riparian wetlands that allow them to act as nitrogen control points. They often possess anoxic, organic-rich soils, which provide favorable conditions for denitrification. Also, with the increased utilization of stormwater detention ponds as Best Management Practices mandated by New Jersey's stormwater regulations, an increasing fraction of urban stormwater runoff must pass through these ponds before entering streams. We are currently conducting fieldwork in an extended detention pond on the Princeton University campus. We will use the data we obtain from this monitoring in support of numerical modeling to better understand key nitrogen cycling mechanisms within this detention pond as well as to determine which design features allow for optimal performance of these ponds as nitrogen sinks. The results of our ongoing fieldwork indicate that there is some removal of stormwater nitrogen in the detention pond that we are studying, but its ability to serve as a watershed-scale nitrogen control point varies considerably with rainfall conditions (eg. intensity and duration of rainfall or antecedent dry period) and with the frequency of performance of maintenance work.

SOCIABILITY LEADS TO INSTABILITY: A METAPOPULATION MODEL OF THE (POTENTIAL) HERON AND EGRET NESTING COLONIES IN NEW YORK HARBOR AND THE MEADOWLANDS

Russell, G.[1,2] and **Rosales**, A.[1]

We present a model of the population dynamics of colonially breeding heron and egret species such as those on various islands in New York Harbor and Long Island Sound. We want to understand why a) the populations fluctuate dramatically, with frequent extinctions and recolonizations, and b) there appear to be 'empty' nesting sites. Our model reproduces these characteristics while invoking only inter-site dispersal, the birds' desire to aggregate, and a simple, global limit on the number of nesting pairs imposed by limited food resources. In light of this, we emphasize the importance of managing this system as dynamic, connected system, and caution against interpreting dramatic population changes on particular islands as prima facie evidence of rapid changes in local habitat quality, predation pressure, or disturbance. Nor should currently unoccupied sites — or large areas, such as the Meadowlands — be 'written off.' Finally, we discuss how our model may be tested, and the implications for future research and monitoring efforts.

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POTENTIAL IMPLICATIONS OF RESTORATION ON *FUNDULUS HETEROCLITUS* AND GILL PARASITE INTERACTIONS

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Parasites can affect many aspects of host functioning including behavior, morphology, growth, fecundity and survival. Little research has been done to examine potential behavioral or physiological effects of high endoparasite loads in the gills of fish. Preliminary studies found that mummichogs (*Fundulus heteroclitus*) from three restored areas in the Hackensack Meadowlands District, NJ had gills that were significantly (p=0.001) more infected (several thousand fold) by digenean trematode metacercariae compared to eight other sites throughout NY and NJ. We hypothesize that severe gill parasite infections can 1) alter host behavior to increase trophic transmission and 2) impair host physiological function and morphology, possibly forcing hosts to compensate for decreases in oxygen extraction by modifying these parameters (e.g., increased blood volume, increase gill surface area). To test these hypotheses, behavioral experiments were conducted, including activity, vertical positioning in the water column, and number of conspicuous behaviors performed. Gill structure, respiration rates, stamina and blood volume were also examined. Each of these parameters was explored using fish from six populations within the District, three of which were from restored sites.

Significantly more parasites (p<0.001) were found at the three restored sites. Significant differences in vertical positioning (p=0.004) and conspicuousness (p<0.001) were found, but no changes in activity (p=0.712) were noted. Heavily parasitized individuals spent more time at the water's surface and performed more conspicuous behaviors than less parasitized conspecifics. Highly significant differences in gill branching were also found, with a positive correlation (R^2=0.291) for parasite abundance and the number of additional gill branches. The anatomical changes in the gills appear to be a response of the fish to increase respiratory surface to compensate for the dense parasites. Although significant differences ($p \leq 0.006$) were found among the populations for respiration, stamina, and blood volume, no correlation with parasite abundance was seen.

In conclusion, it appears that the restoration process may promote parasite abundance and transmission. We have found distinct variability among sites with respect to several important parameters, which in some instances appear to be linked to parasite abundance. Fish with severe gill parasite infections appear to respond with morphological as well as behavioral changes. These behavioral changes may have broader implications to the ecosystem by disproportionately increasing infected prey intake by avian predators.

