



Water Currents

The Newsletter of the Center for the Management, Utilization and Protection of Water Resources
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SUSTAINABLE GROWTH IN TENNESSEE



Photo courtesy of the Water Center

Can Tennessee achieve sustainable growth when the state and nation have limited financial and political reserves to protect and conserve its natural resources? With an antiquated infrastructure to treat and convey wastewater and drinking water, Tennessee must find solutions to deal with increasing pressures of safeguarding its water resources and ensuring that adequate supplies are available for the growing population. Tennessee's most cherished resource is natural beauty, which the state can protect by addressing threats to endangered biological species; risks from hazardous waste and new emerging pathogens; and dangers to water and biological resources from urban, transportation and agricultural pollution.

While the state invests in parks and recreational opportunities to attract visitors to its natural wonderland, Tennessee citizens must understand the connection between their quality of life and the natural environment that surrounds them. Anthropogenic problems like litter, erosion and pollution continue to plague the state and the waters that its citizens long to fish, swim, boat and drink. Diminishing our efforts to sustain water and natural resources for future generations hinders the state's attempts at resource preservation.

To protect and conserve the state's natural resources and improve citizens' quality of life, the faculty, staff and students of the Center for the Management, Utilization and Protection of Water Resources (Water Center) seek innovative solutions to these problems. To this end, the center continues to partner with federal and state government agencies, communities and industry to develop innovative means to detect waterborne pollutants; protect endangered

species; provide safe water; and protect the water quality of the state's rivers and lakes.

This year the Water Center has faced many challenges as the state legislators struggled to find a balanced budget. Despite these financial challenges, the Water Center secured more than \$2 million through state allocations, state and federal projects, and projects with research

foundations and advocacy groups to further its search for solutions to water-related environmental issues. The projects described in this issue of *Water Currents* detail these efforts.

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The beautiful country of Brazil, with its streets literally made of gold (above), is the backdrop for a student exchange program led by Francis Otuonye (right, facing camera) at Tennessee Tech. (Photos courtesy of Francis Otuonye)



For the inspired tourist longing to experience a culture different from his own, Brazil offers rolling hills, plains and breathtaking views of the Atlantic Ocean. But for one Tennessee Tech geology student, the country offers something more.

Clayton McMillan has found that Brazil also provides a once-in-a-lifetime opportunity to learn about a different culture while receiving university credit through the U.S.–Brazil Higher Education Consortia Program. McMillan is the first Tennessee Tech student to participate in the exchange program.

Through the U.S. Department of Education’s Fund for the Improvement of Postsecondary Education, the New Mexico Institute of Mining and Technology sponsors this project led by Francis Otuonye, associate vice president of research and graduate studies at Tennessee Tech. The program allows for up to 47 undergraduate and graduate students to take part.

“The project offers juniors and seniors majoring in environmental engineering or environmental sciences the opportunity to study the environmental impacts of mining, logging, etcetera, and to experience the application of professional skills in a different cultural, social and academic environment,” Otuonye said. “Students majoring in geology or agriculture are eligible to participate in the program if their areas of interest have an environmental focus.”

Participating students from Brazil and the United States receive a stipend that covers their travel and food expenses for a semester or a year while they live either with a local family or in the dorms of the participating universities. They are also trained in the respective language, either Portuguese or English, of the country where they

will study.

According to Otuonye, students who take part will serve as ambassadors for the program and, hopefully, will encourage others to participate. He envisions the project as a chance to produce college graduates with international experience and knowledge of the global marketplace.

Although students must maintain a C or better average while participating in the program, all of the courses will transfer when they return to their home university. They will also be actively involved in hands-on research projects in environmental stewardship along with classroom instruction.

To make the program possible, Otuonye partnered with four mining industries, Michigan Technological University and two universities in Brazil: the Universidade Federal de Minas Gerais and the Universidade Federal do Rio Grande do Sul. He chose institutions that had diverse expertise in mine waste management and were geographically different.

