

Spotlight on Students

New DWRC Research and Education Initiatives

One of the primary goals of the Delaware Water Resources Center (DWRC) is to provide training and education for future leaders in water science, policy and management. In keeping with that objective, the DWRC has focused efforts over the past year on providing funding to support undergraduate internships and graduate fellowships. According to Dr. Tom Sims, Director of the DWRC, "We are committed to providing interns with an opportunity to have a complete research experience - from designing a project with an advisor, to conducting the research, and then presenting their work".

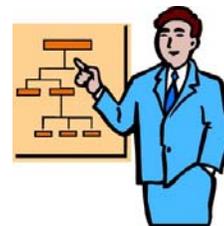
This past Spring, requests for proposals for the DWRC undergraduate internship program were widely distributed and advertised within the University as well as Delaware State College. The DWRC Advisory Panel, which is comprised of representatives from environmental, natural resource and agricultural organizations in Delaware (see back page for membership list) developed criteria which were used to rank the proposals.

To guide their selection process, the Advisory Panel identified the following eight priority areas for funding: nutrient management and water quality for agricultural and non-agricultural systems; sources, fate, and transport of water pollutants; quantifying the response of aquatic systems to pollutant inputs; water supply, demand, and conservation; management and control of stormwater runoff; identification and protection of groundwater resources; treatment and disposal of on-site sewage and wastewaters; and protection and restoration of wetlands.

Proposals were not restricted to the above areas, but the ranking was used to guide the final selection process. Take a look inside for more details on the projects funded by the DWRC....



Come meet the DWRC graduate fellows, undergraduate interns, and their faculty advisors; they will present their research through talks and poster sessions at the 2001 DWRC Annual Conference. Don't miss this opportunity to learn more about both the DWRC and what your colleagues are doing in water related research. The conference will start at 9:00 a.m. and conclude at noon.



For more information, including an agenda and registration materials, please contact: Cynthia Greene, e-mail: cgreene@udel.edu, or Lucille Short, phone: **(302) 831-1392**.

Meet the DWRC Undergraduate Interns

In May, the Delaware Water Resources Center (DWRC) selected nine undergraduate applicants and their faculty advisors to participate in an undergraduate internship program. Each faculty advisor was provided with a \$5,000 mini-grant to support the internship. Interns from seven Departments of the University of Delaware are being funded. Through the program, students are getting a unique opportunity for "hands on" research which addresses water resource related issues of critical importance to Delaware and the Mid-Atlantic region. The following provides a glimpse into the lives of the interns and a summary of their project objectives.



Using a Modified Pricing Mechanism to Manage Water Quantity in New Castle County

Robert Ehemann and Dr. Joshua Duke
Department of Food and Resource Economics

Before coming to the University of Delaware, Robert Ehemann's experience and education in the field of electronics led him to a job as an Instrument and Controls Technician at Peach Bottom Nuclear Power Plant. He was able to see first hand the tremendous quantity of water necessary to generate electricity, as well as the impact which the Power Plant had on aquatic life.

When he is not at work, or school, Ehemann enjoys the outdoors, such as hiking the Appalachian Trail and volunteering with the Delaware Nature Society to plant trees in the Middle Run Natural Area of the White Clay Creek Preserve. Through his previous employment, as well as his current hobbies and volunteer experiences, Ehemann has witnessed the negative impact of corporate and individual consumptive behaviors on our natural world. His major, Natural Resource Management, provides

opportunities for Ehemann to help solve some of the problems he has encountered.

While trying to narrow down a topic for his senior paper and his internship project, Ehemann decided to focus on the economic and management issues associated with the summer drought of 1999. Although water is a plentiful resource around the world, fresh potable drinking water supplies are limited due to factors such as drought and contamination. Furthermore, water demand continues to increase as a result of both population growth and higher per capita residential use.

While the drought in the summer of 1999 was severe enough to cause dangerously low water levels in White Clay Creek, no price increase was implemented to reflect the emergency situation. Residents were instead fined if they violated drought-imposed restrictions.