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INFLUENCE OF PRE-EXPOSURE TO DIETARY METAL ON THE ASSIMILATION AND SUBCELLULAR DISTRIBUTION OF CADMIUM BY GRASS SHRIMP

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Studies have shown that metal cycling through aquatic food chains may be more closely related to the subcellular partitioning of metal within prey than to whole tissue burdens. For example, a direct relationship between metal (Cd and Zn) stored within specific subcellular fractions (heat-stable proteins [HSP], heat-denatured proteins [HDP] and organelles) in soft-bodied estuarine invertebrates and metal assimilation by grass shrimp suggests that metal stored within these fractions may be considered collectively as a subcellular compartment containing trophically available metal (TAM). Beyond the subcellular partitioning of metal within prey, biological factors including metal-induced changes in predator digestive physiology (e.g., enzyme activities, gut residence time and gut pH) may impact digestion and influence the assimilation of dietary metal. The objective of this study was to investigate the influence of pre-exposure to dietary Cd and Hg on the assimilation and subcellular distribution of Cd by grass shrimp (*Palaemonetes pugio*) using radiotracer pulse-chase feeding experiments and subcellular fractionation techniques. Oligochaetes (*Tubifex tubifex*) were exposed for 96 to Cd (control, 0.22, 0.44 or 0.88 μM) or Hg (control, 0.007 0.014, 0.028 μM) through solution with renewal of exposure solutions at 48 h. A separate sample of worms was exposed for 96 h to the radioisotope $^{109}CdCl_2$ (2.22×10^2 kBq l^{-1}; 0.032 μM Cd) through solution. Subsamples of ^{109}Cd-labeled worms were subjected to subcellular fractionation to estimate the percentage of metal potentially available to predators (TAM-^{109}Cd%). Grass shrimp were collected from Great Kills Harbor, Staten Island, NY, USA, acclimated to laboratory conditions and pre-exposed to dietary metal by feeding on Cd- or Hg-exposed worms for 15 d (~5 worms $shrimp^{-1}$ day^{-1}). Following pre-exposure, grass shrimp were fed ^{109}Cd-labeled worms for ~30 min and analyzed periodically for ^{109}Cd activity for 1 week. A linear regression was fit to the physiological loss component of each ^{109}Cd retention curve ($t > 24$ h) and the corresponding *y*-intercept was used to estimate ^{109}Cd assimilation efficiency (AE-^{109}Cd%). Pre-exposed shrimp were also subjected to subcellular fractionation to estimate the percentage of ^{109}Cd distributed to each of five fractions (HSP, HDP, organelles, cellular debris and insoluble). TAM-^{109}Cd% in radiolabeled oligochaetes was estimated at ~83%. AE-^{109}Cd% by grass shrimp pre-exposed to control Cd worms was ~51%, but decreased to ~31% in shrimp pre-exposed to 0.22 μM Cd worms. AE-^{109}Cd% by shrimp fed 0.44 and 0.88 μM Cd worms was similar to controls at ~43% and ~55%, respectively. The percentage of ^{109}Cd associated with the organelles, cellular debris and insoluble fractions was constant over the range of Cd pre-exposures, however, a shift from HDP to HSP was observed in shrimp pre-exposed to 0.22 μM Cd worms. AE-^{109}Cd% by grass shrimp pre-exposed to control Hg worms was ~41%, but increased to ~60% in shrimp pre-exposed to 0.007 μM Hg worms, suggesting that mixed dietary metal exposures can result in the enhancement of metal assimilation. AE-^{109}Cd% by grass shrimp pre-exposed to 0.014 and 0.028 μM Hg worms was ~48%. The distribution of ^{109}Cd among subcellular fractions did not vary over the range of Hg pre-exposures.

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BASELINE AIR CONCENTRATIONS OF PARTICULATE MATTER, ELEMENTAL AND ORGANIC CARBON AND VOLATILE ORGANIC COMPOUNDS IN THE MEADOWLANDS

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The major development projects on-going and planned for the Meadowlands can alter air emissions in the area and affect the exposure to individuals living nearby and utilizing the Meadowland. It is rare to evaluate the changes that might occur in areas when such development takes place. The Meadowlands commission initiated a project in 2004 to collect baseline air concentrations data for particulate matter mass, trace metals, elemental and organic carbon, and volatile organic compounds. Potential emissions in the area of the Meadowlands come from the Meadowland previous use as a landfill, the mixed industrial/residential activities, construction activities and nearby roadways. New development of the area is underway that will include creation of recreational areas, additional residential zoning and commercial/industrial regions which will increase the number of adults and children using and living near the area, creating a population that can be exposed to those emissions. Samples were collected every sixth day, to coincide with statewide monitoring, at two sites for $PM_{2.5}$ mass, metals and carbon and at four sites for volatile organic compounds (VOC). The $PM_{2.5}$ samples were collected using an MSI sampling pump for 48 hours at a constant 10 liters per minute flowrate while the VOC samples are being collected using passive sampling badges (3M 3500 Organic Vapor Monitors). The $PM_{2.5}$ mass is being determined in an EPA certified weighing room, the metals by Inductively Couple Plasma/Mass Spectrometry after acid digestion and the elemental and organic carbon by thermal optical analyses at the Environmental and Occupational Health Sciences Institute and the VOC by solvent extraction followed by gas chromatography/mass spectrometry at the Meadowlands Commissions Laboratory. The PM mass have concentrations from <2 to 30 $\mu g/m^3$, with good tracking between the two sites on most days. This is consistent with most of the $PM_{2.5}$ mass originating outside of the Meadowlands with meteorology being the major controlling factor of its concentration. Elemental and organic carbon show similar variability as the $PM_{2.5}$. The trace metal air concentrations are all in the low or sub ng/m^3 range, levels comparable to levels measured near residences in NJ Cities. The VOCs, show a variety of concentrations patterns for different compounds, consistent with the different sources for these compounds that include mobile source emissions and industrial releases. Concentration levels are similar to that present in urban centers of New Jersey. This data set will provide a baseline concentration level for these pollutants for comparison to levels measured as future developed occurs.