Brazil draws upon a vast amount of natural resources, including gold, timber and iron ore and is South America’s leading economic power. According to Otuonye, the nation has long been interested in learning from U.S. technology, and he believes that this partnership can be beneficial to Brazil as well as the United States.

For more information about the program, contact Brian Mylrea, director of International Student Affairs, who coordinates the logistics of the exchange program and makes preparations for the students’ travels.

RECENT GRADUATES SUPPORTED BY THE WATER CENTER



Mohamed Aboul Eish
Environmental Sciences--Chemistry (Ph.D.)
Major Professor: Dr. Martha J.M. Wells
Dissertation Title: "Characterization of Humic Substances Using Chemical, Chromatographic and Spectroscopic Techniques"



Andrew Jason Hill
Civil and Environmental Engineering (M.S.)
Major Professor: Dr. Vincent Neary
Thesis Title: "Assessment of Hydrologic Functions of Depressional Wetlands on the Highland Rim of Tennessee"



Archana Kotu
Chemical Engineering (M.S.)
Major Professor: Dr. Donald Visco
Thesis Title: "The Use of Signature Molecular Descriptor in Inverse QSAR and Similarity/Diversity Studies"



Manjunath Krishnappa
Civil and Environmental Engineering (M.S.)
Major Professor: Dr. Dennis George
Thesis Title: "Estimation of Surface Diffusion of Organic Compounds Contained in Humic Substances on Activated Carbon"



Thomas Clint Neel
Civil and Environmental Engineering (M.S.)
Major Professor: Dr. Vincent Neary
Thesis Title: "Retrofitting a Flood Control Detention Basin for Water Quality"



Wes Robinson
Civil and Environmental Engineering (M.S.)
Major Professor: Dr. Dennis George
Thesis Title: "Mathematical Description of Subsurface Flow (SF) Constructed Wetlands Using the Advection-Dispersion Mass Balance Equation"

(Photos by Amy Knox)



Girija Shinde
Biology (M.S.)
Major Professor: Dr. S.K. Ballal
Thesis Title: "Tissue Culture of Duckweeds and Analysis of Water with Respect to Lemnaceae"



Jon Slemp
Civil and Environmental Engineering (M.S.)
Major Professor: Dr. Dennis George
Thesis Title: "Determination of the Preferred Electron Acceptor and Pathway for the Microbial Destruction of the Herbicide, Simazine, Using a Constructed Subsurface Flow Wetland"

Eric Britzke (photo not available)
Environmental Sciences--Biology (Ph.D.)
Major Professor: Dr. Michael Harvey
Thesis Title: "Use of Ultrasonic Detectors for Acoustic Identification and Study of Bat Ecology in the Eastern United States"

ALUMNUS SPOTLIGHT

Professor Gary Emmert, Water Center alumnus, recently received a grant from the U.S. Environmental Protection Agency for monitoring disinfection by-products in water distribution systems. Emmert received his bachelor's in 1988 and master's in 1992 and is now teaching in the University of Memphis Chemistry Department.

If you are a Water Center alumnus and would like to be mentioned in an issue of Water Currents, please send the information below and a photo (returned upon request) to: Water Center, Tenn. Tech. Univ., Box 5033, Cookeville, TN 38505; or send an e-mail to akknnox@tntech.edu. Your information will be published as soon as the production schedule will allow.

Name: _____

Year of Graduation: _____

Major: _____

Professional or Personal News and Information:

TTU CHEMIST STUDIES FISH LIPIDS AND FATTY ACIDS TO DETERMINE IMPACT OF LOCKS AND DAMS ON THEIR HABITAT

Environmental chemist Martha J.M. Wells and doctoral student Le-Ellen Daybuff-Nelson use gas chromatography to study the fatty acid composition data from paddlefish, white bass and sauger from the Ohio River to determine the impact of dam and lock construction on their diet.

