New Jersey Flows

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Researchers Report First Known Cases of Ranavirus in New Jersey

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Our initial research problem was to understand the prevalence and intensity of the water-borne fungus *Batrachochytrium dendrobatidis* (Bd) in New Jersey amphibians. The objectives related to addressing this problem were twofold. The first objective was to correlate water and air temperature to the prevalence and intensity of Bd. Other studies in the field and in the lab have shown that Bd is sensitive to both water and air temperature. No such study has been done in New Jersey. Our lab is the first lab to document Bd in the state (Monsen-Collar *et al.*, 2010), and preliminary results show that Bd prevalence may be higher during cooler months. The second objective was to relate biotic factors to prevalence and intensity of Bd. I anticipated species-specific responses to Bd, with some species exhibiting more susceptibility to both infection and disease symptoms. Areas with significant populations of Bd-resistant organisms, such as bullfrogs and tiger salamanders, would have a higher prevalence of Bd.

Anaxyrus fowleri metamorph

While sampling for Bd and not finding any amphibians exhibiting symptoms of even a mild Bd infection, we were alerted to the presence of great quantities of dead tadpoles in Ocean County, NJ; tadpoles exhibited symptoms consistent with a Ranavirus disease. The site is being managed by Herpetological Associates, Inc. (Executive Director, Robert T. Zappalorti) for the endangered pine snake (*Pituophis melanoleucus*), and also harbors a population of Pine Barrens Treefrog (*Hyla andersonii*). The Ranavirus disease is even more lethal than that caused by the Bd fungus, typically killing amphibians within a few days to a week of infection (Harp and Patrenka, 2006). The presence of Ranavirus had never been documented in New Jersey prior to this occasion, and so we decided to focus our efforts on confirming, via molecular analyses, that the diseased tadpoles were indeed infected with Ranavirus and tracking the spread of the disease throughout the state.

Animals were sampled from five ponds located in the vicinity of the Stafford Business Park, in Ocean County, NJ, within an area that is being managed for the benefit of pine snake populations. Because of the mass mortality and severity of the disease outbreak, samples were collected from throughout the state and tested for Ranavirus in much the same way samples were collected from Ocean County. Other sites included Assunpink Wildlife Management Area, Green Creek and Lizard Tail Swamp (Middle Township), Tuckahoe pond (Upper Township), Great Swamp National Wildlife Refuge, Berkshire Valley Wildlife Management Area, Wanaque Wildlife Management Area, Weiss Ecology Center, Norvin Green State Forest and the NJ School of Conservation. Sites were visited multiple times.

Tadpoles at the Ocean County site displayed signs of Ranaviral

Continued on page 3

Features

The Director's Chair

Christopher C. Obropta, Ph.D, P.E.

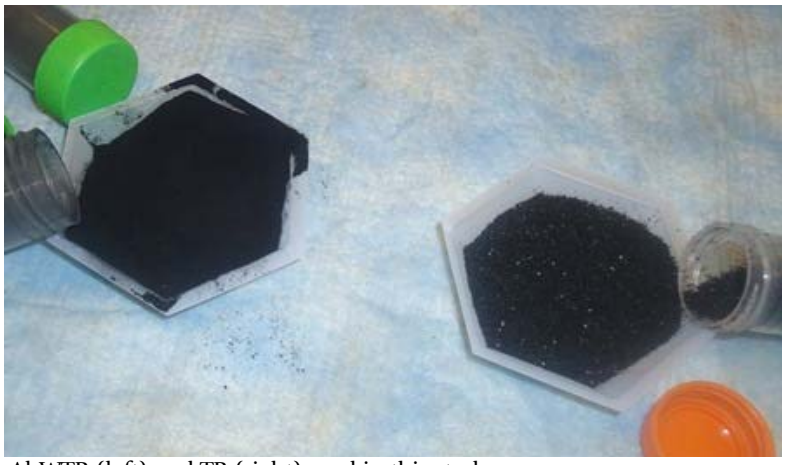
This issue highlights the research funded by the NJWRRI annual competitive grants program and the NIWR/USGS National Competitive Grants Program during FY 2011. In-depth information on the research in this issue can be found in the NJWRRI FY 2011 Annual Report, www.njwrri.rutgers.edu/publications.html. A list of projects funded by NJWRRI for FY 2012 is included on page two.