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CAN WE CONTROL PHRAGMITES IN THE URBAN ENVIRONMENT?

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Wetland restoration in the urban ecosystem has become a major emphasis today. The complexity of the urban ecosystems and the pressures placed upon them, both historically and present, requires an understanding of possible restoration methods that can have attainable results. *Phragmites communis* (common reed) is one of the major species that has demonstrated its plasticity to adapt to the complex urban environment. The species has altered diverse tidal wetland systems, from mesohaline to freshwater, into expansive monotypic stands with low wildlife use. The species has been documented in most states and by the federal government as an invasive species that should be controlled. Various methods have been proposed and implemented from excavation, mowing, flooding, herbicides and goats to control the beast with varying results. The application of any of these restoration techniques has to incorporate an adaptive management plan to ensure success. This paper will present views of these various methods and the applications with successes and failures in the restoration these monoculture systems.

ACCUMULATION OF NITRITE IN ANAEROBIC WETLAND CONDITIONS

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Nitrite accumulation in soil has been observed under a variety of conditions. The phenomenon of NO2 accumulation in soil has generally been considered due to nitrification, which requires aerobic conditions. This study presents a series of experiments of different scales, performed either in a riparian wetland in New Jersey or on the soils from the same location, that show accumulation and production of nitrite in iron reducing conditions. Porewater profiles in anaerobically kept microcosms in a greenhouse showed an increasing concentration of nitrite with depth. This experiment also demonstrated an enhanced nitrite accumulation on addition of inorganic ammonium. Peeper experiment performed in-situ in a riparian wetland affirmed the presence of nitrite under iron reducing conditions in natural conditions as well. Pushpull experiments were done with ammonium and nitrite to determine the rate of utilization of ammonium and nitrite in in-situ conditions. Thus determined rates showed consumption rates of both ammonium and nitrite to be in the same magnitude, supporting the existence of a steady state nitrite pool in such anaerobic conditions. In anaerobic batch experiment 30N2 and 29N2 was observed after the addition of 15N-NH4, indicating the oxidation of ammonium and followed by denitrification of the oxidized N-species. Overall the results show the possibility of production of nitrite in anaerobic conditions in acidic wetland soils.

HABITAT SPECIFIC CHEMICAL AND GENE EXPRESSION SIGNATURES IN YOUNG OF THE YEAR BLUEFISH

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Bluefish (*Pomatomus saltatrix)* are highly migratory and spawn offshore but the young of the year (YOY) are estuarine dependent. The adult fish also may feed extensively in local estuaries. To examine the effects of urbanized estuaries on YOY bluefish this study quantified the major anthropogenic organic species present in the fish tissue and looked for specific gene expression signatures which may be diagnostic of habitat disturbance caused by sub lethal chemical exposure. Young of the year bluefish were collected from Newark Bay, NJ in the Hudson- Raritan estuary and from Great Bay, NJ in the Mullica River - Jacques Cousteau National Estuarine Research Reserve. Newark Bay has a long history of industrial activities and contains some of the more highly contaminated sediments on the east coast of the USA. Twelve individual from each group were freeze dried and prepared for organic analysis by Soxhlet extraction. After extraction, size-exclusion HPLC cleanup, and concentration, Polychorobiphenyl's (PCBs) and pesticides were separated and quantified by gas chromatography with electron capture detection (GC-ECD). BZ 153 was the major PCB congener found, while p',p'-DDE was the major pesticide. Total PCBs (NOAA method) were 356 ng/g for the Newark Bay fish and 52 ng/g for the control fish. As a first attempt at genetic analysis, a suppression subtractive hybridization (SSH) cDNA library was constructed and sequenced to compare gene expression in the livers of fish collected from these contrasting habitats. A number of genes were observed to be more highly expressed in the more degraded habitat. These included (among many others) cytochrome P450 1A, and 2G, apolipoprotein, glutathione-s-transferase, hepatocyte growth factor, c-type lysozyme, precerebellin, complement components C-1 and C-3, antifreeze protein, ferritin, transferrin, laminin receptor, ovary-specific C1q-like factor, warmtemperature - acclimation-related-65 kDa-protein, cofilin, and vitronectin. Some of these genes have been shown in contemporary studies to be related to environmental habitat degredation but several are unique to this study and may represent novel biomarkers. Quantitaitve polymerase chain reaction (Q-PCR) assays were developed for seven of the upregulated genes identified in this study.

