



## Organic Farming

### Soil Scientist Stearman Plows Ahead in Growing Research Area

Soil scientist and one of the Center's core faculty Kim Stearman recently learned that his efforts at breaking into the hot topic of organic farming were finally reaping fruit.

The Tennessee Department of Agriculture is providing funding that will allow Stearman and a multidisciplinary team of professionals – including Jed Young, horticulturist; Jim Baier, agricultural engineer; Michael Best, agricultural economist; Janice Branson, soil scientist; Bruce Greene, animal scientist; and support personnel, including Wade Faw, agronomist and director of the Tennessee Tech School of Agriculture, and Randy Dodson, horticulturist – to begin operating a farm devoted to organic farming methods.

"We're really excited about this opportunity," Stearman said. "The organic farm foundation will provide several opportunities to go after a lot of different research projects."

By that, Stearman means he and other researchers could begin looking into more in-depth questions related to organic farming practices, like whether or not organic products actually are better for us and the environment, and what do we mean by "better"?



TTU agriculture student Jordan Brown prepares soil for organic farm plots at the TTU organic farm.  
(Photo courtesy of Kim Stearman)

ity and maintain long-term soil health; use of biological control and crop rotations, among other techniques, to manage weeds, insects and disease; reduction of external and off-farm inputs and elimination of synthetic pesticides and fertilizers," among many other principles and guidelines.

"Synthetic pesticides and fertilizers have been shown to be potentially harmful endocrine disrupting chemicals, and organic farming should reduce the need for them, thereby reducing their presence in our water systems," said Dennis George, Center director and environmental engineer.

"Our goal is to intensively manage weeds, suppress diseases and effectively manage the soil," Stearman said. "We'll be growing three crops in the spring and three in the fall and using varying amounts of compost to determine the most effective levels."  
*(cont. on page 8)*

According to the U.S. Department of Agriculture Sustainable Agriculture Research and Education program, organic farming "entails use of cover crops, green manures, etc. to fertilize the soil, maximize biological activ-

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(Photo by TTU Photo Services)

## Fisheries Biologist and Center Faculty Associate Phil Bettoli Wins Caplenor Research Award

Phil Bettoli, Center associate and biology professor, was one of the 2007-2008 Caplenor Faculty Research Award winners. The award, first presented in 1984, is TTU's premier research award and is named in honor of Donald Caplenor, former associate vice president for research and dean of instructional development.

Bettoli, who works with the Center through the on-campus Tennessee Cooperative Fishery Research Unit, focuses his research on recreational and commercial fishing and how best to study and manage fish communities to provide sustainable, economically viable fishing opportunities.

Over the last five years, Bettoli has conducted the most high-profile, high-impact work of his career on the conservation of caviar-producing species of paddlefish and sturgeon in the Tennessee and Mississippi Rivers (visit [www.tntech.edu/wrc/pdfs/WatCurrSum07.pdf](http://www.tntech.edu/wrc/pdfs/WatCurrSum07.pdf) for more information about that project).

Although Bettoli frequently interacts with commercial fishermen whose livelihoods depend on continued harvest of a diminishing resource, he has been able to collect and analyze sound data even under adverse conditions.

"His research findings have been instrumental in setting fisheries regulations and management protocols in Tennessee and elsewhere," said Dan Combs, TTU biology department chair.

Bettoli has studied a wide variety of ecological topics of many different species of fish in many different aquatic habitats. For example, his long-term trout study provided some of the best comparative data among reservoir tailwaters anywhere.

"Based on this study, the Tennessee Wildlife Resources Agency was able to fine-tune trout management in Tennessee, including optimum stocking rates and protocols, as well as harvest regulations," Combs said.

National and regional media often feature Bettoli's applied research. Articles about caviar-producing paddlefish appeared in media as diverse as Wine Spectator and the India Gazette. The National Public Radio also aired an interview of Bettoli nationwide.

*"His research findings have been instrumental in setting fisheries regulations and management protocols in Tennessee and elsewhere."*  
— Dan Combs, TTU biology department chair

Bettoli received the 2007 Outstanding Achievement Award from the Southern Division of the American Fisheries Society for his noteworthy and long-standing contributions to fisheries and aquatic sciences. He has received \$3.8 million in grants, has mentored 42 graduate students and has published more than 100 articles, book chapters and major reports.

