Maryland Water Resources Research Center

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Spring 2006 **Dr. Allen P. Davis, Director** **Dr. Phil Kearney, Assoc Dir.**

Urbanization and Water Resources

On November 18, 2005, the Center held a symposium on *Urbanization: Stresses on Maryland's Water Resources*. Over 100 participants attended the symposium. This was our largest symposium to date, primarily due the widespread interest in the subject by a large number of members of our water community. Maryland is experiencing a tremendous period of urbanization. As Maryland's population continues to grow, water supply and natural water ecosystems are increasingly stressed. Our keynote speaker was Dr. Robert Hirsh, Associate Director of Water, U. S. Geological Survey, Reston, VA. Six additional speakers, representing University and State scientists covered a host of related issues. One theme of a number of speakers dealt with the growing problems associated with stormwater runoff from impervious surfaces. Several studies are underway to design systems that will reduce the amount of contaminates from storm water runoff. In many ways, Maryland is at the forefront in dealing with water issues related to urbanization.

The symposium was cosponsored by the *Maryland Sea Grant College*. Presentations from the symposium can be found at the Center webpage.

Future Symposium

We are beginning to think about our next symposium for the Fall of 2006! These conferences take a great deal of advanced planning. Even though it is early February, as we get into the summer months a number of decisions will have to be made. At this stage in the planning process, selecting the topic of the next conference is our most important priority. We would be pleased to hear what ideas you have for a potential topic for the 2006 Symposium. Ideas can be sent to Phil Kearney at kearneyp@umd.edu.

Inside the Newsletter

2006 Funded Research Proposals

The Center is pleased to support three water resources research projects and a summer fellow in 2006. These projects were selected based on a peer review by scientists and engineers external to the University of Maryland. Interestly, all have a salt or salinity focus in one way or another, suggesting that this is a topic of growing interest in the state. Summaries for these projects are presented below.

Salinity effects on using hyperspectral radiometry to determine leaf nitrogen of emergent wetland macrophytes:

David Tilley and Andrew Baldwin, Biological Resources Engineering, University of Maryland.

This research is focused on developing wetland hyperspectral radiometry as an assessment tool that would remotely quantify nitrogen in marsh plant tissue, and distinguish marshes by nitrogen availability for coastal environments where changes in salinity add to the difficulty in detecting nitrogen effects from spectroradiometric readings. Ground-based hyperspectral radiometry will be used to measure the leaf reflectance of common emergent marsh macrophytes exposed to combinations of nitrogen and salinity in greenhouse microcosms. The significance of the effects of nitrogen and salinity on leaf hyperspectral reflectance will be determined. Multivariate data analysis technique of partial least squares (PLS) regression will be employed to develop hyperspectral reflectance models predictive of leaf tissue nitrogen, soil nitrogen availability and salinity stress.

Specific objectives are: (1) determine whether salinity decreases near-infrared and increases visible reflectance of freshwater and salt/brackish marsh macrophytes; (2) determine whether there is an interaction effect between nitrogen and salinity on near-infrared and visible reflectance of freshwater and salt/brackish marsh macrophytes; (3) determine whether species has a significant effect on leaf hyperspectral reflectance across a nitrogen and salinity gradient; (4) determine whether PLS models that use hyperspectral reflectance can distinguish the nitrogen levels of leaf tissue across a gradient of salinity expected at the tidal freshwater brackish interface; and (5) determine whether PLS models that use hyperspectral reflectance can distinguish the salinity of the water column across a gradient of salinity expected at the tidal freshwater/brackish interface. Plants will be collected from donor wetland sites in the College Park region and grown in the University's new Research Greenhouse Complex. The work will lead to fundamental understanding of hyperspectral reflectance response of wetland plants to nutrients and salinity and to a practical tool for assessing the health of wetlands.

Chemical and biological impacts of zinc and road salt from road runoff entering stormwater retention ponds:

Ryan E. Casey, Department of Chemistry, Towson University, Steven M. Lev, Department of Physics, Towson University, Joel W, Snodgrass, Department of Biological Sciences, Towson University, Edward R. Landa, U.S. Geological Survey, Reston, VA