AVIAN ABUNDANCE AND DISTRIBUTION IN THE NEW JERSEY MEADOWLANDS DISTRICT

Tsipoura, Nellie; **Mizrahi**, David; **Witkowski**, Ken; New Jersey Audubon Society (NJAS), Princeton, NJ

The Meadowlands and its expansive wetlands have long been recognized as a critical resource for birds. Given its location amidst a highly urbanized landscape, its importance as an oasis for wildlife cannot be overlooked. The New Jersey Meadowlands Commission contracted New Jersey Audubon Society to conduct two full years of avian surveys in the District. The goal of the project is to collect baseline data about species present, and their abundance and distribution in different sites and habitats. Following standard point count methodology protocols, a total of 122 points at 31 sites were surveyed from the end of August 2004 through August 2006. In addition, marsh bird callback surveys were conducted at 69 of these points. Data were analyzed to produce summary information on the occurrence, relative abundance and relative species diversity of species across all survey locations.

A total of 80261 individual birds of 181 species were observed in the Meadowlands District during the first year of the study. Of these, 1191 were individuals of 29 state endangered, threatened or species of concern. A total of 71801 individual birds of 174 species were observed in the Meadowlands District during the first year of the study. Of these, 753 were individuals of 29 state endangered, threatened or species of concern. The most commonly recorded endangered species during both years of the study were the Northern Harrier and the Great Blue Heron. Red-winged Blackbird, Song Sparrow, Barn Swallow, and European Starling were the most common and most abundant passerine species. Herring, Ring-billed, and Great Black-backed Gull were the most common colonial water birds and Mallards and Canada Geese were the most common waterfowl. The most common raptor seen was the Red-tailed Hawk. Semipalmated Sandpiper and Ruddy Duck were the birds seen in highest numbers during both years of the study. Common Moorhen was the most common bird encountered during secretive marsh bird playback surveys.

In addition to these descriptive statistics, information on abundance and distribution of endangered and threatened species was plotted on aerial maps that graphically show where they occur in the District. We also graphically present seasonal changes in bird abundance.

METAL CONTAMINANT LEVELS AND THEIR EFFECTS ON BIRDS BREEDING IN THE HACKENSACK MEADOWLANDS

Tsipoura, Nellie[1]; **Burger**, Joanna[2]; **Mizrahi**, David[1]; **Yacabucci**, Jan[1]

The Meadowlands District consists of a diverse mosaic of tidal, brackish, freshwater and forested wetlands within an urban setting. These valuable habitats attract a multitude of bird species, however, persistent sources of contaminants remain an ongoing concern. Contaminant exposure in birds can negatively affect reproduction, nest survivorship and nestling growth. In 2006 we initiated a project to: 1) determine contaminant levels in feathers, eggs, and blood of birds breeding in wetlands of the District; 2) investigate patterns and correlations in tissue contaminant levels and breeding success of birds; and 3) examine differences in contaminant levels of avian tissues at different sites.

We studied contaminant levels in eggs, blood, and feathers of Red-winged Blackbirds (*Agelaius phoeniceus*), Marsh Wrens (*Cistothorus palustris*), and Tree Swallows (*Tachycineta bicolor*), all intermediate trophic level, passerine bird species. In addition, we monitored nesting success and chick growth to ascertain how contaminant concentrations relate to these biological parameters. We searched for nests of blackbirds and wrens at three Meadowlands sites, and monitored each nest from the day it was found until the young fledged or the nest failed. Similarly, we monitored a small number of swallow nest boxes. We collected one egg from each nest, and right before fledging we collected feathers and blood samples from each chick. At the same time, we weighed the chicks and measured fluctuating asymmetry in their culmen, wing, and gape. We analyzed tissues for arsenic, cadmium, chromium, mercury, and lead. Using modeling approaches and nonparametric and multivariate statistics, we investigated differences between sites and/or between species in daily survival rates, fledging success, and contaminant levels, and explored the effects of contaminants on morphometric parameters.

