



Water Currents

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Photo by Chris Knox

WATER: ONE OF OUR MOST VALUABLE RESOURCES

Sustaining the health of our water resources for future generations is of primary concern to the Center for the Management, Utilization and Protection of Water Resources (Center).

According to a 2000 report by the U.S. Environmental Protection Agency, the costs of unclean water can be great to our country. In 1998, approximately one-third of the 1,062 beaches in an EPA survey had at least one health advisory or closing. Seventeen states reported 37 recreational water outbreaks caused by microorganisms, according to the 1995 to 1996 Centers for Disease Control data. The EPA also estimated that annually at least a half-million cases of illnesses could be linked to microbial contamination in drinking water. Therefore, it is extremely important for our nation to ensure that clean water supplies are available.

Population projections by the Tennessee Valley Authority and the U.S. Geological Survey indicate an increase to approximately 5.9 million people living in the Tennessee River watershed by 2030. With significant population growth in Tennessee and the southeastern United States, greater demand pressures on the region's limited water resources will occur. Environmental research is invaluable to maintaining citizens' quality of life and should continue to be a top priority among policy makers.

EPA asserts that the nation's economic situation depends on clean water, especially in the fishing, farming, manufacturing and tourist industries. A survey by *Money* magazine showed that two of the top priorities Americans consider when choosing a place to live are clean air and water. Tennesseans cannot afford to take for granted the safety of our water supplies. The Center's work is important to ensuring that our lifestyles are maintained and our water expectations are met.

In the coming year, the Center will advance those goals by continuing work toward its vision: enhancing environmental education through research. Its work will continue to bring water to the forefront of the attention of our state and nation and will show our citizens how their support is needed to maintain the healthy balance of our ecosystem.

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WILLIAMSON COUNTY LANDFILL USED TO STUDY THE EFFECTS OF OXYGEN AND WATER ON WASTE DEGRADATION

Normally, landfills are designed to remain dry to prevent rainwater contaminated by waste from seeping into groundwater supplies. However, in a project headed by Lenly Weathers, environmental engineer and Center associate, researchers are controlling the addition of water, oxygen and nutrients to a landfill in Williamson County to determine their effects on waste degradation and possibly speed up landfill stabilization.

The Williamson County landfill created large amounts of runoff that the county was attempting to eliminate and treat. County officials also wanted to accelerate the rate at which the landfill stabilized.

“It could take several hundred years for waste to completely degrade where the landfill could be called stable,” said Weathers. “In this project, the landfill seems to be reaching that point more quickly because degradation reactions happen faster when oxygen is present.”

The project is sponsored by Civil and Environmental Consultants, Inc., where Tennessee Tech doctoral student Kevin Wolfe is employed. Wolfe worked with Weathers and his research team to change the original landfill from an anaerobic system, one without

oxygen, to an aerobic system, one with oxygen present, to create the first real-world application of a total aerobic bioreactor landfill in the United States. In this system, biological processes are used to accomplish the chemical reactions that degrade the waste, and a leachate system recirculates the water through the landfill to prevent its infiltration into groundwater.

Samples are taken every three months from the waste components to determine how the material composition has changed. In a unique method of data analysis, researchers then use the biochemical methane potential of the waste to determine if the landfill is stabilizing. When the potential for methane formation is low, the landfill material is near complete degradation. Since methane is made from the breakdown of lignin and cellulose, researchers also note the amount of those substances in the waste materials.

The analytical testing phase of this project, which has been the subject of graduate work for former students Justin Murray and Nathan Mathis, is complete. According to Weathers, he and his research team will continue to process the data even after another organization begins data collection.

ANGLERS SURVEYED TO DETERMINE MOTIVATIONS, ATTITUDES AND VALUES OF FISHING RESOURCES

In one of the largest projects of its kind in this region, Tennessee Tech fisheries researchers undertook an extensive survey of trout anglers who fished eight Tennessee tailwaters to determine why they fished and how much they valued those fishing resources.

“This was a unique project because it represented a simultaneous examination of an important sport fishing group across Tennessee,” said project principal investigator Phillip Bettoli, who is a U.S. Geological Survey scientist and associate of the Center. “Our work was both intensive and extensive because we spent a lot of time surveying anglers at each river, and we went to many different rivers.

“Our goal was to help the TWRA [Tennessee Wildlife Resources

Agency] understand its clients. Just like with any business, this natural resource management agency needs to understand its customers to better manage the sport fishery resources it provides to those clients.”

According to Bettoli, those “customers” served by TWRA are people who buy fishing licenses and spend time and money to fish the waters of this state.

Bettoli and his research team, which included two graduate students supported by the Center, surveyed more than 2,600 anglers in this study. The researchers chose random days and times to visit the Caney Fork, Clinch, Hiwassee, Duck, Obey, Elk, South Fork of the Holston and Watauga Rivers and interviewed anglers on each river.

