

THE UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

2008

Environmental Report



THE



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Ivan Varlamoff



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Reflections along the Okefenokee swamp



Scott Angle

Dean and Director,
College of Agricultural
and Environmental Sciences

With only months of drinking water available in some north Georgia communities, the College of Agricultural and Environmental Sciences has shifted into high gear to help Georgians conserve this precious resource. Our Cooperative Extension specialists and agents are working throughout the state to assist farmers, gardeners, local governments, the food industry, homeowners and youths to learn to be better stewards of all natural resources.

Early in 2008, UGA Extension will introduce waterSmart, an indoor and outdoor water conservation program adopted by the Georgia Environmental Protection Division. The Center for Urban Agriculture is working closely with the green industry to help it cope with the outdoor water ban and keep this important industry viable.

We have stepped up our research and outreach programs at the Strippling Irrigation Research Park to help farmers make every drop count as they battle to keep their crops growing and profitable. And we are putting 25 years of research into action as our food scientists, economists and horticulturists find ways to recycle water in the poultry industry and in greenhouse operations.

Our scientists and extension agents also work to protect our water quality. In this report, our first watershed agent writes about the whirlwind year he had assisting communities in the Upper Oconee watershed with many water issues including stormwater management, water conservation and water quality concerns.

In the Chattooga River watershed, a four-year study showed that a leaky waste water treatment system and booming development are primarily responsible for fecal and sediment contamination in the streams. Poor farming practices were once falsely accused of being the cause. Also read about how CAES research showed southwest Georgia streams have low dissolved oxygen rates because of naturally occurring processes, not pollution.

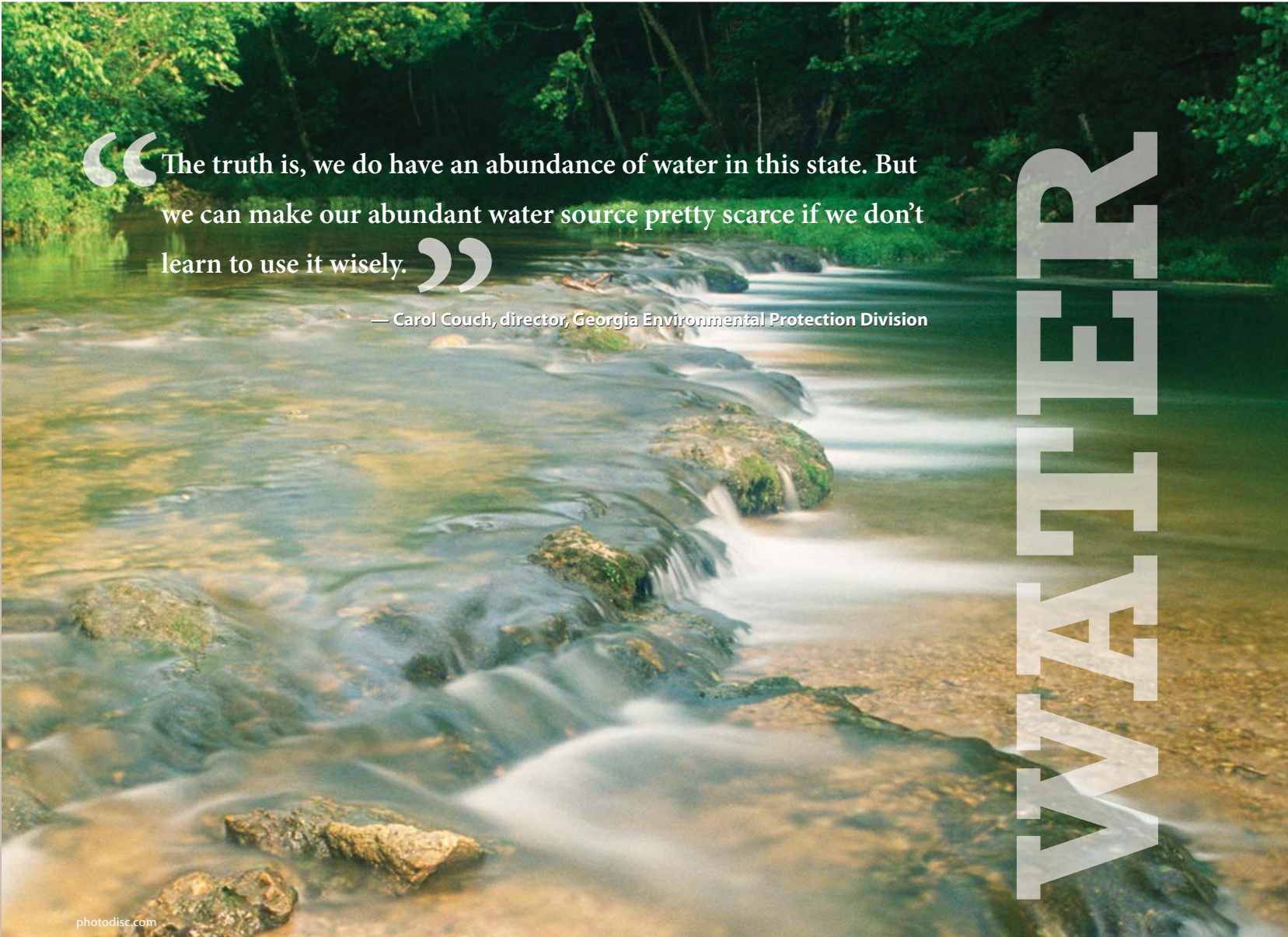
Climate change is capturing international headlines and fueling great scientific debate. An award-winning scientist on our faculty in Griffin is conducting pioneering research in carbon sequestration. Some of our engineers who have worked nearly 30 years to reduce greenhouse gases through biofuels research are today witnessing Georgia embracing this technology.