He received his doctorate in wildlife and fisheries science from Texas A&M, his master's degree in biology from TTU, and his bachelor's degree in wildlife ecology from the University of Maine.

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Mechanical engineering undergraduate student Brent Frounfelker (above) has been integral to the water quality sampling that has been part of this project at Jones Creek. (Photos courtesy of Brent Frounfelker)



## Center Researchers Engage in Innovative Nutrient and Biological Assessment of Jones Creek in Dickson County

Jones Creek may seem like any other body of water, but in reality, it is the site of an important project in which Center researchers are monitoring its quality and the number and types of aquatic animals living there.

Part of the Harpeth River Watershed, Jones Creek is on the Tennessee Department of Environment and Conservation's 303(d) list that tells which rivers, lakes and streams don't meet water quality standards in Tennessee. Jones Creek made TDEC's list because it contains *Escherichia coli* and a large amount of nutrients. Nutrients, from pesticides and fertilizers, can be detrimental to aquatic life because they can lead to the formation of algae, which uses the oxygen supplies that the animals need to survive.

"This project is innovative because our student Brent Frounfelker spent two weeks in Dickson County, taking hourly water quality samples and measurements in an intensive on-site monitoring session," said Dennis George, the project's principal investigator and Center director.

"We've never done continual monitoring of a natural site," Frounfelker said. "The depth and continuity of the data that were taken make this project unique to the Water Center."

According to Frounfelker, continuous monitoring included taking water temperature, pH, dissolved oxygen, water level and conductivity measurements. He also gathered information on the water's alkalinity, total nitrogen and other water quality-indicating data.

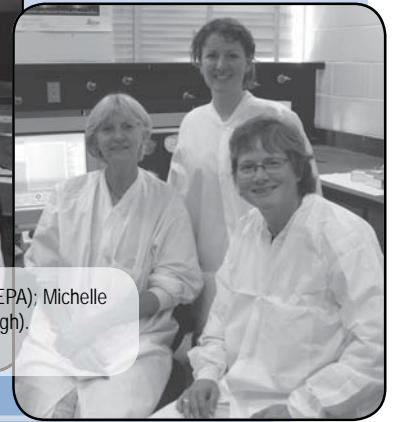
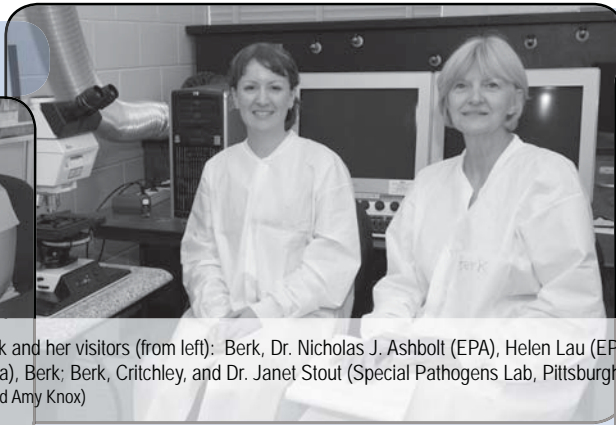
Funded by the Water Authority of Dickson County, the project also assesses how much nutrient mass is carried along during rain events, as well as during low-flow conditions. Biologist Brad Cook and his students are also assessing the benthic macroinvertebrate, or those spineless, literally, bugs and insects that live along the bottom of the creek. To achieve all of those goals, the researchers are breaking their work into three phases, the first of which involved determining where the monitoring would be done along the creek.

"We were looking for land use, hydrology, stream geomorphology and habitat when we considered the sites," George said.

Phase two is the sample-collecting stage. A final report, outlining conclusions and recommendations, will be provided to the Water Authority of Dickson County in the final stage.



Microbiologist Sharon Berk and her visitors (from left): Berk, Dr. Nicholas J. Ashbolt (EPA), Helen Lau (EPA); Michelle Critchley (CSIRO, Australia), Berk; Berk, Critchley, and Dr. Janet Stout (Special Pathogens Lab, Pittsburgh). (Photos by Photo Services and Amy Knox)



## National and International Visitors Seek Out Microbiologist Berk for Collaborative Research

The expertise of Sharon Berk – microbiologist and one of the Center's core faculty members – is in strong demand. In the past few months, she has opened her lab to visitors from as far away as Australia who are hoping to foster collaborative research opportunities with her. Berk's work focuses on amoebae and their role in both food safety and the spread of *Legionella*, the bacteria that cause Legionnaire's disease.

