

Mission

The faculty, staff and students of the Center for the Management, Utilization and Protection of Water Resources (Center), at Tennessee Technological University, work to enhance research by addressing diverse water-related problems in Tennessee, the nation and the world; enhance educational opportunities through research, university instruction and educational outreach; and enhance citizens' quality of life by providing technical assistance and technology transfer to peers, citizens and industry.

Accomplishments/Awards

Center faculty and associates worked very hard to earn funding to pursue their research initiatives. This was evident through the large grants received this fiscal year. Biology Professor Sharon Berk received funding of more than \$204,000 from the U.S. Department of Agriculture to pursue her work that deals with the interactions of *Salmonella enterica* and *E. coli* O157:H7 with protozoa. Hydrologist and Assistant Professor Faisal Hossain earned an award of more than \$130,000 from NASA to pursue work titled "Advancing the Hydrologic Potential of NASA's TRMM-Based Satellite Rainfall Estimation System for Global Flood Monitoring." Biology Associate Professor Hayden Mattingly received more than \$186,000 in funding from The Nature Conservancy to further research titled "Identifying Linkages Between Water Resource Development Activities and Stream Habitat Variables Important to Endangered Species on the Cumberland Plateau."

Biology Professor Tom Roberts and research specialist Ken Morgan initiated a workshop that brought consultants and state agency representatives to campus to discuss relevant wetland issues in Tennessee. Sandra Pigg, secretary III; Amy Knox, editor; and Dennis George, Center director and environmental engineering professor, helped coordinate the workshop, which was held May 19 and 20, 2009.

Sharon Berk participated in the Visiting Scholar Program at Flinders University Research Centre for Coastal and Catchment Environments in Adelaide, South Australia. She was chosen to participate in the prestigious program because of her extensive work in the ecology of *Legionella* (the bacteria that cause Legionnaires' disease), protozoology and protozoan/bacterial interactions.

Center faculty and associates published 17 refereed papers and 2 book chapters and made 71 presentations at professional organizations' conferences.

Biology Professor Phil Bettoli was invited to present "Wrong Place at the Wrong Time: Incidental Take of Endangered Pallid Sturgeon in a Commercial Caviar Fishery" at the Southeastern Fishes Council Annual Meeting, held November 2008 at Chattanooga. His co-authors were students M. Casto-Yerty and G.D. Scholten.

Biology Professor Brad Cook developed an educational sign for placement at Abrams Creek Campground in the Great Smoky Mountains National Park. The sign describes threats to rare fish species due to human impacts. He also worked with the "Tennessee Wildside" television show to film an episode regarding rare fishes in Abrams Creek, Great Smoky Mountains National Park.

Faisal Hossain won the NASA New Investigator Award (2008-2011) to pursue his work in satellite-based forecasting. He also won the 2009 Outstanding New Faculty Research Award through the American Society of Engineering Education.

Biology Professor Jim Layzer won the Lifetime Achievement Award from the Freshwater Mollusk Conservation Society in April 2009.

Hayden Mattingly and his students Tyler Black, Jason Detar, and Brena Jones won the third place Student Poster Award for their paper titled "Ecology and Conservation of the Threatened Blackside Dace, *Phoxinus cumberlandensis*, a Threatened Stream Fish in Kentucky and Tennessee, USA," presented at the Southeastern Fishes Council Annual Meeting, held in Chattanooga, Tennessee, November 2008. Mattingly is also leading a Scientific Advisory Committee charged with providing expert guidance on the species and land-use activities that will potentially be covered in a Habitat Conservation Plan (HCP) being considered for the Northern Cum-

berland Plateau area. The HCP will provide a "means to integrate the use and conservation of natural resources associated with threatened and/or endangered species." The Cookeville mayor and other regional officials are in support of this plan, which is the only one like it in Tennessee. The HCP project recently was awarded approximately \$320,000 for continuation of the work.