Scrap Tire and Water Treatment Residuals as Novel "Green" Sorbents for Removal of Common Metals from Polluted Urban Stormwater Runoff

Yang Deng, Sudipta Rakshit and Dibyendu Sarkar, Department of Earth & Environmental Studies, Montclair State University

Heavy metals are pollutants of great interest in urban stormwater runoff due to their non-biodegradability, accumulation in the environment and toxicity. Copper (Cu), zinc (Zn) and lead (Pb) are the most frequently found; of these, Pb is the most toxic and has consistently ranked #2 in ATSDR's most hazardous chemicals list.

Stormwater best management practices (BMPs) are control measures taken to address the quantity and quality issues of urban runoff. To remove metals from urban runoff, many structural BMPs have been attempted, including bioretention, wet ponds, constructed stormwater wetlands, dry wells, extended detention basins, infiltration basins, and manufactured treatment. Some of the conventional structural BMPs are almost ineffective for metals, and many others, such as infiltration basins, are often impractical to implement in urban environments. These limitations have generated modifications to existing structural BMPs or led to the design of new BMPs that can properly treat urban stormwater constituents. Therefore, innovative, cost-effective, low-impact treatment options for heavy metals in urban runoff are needed to improve environmental quality and safeguard public health.



Al-WTR (left) and TR (right) used in this study.

The long term goal of this study was to develop an effective, low-cost and "green" BMP to sustainably address the issue of metal pollution in urban runoff. The primary objective of this study was to evaluate the performance of two recycled wastes, aluminum-based drinking water treatment residuals (Al-WTR) and Tire Rubber (TR), in the adsorption of three major runoff metals (Cu, Zn and Pb), and to assess potential leaching of metals from spent sorbents. Our central hypothesis was that Al-WTR and/or TR can effectively and irreversibly adsorb Cu, Zn and Pb from urban stormwater runoff under a variety of relevant environmental conditions. The specific objectives were:

Objective I: to physically characterize TR and Al-based WTR surfaces by SEM, XRD, BET, and zeta potential analyses.
Objective II: to determine sorption/desorption of Cu and Pb by TR, and Cu, Pb and Zn by Al-WTR as a function of solution pH, ionic strength, solid:solution ratio, and temperature.
Objective III: to determine sorption/desorption of Cu, Pb and Zn by a composite TR/Al-WTR matrix from single and mixed-metal systems.
Objective IV: to assess potential leachability of spent TR and Al-WTR using Toxicity Characteristics Leaching Procedure tests.
Objective V: to evaluate potential leachability of benzothiazole from TR and the effectiveness of Al-WTR in its retention.

Based on the current data, a few significant outcomes were obtained, including:

- WTR can rapidly adsorb Cu, Zn and Pb from water. Moreover, it has high adsorption capacities for the metal of concern. Therefore, WTR appears to be an excellent remediation material to address metal pollution in urban runoff.
- TR also adsorbs Cu and Pb in water. However, compared to WTR, its adsorption rate is relatively slow. Likewise, its adsorption capacity is lower than that of WTR. Accompanied with Cu and Pb adsorption on TR, Zn in TR gradually leaches out into bulk solution, implying that Zn leaching might have been enhanced by Cu/Pb-Zn exchange in TR.
- A mixture of WTR and TR are able to quickly and effectively adsorb Cu and Pb. In addition, in the presence of WTR, less Zn is leached, thus indicating that WTR can adsorb Zn released from TR. This finding suggests that TR should be used in conjunction with WTR, because the latter can minimize Zn release from TR.

Yang Deng, Sudipta Rakshit and Dibyendu Sarkar are professors in the Dept. of Earth & Environmental Studies, Montclair State University, www.montclair.edu.

Research Projects funded by NJWRRI in FY 2012

-Performance Assessment of Bioretention for Car Wash Runoff Treatment, Michele Bakacs and Steven Yergeau, Rutgers
-Application of Graphene-based Sorbents for Arsenic and Lead Removal from Drinking Water Resources, Shifeng Hou and Huan Feng, Montclair State
-nHFO Microalgae and Immobilization for Water Quality Improvement, Liping Wei, NJIT
-Predicting the matric potential of unsaturated porous media using nuclear magnetic resonance, Sam Falzone, Rutgers—Newark
-Understanding metabolic flux dynamics during hydrolytic and fermentative digestion of wastewater treatment sludge for advanced ammonic-nitrogen removal, Amanda Luther, Rutgers
-Mitigation of Environmental Nitrogen Release by Enrichment of Hyper Ammonia Producing (HAP) Bacteria in Waste Treatment Systems, Sunirat Rattana, Rutgers
-Urban wetland plant assemblage species diversity and invasive species dominance as expressions of flood regime, Laura Shappell, Rutgers
-Reductive Halogenation of Brominated Organic Compounds by Nano FeS Particles, Cynthia Steiner, Rutgers