ANGLERS SURVEYED TO DETERMINE MOTIVATIONS (CONT.)



More than 2,600 anglers were surveyed in this study to determine the reason they fished and the value they placed on the fishing resource.

(Photo courtesy of Phillip Bettoli)

Those anglers were also allowed to participate in a lengthy mail survey. The anglers were asked questions ranging from how often they fished to how often they harvested the trout they caught. Their responses were used

to determine the anglers' motivations for fishing, whether it was for sport, to practice their skill or for any other number of reasons. Based on their responses to the survey questions, anglers were also assigned to subgroups using sophisticated statistical models.

About 14 percent of the anglers interviewed were out-of-state residents. Anglers fished for trout an average of 32 days per year and averaged 16 years of trout-fishing experience. Researchers were able to categorize respondents into five subgroups that they labeled as nonconsumptive specialists, occasional trout anglers, casual trout anglers, consumptive specialists and fishing generalists. Twenty-eight percent, the largest group, of the anglers was assigned to the consumptive specialist group. These anglers mainly fished for trout and fished an average of 42 days per year. To this group, angling was an important form of recreation, and they were likely to harvest and eat the trout they caught, as opposed to the nonconsumptive specialists.

Although the attitudes among anglers in the various subgroups varied on the importance of harvesting trout and catching trophy trout, most anglers agreed that they were not in favor of closed fishing seasons, and most were against any prohibition on the types of baits they could use. On some rivers (the Caney Fork, Clinch and Hiwassee), no single subgroup predominated, which will complicate the task of maximizing benefits to the most anglers. Other rivers were dominated by only one or two subgroups, which will make it easier for TWRA to satisfy the greatest number of anglers with their management programs.

Researchers also studied the economic value that the anglers placed on the fishing resource and used a contingent valuation method to arrive at estimates of net value, also known as consumer surplus. This is the same approach used by resource economists around the world to assign values to nonmarket goods such as a fishing experience.

"In this method," Bettoli said, "we asked the angler how much he would be willing to pay for the fishing experience above what it already cost them to experience it."

Actual fishing costs would include such things as gas, food, a canoe rental, a fishing guide, lost wages or other expenses. The estimated net economic value that anglers placed on trout fishing under current conditions ranged from \$39 to \$91 per angler per fishing trip. Most respondents placed higher values on the potential for catching larger fish. The total economic value (expenditures plus net value) over a six-month fishing season ranged from a low of \$148,000 on the Elk River to a high of nearly \$1.5 million on the Hiwassee River.

"TWRA can use this information to help determine if it can increase the value of the fishery resource in the eyes of the angler," Bettoli said. "These same rivers generate value from the hydroelectricity and flood control that the dams on them provide, so it is important to know the value of the recreational fishing resource. In some cases, the fishing is more valuable than the power produced, and the operation of the dam can be altered to favor fish and fishermen."

TWRA is now in the process of discussing different management approaches for these tailwaters. From the data provided, TWRA officials can determine, for example, whether or not most of the anglers want to fish for large trophy fish at a particular river, and they can then undertake management schemes that would increase the average size of trout in the river.

"Our work is intended to help TWRA prioritize their resources and decide on plans that will lead to the best management of a fisheries resource," Bettoli said. "TWRA wants to ensure that the anglers receive the most satisfaction possible from their fishing experience."

STUDENT SPOTLIGHT



Jeff Norman (Photo by Amy Knox)

ATHLETICS AND ACADEMICS CAME NATURALLY TO ONE FORMER CENTER STUDENT

Making touchdowns and excelling academically would seem hard to most college students, but doctoral student Jeff Norman, supported by the Center, seemed to take it all in stride.

During his senior year as an undergraduate at Tennessee Tech, Norman was recognized as an Academic All American for effectively combining athletics and schoolwork, and he also received the 1997 Burger King Scholar Athlete Award. With this award, \$10,000 was given to Tennessee Tech's general fund in Norman's name. Norman was also chosen as the 1997-1998 Tennessee Tech Man of the Year for his academic and athletic achievements.

Upon earning his bachelor's degree, Norman immediately began work on his doctorate in the new Environmental Sciences-Chemistry program in the fall of 1998. Although he was

required to take about 35 hours of core master's courses before he could begin the Ph.D. program, Norman graduated in Summer 2003 after only five years of study, a short period to complete doctoral work.

"It's always been a goal of mine to get a Ph.D.," Norman said. "I felt it would open up more doors for my career."