Studying that disease is particularly important to her first guest, Michelle Critchley who works for Australia's national science agency, CSIRO. Critchley chose a six-week visit with Berk, over other U.S. opportunities, to increase her knowledge of Legionnaire's disease, after an Australian outbreak in 2000 was linked to cooling towers.

"Michelle's specialization in molecular biology will complement my own expertise in protozoan ecology," Berk said.

Critchley, who traveled to TTU through the "Backing Australia's Ability" program, has worked for the last five years with chemical treatment for controlling *Legionella* in cooling towers, while Berk and her research team have spent a great deal of time trying to understand how *Legionella* bacteria persist in cooling towers.

Among Berk's other guests were Dr. Nicholas J. Ashbolt, Title-42 Senior Research Microbiologist, Office of Research and Development, National Exposure Research Laboratory (MD-564), U.S. Environmental Protection Agency; Helen Lau, a postdoctoral researcher from the EPA; and Janet Stout, Ph.D. and director of the Special Pathogens Lab in Pittsburgh, Pennsylvania.

Stout is an esteemed researcher in her field and discovered the link between the presence of *Legionella* bacteria in hospital water and the occurrence of hospital-acquired Legionnaire's disease.

"All these researchers wanted to be trained in protozoology and discuss the possibility of future collaborations," Berk said.

Berk is also being sought out for other collaboration opportunities, one of those being an offer to develop a proposal with Dr. Delene Bartie, with the Immunology/Microbiology Section of the National Institute for Occupational Health, in Johannesburg, South Africa. Bartie visited TTU several years ago, looking for guidance in setting up a lab similar to Berk's, but in South Africa. Susan Springthorpe, director of research at the Centre for Research on Environmental Microbiology at the University of Ottawa, Ontario, Canada, recently asked Berk to join a research team on food safety.

Not only has Berk been visited by several renowned biology researchers, but she has also taken her expertise on the road. She recently made an invited presentation at the Biology Department of the University of North Carolina, Charlotte. She also visited a colleague in Halifax to discuss food safety and *Legionella*. Along with esteemed colleagues from the Centers for Disease Control and Prevention, Virginia Commonwealth University, the University of Arizona, and the EPA, Berk also spoke in a special topics session and panel discussion on amoebae.

*"Hosting all these visitors and making so many presentations of our work will open the doors for many research opportunities in a variety of arenas. It should keep us very busy."*  
– Sharon Berk, microbiologist

Most recently, Berk was strongly encouraged to apply for the Flinders Research Centre for Coastal and Catchment Environments Visiting Scholars Program at the University of Adelaide in South Australia, where she would work for a minimum of a month in a number of different areas of water research.

"Hosting all these visitors and making so many presentations of our work will open the doors for many research opportunities in a variety of areas," Berk said. "It should keep us very busy."

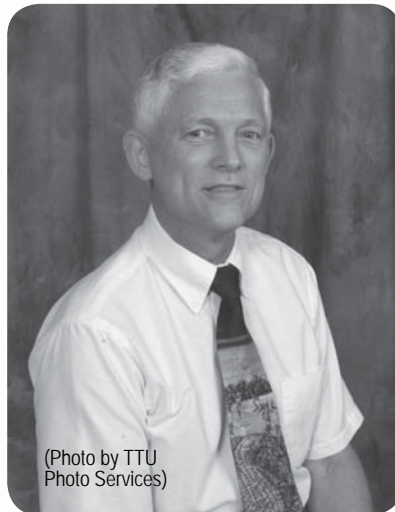
A poster presentation, titled the "Environmental Survival of Novel Amoeba-Associated Bacteria," was awarded the Best Poster Award at the 2007 American Society for Microbiology Kentucky/Tennessee Branch Meeting, held Oct. 5-6 at Cumberland Falls State Park in Corbin, Kentucky. The poster was the work of biology undergraduate student James White; chemistry undergraduate student Wesley Willeford; biology undergraduate student Michelle Lowe; Middle Tennessee State University biology Assistant Professor Mary Farone; and microbiologist Sharon Berk.