An Investigation of the Water Quality of Rainwater Harvesting Systems

Michele Bakacs and Mike Haberland, Rutgers Cooperative Extension

In New Jersey, small scale rainwater harvesting using rain barrels has become a popular method for watering backyard and community gardens. This research will help increase our understanding of the chemistry of harvested water and the safety of using harvested rainwater on vegetable gardens, for which little information currently exists. In a survey done at four residential "Build A Rain Barrel" workshops in Middlesex and Union Counties in spring 2010, 57% of the survey participants (n=58) indicated that they would be using their rain barrel water to water a vegetable garden. Studies have shown that roof runoff can have high levels of pathogens, zinc, lead, and hydrocarbons. Many homeowners and community gardens harvest rooftop runoff with little to no protection from the first flush of runoff that has been shown to have the highest levels of contaminants. This study examined levels of four contaminants in rainwater draining off asphalt shingled roofs and collected by rain barrels: lead, zinc, total coliform, and *Escherichia coli*. In addition, we investigated whether there is a significant difference between levels of contaminants draining roofs in different land uses, specifically, suburban verses urban communities. The results of this research will help to develop guidelines for water testing, results interpretation and best management practices for applying harvested rainwater to backyard and community gardens.

This project analyzed stormwater runoff from asphalt shingled roofs that was collected in rain barrels. Rain barrel water samples were collected from both urban and suburban locations to determine whether surrounding land use has an impact on water quality. Rain barrels were installed in two medium density housing communities in southern New Jersey, representing a suburban community, and high density housing in central New Jersey, representing an urban community.

Water quality analyses showed that the water quality standards for zinc were not violated in either the suburban sites or the urban sites. The mean zinc concentration in the urban sites (89.4 μg/L) was more than double the suburban sites (37.1 μg/L). The surface water and groundwater quality standard for lead in both urban and suburban sites was violated. The groundwater and drinking water quality standards for total coliform were violated at all sites for all sampling events. Potential sources of total coliform are wildlife (birds, small mammals/squirrels) that have access to the monitored roofs or are living in trees adjacent to the homes. There is no surface water quality standard for total coliform. *E. coli* data was not included in the analyses due to the low number of samples collected.

In analyzing whether land use had an effect on rain barrel water quality, zinc showed a statistically significant difference between urban and suburban land uses in all of the analyses performed. Zinc concentrations were much higher in the urban sites when compared to the suburban sites. There was no statistical difference between urban and suburban land uses for all analyses of lead. Total coliform levels showed no statistically significant differences between urban and suburban land uses. Residual water left in the barrels does not seem to impact total coliform levels.

Michele Bakacs and Mike Haberland are Environmental & Resource Management Agents with Rutgers Cooperative Extension, www.njaes.rutgers.edu.

Continued from page 1

disease, including lethargy, swelling, and red skin lesions. Disturbingly, *Anaxyrus fowleri* tadpoles sharing the same body of water with the infected tadpoles were observed consuming the carcasses of dead Green Frog (*Lithobates clamitans)* tadpoles.

PCR results: Of the 27 *L. clamitans* samples from the Ocean County site that were subjected to traditional PCR, 20 (all tadpoles) tested positive for the presence of Ranavirus DNA. Results were confirmed by sequencing. Of the 38 *A. fowleri* tadpoles collected, three tested positive for Ranavirus using traditional PCR; after rerunning these samples with RT-PCR, one additional sample tested positive for Ranavirus. One adult Southern Leopard Frog (*Lithobates sphenocephala)*, which was found dead on site, tested positive for Ranavirus using traditional PCR. With regards to the other New Jersey sites, one *A. fowleri* tadpole from Tuckahoe pond in Upper Township has tested positive for Ranavirus.

To our knowledge, this is the first reported case of Ranavirus in the state of New Jersey. What is disturbing is the significant level of mortality associated with an outbreak of Ranavirus and the rapidity with which it spreads through a population. Furthermore, at this time it seems as if Ranavirus is located in the southern part of New Jersey, which is home to numerous amphibians and reptiles of special concern, such as the pine snake, the Pine Barrens Treefrog and the Southern Gray Treefrog (*Hyla chrysoscelis*). Ranavirus has been known to affect a wide variety of amphibians and reptiles. Therefore, this deadly disease could pose a significant threat to New Jersey's herpetofauna. Additionally, results from this work have shown that while traditional PCR is apparently effective at detecting Ranavirus in heavily infected individuals (such as the dead and dying tadpoles at the Ocean County site), its sensitivity may be insufficient for detecting Ranavirus during the initial stages of infection. Indeed, one sample that came up negative using traditional PCR then tested positive when RT-PCR was used.