In addition, you will learn about the four CAES scientists who are part of a UGA team working with researchers at select institutions to develop a cost-effective method to produce cellulosic ethanol.

Food scientists here and around the world have growing concerns about the safety of our food supply. The public's interest in locally grown, organic produce is on the rise as a result. Responding to the need, we have added a certificate program for organic agriculture to the college's academic program.

While our repository of scientific research helps our growers stay competitive in the world market, we can't be productive without nature's help. We depend on honeybees to pollinate crops and fruit trees. The devastating colony collapse we saw last year is cause for concern. Our entomologists are doing all they can to find the heart of the problem and save our native bee population.

Although north Georgia has suffered in 2007 — from a late freeze that hit fruit crops hard to a relentless drought that gripped the region through the summer — there is a bright spot on the horizon. Georgia's burgeoning wine industry in north Georgia can help preserve farms and conserve land to produce quality vintages. Here's a toast to success.



“The truth is, we do have an abundance of water in this state. But we can make our abundant water source pretty scarce if we don’t learn to use it wisely.”

— Carol Couch, director, Georgia Environmental Protection Division

WATER

Helping local governments solve water problems

BY FRANK HENNING

The concept isn’t a hard one to get. We all need clean, abundant water.

The extreme drought in 2007 opened many Georgians’ eyes to the fact that our water supply is limited. Georgia Environmental Protection Division figures reveal that water use in Georgia expanded by more than 20 percent between 1990 and 2000. And demand continues to increase.

Water quality is also a concern. As of 2002, of the 11,285 miles of streams and rivers assessed in Georgia, the U.S. Environmental Protection Agency listed roughly 57 percent as impaired.

As Georgia’s population and economic development continue to expand, demands on water resources will likely increase. It would be a big challenge for most communities to maintain current levels of water use and water quality even five or 10 years from now. Trying to reduce demand and improve quality with even more faces, rooftops and industries is a much

greater challenge.

Along with growth, local governments must maintain the streams and rivers that flow through many political jurisdictions. Water doesn’t recognize boundaries. The rainfall and pollutants that enter in one region may affect communities many miles away.

Because of these challenges, UGA Cooperative Extension established the first watershed Extension agent position in 2006. Watershed agents work across county boundaries and focus on water issues in the entire watershed. The aim is to develop educational initiatives that address local needs and bring people in the watershed together to find solutions to help protect and restore water resources.

Using the Cooperative Extension model, counties in the Upper Oconee watershed contribute funds annually as a match for federal Clean Water Act Section 319 grant dollars. In return for their support, participating counties receive:



Photos provided by Frank Henning

Soque Watershed Coordinator Duncan Hughes (left) and Watershed Agent Frank Henning collect micro-invertebrates for the Master Naturalist training.

- Cost-effective watershed management solutions focused on meeting state and federal water quality regulations.
- Help identifying and procuring intergovernmental grants and cost-saving measures that address multicounty watershed issues.
- Current research data and information delivered to local governments.