Ehemann and his advisor, Dr. Joshua Duke, Assistant Professor of Food and Resource Economics, will be conducting research to determine whether increasing the cost of water is an efficient and fair method for allocating water in times of scarcity. They will also evaluate whether conservation measures, including those which result from the increased cost of water, will eliminate the need to expand water supplies. In light of previous research related to this topic, the project is being coordinated with the Water Resources Agency of Delaware, which finalized the 1999 Governor's Water Supply Task Force Report.

Through the internship experience, Ehemann is looking forward to enhancing his research and literature review skills, as well as his abilities to use Geographic Information Systems technology.



Survey of Bottled Water Consumers: Attitudes and Perceptions Toward an Alternative Drinking Water Source

**Emily Gonce and Dr. James Morrison
Department of Consumer Studies**

Perhaps you are drinking from your purchased bottle of water as you read this article. If so, do you know what made you choose bottled water to drink today? Why not tap water or some other beverage?

A team of researchers, including Dr. James Morrison and Dr. Hye-Shin Kim of the Department of Consumer Studies, Bernard Dworsky and Gerald Kauffman of the University's Water Resources Agency and student intern Emily Gonce plan to get to the bottom of these and other questions related to bottled water purchasing decisions. Through the DWRC funded internship program, they will be conducting a survey of consumer's attitudes and perceptions regarding bottled water as an alternative drinking water source. While safety and convenience have often been pinpointed as probable reasons for people to purchase bottled water, other factors which may be influencing buying decisions, such as perceptions of water quality, lifestyle patterns, fitness concerns, cost, availability, and environmental conditions (such as drought), will be explored as part of the survey.

Gonce, a senior majoring in Leadership and Consumer Economics, has gained valuable experience serving as President of the Delaware Consumer Interest Council and as a Student Ambassador for the College of Human Resources, Education and Public Policy. She hopes to enhance her research skills through her internship project. Gonce became interested in her research topic because as a consumer of water, she questions the benefits of bottled water versus tap water and what adverse effects, if any, the tap water may be having on her own health.



As the governor appointed State Water Coordinator, Gerald Kauffman of the Water Resources Agency (WRA) is excited about the bottled water survey and research. Substantial growth in the bottled water industry has been witnessed over the past several years and the American Bottled Water Association predicts the growth rate to accelerate in the future. According to Kauffman, "we do not know very

much about why people drink bottled water instead of tap water. We are optimistic that this research can answer some of the questions regarding this alternative water source". The WRA and the Delaware Water Resources Center will work together to distribute the results of the survey to municipalities and companies which supply water.

The University of Delaware Experimental Watershed Project

**Jennifer Campagnini and Gerald Kauffman
Water Resources Agency
Institute for Public Administration**

The purpose of this internship project is to delineate, characterize and assess the first ever experimental watershed on the University of Delaware's Newark campus. Modeled after projects conducted at other land grant institutions throughout the United States, the University's experimental watershed contains popular landmarks such as Clayton Hall, the Blue and Gold Club, the Deer Park restaurant, and the University farm. The experimental watershed, which encompasses several small tributaries to the White Clay Creek, is designed to become a living laboratory for research and education within the University community.

The health of the watershed will be assessed by evaluating both land use/land cover map data as well as field data. The map data will include information on land use, potential contaminant sources, zoning, geology, soil types, topography, wetlands and floodplains in the watershed, utilizing Geographic Information Systems (GIS) technology. The field data to be collected will include information on water quality, stream habitat and stream bank vegetation.

The data will be used to compile a "report card" on the overall health of the watershed, and to assess the relationship between land use and watershed health. It is anticipated that similar evaluations will be conducted in the future to monitor changes over time, thereby providing valuable research and educational data for students and faculty in future semesters.

Jennifer Campagnini gained some previous experience through other internships with the Department of Natural Resources and Environmental Control and with the Delaware Emergency Management Agency. She met her advisor, Gerald Kauffman, of the College of Human Resources, Education and Public Policy's Water Resources Agency, when she worked on issues concerning Delaware's severe drought of 1999.