Highway runoff has the potential to negatively impact receiving systems due to elevated levels of constituents such as deicing salts and metals. Road runoff contributes large quantities of Zn to the environment, much of which is derived from tire particulate matter. Mobile Zn has been implicated in causing adverse effects in aquatic organisms. Retention ponds attract and are utilized by a wide range of wildlife species, therefore deposition of metal-bearing vehicular wear particles may result in significant exposures of biota to elevated levels of Zn. Accumulation of Zn by biota inhabiting ponds (e.g., larval amphibians and fish) may result in trophic transfer of Zn out of ponds as semiaquatic wildlife (e.g., wading birds, waterfowl) feed on pond organisms that accumulate significant quantities of Zn. Neither the magnitude nor the effects of such exposures are clearly known. Recent evidence has demonstrated that Zn in pond sediments is relatively unavailable compared to Zn in road runoff entering the pond. Runoff can contribute substantial loads of Zn in single storm with up to 40% of the Zn in the truly dissolved phase. This aqueous phase is the most relevant toxicologically. The proposed research will continue the efforts currently underway (quantifying Zn in roadway runoff and characterization of roadway particulate matter) while adding two new objectives.

The first objective is to determine the storage of Zn in stormwater ponds throughout the Red Run watershed and compare that storage to fluxes of Zn out of the watershed in surface water. This will allow us to assess the watershed-level impacts of stormwater management strategies on control of Zn export from this region. Secondly, recent research has also demonstrated that road salt applications are resulting in increased salinization of freshwater systems throughout the year with potential toxicity occurring in sensitive organisms. In the first year of this project, our laboratory found that extremely high salt concentrations (up to 17,000 mg Cl- L-1) persisted through the summer in this retention pond and that lower (though still elevated) levels of salinity resulted in 100% mortality for wood frogs (*Rana sylvatica*). The salinization of retention ponds throughout the Red Run watershed will be measured. Road salt applications are resulting in increased salinization of freshwater systems throughout the year with potential toxicity occurring in sensitive organisms. Both water column salinity as well as that in shallow groundwater could be discharging into adjacent surface waters will be evaluated.

Investigation of the effects of increased salinization from deicer use on increased transport of nitrogen in streams of the Chesapeake Bay Watershed:

Sujay Kaushal, Keith Eshleman, and Ray Morgan, UMCES Appalachian Laboratory, Frostburg, MD, Gary Fisher, U.S. Geological Survey, Reston, VA, Peter Groffman, Institute of Ecosystem Studies, Millbrook, NY, Paul Mayer, EPA, Office of Research and Development, Ada, OK

Salinity is now increasing in many streams across Maryland toward thresholds beyond which significant changes in ecological communities and ecosystem functions may be expected due to increased deicer use on roadways, fertilizer applications, operation of water softeners, and discharges from septic systems and wastewater treatment plants. As a result of large increases in suburban and urban growth over decades, concentrations of chloride, a common anion of many salts, have now exceeded the limit of 250 mg/L established by the U.S. EPA for chronic toxicity to freshwater life in many streams of the Baltimore metropolitan area.

The ranges and extreme fluctuations in salinity observed in Maryland streams have been shown to inhibit denitrification, a microbial process that is critical for the removal of nitrate and maintenance of water quality in many streams. The effects of increased salinization on impairment of in-stream processing and removal of nitrogen via denitrification in streams, will be studied. The objectives of the study are to (1) investigate the effects of increased salinity on rates of nitrogen removal through denitrification in different stream features (debris dams, and sediments from pools, riffles, and gravel bars) in streams across Maryland surrounded by different land use and geomorphic setting and (2) characterize seasonal changes in levels and sources of salinity in streams by measuring concentrations and ratios of Na, Cl, and K ions. Denitrification potential will be measured in streams under ambient conditions in streams near roadways and nearby forested control sites and following amendments with road salt. Denitrification measurements will be conducted twice per year in the Appalachian Mountains, Piedmont, and Baltimore metropolitan area during summer and winter months. Water samples from all sites will be collected monthly for measurement of concentrations and ratios of Na, Cl, and K ions as part of existing studies that are already maintained by the UMCES Appalachian Lab, Maryland Biological Stream Survey, USGS, Institute of Ecosystem Studies, NSF supported Baltimore LTER site, and EPA. The work will specifically identify thresholds for critical ecosystem processes related to downstream nitrogen transport and water quality. The project also has the potential to build on the Maryland Biological Stream Survey for future research because broader scale characterizations of baseline biogeochemical processes critical to water quality and expectations on how they may be altered by land use change are rare in the literature.