Lead was relatively high in feathers, and even higher in blood for all three species, reaching levels at which negative effects are anticipated. Marsh Wrens, the species with the highest lead concentrations in blood, displayed a negative relationship between blood lead level and chick weight. However, we saw no obvious signs of lead poisoning. Mercury, while below levels considered biologically harmful, was higher in the eggs and feathers of Meadowlands birds than those documented in other studies of passerines. Furthermore, un-hatched eggs from wrens had higher mercury levels than hatched eggs. Chromium levels were relatively high in eggs and in blood, but lower in feathers, compared to those reported in the literature. Cadmium and arsenic occurred at levels that are not considered biologically harmful. While levels of some metal contaminants were high in our study, they were lower than those reported previously for bird tissues from the Meadowlands District. Finally, our study revealed few differences between sites in nest success and metal contaminant levels, and no relationship between metal levels and measures of fluctuating asymmetry.

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NUTRIENT CONCENTRATIONS AND LOADS IN AN URBAN WETLANDS WATERSHED IN TEANECK CREEK, NEW JERSEY

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A water-quality network was designed to monitor nutrient concentrations and loads during varying hydrologic conditions in the Teaneck Creek watershed—a small urban wetlands area in Teaneck, New Jersey. An objective of the monitoring program is to evaluate the variability in concentrations and loads of nitrogen and phosphorus among the various parts of the hydrologic cycle including precipitation, stream water, storm water, and ground water before and after a wetlands-restoration project. Results of nutrient analyses for the first two years of the study from the network will be presented to show pre-restoration conditions at sites in water from the wetlands and uplands areas.

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STUDY OF BASELINE QUALITY OF AMBIENT AIR WITHIN THE NEW JERSEY MEADOWLANDS DISTRICT: MODELING COMPONENTS

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The objective of this project is to investigate and quantify baseline ambient air quality in the vicinity of the Meadowlands District, using various available emissions, land-use, meteorological, etc. databases, along with the results of a field measurement study. Iterations of air quality modeling were performed employing a series of steps: (a) estimation of background levels of air toxics, (b) preprocessing of emission inventories, (c) preprocessing of local meteorology information, (d) estimation of local ambient concentrations of air toxics of concern through applications of local-scale air quality models such as the Industrial Source Complex Short Term Version 3 (ISCST3) and AMS/EPA Regulatory Model Improvement Committee Model (AERMOD).

Dispersion modeling was performed for receptors corresponding to 4 fixed site monitor locations within the Meadowlands district for 20 sets of 3-day periods, from March 17 to November 6, 2005, corresponding to the field sampling dates at these monitors.

National Emission Inventory (NEI) data corresponding to the years 1999 and 2002 were processed through the Emissions Modeling System for Hazardous Air Pollutants Version 3 (EMS-HAP) for various air toxics of concern (e.g. benzene, formaldehyde, TCE, PERC, arsenic, lead, mercury).
Two different sets of meteorological inputs (Newark Airport data and MERI station data) were used in the dispersion modeling to test the sensitivity of the predicted ambient concentrations. The modeling results for selected air toxics of concern were compared with field measurements collected at the four fixed-site monitors. A subset of three-day-long hourly simulation periods overlapping the 48-hour sampling periods were extracted and averaged to be compared with the corresponding 48 hour integrated ambient measurement.

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AIR CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS ALONG THE TRAILS

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As part of the development of the Meadowlands, hiking and water trails have been included for the recreational use of visitors to the area and nearby residents. These trails wind through the wetlands of the area and may be on or near areas that were once used for landfills and are adjacent to areas in which construction is occurring and that have industrial activities. In addition, the Meadowlands is near the NJ Turnpike, a major roadway with large mobile source emissions. Thus, emissions of a variety of volatile organic compounds are expected to occur in the area that could lead to exposure to individual on the trails. This exposure could change while as additional development of the Meadowlands occur or during different seasons and meteorological conditions. The air concentrations for a suite of aromatic and chlorinated hydrocarbons were determined during December 2004 – January 2005; August – September 2005 and September – November 2006. The air samples were collected while walking along the trails both during the morning and afternoon for approximately two hours using a personal air sampling pump and a mixed bed adsorbent. The samples were analyzed by thermal desorption coupled with gas chromatography/mass spectrometry. Correlation coefficients, scatter plots evaluate and the relationship between the concentrations and wind speeds were examined to identify which compounds had similar sources. The nearby roadways appear to be a major source for the aromatic compounds to the area. The concentrations of the aromatic compounds were higher in the summer than winter, reflecting the difference in combustion efficiencies of the two seasons. Chlorinated compounds were detectable in a subset of the samples and showed little correlation between individual compounds. The concentrations of the chlorinated compounds were higher in the summer than winter. These associations are indicative of unique sources for each of the compounds that are a function of evaporative processes. Overall, the concentrations of most of the VOCs measured in the Meadowlands are similar to the concentrations measured in urban centers in New Jersey. This suggests that exposures to VOCs while hiking within the Meadowlands would be similar to what most residents would receive near their homes.