Campagnini looks forward to enhancing her skills in mapping, and research, as well as learning more about the relationship between watershed management and water quality through her internship project.

A senior this year, with a major in Natural Resources Management, Campagnini still finds time for volunteer efforts. She has served as a scout leader for Girl Scouts of the Chesapeake Bay, Inc., is the president of the Sigma Alpha Professional Agriculture Sorority, and last summer traveled to Arizona to participate in Columbia University's Bio-sphere 2 research program. In addition, Campagnini received an outstanding club member award this past Spring for her work as an Ag College Council member.



Wetland Functional Analyses: Data Collection and Analyses to Support Model Development

**Maeve Desmond and Dr. Bruce Vasilas
Department of Plant and Soil Sciences**

Maeve Desmond, who grew up in Toledo, Ohio became interested in environmental issues after taking ecology and soil science courses at Delaware Valley College. Her interests led her to the University of Delaware, where she gained experience as an intern working at the University's Botanical Gardens. In her senior year now as a Plant Science major (with a minor in Soil Science), Desmond is enthused about her internship with Dr. Bruce Vasilas, Professor of Plant and Soil Sciences. Because of her interests, she is planning to specialize in a wetland science career when she graduates.



Wetlands play a critical role in protecting water quality by trapping potential pollutants, removing sediment from runoff waters and reducing soil erosion through the storage of flood waters following storm events.

Wetland mitigation is the creation or restoration of wetlands to compensate for wetland losses. Wetlands can be lost due to many causes, including road development, housing construction and agricultural drainage. Since mitigation is most successful when the lost wetland is replaced by a wetland with similar functions and values, it is critical to have a wetland classification system that accurately characterizes the functions of specific types of wetlands.

The Hydrogeomorphic (HGM) Method for wetland functional analyses relies on using collected data in a model that predicts how well the wetland will function. The predictions are then compared to reference standards which were developed using data collected from wetlands in the same HGM sub-class. The first step in the process is to collect data on reference standard wetlands.

Desmond will be working with her advisor and a team of scientists, including Lenore Vasilas from the Natural Resources Conservation Service and Paul Minkin from the Army Corps of Engineers, to collect, organize and analyze data from reference wetlands in Delaware and Maryland. She will receive training in plant identification, plant community assessment, soil morphology descriptions and the interpretation of hydrologic conditions based on soil morphology.

Use of Ectomycorrhizae as a Soil Hydrology Indicator for Wetland Assessments

**Anna Palermo and Dr. Bruce Vasilas
Department of Plant and Soil Sciences**

Wetlands are protected by Section 404 of the Clean Water Act. The U.S. Army Corps of Engineers developed a Wetland Delineation Manual to provide technical guidelines and methods for the identification and delineation of wetlands. The manual endorses a three criteria approach for wetland determinations: the presence of a hydrophytic plant community, hydric soil and wetland hydrology. For the majority of fresh water wetlands on the DelMarVa Peninsula, wetland hydrology is only evident for a part of the growing season. Therefore, many wetlands have been destroyed because of inaccurate characterizations.

Typical indicators of wetland hydrology such as drift lines and blackened leaves require inundation which does not occur in many wetlands. One potential hydrology indicator is the presence of ectomycorrhizae, a symbiosis between fungi and plant roots, in which fungal hyphae surround a root tip forming a visible

'mantle'. Ectomycorrhizae start forming early in the growing season when the water table is close to or at the soil surface, and remain there for most of the growing season. The vertical distribution of the visible 'mantle' within the soil profile should provide valuable information regarding previous heights of the water table.

Anna Palermo, a senior majoring in Environmental Soil Science, will be working with a team of scientists, including her advisor, Dr. Bruce Vasilas, Jeff Thompson from the Maryland Department of the Environment and Lenore Vasilas from the Natural Resources Conservation Service, to evaluate the potential of ectomycorrhizae as a hydrology indicator. She will be receiving training in plant identification, plant community assessment, soil morphology descriptions and the interpretation of hydrologic conditions based on soil morphology.