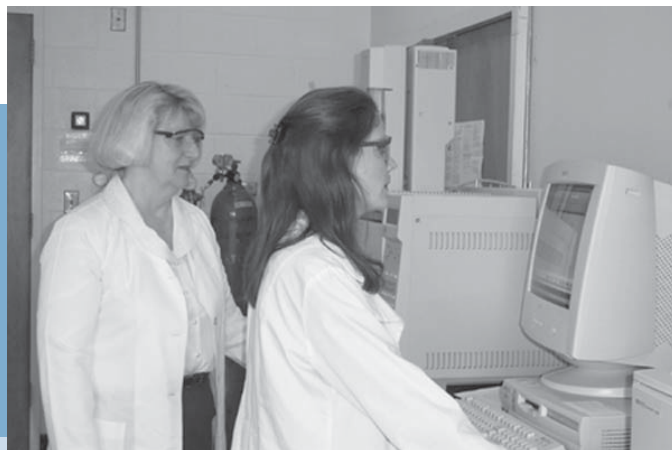


Photo by Amy Knox

You can tell a lot about a fish by what it eats. Just ask Tennessee Tech environmental chemist Martha J.M. Wells.

Through a contract with the West Virginia Division of Natural Resources (WVDNR), Wells, of the Water Center, is studying the fatty acid and lipid composition of fish taken from the Ohio River to determine if their diet has changed due to the construction of dams and locks. Dam and lock construction can limit the mobility of fish and lead to problems in overwintering if fish have not developed enough lipids and fatty acids to survive the winter.

Lipids are important to fish survival, growth and reproduction and insulate and protect different parts of their bodies, especially vital organs. Fatty acids are the building blocks of lipids.

“Lipids, which are components of all living cells, can tell us about the environment in which the fish lives,” Wells said. If environmental conditions—and, thus, the food supply—change from dam and lock construction, the lipid content and fatty acid distribution, which may vary among age, sex, species, location or season, of the fish are influenced. Data from fatty acid studies help improve fisheries managers’ understanding of the fish’s survival in a given environment.

Wells says studying fish fatty acids and lipids is significant in three main areas. The first involves the nutritional importance of fish and fish oils as part of our regular diet. When we consume fish, our bodies are enriched by certain fatty acids that can reduce the risk of cardiovascular disease; protect against breast, colon and prostate

cancer; and influence brain development, learning, memory and visual functions.

The second category entails the forensic uses of fish fatty acids. In certain cases, wild fish are intentionally portrayed as cultured fish. Since the fatty acid profiles of fish represent the fish’s diet, the fatty acids of a cultured fish will reveal a diet derived from commercial feeds. The fatty acids of a wild fish will show that its diet has come from the environment. This evidence could help protect consumers from eating large quantities of wild fish that may have accumulated pollutants from their respective natural habitats.

The last category involves the use of fatty acids as environmental biomonitors of pollutants. The accumulation of pollutants from their aquatic habitats may be related to the fatty acid profile and percent of lipids in the fish.

Analyzing fatty acids and lipids as monitors of specific pollution concentrations and effects could prove useful in establishing environmental policy, Wells said.

Three different fish species, paddlefish, white bass and sauger, are being tested in this project. Paddlefish, in particular, were chosen for the study because of their potential use as caviar fish and the economic interests involved in their survival. The other species were chosen for their significance in recreational fishing and for their biological diversity. The samples are collected by project

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personnel with WVDNR and sent to the Water Center to be analyzed by Wells, doctoral student Le-Ellen Dayhuff-Nelson and research assistant Tammy Boles of the Water Center's Environmental Quality Laboratory.

Wells' research team will determine the concentrations of the fatty acids and lipids for each individual fish sample collected for this study, and that information will be combined with data gathered on the location, age and sex of the fish samples. They will then perform a statistical analysis to develop a profile showing the variation of fatty acid and lipid concentrations between age-classes over time and location.

Civil engineer Yvette Clark, also with the Water Center, is working with the WVDNR to develop a Geographic Information Systems (GIS) template of the Ohio River and its major tributaries. In this part of the study, WVDNR personnel tag captured fish, and Clark uses GIS technology to mark the location of capture. When the fish are recaptured, Clark notes that location, and the distance is measured between those points to understand the fish's movement throughout the dam and lock system.

Wells' work on the project, which began in 2001, will be complete by August of this year.