Linking geomorphic stability, nutrient dynamics, and algal communities in the context of stream restoration:

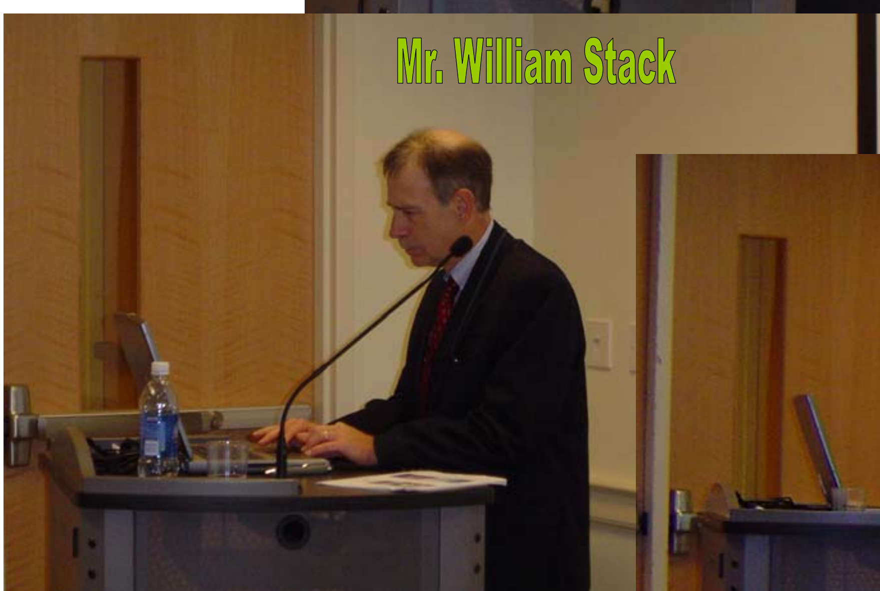
Brian Laub, Summer Fellow, Department of Biology, University of Maryland, Dr. Margaret Palmer, Advisor

In recent years, stream restoration projects have increased exponentially in the Chesapeake Bay watershed; however, these projects are rarely monitored for effectiveness. In order to evaluate the success of stream restoration, monitoring of individual projects is normally applied to provide guidance for future restoration initiatives. For this project, 11 streams located in Anne Arundel County, Maryland will be monitored. The success of stream restoration will be measured by the amount of sediment transported, nutrient concentrations, and stream biota. All data collected will be used to determine which projects are most effective at mitigating the impacts associated with watershed development. If effective, this information should help guide future stream restoration initiatives and ensure that money is being used efficiently.

THANK YOU TO ALL OF OUR SPEAKERS AND ATTENDEES FOR MAKING THIS YEAR'S SYMPOSIUM A SUCCESS!

Dr. Robert Hirsch

Dr. Gerrit Knaap



Mr. William Stack

Dr. Richard Eskin

URBANIZATION: STRESSES ON MARYLAND'S WATER RESOURCES

NOVEMBER 18, 2005

Featured Scientist: Dr. Adel Shirmohammadi

Dr. Adel Shirmohammadi is a Professor in the Biological Resources Engineering Department since 1986. He received his BS degree in Agricultural Engineering from the Agricultural Engineering College of Rezaeiyeh (Urumei) in 1974, his MS degree in Agricultural Engineering from the University of Nebraska in1977, and his Ph.D. in Biological and Agricultural Engineering at North Carolina State University. At Maryland, he focuses on applying his engineering and biosystems education to both research and teaching activities related to watershed hydrology, nonpoint source pollution assessment, watershed management, hydrologic and water quality modeling, bioengineering, and uncertainty related to these systems.

His research involves experimental and theoretical evaluation of the hydrologic and water quality responses of mixed land use watersheds, design of water table management systems and the impact of various agricultural management practices on hydrologic and water quality response of watersheds. Theoretical work has involved developing mathematical models to predict water and solute transport, and modifying and using existing models (CREAMS, GLEAMS, PRZM, SWAT) for assessing the impact of agricultural management practices on surface and ground water hydrology and water quality. He and his graduate students use tools such as GIS to interface with hydrologic and water quality models, thus increasing their application domain in spatial and temporal scale. He has been leading a multi-state project in assessing the uncertainty related to TMDL (Total Maximum Daily Load) models, thus helping the regulators and the decision makers in assessing the health of an ecosystem. Experimental research has involved field and watershed evaluations of the impact of agricultural management systems on hydrologic behavior of mixed land use watersheds, and assessing nutrient and pesticide losses. With an EPA funded National Monitoring and Modeling project, he has been assessing the hydrologic and water quality response of a large watershed in the Monocacy River Basin since 1993.