C e n t e r

# Spotlight

## Lee Barclay

Lee Barclay, member of the Center's Advisory Board, is the supervisor of the U.S. Fish and Wildlife Service's Tennessee Field Office in Cookeville. He received a Ph.D. in aquatic ecology and fisheries in 1973 from Auburn University. Before beginning his career with the Fish and Wildlife Service, he taught ichthyology, freshwater fish ecology, aquaculture, and conservation biology at California Polytechnic State University in San Luis Obispo, California.



(Photo by TTU Photo Services)

Barclay's career with the Fish and Wildlife Service began in 1975 as the assistant Regional Coastal Ecosystem team leader in Galveston, Texas (for one-and-a-half years) and later in Charleston, South Carolina (five years). He then served six years as the environmental contaminants specialist in the Tennessee/Kentucky Field Office in Cookeville, Tennessee. Barclay served as senior contaminants specialist in the Fish and Wildlife Service's Headquarters Office in Washington, D.C., in 1987 and 1988, and then he was appointed as supervisor of the Mississippi/Arkansas Field Office in 1989. Barclay transferred back to Cookeville in 1991

as supervisor of the Tennessee/Kentucky Field Office.

"Lee's leadership of the Fish and Wildlife's Tennessee Office in Cookeville has been a tremendous asset to Tennessee and the Center," said Dennis George, Center director and environmental engineer. "With the expertise of all our Advisory Board members, we have an outstanding team."

"I enjoy working with the Water Center because it keeps me in touch with aquatic research in the state," Barclay said, "and the Water Center is a leader in that field of research throughout the Southeast."

Barclay and his wife, Judy, reside just outside the Cookeville city limits. In addition to caring for a wide assortment of domestic animals such as dogs, cats, horses, donkeys and geese, the Barclays also operate the Upper Cumberland Wildlife Rehabilitation Center, focusing primarily on raptorial birds such as hawks and owls.

## TDEC and the Center Team Up to Initiate Water Reuse Survey of Tennessee Wastewater Utilities

Reuse Type	Number of Systems	Capacity (mgd)	Flow (mgd)	Area Acres
<b>Public Access Areas &amp; Landscape Irrigation</b>				
Golf Course Irrigation	4	30.2	2.4308	622.5
Residential Irrigation	1	12	0.004	2.5
Other Public Access Areas	2	12.53	0.061	103
<b>Subtotal</b>	<b>7</b>	<b>54.73</b>	<b>2.4958</b>	<b>728</b>
<b>Agricultural Irrigation</b>				
Edible Crops	0	0	0	0
Other Crops	1	0.59	0.34	68
<b>Subtotal</b>	<b>1</b>	<b>0.59</b>	<b>0.34</b>	<b>68</b>
<b>Groundwater Recharge &amp; Indirect Potable<sup>*</sup></b>				
Rapid Infiltration Basins	0	0	0	0
Adsorption Fields <sup>‡</sup>	0	0	0	0
Surface Water Augmentation	1	1.6	0.734614	not given
Injection	0	0	0	0
<b>Subtotal</b>	<b>1</b>	<b>1.6</b>	<b>0.734614</b>	<b>not given</b>
<b>Industrial</b>				
At Treatment Plant	0	12	0.66	0
At Other Facilities	0	0	0	0
<b>Subtotal</b>	<b>0</b>	<b>12</b>	<b>0.66</b>	<b>0</b>
Toilet Flushing	0	0	0	0
Fire Protection	0	0	0	0
Wetlands	0	0	0	0
Other Uses	0	0	0	0
<b>Totals</b>	<b>9</b>	<b>68.92</b>	<b>4.230414</b>	<b>796</b>

<sup>\*</sup>**Indirect Potable Reuse:** for these purposes, the planned discharge of reclaimed water to surface waters to augment the supply of water available for drinking and other uses.

<sup>‡</sup>**Adsorption Field:** a drainfield, including the application/distribution system, intended for the reuse of reclaimed water.