This work is ongoing and sites visited in 2011 will be re-visited to track the progression of the disease over multiple years and seasons. Results are being shared with the NJ Division of Fish and Wildlife to implement wide-scale sampling for Ranavirus throughout the state and to create educational materials for wildlife managers to help document outbreaks and contain the spread of the disease.

References

Harp, EM and JW Patrenka. 2006. Ranavirus in wood frogs (Rana sylvatica): Potential sources of transmission within and between ponds. Journal of Wildlife Diseases, 42(2), 307-318.

Monsen-Collar KJ, L Hazard, R Duss. 2010 Comparison of PCR and RT-PCR in the First report of *Batrachochytrium dendrobatidis* in amphibians in New Jersey. *Herpetological Review*, 41(4), 260-462.

Paola Dolcemascolo is a Ph.D. student in the Dept. of Earth and Environmental Studies, Montclair State University, www.montclair.edu.

A push-pull technique to characterize volatilization and biodegradation rates of VOCs in shallow wetland sediments

Matthew Reid, Dept. of Civil and Environmental Engineering, Princeton University

New Jersey's industrial history has resulted in a legacy of surface and groundwater resources contaminated with volatile organic compounds (VOCs). 44% of New Jersey's community water supply wells were classified as "highly susceptible" to VOC contamination, and 19% of wells with available data met or exceeded the maximum contaminant limit for trichloroethylene (TCE). TCE has been identified in 55 contaminated sites in New Jersey, benzene at 56 sites, and vinyl chloride (VC), a degradation product of TCE and a known human carcinogen, has been identified at 28. These VOCs are highly toxic to humans and their removal from contaminated groundwater is a major priority for the protection of New Jersey's water resources.

Plant-enhanced remediation of contaminated sediments and groundwater, or "phytoremediation," is an attractive alternative to traditional environmental remediation methods due to its energy-efficiency and cost-effectiveness. Vegetated soils act to remove organic contaminants through biodegradation, sorption, and plant uptake. Of these three processes, plant uptake remains the least understood. In particular, the extent to which organic pollutants are transported through plants and volatilized to the atmosphere ("phytovolatilization") is highly uncertain due, in part, to difficulties in the measurement of these processes. Volatilization can be an effective remediation mechanism because it transports VOCs to the atmosphere, where they are degraded to nontoxic products on the order of days relative to months to years by natural attenuation in groundwater. Effective phytoremediation strategies require estimates for volatilization rates, however, and the subsequent times scales for phytoremediation applications. Phytovolatilization rates will be highly site-specific, and at present there are no good field measurement techniques for assessing rates of phytovolatilization. The objective of this project was to develop a push-pull test (PPT) to simultaneously quantify in-situ rates of biodegradation and volatilization of organic contaminants in shallow wetland sediments.

The principal findings of this research project are:

(a) The push-pull test, modified to include volatile tracers, provides novel quantitative information on the rates of transport and volatilization processes in near-surface saturated soils.

(b) The effect of trapped gas bubbles on measuring rates of processes involving volatile substances can be (partially) overcome using the dual volatile tracer method. This is a novel application of a measurement technique adapted from chemical oceanography.

(c) A basic model describing the ratio of the volatilization rates of two substances as a function of the ratio of the diffusivities of the two compounds has been shown to be appropriate for modeling phytovolatilization rate constants. More work needs to be done to determine which diffusivities are most appropriate – diffusivity in water, or in some type of polymer?

Matthew Reid is a Ph.D. student in the Department of Civil & Environmental Engineering, Princeton University, www.princeton.edu.

Release of Hazardous Metals into Surface and Groundwater by Microbial Oxidation of Sulfide Minerals

Andrea Walczak, Dept. of Biochemistry and Microbiology, Rutgers University

Current research on metal distribution in waterways in the Newark Basin has largely focused on aquatic chemistry, hydrology, and on aquatic organisms such as fish and birds. A crucial link remains to be understood regarding the fate of these metals, namely the effects of microorganisms. Once metals such as lead (Pb) are mobilized, the likelihood of human exposure increases and can result in well-documented health effects. Lead has also been shown to reduce photosynthesis in phytoplankton; increase mortality of polychaetes, bivalves, and crustaceans; affect development of fish embryos; and cause neurological disorders in birds.