From Lynchburg, Tenn., home of the famous Jack Daniel, Norman came from a small family of two children. While his older brother worked toward a biology degree at Middle Tennessee State University, Norman dreamed of becoming an engineer to explore his interest in math. His aspirations would change, though, when he would be recruited from Moore County High School to play football at Furman University in Greenville, South Carolina. Then recruited by Tennessee Tech to play football in the spring of 1995, Norman decided he would follow his interest in the environment and began pursuit of a degree in chemistry.

"When I was in high school," Norman said, "I never thought I would major in chemistry, but it interests me because aspects of that field are in everything we do. From improving the performance of cleaning products to baking a cake, chemistry is everywhere." Norman hopes that someday he will develop new products or enhance existing ones through his knowledge of chemicals and elements.

While working with the Center, Norman was mentored by respected faculty including Martha J.M. Wells, environmental chemist; G. Kim Stearman, soil scientist; and Dennis George, environmental engineer. For his dissertation, Norman studied the ability of simulated wetlands, or microcosms, to degrade pesticides in wastewater. He and the faculty researchers then looked at the potential of natural and constructed wetlands to be used as wastewater treatment tools.

"The professors are really knowledgeable here, and there is potential to work on interesting research topics," Norman said. "I think I've received a great education at Tennessee Tech."

Norman hopes to find a job in the environmental field. He says he would like to work for the U.S. Environmental Protection Agency in registering pesticides and evaluating Superfund sites, locations where hazardous waste has become uncontrolled and the government has provided funds to clean up the pollution.

He believes that earning his doctoral degree has been worth the work and advises others who are pursuing their degree that it will require effort and dedication, but the rewards will make it worthwhile.



In Fall 2003, Janey Smith, civil and environmental engineering graduate student supported by the Center, won a scholarship from Builder's Supply to help pay her student fees. She is the first to win this award. (Photo by Amy Knox)



When Chandler Norris discovered that foam was appearing in a pond near his home, he was determined to discover what had caused it. He took the sample to the Center's Environmental Quality Laboratory where he received guidance on determining its composition and source. His research led to a first prize at his school's science fair.

Norris is the grandson of the late Banis Norris who is featured in the Hooper Eblen Center Hall of Fame for his athletic contribution in basketball while attending Tennessee Tech in the 1920s. (Photo courtesy of the Center)

Srilaxmi Dosapati (center), a Center-supported graduate student from India, received an Ivanhoe Foundation scholarship to support her studies while she is in the United States. The Ivanhoe award is given to students who plan to use their knowledge gained in pursuing a degree to better their homelands when they return. Presenting Dosapati the certificate are, from left, Dennis George, Center director; Nader Ghafouri, former chair of the Department of Civil and Environmental Engineering; Francis Otuonye, associate vice president of Research and Graduate Studies; and Subramaniam Deivanayagam, associate dean of Graduate Studies and Research. (Photo by Amy Knox)



EXCHANGE STUDENT AMANO RETURNS HOME TO JAPAN



Yoshimasa Amano, yearlong exchange student at the Center, completed his research and returned home to Japan in September 2003. Amano came to the Center to study lakes in this region and advance his knowledge of English.

Amano said that it was a "precious and interesting time" for him. He especially thanked Dennis George, Center director and Amano's advisor while working in the United States, for his help in his doctoral research. While here, Amano was able to conduct experiments and other research on entropy, or disorder, in the composition of aquatic species living in a water body. This study will be the foundation of his doctoral thesis.

Amano said that he wants to continue his study of English when he returns to Japan, and he hopes to return to the United States sometime after he graduates.

SUPPLEMENTAL INTERNET CONNECTION ENHANCES RESEARCH

Tennessee Tech will soon have a faster Internet connection thanks to funding from the National Science Foundation (NSF). The new high-performance 45 megabytes-per-second network connection, hosted by Internet2, will supplement the existing 10 megabytes-per-second campus connection.

According to Doug Talbert, principal investigator for the project and assistant professor in the Department of Computer Science, the Internet2 connection will allow more projects involving collaborative virtual environments and distance education. Distance music lessons, virtual communities for minorities and collaborative virtual dance groups are just some of the projects that have been enabled by Internet2 at other universities. The Center advocates the connection to enhance its ability to work with other institutions in research projects.

“This new connection should open the door for the university to win grants that might not have been won before,” Talbert said. “Some funding agencies view more highly the universities that have a high-performing network connection like this.”

The high-performance connection will be used to communicate with other universities and agencies that also have Internet2 capabilities rather than for general Internet travel. It will enable students and faculty to transfer large data files that could not be transferred by the old connection.

Jerry Boyd, operations manager for Tennessee Tech’s Information Technology Services, is overseeing the installation of the connection. According to Talbert, the average setup time is about six to nine months.

NSF will partially fund the connection for two years, and then the university will pay the entire cost to support it. In the future, Tennessee Tech may be able to participate in a Sponsored Education Group Participants (SEG-P) program that creates a statewide Internet2 network that could allow the costs to be split among the statewide participants. For now, though, Talbert and the other

investigators in the project want to ensure that the connection is used to the greatest extent possible.