A watershed agent can help address issues faced by county governments and serve as a clearinghouse for information on water conservation, including water-wise landscaping, water audit training and irrigation calibration.

For example, I worked with landscape management, public works and parks and recreation departments in Athens-Clarke County to install two moisture-sensor demonstration projects. One targets home landscape irrigation and the other government and industrial sites. Government officials,

irrigation contractors and homeowners will be instructed in using these sensors to improve irrigation efficiency.

Watershed agents also help address flood management issues. Adding impervious surfaces such as rooftops and driveways can change the quantity and timing of water movement and increase flooding.

We offer training on storm pond management, low-impact development, green roofs, impervious surfaces, stormwater management and training, hazardous waste and buffer education, and stream restoration and maintenance training.

In 30 one-day erosion and sediment classes, more than 1,500 contractors, developers, builders and landscapers learned to comply with local, state and federal erosion and sediment laws.

Assessments are critical for protecting drinking water supplies. The EPD requires assessments for NPDES wastewater

discharge and water withdrawal permit renewals. They may require ordinances, public input and participation.

UGA Extension can help implement the assessment, provide critical review and help local governments develop and implement technically and fiscally sound plans. We can help with associated water monitoring, public education, involvement and ordinance development.

A watershed agent can help address issues faced by county governments and serve as a clearinghouse for information on water conservation, including water-wise landscaping, water audit training and irrigation calibration.

Communities with more than 1,000 people per square mile and industries and developers that disturb more than an acre of land must comply with national NPDES stormwater regulations. We can help local governments improve public education, broaden public support and comply with illicit discharge regulations, and train government employees, builders and developers.

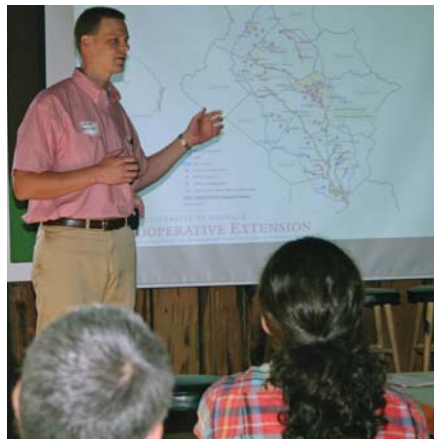
Programs available through your local Extension office will educate your citizens and help your county meet its Municipal Separate Storm Sewer System requirements for public education and public involvement.

Workshops and trainings on artificial wetlands, pond management, vegetation control, storm-pond management and others can help your county meet postconstruction stormwater requirements.

As part of a rain barrel project, UGA Extension's Watershed, 4-H and Master



Walton County agent William Carlan and Frank Henning install a rain barrel to collect air conditioning condensate at the Walton Recycling Center.



Frank Henning presents a watershed project to the regional Association of Natural Resource Extension Professionals meeting in Dalton.



Frank Henning installs a moisture sensor for an outdoor irrigation system to determine water conserved.

Gardener programs in Clarke, Barrow and Walton counties made more than 300 rain barrels. This community project is improving water use by helping convert 700,000 gallons of rooftop runoff each year into water for garden irrigation.

Georgia EPD tests state waters and lists them as supporting or not supporting their designated use (fishing, recreation, drinking). Waters that don't meet standards are listed as impaired and require a TMDL implementation plan.

UGA Extension can help local governments verify water quality problems, monitor and assess water bodies and identify pollution sources. If a local government needs to improve water quality, a watershed agent can help. Once

Workshops and trainings on artificial wetlands, pond management, vegetation control, storm-pond management and others can help your county meet postconstruction stormwater requirements.

improvements are made, UGA Extension can help the county remove a water body from the TMDL list.

An Extension watershed agent isn't the answer to all water woes in Georgia or even in a given county. But these trained educators can assist counties solve many problems they face now and in the future by helping with assessments and plans; educating citizens, leaders and industry; and providing useful solutions and prevention measures. ■

Frank Henning is the first Watershed Extension Agent located in the Upper Oconee watershed. He can be reached at fhenning@uga.edu.

Boosting water conservation programs for farmers

BY FAITH PEPPERS

The extreme, extended drought in 2007 added an exclamation point on the decades-long issue of water supply and use in Georgia. And despite occasional light rains throughout the summer and fall, there's no end in sight.