This study will focus on determining the effect microbial activity has on releasing Pb from the sediments. *Bosea* sp. str. WAO was isolated from the Lockatong formation based on its ability to oxidize and mobilize arsenic and sulfur from arsenpyrite and will be used as the experimental model organism in this study. The metal sulfide galena (PbS) will be used as an energy source for this chemolithitrophic organism to grow at mesophilic temperature and circumneutral pH. The rate and extent of oxidation of the mineral will be monitored by measuring the release of sulfate and metal ion by ion chromatography and Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES), respectively. The oxidation process will also be monitored visually using confocal microscopy. This study will demonstrate WAO's ability to oxidize metal sulfides, releasing soluble metal ions and sulfate at mesophilic temperature and circumneutral pH. This research can be applied to advanced modeling and mitigation strategies.

Overall Conclusions and Significance:

1. Oxidation of sulfide bound to PbS only occurs in the presence of *Bosea* sp. str. WAO and not with killed cells or when incubated with only media. Therefore, this is a microbially mediated process.
2. Metal analysis shows there is not a release of Pb into the bulk solution even with sulfide oxidation, suggesting that secondary reactions are taking place to sequester the Pb.
3. *Bosea* sp. str. WAO remains in close association with the surface of the PbS mineral, suggesting that it must be in contact for oxidation to occur.

Continued on page 5

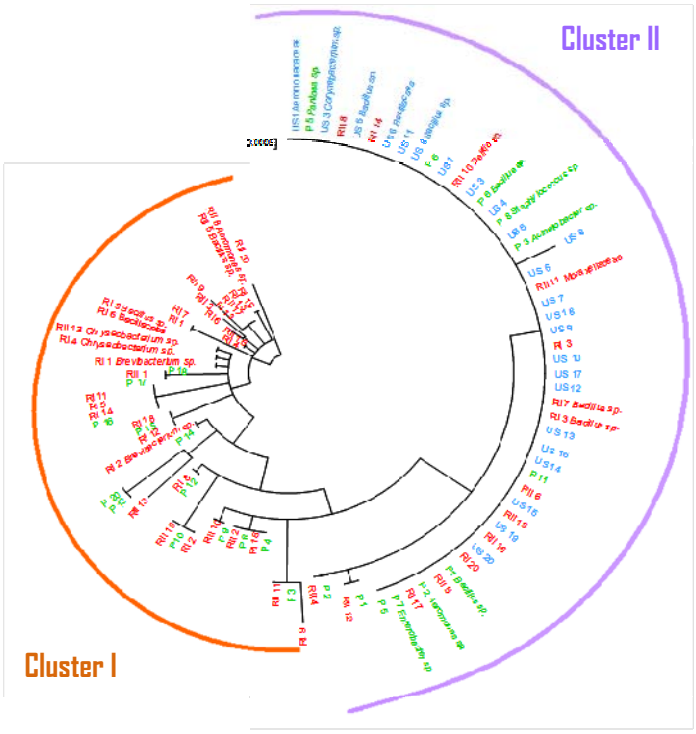
Identification and characterization of novel antibiotic resistance genes from wastewater effluents and surface waters

Maryam Honarbakhsh, Dept. of Biochemistry and Microbiology, Rutgers University

This project fits within a broader study currently carried out in the lab concerning the impact of antibiotic pollution on the establishment of emerging diseases. The rationale for the work is provided by preliminary data generated during the preparation of my masters thesis. I had compared the structure of microbial communities at different sites upstream and downstream of the Somerset Raritan Valley Sewage Authority in New Jersey. I had also investigated the occurrence of antibiotic resistance in bacterial isolates from the final effluents of the plant and from two locations downstream the sewage discharge. All the isolates resulted resistant to elevated concentrations of amoxicillin, regardless of the site of sampling, and many showed azithromycin and trimethoprim resistance. Based on these results, I made the hypothesis that resistance to specific antibiotics observed downstream the discharge is due to lateral transfer of resistance genes from wastewater effluents to freshwater bacteria. Alternatively, resistance might have derived from the selection of pre-existing resistant genes in the native community as a consequence of prolonged exposure to antibiotic pollutants. To distinguish between these two hypotheses, gene sequences would be analyzed and compared to establish if antibiotic resistance is mediated by lateral gene transfer (sequences have a common origin), or if it emerged by selection of rare pre-existing resistant genes in the native community (multiple or polyphyletic origins). To enable the detection of unknown and novel antibiotic resistance genes encoded by plasmids or chromosome encoded, I proposed the following approach:

Aim #1. Detection of antibiotics resistant genes encoded by plasmids. Plasmids of cultured microorganisms and metagenomic DNA isolated from the water treatment plant effluents and the surrounding area were targeted for sequencing to detect novel antibiotics resistance genes.