“We want to show other departments on campus how it can enhance their educational and research initiatives,” Talbert said. “This will involve thinking creatively to make sure the connection is used efficiently.”

EXCHANGE STUDENT RETURNS FROM BRAZIL

For Tennessee Tech geology major Clayton McMillan, the phrase “there’s no place like home” probably holds new meaning for him. McMillan recently returned from his yearlong studies in Brazil as part of the U.S.-Brazil Higher Education Consortia program, sponsored by the New Mexico Institute of Mining and Technology and run through the Center.

The program allows university students to study about the environment in a different cultural and academic setting, said Francis Otuonye, associate vice president of Research and Graduate Studies and project principal investigator.

While in Brazil, McMillan studied geology, mining engineering, mineralogy and gemology and also worked with a mining company for 20 to 25 hours per week. At the company, he and other geologists in the Mining Planning Department examined mineral quality of the iron mine. For three weeks, he also traveled in a three-state area to observe the history of the geology in those lands.

“In Brazil, the geology is older, Precambrian and Archean age even,” McMillan said. “We don’t get to see this in Cookeville.”

For six weeks prior to arriving in Brazil, McMillan studied Portuguese to prepare himself for life in that country, but his best language instruction would come when he arrived there.

“While some books were in English, and our professors could speak English,” McMillan said, “all of our classes were taught in Portuguese.”

McMillan studied at the Universidade Federal de Minas Gerais and experienced Brazilian dorm life before moving into an apartment with three Brazilians and an American missionary (cont. on next page)

EXCHANGE STUDENT RETURNS FROM BRAZIL (CONT.)

from Chattanooga, Tenn. He found that studying in Brazil would be much different from the life he had grown accustomed to in the United States. The classroom settings were more relaxed than at home; the computer labs were not as advanced; and the relationships between the students and the professors were much more informal.

“The faculty there would get upset if we didn’t call them by just their first name,” McMillan said. “And the classes were in longer blocks too, lasting from two to three hours for one or two days a week.”

While making the most of the educational opportunities in Brazil, McMillan also took time to experience the culture in the country.

“We went to soccer games between studying,” McMillan said. “They have McDonald’s down there and Wal-Mart. The malls were also a lot like the ones we have in Nashville.”

To McMillan, the whole way of life seemed to be more relaxed than in the United States. He noticed that the cost of living was also lower there.

“They’re very happy, personable people,” McMillan said. “They’re relationship oriented and are passionate about their country.”

“We live in a culture where we can have everything we want, and we live somewhat in a bubble. Traveling to Brazil and living there has taught me a lot spiritually and educationally.”

The youngest of six children, McMillan, who grew up in Oneida and also lived in Crossville and Maryville, is only the second in his family to travel outside the United States.

“I think it is almost essential for college students to participate in a program like this for the experience it provides,” McMillan said. “For me, it has helped broaden my vision of the world.”



Student Clayton McMillan studied geology in a different cultural setting when he became an exchange student to Brazil. These students are identifying rocks from a stream in that country.

(Photo courtesy of Clayton McMillan)

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CENTER DIVES INTO MOTOR POOL



The Center acquired nine new vehicles, including four-wheel drives, a van and a sedan, when it took over part of the campus motor pool in July 2003.

(Photo by Amy Knox)

While spending for higher education decreased the past fiscal year, Tennessee Tech administrators searched for ways to meet budget cuts with the fewest detrimental effects to the quality of education and the campus community. To adjust to state appropriations, the administration chose to distribute control of the motor pool to other units on campus. Effective July 1, 2003, the Center chose to adopt a portion of the motor pool, including seven four-wheel drives, a van and a sedan.

“The university worked with the Center to make this transition as smooth as possible,” said Dennis George, Center director.

“The initial setup of the motor pool required a lot of time,” said Glenda Shanks, grants fiscal clerk at the Center. “We had to establish a system for making reservations, distributing the keys and servicing the vehicles on top of our other regular duties.”

She and Jeannie Mullinax, Environmental Quality Laboratory technical clerk, are responsible for overseeing the motor pool operations. Mullinax makes reservations and schedules vehicle servicing, and Shanks takes care of paperwork and vehicle key distribution.

“The vehicles are in high demand by the Fisheries and Biology Departments,” Shanks said.

“Those students require four-wheel drive vehicles to do their work in the field. Off-campus rental companies do not want their four-wheel drives taken off road, so it was vital that we continued to have access to the campus’ off-road vehicles.”

The vehicles are essential for carrying out the Center’s mission.

Depending on availability, however, other departments or organizations on campus are using the motor pool also.



(Photo by Amy Knox)

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