"Prolonged drought conditions coupled with unprecedented population growth in Georgia have accelerated and exacerbated the need for more water-use research and more far-reaching public education and outreach programs," said J. Scott Angle, dean and director of the University of Georgia College of Agricultural and Environmental Sciences.

For the week of July 9, state climatologist David Stooksbury said the Flint River was at or below the 10th percentile, with Bainbridge, Ga., at a record low for the date. In Albany, Ga., the Flint had less water than it does in 99 years out of 100. These critical figures follow record-setting daily low flow rates in June.

"Over the past decade, we have worked closely with agricultural producers to help monitor how much water Georgia agriculture uses and to find creative solutions to maintaining our vital crop production while decreasing demands on our limited water supply," Angle said. "However, we feel the time has come that we must renew and increase our efforts to help Georgia address this issue."

To begin the renewal effort, Angle announced an initiative in July focused on the college's Stripling Irrigation Research Park. The plan will help further address solutions to water-use problems and begin research that will help set the agenda for future usage decisions.

"In November 2000, C.M. Stripling gave 133 acres of his family's land just west of Camilla to the college to study irrigation," Angle said. "We have made tremendous progress in generating a body of irrigation research that is already benefiting the state." However, as the struggle to balance water supply and demand has intensified, Angle feels the college can do more to help.

"We are establishing three new positions at the facility to help us deliver more educational programs targeted to growers in the area," he said.

Water resource education is an integral element of the Stripling facility. The new effort, though, will help the center



Center pivot at Stripling Irrigation Park, Camilla, Ga., showcases water conservation technology.

Jay Oliver

focus more efforts on outreach to the community and local industry.

"Rad Yager, a former Mitchell County Extension agent and superintendent of the Stripling center, has done a tremendous job leading efforts at the center since its inception," Angle said. "We are now asking him to lead development of new education and outreach programs."

Yager will work at the Stripling station half time and assume a new role as a Dougherty County Extension agent half time, allowing him to work more directly with producers in the Flint River Basin area. Dougherty County is just north of Camilla on the Flint River.

"We will rely on Rad's strong background in Cooperative Extension programming and his familiarity with local agricultural issues to develop the type of

quality programs needed," said Beverly Sparks, CAES associate dean for extension.

A search is under way for candidates to fill the three new positions at the Stripling facility. They will support research programs that will provide the basis for future education and outreach programs.

"These new positions should put us on track to support numerous water-related research programs that are vital to the future of Georgia agriculture," said Bob Shulstad, CAES associate dean for research.

"Having an ample water supply, a sustainable water conservation-and-use plan and strong research and education programs to help us all make wiser decisions about how we use water in the future are vital to the prosperity of Georgia and the agriculture industry," Angle said. "We want to make sure that the college is doing all it can to help us maintain and preserve our water resources."

The rest, however, depends on nature. ■

Faith Peppers is a news editor for the University of Georgia College of Agricultural and Environmental Sciences.

For more information, visit Stripling Irrigation Research Park at www.nespal.org/SIRP.

Recycling water in the poultry industry

BY SUSAN M. VARLAMOFF

Water use is a chronic problem in the poultry industry, the state's single largest agricultural industry. Each year 8.7 billion chickens are processed with an average of 7 gallons of water each.

Stricter federal regulations passed in 2000 to ensure meat is as pathogen free as possible increased the industry's water use by 29 percent. As a result many Georgia communities are straining to provide water for processing and capacity to treat contaminated discharge. Also, the drought gripping north Georgia has prompted mandatory water restrictions and requests for voluntary cuts in water use by 10 percent.

In 2003, food scientist Rakesh Singh and applied economist Jack Houston responded by looking for ways to reduce water use and the volume of wastewater discharged to local treatment facilities. Pilgrims Pride of Athens allowed their plant to be used for a pilot project. Food PAC provided funding.

"One of the main movers to recycle water was the high wastewater surcharges many companies were facing in their communities," Singh said. Processing poultry produces wastewater with high levels of contaminants such as fats, grease and microbes that violate water quality standards. Treating the water to comply with regulations is costly.

After examining all the processes in a poultry facility, the researchers decided that recycling chiller water made the most sense, saving both water and money. An additional bonus was reducing the energy needed to chill the water.