THE MEADOWLANDS COMPREHENSIVE RESTORATION IMPLEMENTATION PLAN

Weppler, Peter [1]; **Appell**, Karen [2] and **Doss**, Teresa [2]

The Meadowlands Comprehensive Restoration Implementation Plan (MCRIP) is being prepared by the U.S. Army Corps of Engineers – New York District, with assistance from the New Jersey Meadowlands Commission, the National Oceanic and Atmospheric Administration, the New Jersey Department of Environmental Protection, and the U.S. Fish and Wildlife Service. The Meadowlands is an integral part of the greater Hudson-Raritan Estuary (HRE) and, as such, the MCRIP has been closely coordinated with the HRE Feasibility Study.

The MCRIP is a single comprehensive Meadowlands-wide analysis of ecosystem restoration opportunities, with the necessary planning guidelines and implementation plan for future restoration within the Meadowlands, including but not limited to analysis and recommended solutions to salt marsh restoration, infrastructure encroachments on tidal flow, water management control structures, contaminated sediment impacts on biota, brownfields impact on coastal habitat, habitat fragmentation, benthic habitat restoration, and landfill impacts on coastal habitat. Restoration opportunities that meet federal criteria will either be recommended for construction or, if additional analysis is required, will be recommended for further study. The MRIP will also develop initial ecosystem restoration and monitoring plans for specific candidate restoration sites.

Ecosystem-level research and ecosystem modeling will be incorporated into the monitoring plan to increase our understanding of wetland function at the larger spatial scales and longer time scales than those of most ecological experiments. Predictive ecological modeling also may enable ecologists to estimate how long it will take the mitigation wetland to achieve steady state. This MCRIP, the first to be completed by the NY District, will be integrated into future planning and National Environmental Policy Act documents as well as lead the way for much of the restoration occurring through the New York-New Jersey Harbor Estuary.

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TREE ECOLOGY IN A HARDWOOD WETLAND FOREST AT TETERBORO WOODS

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Only a few small stands of hardwood wetland forest remain in the New Jersey Meadowlands today. Presented here is a tree survey that was conducted in an approximately 70 year-old, hardwood wetland forest stand at the Teterboro Airport, in Teterboro, NJ. Specifically, the species, trunk diameter and estimated height of all trees taller than 5 meters in a 0.8 hectare plot were recorded on an x-y coordinate spatial grid.

The data suggest that the species composition of this forest may be in a dynamic phase of change. Two of the most common canopy tree species, *Quercus palustris* Muenchh. and *Sassafras albidum* (Nutt.) Nees, are not well represented in the midstory or subcanopy levels, suggesting that their abundance is likely to decline in the future. Similarly, although *Betula populifolia* Marsh. is common in the subcanopy stratum, it is largely absent from the midstory. Conversely, while *Prunus serotina* Ehrh. is nearly absent from the canopy, and *Nyssa sylvatica* Marsh. canopy trees are rare, these two species may increase in importance over time because they are currently two of the most abundant species in the midstory. *Acer rubrum* L., which is abundant in all vertical strata, is likely to continue to codominate the stand in the future. Species present at the site in very low abundance include *Amelanchier laevis* Wieg., *Liquidambar styriciflua* L., *Populus deltoides* Bartr. ex Marsh. and *Quercus bicolor* Willd. Overall, the degree of shade tolerance does not explain most of the differences in species' size class distributions. Other factors, such as soil hydrology and deer browsing may play important roles.

Spatial dispersion is aggregated for most species. Underlying factors are apparent for some species. *B. populifolia*, which is highly shade intolerant, exists only along the forest edge and stream bank. In contrast, *S. albidum* is present as one isloated colony that is likely the result of root sprouting. The aggregated pattern of the other species may be the result of interspecific competition, variation in microhabitat, seed dispersal or founder effects.

Future research should further examine the mechanisms that underlie vertical and horizontal patterns within this tree assemblage. The data reported here will also serve as a baseline for comparison with future surveys that will reveal temporal dynamics in this relatively rare swamp forest ecosystem.

TEMPORAL ORGANOCHLORINE SIGNATURES IN YOUNG-OF-THE-YEAR BLUEFISH (*POMATOMUS SALTATRIX*) IN THE HUDSON RIVER ESTUARY

Williams, Shayla D.[1]; **Deshpande**, Ashok [1]; **Johnson**, Elijah [2], **Noji**, Thomas [1]