AEESP DISTINGUISHED LECTURER PHILIP SINGER PRESENTED TALK ON DISINFECTION BY-PRODUCTS

Each year the Water Center competes nationally for the opportunity to host a speaker from the Association of Environmental Engineering and Science Professors (AEESP) Distinguished Lecture Series. This spring, the center won the honor of cosponsoring Philip Singer, the Dan Okun Distinguished Professor of Environmental Engineering in the Department of Environmental Sciences and Engineering, School of Public Health, at the University of North Carolina, Chapel Hill.

Singer, who has conducted research on the chemical aspects of water and wastewater treatment and on aquatic chemistry for 35 years, has published more than 160 papers and reports on those subjects. Singer spoke in March on the "Formation and Control of Disinfection By-Products in Drinking Water." His presentation focused on the potentially harmful compounds, termed "disinfection by-products" (DBPs), that are produced when chemical disinfectants are added to water to inactivate disease-causing microorganisms. DBPs have been studied for the past 28 years, and according to Singer, much research has been done to determine the factors influencing their formation. Treatment technologies and water quality management strategies for the control of DBPs have been among the focuses of the research. Singer centered his talk specifically on the

trihalomethane and haloacetic acid by-products of chlorination and presented observations from controlled laboratory experiments and field measurements at full-scale water treatment facilities.

Singer directed the Water Resources Engineering Program for 19 years at the University of North Carolina. He is currently the director of the university's Drinking Water Research Center. Among Singer's honors are his selection as the Freese Lecturer by the American Society of Civil Engineers in 1993. He was presented the A.P. Black Research Award by the American Water Works Association (AWWA) and inducted into the National Academy of Engineering in 1995. Singer also received the Fuller Award from the North Carolina section of the AWWA in 1999.

The AEESP chooses lecturers based on their accomplishments, speaking ability and the reputation they have gained for research and/or teaching. Throughout the year, the speaker will travel to approximately 18 campuses. Previous lecturers have included Alberto E. Cassano of the National University of Litoral, Argentina (1999), Calvin H. Ward of Rice University (2000), Vernon L. Snoeyink of the University of Illinois (2001), and C.P. Leslie Grady Jr. of Clemson University (2002).



Timely Theme of "Homeland Security in a High-Tech Age" Draws Speakers from Military, Industry and Academia



Clockwise from top left: Ret. four-star Gen. Carl Stiner, Tennessee Tech alumnus; David McIntyre, deputy director of the ANSER Institute for Homeland Security; Kathleen Carley, director of the Center for Computational Analysis of Social and Organizational Change at Carnegie Mellon University; James Albaugh, president and CEO of Integrated Defense Systems of the Boeing Company; Maj. Gen. Jerry Humble, Tenn. director of Homeland Security. (Photos by TTU Photo Services)

The intense international situation and the war in Iraq made this year's Stonecipher Symposium on Technology, Communication and Culture especially timely. With the theme of "Homeland Security in a High-Tech Age," the sixth annual event provided a forum for respected leaders in academia, industry, government and the military to discuss issues related to ensuring our country's safety. The participants centered their discussions on privacy and security and whether or not citizens should relinquish certain rights for the sake of homeland security.

Retired four-star General Carl Stiner, former Commander in Chief of the U.S. Special Operations Command and Tennessee Tech alumnus, delivered the keynote address that kicked off the symposium events held March 24-25. Stiner depicted the chain of events that led to the September 11 attacks by recounting the history of Islam and the Arab states and the conflicts between Israel and the Palestinians.

David McIntyre, deputy director of the ANSER Institute for Homeland Security, spoke on "Homeland Security and the New Long War." Other noted participants included Major General Jerry Humble, director of Tennessee's Office of Homeland Security;

Kathleen Carley, director of Carnegie Mellon's Center for Computational Analysis of Social and Organizational Change; James Albaugh, president and CEO of Integrated Defense Systems of the Boeing Company; Rebecca Dornbusch, deputy director of the International Biometric Industry Association; and Clyde Wayne Crews Jr., director of Technology Policy at the Cato Institute. The symposium also featured a showcase of new technology in which Tom Jones, of Research Electronics International of Cookeville, displayed and described modern information-gathering technology.