Palermo, who grew up in Newark, spent her spare time volunteering as a 4-H camp counselor and raising money for an advocacy group to support foster children. She became interested in studying chemistry and plants in high school. To help her decide on her college major, she arranged a meeting with Dr. Donald Sparks, Chair of the Department of Plant and Soil Sciences, who suggested she consider studying soil science.

From her internship experience, Palermo has already learned about what is involved in organizing a research project, as well as specifics on how to delineate wetlands and characterize soils. She is enthused about continuing to learn more through her internship project.



Diversity of the atzA gene in Soil Microbial Communities after Triazine Treatment

**Melissa Weitz and Dr. Mark Radosevich
Department of Plant and Soil Sciences**

The purpose of this research project is to better understand how s-triazines, the most widely used pesticides globally, impact the molecular ecology of microbial communities which degrade these pesticides in the field. Since biological degradation is the primary means in which most organic pollutants in soils and waterways are dissipated, a better understanding of this degradation process is critical for predicting fate and transport of organic pollutants, and potential threats to humans and the ecosystem.

Within the class of s-triazines, the environmental fate of the herbicide atrazine has been best characterized. It is not known, however, whether the bacterial cultures which have been isolated, characterized, and shown to completely mineralize atrazine are actually representative of the natural atrazine-degrading bacteria found in the field. In order to help answer this question, this project will better characterize the genetic make-up of soil microbial communities which have differing atrazine treatment histories.

Melissa Weitz is looking forward to expanding her knowledge and experience as she works with her advisor, Dr. Mark Radosevich, Associate Professor of Environmental Soil Biochemistry. In her senior year as an animal science major (with double minors in chemistry and geography), Weitz has already gained valuable experience in the use of laboratory techniques to study molecular biology and genetics.

In addition to biology and genetics, Weitz has had a long-time interest in animals, as evidenced by her employment and educational history; this past Spring she participated in a semester at Columbia University's Biosphere 2 living laboratory where she studied jaguar conservation and environmental science. Her summer jobs before the Biosphere experience included working in animal science labs, as an intern at the Philadelphia Zoo, and with an equine vet.



Feasibility of the Use of a Fungal Bioreactor to treat Industrial Wastewater

**Jason Hetrick and Anastasia Chirside
Department of Bioresources Engineering**

Jason Hetrick was initially going to major in Civil Engineering, but then became interested in the clean up of chemical wastes and other environmental issues. After visiting a wastewater treatment plant in high school, he made up his mind to major in Environmental Engineering with a focus on water treatment. Now in his junior year, Hetrick has been working in the Department of Bioresources Engineering as a research assistant for the past year. Through his job, he became interested in the research of his advisor, Anastasia Chirside, Associate Scientist, who has been exploring the use of a fungal bioreactor to treat pesticides in water.

The objective of this internship project is to evaluate the ability of a fungal bioreactor to treat an industrial textile wastewater containing high concentrations of nitrogen and complex organic compounds. These two contaminants have historically been resistant to conventional bacterial wastewater treatment schemes.

Numerous tests will be conducted, using a laboratory scale bioreactor, to evaluate the effectiveness of using a white rot fungus to degrade wastewater. Different hydraulic flow regimes, such as one containing a recycling flow to increase residence time versus one without, will be evaluated for their effectiveness in maximizing treatment.

Since the concept of using natural organisms to transform hazardous substances into a harmless form has intrigued Hetrick for some time, he is looking forward to learning more about these organisms. Hetrick believes it will benefit him to learn about the whole research process as well as the real life applications of his research.



The Feasibility of Composting Poultry Litter and Food Waste for Use as a Soil Amendment and Potting Medium

**Leigh Johnson and Dr. William Ritter
Department of Bioresources Engineering**

Sussex County Delaware is home to the highest concentration of chickens in the nation. Since it is also home to scenic beaches, fragile bays and vulnerable drinking water sources, it is critical that the 300,000 wet tons of poultry litter generated each year be managed to protect these valuable natural resources.