Aim #2. Detection of antibiotics resistant genes chromosome-encoded. Gene expression libraries were prepared using metagenomic DNA and screened for their ability to confer specific antibiotic resistance to sensitive strains. The sequences of clones identified this way were determined.



Distribution of the TEM4 genes. Phylogenetic analysis of TEM4 fragments of the β–lactamase genes amplified from community DNA and plasmids from environmental isolates. The tree was obtained with Mega 5 using the neighbor-joining method.

The sequences obtained through aim #1 and #2 were analyzed using phylogenetic methods, including distance and maximum parsimony analyses, to assess the relationship among sequences from different sites and to track their origin.

The data obtained from the antibiotic profiling of the isolates showed resistance to high concentrations of β-lactam antibiotics, including amoxicillin, and multi-drug resistance, which are regarded as common features of isolates from wastewater. However, the analysis of the distribution of plasmid-encoded *bla* TEM genes of the isolates suggests that the spread of resistance genes might also occur through HGT among different genera, and that isolates not previously reported in the literature may indeed contribute to the spread of resistance. By looking at the distribution of the *bla* TEM gene within our communities, it was found that genes grouping within cluster I are remarkable in that they are exclusively found in the plant, RI and RII sites, but they were not detected in the upstream site. We can speculate that *bla* TEM genes specific to the community of the plant effluent moved to the community of receiving body of water, which would explain the particular distribution of the *bla* TEM genes belonging to cluster I. In contrast, *bla* TEM genes belonging to cluster II are ubiquitous, and do not seem to be prevalent at any specific site.

Maryam Honarbakhsh is a masters degree student in the Department of Biochemistry and Microbiology, Rutgers University, www.rutgers.edu.

Continued from page 4

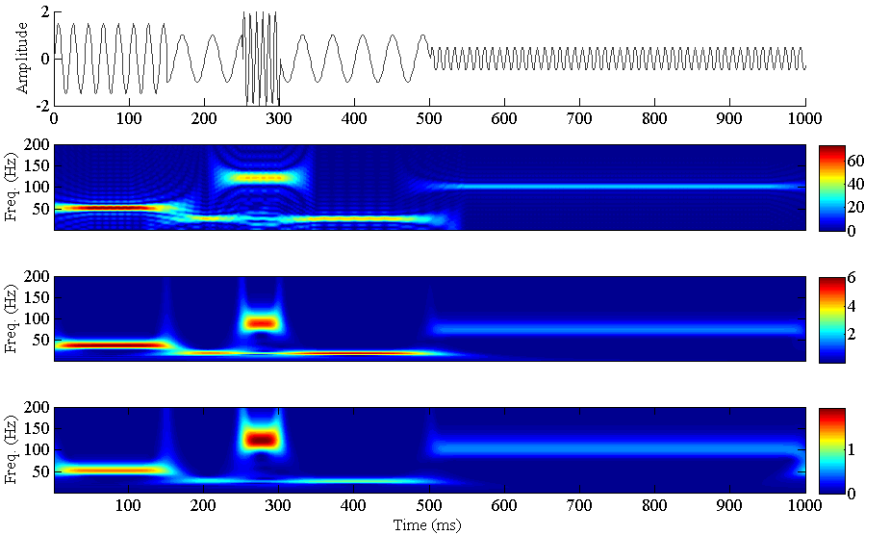
4. The concentration of phosphate has an effect on the amount of sulfide that can be oxidized from PbS. Reduced phosphate levels showed a reduction in the concentration of sulfate released.
5. X-ray diffraction of reacted mineral shows the remaining precipitate has been transformed from PbS to $Pb_9(PO_4)_6$ in both abiotic and biotic conditions, indicating that this reaction is abiotically occurring. This abiotic reaction is sequestering the Pb from the media and can serve as a remediation technique; however, the release of sulfide for microorganisms to oxidize can potentially acidify the environment.
6. Sequencing and analysis of WAO's genome will allow for the elucidation of its sulfide oxidation pathway.

Alexandra Walczak is a Ph.D. student in the Department of Microbiology and Molecular Genetics, Rutgers University, www.rutgers.edu.