This year's planning committee included Kurt Eisen, English professor; Dennis George, Water Center director; Bob Smoak, mechanical engineering professor; and Katherine Osburn, associate professor of history. Amy Knox, of the Water Center, and Tennessee Tech's Office of Public Affairs handled publicity. Other Water Center staff who provided support for the symposium included Sandra Pigg, who made contract and booking arrangements; Mary Williford, who handled the finances; and Yvette Clark, who provided technical assistance to speakers.

The Water Center, the Colleges of Arts and Sciences and Engineering, Center Stage, the Electric Power Center, and the Center for Manufacturing Research sponsored the event.

FACULTY RECOGNITION AND ACHIEVEMENTS

- Martha J.M. Wells, environmental chemist, received the American Chemical Society Division of Environmental Chemistry Distinguished Service Award (2002) as well as its Award for Outstanding Service as the 2000-2001 chair (2002).
- Michael Harvey, emeritus biology professor, was awarded the Lifetime Achievement Award from the Southeastern Bat Diversity Network in recognition of a lifetime of significant contributions to research and conservation of bats in the southeastern United States.
- Sharon Berk, biologist, was invited to speak to researchers with the U.S. Department of Agriculture in Albany, California, in March. She presented “Interactions of Protozoa with *Legionella*

and Other Pathogens.”

- Donald P. Visco, chemical engineer, placed second for the American Society for Engineering Education Southeastern Section New Faculty Research Award.
- Last October, biologist Hayden T. Mattingly made an invited presentation titled “Ecology and Conservation of a Threatened Ozark Stream Fish” to the Department of Biological Sciences at Old Dominion University in Norfolk, Virginia.



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STAFF & STUDENT ACHIEVEMENTS

Personnel changes and additions, graduations, and personal achievements by our faculty, staff and students have encompassed this past year at the Water Center. Among these events was the hiring of former Water Center student Daniel Basham as a research technician in the Environmental Quality Laboratory. Other staff received promotions, including Sandra Pigg who was reclassified from secretary II to secretary III and Amy Knox, former assistant editor, who was hired as editor to replace Binney Stumpf.

Mary Williford, Water Center financial analyst, received her bachelor's degree in business this spring while juggling a full-time job, a family and classes. Don Limbaugh, electrical and computer engineering student, and Tiffany Franklin, nursing student, also earned their bachelor's degrees this spring.

Two biology graduate students supported by the center received awards this year. Kevin Hoffman won the Robert M. Jenkins Memorial Scholarship given by the Southern Division of the American Fisheries Society, and George Scholten won the 2002-2003 Pennebaker Scholarship Award for Outstanding Incoming Graduate Student in the Tennessee Tech Department of Biology.

The Environmental Quality Lab recently passed certification tests for drinking water analysis required each year by the Water Center. During the certification process, lab technicians analyze performance

evaluation samples prepared by the Environmental Resource Associates, a company subcontracted by the EPA, to determine various drinking water parameters. The Water Center lab is capable of analyzing trace metals, minerals, anions, nutrients, cyanide, organics, fish lipid profiles, total and fecal coliforms, trihalomethanes, pesticides and herbicides, among others. For a complete listing of Water Center lab capabilities, visit www.tntech.edu/wrc/environqualitylab.htm.



Photo by Clint Neel

Water Center faculty and staff showed their support of Earth Day, April 22, by wearing commemorative t-shirts. From left to right: Amy Knox, editor; Glenda Shanks, grants fiscal clerk; Martha J.M. Wells, environ. chemist; Sharon Berk, biologist; Mary Williford, financial analyst; Sandra Pigg, sec. III; Daniel Basham, research tech. II; Jeannie Mullinax, tech. clerk; Dennis George, Water Center director

Downloadable versions of previous issues of *Water Currents* are available on our Web site at www.tntech.edu/wrc/publications.htm.

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