To determine the reliability of using chemical fingerprinting as a means to link young-of-the-year (YOY) bluefish with habitat usage, we examined the unique intra- and inter-annual chemical signatures of 31 polychlorinated biphenyls (PCBs) congeners and 23 chlorinated pesticides in 176 YOY bluefish collected in the Hudson River Estuary over a three-year period. Intra-annually, we observed remarkable similarity in PCB and pesticide profiles. Principal component analysis identified distinct coherent clustering of bluefish by year. The chemical signatures of the first two years (2002 and 2003) were similar while the chemical profiles in 2004 bluefish were different from those of the first two years demonstrating that chemical signatures are subject to inter-annual shifts. The shift in chemical signatures in 2004 may be the response to changes in bioavailability of chemicals due to high flow and sediment resuspension rates in 2003. Although we found no correlations between organochlorine concentrations and such fish characteristics length, weight, lipid, or Fulton's condition index in fish < 150 mm fork length, there was a correlation between chemical signatures and fish size. A distinct PCB profile was seen in fish as small as 45 mm. The likelihood of observing the same chemical signature increased with fish size. This trend was not evident in the pesticide profile of the 2002 and 2003 fish. From these results, we were able to produce for the first time generalized accumulation patterns of organochlorines during the rapid growth stage of age-0 bluefish. Since the chemical fingerprint is stable, fingerprinting may serve as a tool to elucidate habitat usage.

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MULTISENSOR PRECIPITATION ESTIMATES PRODUCED BY NOAA NATIONAL WEATHER SERVICE RIVER FORECAST CENTERS

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Quality, high resolution precipitation estimates are produced hourly over the United States by NOAA's National Weather Service River Forecast Centers. These estimates are produced by a combination of precipitation gage data, RADAR data, and manual quality control. The data is presented graphically and can be summed over any desired time period.

This presentation will provide an overview of the mission, products and services of the National Weather Service River Forecast Centers, and an overview of multi-sensor precipitation data, showing how it is created and how accurate it is specifically in the Mid Atlantic River Forecast Center domain. A brief summary of known applications of this data by environmental interests will be given.

NEKTON USE OF *PHRAGMITES AUSTRALIS* AND *SPARTINA ALTERNIFLORA* IN THE HACKENSACK MEADOWLANDS

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We studied the two dominant forms of tidal marsh vegetation [the invasive common reed *Phragmites australis* and the native salt marsh cordgrass *Spartina alterniflora*] in the Meadowlands of Bergen and Hudson Counties, New Jersey, with regard to their respective use by estuarine nekton. While there has been similar work done in Chesapeake Bay, Southeastern New Jersey and Connecticut, this study is unique in that the large stands of *P. australis* and *S. alterniflora* that were sampled exist adjacent to each other, offering nekton a "choice" upon entering the marsh plain. Field studies were conducted at two sites along the Sawmill Creek. Marshes were sampled using 6.66m long x 1m high flume nets and standard killifish traps. Nets were sampled twice a month for six months (May-October 2001). *Fundulus heteroclitus* (common mummichog) sub-adults to adults were abundant in the collections and showed a strong preference for the *S. alterniflora* marshes compared to *P. australis* marshes. Other species showed little to no preference for either marsh. *Palaemonetes pugio* (grass shrimp) were abundant in each collection, showing no preference for either habitat, while *Callinectes sapidus* (blue crab) was found occasionally, also showing no preference for either marsh type. Amphipods (Gammarus sp.) were present in all collections and were equivalent in both marshes. The fishes *Gobiosoma bosci* (naked goby), *Menidia menidia* (Atlantic silverside), and *Syngnathus fuscus* (Northern pipefish), and the fiddler crab (*Uca pugnax*) were found sporadically, thus providing inconsistent or insignificant results. Stable isotope analysis revealed δ13C values intermediate between plankton and benthic microalgae (BMA) as the base of the food web for mummichogs. Gut content analysis of *Fundulus* revealed similar dietary components in both marsh types. Major dietary components included amphipods and grass shrimp; minor dietary components included fish larvae, blue crabs, fiddler crabs, chironomids, tubeworms, worms, insects and seeds. There were no significant differences between the numbers of blue crabs, fiddler crabs, *Gammarus* spp. or grass shrimp in the stomachs of fish from *Phragmites*- and *Spartina*-dominated marshes.

DEVELOPMENT OF A WATER BUDGET FOR KEARNY MARSH

Yergeau, Steven[1]; **Obropta**, Christopher[2]; **Ravit**, Beth[1]; and **Kallin**, Peter [3]