Dr. Shirmohammadi also teaches undergraduate and graduate level courses in the area of water resources engineering (biosystems, hydrologic cycle components, erosion prediction and assessment, and design of conservation structures such as vegetate waterways, conservation structures and reservoirs, etc.), flow through porous media (saturated and unsaturated flow of water and agricultural chemicals modeling), and numerical modeling (mathematical methods used in hydrology and other engineering fields). In addition, he coordinates a freshman course titled “Introduction to Biological Resources Engineering”, which is a one credit team-taught course to orient the freshmen to different focus areas within the department. His teaching has always ranked very highly by his students and peers. In the specialized courses taught to seniors and graduates, Dr. Shirmohammadi brings in new hydrologic and watershed environmental assessment models to the classroom and provides real world design projects to his students. Examples of such models are TR-55 (for flood hydrograph prediction), HEC-RAS (for establishing stream hydrographs and design of storm water management systems), and GLEAMS model (for simulation of hydrologic and Water Quality response of the agricultural watersheds).

In recognition of Dr. Shirmohammadi’s teaching achievements, he has been given many awards honoring his contributions to higher level education, such as the Department of Biological Resources Engineering “Outstanding Teaching Award” in the 1998-1999 academic year.

Featured Scientist: Dr. Ahmet Aydilek

Dr. Ahmet H. Aydilek is an assistant professor of civil and environmental engineering at the University of Maryland-College Park since 2001. He received a BS. from Technical University of Istanbul, Turkey, and M.S. and Ph.D. degrees from the University of Wisconsin-Madison. Ahmet's work emphasizes analysis of the behavior of geomaterials, field performance and assessment, and quality control. One area of focus of his work is remediation and beneficial reuse of recycled materials and high water content geomaterials.

He is currently involved in a study to investigate the possible uses of petroleum contaminated soils in geotechnical construction. The study is supported by grants from the Maryland State Highway Administration and the Maryland Department of Natural Resources and involves collaboration with Dr. Eric Seagren of Department Civil and Environmental Engineering. Ahmet has recently finished a project on alternative ways of handling the dredged sediments. The work included the beneficial reuse of these sediments in cut-off wall applications and was funded by the Maryland Water Resources Research Center. Currently, majority of the sediments dredged from the Chesapeake Bay is disposed on islands, such as Poplar Island. Dewatering of these disposed sediments has been a major issue for the Maryland Port Authority, and in some cases leaching of effluent with undesirable pH levels. The study evaluated the reuse of the Bay sediments in two important geoenvironmental applications: slurry walls and landfill liners. In another research study funded by the Maryland State Highway Administration, Ahmet and his team investigated the geotechnical and environmental suitability of fly ash amended soil/cement mixtures for highway subbase applications. Experiments were conducted to investigate the geotechnical characteristics and leachability of various metals from fly ash. An environmentally friendly remediation option to abate acid mine drainage (AMD) from abandoned coal mines is currently being investigated through a series of laboratory tests. The research project involves large-scale use of Maryland coal combustion by-products in neutralization of AMD, and the laboratory-based findings will be compared to the field data collected from a Western Maryland coal mine that was remediated in 1996.

Another focus area of Ahmet's research is soil and groundwater remediation using geosynthetics. Geosynthetics are polymeric materials and being increasingly used in a variety of civil infrastructure and environmental construction applications, including the ones in upgrading the country's interstate highway system and protecting fragile wetlands. Ahmet has been involved in studies to investigate the dewatering performance of geotextile containers, also called geotubes, and filtration performance of geotextiles that are in contact with high water content geomaterials. Proper filtration of high water content geomaterials, such as fly ash slurries, wastewater treatment sludge, and dredged sediments opens new avenues for their possible beneficial uses in geotechnical construction. These are areas of research interest at the national as well as international levels and would not only present cost-savings to the public, but would also conserve valuable natural resources and energy. Ahmet is the recipient of the International Outstanding Achievement Award from the Industrial Fabrics Association International (IFAI) and the Engineering Achievement Award from the American Society of Civil Engineers (ASCE) for his work on a U.S. EPA Superfund site. The project involved capping of soft and highly compressible sludge in the lagoon system of the site using geosynthetics. The site was recently included within the boundaries of the new Capital Springs Centennial State Park in Wisconsin because of its enhanced recreational and aesthetic value. In addition to his research activities, Ahmet teaches courses in design of waste containment systems, geoenvironmental site remediation, slope stability and seepage in soils.

Maryland Water Resources Research Center

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