Advancing the characterization of sandstone and fractured limestone aquifers using surface electrical geophysical methods

Mehrez Elwaseif, Dept. of Earth and Environmental Sciences, Rutgers University—Newark

The primary objective of this research is to advance surface Ground Penetrating Radar (GPR) and Electrical Resistivity (ER) processing techniques for characterizing sandstone and limestone subsurface aquifers at two sites in New Jersey. Our research explores the use of time – frequency analysis to process GPR data in order to better characterize sandstone and limestone aquifers. We have applied three popular time frequency analysis tools [short time Fourier Transform (STFT), Wavelet Transform (WT) and STransform (ST)] on a synthetic non-stationary signal to identify the optimum approach to use for the GPR processing. In addition, we have tested the performance of our suggested approach, S-Transform, on synthetic GPR data representing a variety of fractured limestone and sandstone model scenarios. The S-Transform results show that a frequency shift occurs when the GPR signals transmit through mediums that have different dielectric permittivity values. Furthermore, our developed approach facilitates mapping particular targets of interest (e.g., water filled fractures) based on their observed frequency shift and ignoring all the remaining features within the data. We also describe a resistivity inversion strategy that is more appropriate for defining layers and for reconstructing the conductivity distribution within those layers.



Time – Frequency analysis for a synthetic signal (a) time series, (b) STFT section, (c) WT section and (d) ST section.

Mehrez Elwaseif recently received his Ph.D. from the Dept of Earth and Environmental Sciences, Rutgers University—Newark, www.newark.rutgers.edu.

Assessment of Green Frog populations as biological indicators of risk to communities near Superfund sites

Jennifer Costello, Department of Biology, College of Staten Island

The objective of this study was to determine if correlations exist between the presence of metals in the environment and observable differences in ultrastructure of tissues, feeding behavior and population composition in the biological indicator species, the green frog, *Lithobates clamitans*. Elevated metal concentrations at the site were used as a measure of anthropogenic habitat degradation. Individuals from the site of interest, a pond adjacent to Lone Pine Landfill, a New Jersey Superfund site, were compared to individuals from a pristine site in Ulster County, N.Y. The following hypotheses were tested:

1) Does metal exposure correlate with cellular metal accumulation and ultrastructural differences in tissues?

2) Does metal exposure correlate with decreased prey capture efficiency?

3) Does metal exposure correlate with survival to adulthood?

4) Does a link exist between lower levels of biological organization, such as cellular abnormalities and metal accumulation, and upper levels of biological organization, such as feeding behavior and population composition?

Amphibians have permeable skin that has the potential to absorb harmful substances from their environment. Responses to these pollutants may be intensified by stressors present in their surroundings. Exposure to both stressor and pollutant are not limited to adulthood, but rather are continuous throughout their lifetime due to the unique nature of the amphibian lifecycle. The effects of such exposure may not be immediately lethal, but rather may result in sublethal responses. Decreased feeding efficiency is one such response. Preliminary findings in this study demonstrate correlations of at least one environmental stressor, low levels of dissolved oxygen (DO) in pond water critical for survival of eggs and tadpoles, with decreased feeding efficiency.

While no significant difference is immediately apparent between UVB readings from each site, previous studies have found UVB intensity readings as low as 93 μW/cm2 to contribute to 93% mortality of larval amphibians. While most intensity readings collected from both sites were two to three times greater than this value, vegetation cover and oviposition depth could minimize UVB impacts to both amphibian embryos and larvae. Limited cover from UVB radiation has been associated with developmental abnormalities such as delayed development and limb deformities.

Further analysis of correlations between metals present in the soil and sediment at each of these sites with feeding efficiency is anticipated to reveal similar relationships. In addition, continued analysis of the data is necessary to determine if any synergistic interactions are evident between abiotic factors and feeding efficiency.

Jennifer Costello is a Ph.D. student in the Department of Biology, College of Staten Island, www.csi.cuny.edu.

Does urbanization decrease baseflow? A historical, empirical analysis in the coastal states of the Eastern United States

Joshua C. Galster, Montclair State University, and Kirk Barrett, Manhattan College

Approximately half of the U.S. population depends on surface water (rivers and reservoirs) for their drinking water. During dry weather, rivers and reservoirs are fed by baseflow. Many of these areas are urbanizing, in some cases rapidly. Theoretically, urbanization will cause a decrease in baseflow, which means urbanization is a threat to water availability for about half the population. Reduced baseflow can also negatively affect stream biota. The problem is that it is not clear if (and to what degree) this theoretical linkage between urbanization and decreased baseflow is actually experienced in the real world. There are several processes associated with urbanization that could confound the theoretical relationship.

This project helps resolve this relationship by conducting a large spatial and temporal scale, empirically-based investigation into the urbanization-baseflow relationship. The project determined the relationship between urbanization and baseflow in real watersheds. It provided the most complete assessment about how urbanization actually affects baseflow. Water supply managers and land development regulators can use this information to better understand the effects of land development and manage it accordingly, especially in rural and water supply watersheds. The project results should be useful in assessing the threat posed by urbanization to dry-weather water availability and stream ecology.