Hydrologist Vince Neary was invited to present "Ecohydraulics: Fish Passage Kinetics and Effects of Vegetation on Lotic Organisms" at the Oak Ridge National Labs and to the University of Tennessee, Knoxville, in April 2009. He was also invited to present "Ecohydraulics" to the Center's Advisory Board on March 4, 2009, and "Ecohydraulics Research at TTU" to the American Society of Civil Engineers Student Chapter on February 24, 2009.

At the TTU Student Research Day poster contest held in March 2009, Ph.D. student Vasanta Pallem, advised by chemical engineering Assistant Professor Holly Stretz and environmental chemistry Professor Martha J.M. Wells, won first prize in the



chemical engineering division. The work deals with the fate and transformation of diagnostic imaging nanoparticles in surface water. Environmental sciences chemistry Ph.D. student Alisha Pendergrass, advised by Professor Wells, won first place in the environmental sciences division. Their work is titled "Extraction and Chromatographic Analysis of Eicosanoids in Fish Tissues." In a poster contest held during the Kentucky-Tennessee Water Professionals Conference on July 22, 2008, Juan Sáñez, environmental sciences chemistry Ph.D. student, and his co-authors, Professor Wells; George C. Garden and William P. Hamilton, of Barge Waggoner Sumner and Cannon Inc. (the engineering firm that funded the research); and Kati Y. Bell, of the CDM consulting and engineering firm, won first prize. Their poster was titled "Influence of Dissolved Matter on Potable Water Production: Relationship Between Fluorescence Spectroscopy and Disinfection By-Products in Tennessee Surface Source Waters." Sáñez's work is supported through the Environmental Sciences Ph.D. program.

A paper authored by Earth sciences Professors Peter Li and Hugh Mills and student Derrick Ho won first place at the Technical Session of the 118th Annual Meeting of the Tennessee Academy of Science in November 2008. The paper was titled "Spatial Modeling in Sinkhole Flooding Analysis and Management System."

Investments for the Future

- ▶ Look for funding to address detection and treatment of pharmaceuticals and personal care products and endocrine disrupting compounds.
- ▶ Address the effects of climate changes on endangered species and hydrology.
- ▶ Explore treatment processes related to waterborne pathogens.
- ▶ Continue to explore fisheries research dealing with endangered and threatened species.
- ▶ Further already established international partnerships and create new ones.

Research Project

Highlights

▶ One project, which was recently completed, involved Kim Stearman, soil scientist and professor; Dennis George, Center director and environmental engineering professor; and Vince Neary, hydrologist and associate professor. In this work, researchers examined approaches for managing urban watersheds and reducing and controlling runoff on the Pigeon Roost Creek. The project was funded by the Tennessee Department of Agriculture Nonpoint Source Program.

▶ In another project, former graduate student Rupesh Puttagunta worked with his committee — including Dennis George; Pedro Arce, professor and chair of the Department of Chemical Engineering; Martha J.M. Wells, environmental chemistry professor; and Joe Biernacki, chemical engineering professor — to evaluate the use of advanced oxidation processes to characterize and evaluate an ultraviolet system to treat commercial kitchen exhaust emissions. The project was funded by Franke Inc.

▶ Holly Stretz, assistant professor of chemical engineering; Martha J.M. Wells; and Vasanta Pallem, chemical engineering doctoral student, are looking at the effects of gold nanoparticles — which can be used in drug delivery, biomedical imaging and chemical sensing processes — when they are found in the environment. Because the fate and transport of those nanoparticles in the environment are relatively unknown, researchers are trying to determine how those processes are affected when the nanoparticles interact with the environment.

▶ Martha J.M. Wells and Dennis George are also continuing their work with the use of advanced oxidation techniques to decompose toxic materials in water supplies and are continuing their research in microconstituents, which include the potentially endocrine-disrupting pharmaceuticals and personal care products (PPCPs). The Center's work in microconstituent substances proved to be an invaluable resource when an Associated Press study revealed that small traces of PPCPs had been found in drinking water. Wells was one of the researchers the media sought when looking for the answer to the question of whether or not our drinking water is safe.