Having grown up on a farm in Sussex County, Leigh Johnson came to appreciate the importance of farmland and the beauty of wide open spaces, as well as the value of clean water. She became interested in protecting water quality and remediating contaminated areas. Her interests led her to pursue a degree in Environmental Engineering, with double minors in Chemistry and History. Now



in her junior year, Johnson has been working as a Research Assistant in the Department of Bioresources Engineering Water Quality Lab. Through her job, she learned about the DWRC internship opportunity from her advisor, Dr. William Ritter, Professor of Bioresources and Environmental Engineering.

Johnson and Ritter will be working on a problem of major importance not only for Sussex County, but the whole DelMarVa peninsula: how to turn poultry litter and food waste into a product that is economically feasible to market. Through the project, Johnson will be testing various ratios of a compost mixture of broiler litter, food waste and straw for numerous parameters, including total carbon, total nitrogen, different forms of nitrogen, soluble salts, pH, temperature and moisture. The results of the tests will be used to determine the optimum compost mixture for use as a soil amendment or potting medium.

Through her internship experience, Johnson is looking forward to enhancing her data analysis skills and learning about the complete research process.

The Impact of Alum on Pathogen Survival in Poultry Litter

Greg Buckmaster and Dr. Jeff Fuhrmann
Department of Plant and Soil Sciences

Most poultry litter is currently applied to agricultural lands, a practice that is under scrutiny by both federal and state lawmakers, due to concerns regarding nutrient contamination of surface and groundwaters from the poultry litter. Aluminum sulfate (Alum) is used to control ammonia emissions from poultry houses, thereby improving air quality. It also has been shown by USDA's Agricultural Research Service that alum reduces levels of phosphorus available for runoff to waterways. Yet, despite a growing interest and increased use in alum as a poultry litter amendment, its effect on pathogens and other microorganisms is virtually unknown.

The purpose of this project is to evaluate the effects of high rates of alum application on the survival of bacterial pathogens in broiler litter. Research demonstrating that alum negatively affects pathogen survival would increase justification for its use to meet poultry health and marketability objectives as well as human health and environmental protection concerns. However, if research shows that pathogen survival is enhanced through the use of alum, the wide-spread adoption of alum application to litter should clearly be avoided.

Gregory Buckmaster, who grew up in Wilmington, Delaware, is a sophomore majoring in biochemistry. His interest in his major was sparked by an enthusiastic Concord High School biology teacher. Buckmaster believes there are a growing number of interesting employment opportunities in his field. He is looking forward to working with Dr. Jeffry Fuhrmann, Professor of Soil Microbiology, who will be advising him on his internship project. Buckmaster hopes to attain a better understanding of microbiology through his internship experience and gain valuable skills working in a research laboratory.



Nutrient Management News

A regular update on Delaware's Nutrient Management Program

As described in our Spring newsletter, the DWRC is supporting three graduate fellowships to provide scientific support to the ongoing efforts of the Delaware Nutrient Management Commission (DNMC). Delaware's 1999 Nutrient Management Act charges the DNMC with the responsibility of developing the State's Nutrient Management regulations. Draft regulations, which outline nutrient management certification requirements and procedures for complaint and enforcement of nutrient management standards, have been drafted and are undergoing review through a series of regulatory workshops and public hearings.

In an effort to acquaint the agricultural community with the State's Nutrient Management Program, the Cooperative Extension Service has been hosting outreach meetings. In addition, the University of Delaware has been conducting training for nutrient management planners.

Financial assistance to help implement the program will be available to those growers who apply nutrients to greater than ten acres of land and hire a private consultant to develop their Nutrient Management Plan. Eligible expenses under the cost-share program include soil and animal waste testing as well as consultant planning time. Another new initiative recently established is the Nutrient Relocation Program, which provides cost-share funding to assist in transporting manure from areas of excess to areas in need of nutrients. While manure shipment can either be between farms or to "alternative use projects", the reimbursement is not to exceed \$20 per ton transported.

There is active participation in both cost share programs and funds are based on a first come, first serve priority. For more information on Delaware's Nutrient Management Program contact William Rohrer, Program Administrator, Delaware Department of Agriculture (phone: 1-800-282-8685).