Kearny Marsh is a freshwater ecosystem located in the heavily urbanized Hackensack Meadowlands District. The New Jersey Meadowlands Commission has determined that remediation of this ecosystem is a high priority and has partnered with Rutgers to achieve this goal. The current hydrologic conditions of the marsh are the result of human alterations including municipal stormwater inputs from the Town of Kearny, construction of railways and highways around the marsh, creation of mosquito drainage ditches through the marsh, channeling of marsh drainage to a partially clogged pipe in the northeast corner of the marsh, and diverting stream flow from the Hackensack River into the Passaic River. Due to the surrounding urban land use and the adjacent Keegan Landfill, significant impacts are suspected from groundwater and surface water interactions and discharges from storm drains into the marsh. In addition, a bulkhead separating Kearny Marsh from Frank's Creek, which is conveying stormwater from the Town of Kearny, has been breached, allowing for the interchange of water. To determine the routes and magnitudes of flows entering and exiting the marsh, a water budget was developed. Storm water and groundwater sampling are occurring and will be combined with the water budget to determine potential sources of contaminants in Kearny Marsh. The water budget uses a mass balance approach (inputs – outputs = change in storage) between all routes of water entering and exiting the system. Inputs include precipitation and runoff while outputs include evapotranspiration and surface water outflows. Groundwater flows were assumed to be small compared to the surface flows for this system. Some tidal exchange is also occurring at the bulkhead breach along Frank's Creek. A SWMM hydrologic model is being developed to analyze the various components of this complex system. The largest source of water is from runoff and the largest water losses are from surface water outflows. Changes to the water budget will be investigated using different development or restoration scenarios, especially those that include land use changes that alter the calculated runoff, water flows that are diverted, or repairing the breached bulkhead. Water quality analyses of both stormwater and groundwater show elevated heavy metals, PCBs, and some PAHs. In addition, total phosphorus and ammonia are elevated which indicates the potential for a high degree of future eutrophication of this ecosystem. Results obtained from the water budget will be used with water quality data to determine pollutant loadings to the marsh. Future hydrologic monitoring, especially of the groundwater system and measurement of evapotranspiration rates, will help to refine the water budget and SWMM models.

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SELF-SHADING AND PHYSIOLOGICAL INTEGRATION IN *PHRAGMITES AUSTRALIS:* FACTORS LEADING TO DIVISION OF LABOR

Zagajeski, Jane E. [1] & **Holzapfel**, Claus [2]

Phragmites australis (the common reed) is increasingly invading new sites and expanding into low salt marshes in the Northeastern United States. In the Meadowlands of New Jersey, *Phragmites* is widespread, thriving both on reclaimed landfills and in the wetlands themselves. Precious research has focused on the role of clonal integration in supporting clonal parts (=ramets) that are expanding into harsher environments. Established *Phragmites* stands grow very dense and experience light limitation within the stand. Therefore we test the hypothesis that expanding (daughter) ramets experience a release from light limitations, specialize in light gathering structures, and are engaged in basipetal (=backwards) translocation of carbon to the benefit of the established (mother) ramets. For this three studies were conducted: (I) Root/Shoot ratio was measured for inner and outer plots in *Phragmites* stands in the Meadowlands in New Jersey. Ramets on the edge of the main stand were found to invest proportionally more dry weight in above ground, light gathering structures. (II) A shading-severing study was conducted in outdoor tubs to test the impact of shading mother ramets when severed from or connected to unshaded daughter ramets. Connected ramets demonstrated division of labor with unshaded daughters allocating proportionally more dry weight to above ground structure than below. (III) Finally in the labeling study, the middle of three connected ramets was labeled with ^{13}C to see if shading the most basipetal shoot induced increased translocation of photosynthetic assimilate. We found indications for this in the form of slight isotope enrichment in shaded ramets. Overall, these results suggest that light limitations can shift carbon sinks within *Phragmites* and that physiological integration induces these sinks to reflect division of labor. Therefore, expanding ramets may experience release from light competition and serve as profitable colonies for the main stand with basipetal translocation of photosynthetic assimilates. This may help to clarify why stands support the expansion of ramets into sub-optimal areas. Additionally, seeing expanding fronts as a potential carbon source for the whole clone may help to inform management strategies for *Phragmites* in the Meadowlands and beyond.

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MASS SIZE DISTRIBUTION OF PARTICULATE WATER-SOLUBLE IONS OVER NEWARK

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Chemical composition and size distributions of atmospheric particles play a significant role in their transportation, transformation, removal, serving as cloud condensation nuclei and governing other properties. Newark is the largest city in New Jersey adjacent to the Atlantic Ocean. Therefore, the states of particles in the ambient air in Newark could be urban particles and the mixture of urban particles and sea-salts. To investigate the mass size distributions of particles and their water-soluble ions over Newark, sampling of atmospheric particles was carried out from July 2006 to Decemebr 2006 on Rutgers University - Newark campus located in the downtown of Newark. Ambient particles with diameters of 0.056-18 μm were collected using a 10-stage MOUDI (micro-orifice uniform deposition impactor) sampler. The samples were analyzed by Ion chromatography (IC) to attain the concentrations of formate, methanesulfonate, chloride, nitrate, sulfate, succinate, malonate and oxalate, ammonium, sodium and calcium. In this paper, the mass distributions of particles and their water-soluble ions in particles along with their formation pathways will be discussed. In addition, the dependence of chloride depletion and the contribution of different species to chloride depletion will also be addressed.

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