We analyzed historic United States Geological Survey gage data to determine trends in baseflow over time. Baseflow data were collected for the states of Maine, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia. We used different timeframes and baseflow metrics for their utility in identifying trends. We used three metrics of annual baseflow: 1) baseflow per unit drainage area (BF); 2) ratio of BF to precipitation (BF/P); and 3) BF as a fraction of total flow (BF/TF). Trends were indentified using the non-parametric Mann Kendal statistical test, the Sen slope estimator, and through the use of dummy variables and panel data fixed effect models to determine baseflow trends for regions.

Post-urbanization results in increased impervious surfaces and increased water delivery systems. The impervious surfaces will decrease river baseflow by decreasing infiltration rates, while water delivery systems are notoriously leaky. The net result of these two counteracting forces is that the Appalachians and New England experience net water gains as they add more water through leaky systems than is lost from increased runoff. However, the Coastal Plain is the opposite, as it has net water losses as impervious surfaces decrease infiltration to a larger degree than water is added through leaky systems.

Joshua Galster is an assistant professor in the Dept. of Earth & Environmental Studies, Montclair State University, www.montclair.edu.

Drought and Flood in the Eastern U.S.

James Smith, Justin Sheffield and Eric Wood, Princeton University

We propose to develop statistical procedures for regional analyses of drought and flood in the eastern US based principally on USGS stream gaging data. We will focus on the interrelationships between drought and flood, with a particular emphasis on water supply systems for large urban centers of the eastern US. Procedures will exploit mixture distribution representations of flood and drought variables; these representations center on tropical cyclones, which are major rainfall and flood agents during summer and fall, and extratropical systems, which are major rainfall and flood agents during spring and fall in the eastern US. We adopt a regional approach covering the eastern US due to the scale of the weather and climate systems at play. Special emphasis will be placed in this study on the Delaware River basin (water supply for New York City), the Potomac River basin (water supply for Washington D. C.), the Catawba River basin (water supply for Charlotte, North Carolina) and the Chattahoochee River basin (water supply for Atlanta, Georgia). The procedures that we will develop are designed for broad use by USGS National and District offices for water resource assessment studies. Additional users will include river basin planning and management agencies (including the Delaware River Basin Commission and Interstate Commission on the Potomac River Basin), states and local municipalities.

The procedures will be used for regional assessments of drought and flood frequency, short-term (seasonal to interannual) characterization of drought and flood occurrence and long-term trend assessment of drought and flood variables. These procedures will provide capabilities for regional water resources analyses covering the eastern US. Detailed analysis capabilities will be developed for the Delaware, Potomac, Catawba and Chattahoochee River basins, providing information on drought and flood frequency for major urban centers of the eastern US.

The broad objective of this study is to develop statistical tools for characterization of water resources and flood hazards based on USGS streamflow records. The specific objectives of the study are to develop statistical procedures for: 1) assessing non-stationarities of drought and flood variables (in terms of change-points, slowly varying trends and long-term persistence), 2) characterizing spatial extremes of drought and flood and 3) characterizing the interrelationships between drought and flood, including their relationships to climate indices. The project will be carried out over a two year time period. Development of data sets and statistical procedures will be largely completed during year 1. Implementation of procedures for assessing nonstationarities in drought and flood variables will be completed in year 1. Other project tasks will be initiated during year 1. In the second year of the project, we will complete analyses of the interrelationship of drought and flood for the eastern US, analyses of spatial extremes and analyses of drought and flood occurrence in terms of climate indices. We will also synthesize analyses for the Delaware, Potomac, Catawba and Chattahoochee River basins during year 2.

James Smith and Eric Wood are professors, and Justin Sheffield is a research scholar, in the Dept. of Civil & Environmental Engineering, Princeton University.

Conference Calls

Passaic River Symposium V—"Today's Status, Tomorrow's Perspective"

October 19, 2012 at Montclair State University, Montclair, NJ

For more information, please visit: www.montclair.edu/csam/passaic-river-institute/conferences-symposiums/

39th Annual ANJEC Environmental Congress

October 20, 2012 in Edison, NJ

For more information, please visit: www.anjec.org/ConfWorkshops.htm

2012 AWRA Annual Water Resources Conference

November 12-15, 2012 in Jacksonville, FL

For more information, please visit: www.awra.org/meetings/Jacksonville2012/

Delaware Estuary Science & Environmental Summit 2013

January 27-30, 2013 in Cape May, NJ

For more information, please visit: www.delawareestuary.org/news_pde_science_conference.asp

For upcoming conferences, events and training sessions in New Jersey and beyond:

www.njwrri.rutgers.edu/events_list_page.htm

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