TDEC Environ. Field Office	No. of Reuse Systems	No. of Homes Irrigated	No. of Golf Courses Irrigated	No. of Parks Irrigated	No. of Schools Irrigated	Other Public Access	Edible Crops	Grass, Pasture, Other Crops	Groundwater Recharge & Indirect Reuse
Chattanooga	0	0	0	0	0	0	0	0	0
Columbia	2	0	1	0	0	0	0	1	0
Cookeville	1	0	0	0	0	0	0	0	1
Jackson	0	0	0	0	0	0	0	0	0
Johnson City	0	0	0	0	0	0	0	0	0
Knoxville	0	0	0	0	0	0	0	0	0
Memphis	1	0	1	0	0	0	0	0	0
Nashville	3	7	2	0	2	1	0	0	0
<b>2006 Total</b>	<b>7</b>	<b>7</b>	<b>4</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>1</b>

This table shows the number of facilities that reuse water in each TDEC Environmental Field Office District. It also shows how the treated wastewater was used within each district (how many golf courses, schools and parks were irrigated with it, etc.).

The Center has recently teamed up with the Tennessee Department of Environment and Conservation (TDEC) to initiate a survey of wastewater treatment utilities to find out which ones were using water conservation and water reuse practices. This is important to Tennessee as it faces strong pressures on water resources from human use.

"This survey is the first of its kind in Tennessee, and it's a tool for all the wastewater utilities to show them ways they can reuse wastewater – if they're not already doing so – or how they can reuse more efficiently if they already are," said Dennis George, Center director and environmental engineer.

Eighty-five wastewater treatment facilities returned the survey. Of these, seven treated wastewater (or reclaimed water) to be reused in the 2006 period. Only those facilities that handle 0.1 million gallons or more of water per day (mgd) were surveyed. The total amount of wastewater that the treatment facilities who responded can handle is 20.92 mgd, and those facilities treated 15.6 mgd of domestic wastewater in 2006. Approximately 2.868 mgd of treated wastewater from those facilities were reused for beneficial purposes.

"We sent out the 2007 survey in October," George said. "And we'll be posting those results soon."

A summary of the 2006 survey results are posted on the Center's Web site at [www.tntech.edu/wrc/WaterReuseSurvey.htm](http://www.tntech.edu/wrc/WaterReuseSurvey.htm) and from TDEC's Web site at [www.state.tn.us/environment/dws/](http://www.state.tn.us/environment/dws/) and [www.state.tn.us/environment/wpc/other.shtml](http://www.state.tn.us/environment/wpc/other.shtml), but some of the summary data is included here to the left. For the complete results from all the survey respondents, call the Center at 931/372-3507, or send an e-mail to [cmupwr@tntech.edu](mailto:cmupwr@tntech.edu).

## Center Hosts Poster Workshop to Assist Faculty and Students in Creating Presentations

Among the many other services the Center provides, one of its core competencies has become offering assistance to faculty and students in preparing posters for presentations. The Center's editor/graphic designer, Amy Knox, has always helped students and faculty across campus in printing and designing professional conference posters. But recently, she took that guidance a little farther and led a workshop in which participants were shown how to prepare posters and graphics more effectively using the Adobe Illustrator and Adobe Photoshop softwares.

"Working with faculty and students almost daily on printing and laying out their posters, I thought this workshop would help make that process smoother," Knox said. "Most people on campus began using Microsoft PowerPoint to create large-size posters. But PowerPoint was not ever intended for that, and it's not as user-friendly as Illustrator for aligning graphics and entering text.



Participants of a recent poster workshop, hosted by the Center, learned to use Adobe Illustrator and Adobe Photoshop to create professional-quality posters. (Photo by Amy Knox)

"Most sign companies use Illustrator to create large documents, and it works better with our large-format printer."

Knox also discussed how to resize and resample graphics to make sure they are clear in large formats. "A lot of people don't know how to change the resolution on photos or why images downloaded from the Web don't print clearly. Through this workshop, I hope the participants learned a little bit of the process of creating great graphics because, to represent our university well, our presentations should look professionally done."

The Adobe Illustrator handout from this workshop is available at <http://www.tntech.edu/its/pubs/pdf/CreatingPosterHandoutITFormat.pdf>. To receive an Illustrator poster template or a copy of the other handouts, including information on graphics and preparing posters more effectively in PowerPoint, send an e-mail to [akknox@tntech.edu](mailto:akknox@tntech.edu).