▶ Microbiology Professor Sharon Berk and her research team are studying pathogens as they relate to food-borne illnesses and how protozoa can affect transmission of these illnesses. According to Berk, protozoa could enhance the survival of food-borne pathogens in the environment. In their preliminary studies, Berk and her team examined how *Salmonella enterica* bacteria found in food were affected when they interacted with protozoa, which feed on bacteria. They were especially interested in the protozoan *Tetrahymena*, which live in water, even the water in soil. In other work, they are examining protozoa directly from produce to determine whether the protozoa would release vesicles containing *Escherichia coli* O157:H7, *S. enterica* and *Listeria monocytogenes* bacteria.

▶ Kim Stearman, along with his collaborative partners, is opening doors to the environmentally sound techniques found through organic farming and thereby building a name for TTU as an organic research center. Some of the projects use Waters Organic Farm, under the guidance of horticulturist Randy Dodson, and focus on season-extending growing techniques using high tunnels and other emerging techniques that will help build soil quality, improve farmers' yields and also reduce runoff and improve water quality in the streams and rivers. Melinda Anderson, assistant professor in the School of Human Ecology, and her research team are also working on a project dealing with innovative agricultural techniques.

The work is funded by the U.S. Department of Agriculture and involves hydroponic growing practices; the cost-effectiveness of growing hydroponic vegetable gardens in high school vocational classrooms for rural adolescents and their families; and the impact of class-produced hydroponically grown vegetables on obesity indices in participants.

▶ The Center continues its work in fisheries species protection and conservation through the Tennessee Cooperative Fishery Research Unit on campus. This work benefits the state's \$480 million annual fishing industry, which reaches approximately 900,000 anglers. Through a project sponsored by the Tennessee Wildlife Resources Agency (TWRA), biology Professor Phil Bettoli and his research team are studying the movements and habitat selection of the endangered pallid sturgeon to provide data to help in recovery efforts. Because these fish move great distances, management must be considered at the multi-state scale. This project will provide data on the potential spawning areas and the impact of the shovelnose sturgeon commercial fishery.

▶ Biology Professor Jim Layzer and his team are involved in a project funded by the U.S. Geological Survey and directed at the recovery of endangered mussels. The objectives of the project are to determine the current status of endangered mussels in the Green River; determine whether modifications made to the discharge regime from the Green River Dam (GRD) are enhancing mussel recruitment; and if necessary, establish captive breeding populations of ringpinks, clubshells and northern riffleshells mussels.

▶ TWRA funds a project in which biology Associate Professor Hayden Mattingly oversees an assessment of the Barrens topminnow population. For the 25 sites where Barrens topminnow are known to exist (dependent upon access to private lands), trends in population status, structure and reproductive success will be reported. Based on analysis of data, management and monitoring recommendations will be suggested.

▶ Biology Professor Brad Cook is working with the Great Smoky Mountains National Park (GSMNP) on a project titled "Benthic Macroinvertebrate Assessment Associated with Brook Trout Restoration of Lynn Camp Prong, Great Smoky Mountains." Brook trout are the only trout native to the southern Appalachian Mountains and the GSMNP. Since 1900, this salmonid has lost approximately 75 percent of its range inside the park boundary. The GSMNP Fishery Management Plan identifies brook trout restoration as a high priority. This research project will help to characterize the benthic macroinvertebrate population of Lynn Camp Prong before, during and after brook trout restoration.

▶ Hydrologist and Assistant Professor Faisal Hossain is working on a NASA-funded project titled "Defining Optimality Criteria for the Effective Use of Satellite Precipitation Datasets in Land Surface Hydrology." Through this research, Hossain is assessing the effectiveness of NASA's Global Precipitation Measurement system to predict flood-water cycles by integrating satellite rainfall error models that he developed.

▶ Biology Professor Tom Roberts and research specialist Ken Morgan are working on a project funded by TWRA and titled "Monitoring Groundwater Hydrology and Selected Plant Communities at the Three Rivers Mitigation Bank." TWRA developed a mitigation bank in Obion County, Tennessee, adjacent to a section of the Obion River that had been altered by channelization and levee construction. The researchers in this project are documenting the hydrologic regime and plant community characteristics that have occurred following restoration.