## How Important is Water to Our Future? ASK HER.

With recent droughts and NBC news broadcaster Brian Williams speaking about water wars and the importance of clean water in his series "Thirsty Planet," water has suddenly come to the forefront of national attention. At the Center, we've always known how important it is, not only now, but for the future. After all, if our groundwater tables are not replenished, and storm water continues to flow unabated over the ground via massive areas of impenetrable concrete, where we will get the precious resource that so many of us take for granted?

Those ideas are the subject of a DVD that the Center is working on with Kevin Liska, director of TTU's Business Media Center ([www.tntech.edu/cob/facstaff/bmcdesc.htm](http://www.tntech.edu/cob/facstaff/bmcdesc.htm)). The project will focus on how communities can be developed to lessen storm water runoff and keep more rainfall in the ground. Interviews with Dennis George, Center director and environmental engineer; Vince Neary, hydrologist; Alan Sparkman, executive director of the Tennessee Concrete Association; Don Green, water resources project manager at Fuller, Mossbarger, Scott and May Engineering Inc.; and Jerry Anderson, with the Memphis Groundwater Institute, are among those peppered throughout the project as they make a case for more environmentally friendly urban development.

After all, "you can either reduce runoff now or pay higher costs later in water quality treatment," George says.

Look for the DVD to be available later this year. For more information, call 931/372-3507.





# Organic Farming

(cont. from page 1)



Soil scientist Kim Stearman applies a low rate of compost on organic farming plots at the TTU organic farm.

(Photo courtesy of Kim Stearman)

Stearman said he and the other researchers will also vary drip irrigation rates to determine which level is the most conducive to growing.

"We're using today's modern technology to expound on ideas and techniques with soil management and weed suppression that were being developed in the 1800s and 1900s," Stearman said.

The funding provided by the Tennessee Department of Agriculture has been used to get the farm ready to be planted and has gone toward purchasing a tractor, high tunnels (which are similar to greenhouses), compost and other farming implements.

"We'd like to use this start-up money to leverage other sources of funding," Stearman said. "We plan to compare yield and quality of the produce, and we hope that someday it will be certified through the government."

Stearman and the other researchers are also tossing around the idea of developing a complete college-level curriculum from their work.

Gary and Brenda Waters own the 114-acre test farm that TTU is leasing for this research. Stearman says the organic section of the farm is in a 10-acre parcel.

According to the U.S. Department of Agriculture, "organic farming has been one of the fastest growing segments of U.S. agriculture for over a decade." The number of acres certified as organic farmland doubled between 2002 and 2005. In 2005, the U.S. had 8,493 certified organic pasture and cropland operations.

"This industry is growing fast," Stearman said. "For the last 10 years, it's been growing at 20 percent per year. It's important for us to get involved in this field of research, and we appreciate the support that the Water Center and College of Agriculture and Life Sciences have provided already."

## Learn More About Organic Agriculture

- *Sustainable Agriculture: Definitions and Terms*, Mary V. Gold, USDA, NAL, Alternative Farming Systems Information Center, 1999. [www.nal.usda.gov/afsic/AFSIC\\_pubs/srb9902.htm](http://www.nal.usda.gov/afsic/AFSIC_pubs/srb9902.htm)
- *Organic Crop Production Overview*, George Kuepper and Lance Gegner ATTRA - National Sustainable Agriculture Information Service, 2004. [attra.ncat.org/attra-pub/organiccrop.html](http://attra.ncat.org/attra-pub/organiccrop.html)
- *Definition of Organic Agriculture*, International Federation of Organic Agriculture Movements (IFOAM), no date. [www.ifoam.org/organic\\_facts/doa/index.html](http://www.ifoam.org/organic_facts/doa/index.html)
- *Frequently Asked Questions on Organic Agriculture*, Food and Agriculture Organization of the United Nations, 2007. [www.fao.org](http://www.fao.org)

USDA Source: [afsic.nal.usda.gov/nal\\_display/index.php?info\\_center=2&tax\\_level=1](http://afsic.nal.usda.gov/nal_display/index.php?info_center=2&tax_level=1)

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