About 10 percent of the water used during poultry processing is chiller water. After the birds are plucked and eviscerated, they are cooled in a water bath. Rapidly cooling the carcasses from about 70 degrees to 40 degrees Fahrenheit minimizes microbial growth and preserves product quality.

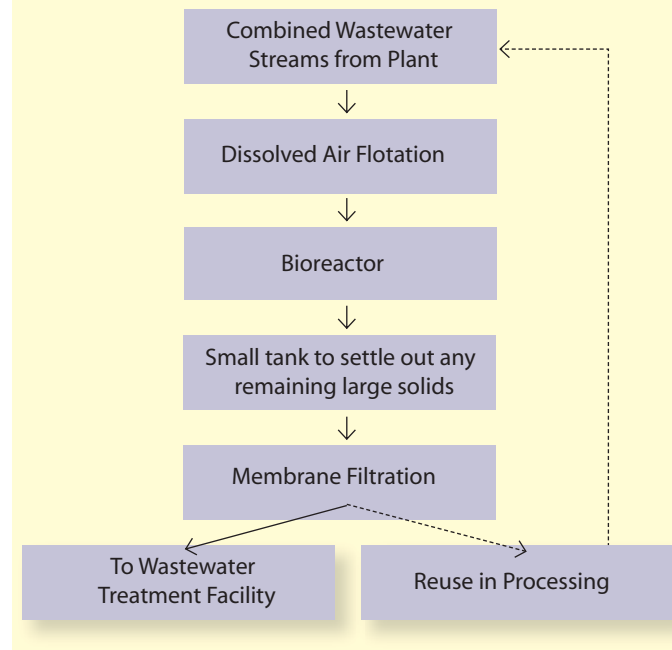
Most poultry plants use two chilling tanks – a pre-chiller and a main chiller. Water continually overflows from the pre-chiller into the main chiller to remove body heat from the chicken. A large, well-run plant might have a daily overflow of about 250,000 liters of chiller water.

The researchers used a very finely pored ultrafiltration membrane to remove microbes, fats and grease from chiller water as it overflowed into the second tank. This technology requires little energy and works without adding chemicals. Initial results showed nearly 50 percent of the water could be recycled and meet the sanitary regulations which require a 60 percent reduction in microorganisms.

"Ultrafiltration was almost too good," Houston said. "It removed so much (material) that it interrupted the process." To periodically unclog the membrane, the filtration unit was back flushed for two minutes every hour. Every 8 hours, the unit was cleaned with a solution for two minutes.

The estimated annual savings of recycling chiller in the pilot test was \$160,000 and 250,000 liters per day. The economic savings were attributed to 14 percent from reduced energy use, 27 percent from water savings, and 59 percent from averted waste water treatment costs.

Flow Chart of Water Treatment



"Recycling water in poultry processing is significant to local municipalities, state governments and stressed watersheds," Houston said. "And the company benefits by reducing the amount of water brought to the plant, reducing the cost for treating waste water and reducing electrical and chemical use."

After perfecting this recycling process and gaining acceptance from the U.S.D.A., the poultry industry issued another call for help. "The plant people said chiller water is still small, let's look at the total plant," said Singh.

The next phase of the project consisted of developing a bioreactor that could treat the plant waste water inhouse. Pilgrim's Pride again volunteered their facility. Company officials had managed to reduce the amount of water they used for each bird from 7 to 5 gallons and now were interested in reducing it further. They also wanted to avoid the costs of sending the waste water to a local treatment facility.

A membrane bioreactor was installed to filter the solids and clarify the water. "We got the bacteria from the local waste water treatment plant to seed the reactor," Singh said. Then the waste underwent biological degradation.

After researching different strategies, the water from the reactor was clean enough to reuse in the facility to clean the floors. By installing a bioreactor, the company could reduce their water per bird to 3-3.5 gallons and avoid the costs for treating the wastewater. ■

Susan Varlamoff is the director for the University of Georgia College of Agricultural and Environmental Sciences Office of Environmental Sciences.

Low dissolved oxygen in rivers — a summertime phenomenon

STORY AND PHOTOS BY GEORGE VELLIDIS

We depend on clean water for daily life around our homes, for farming and for manufacturing. We also value it for recreational activities such as fishing, boating and enjoying the outdoors. However, these activities can impair the health of streams and rivers for people living nearby that rely on them. That's why government agencies began monitoring the quality of our nation's waterways in the late 1800s.

In 1972, Congress passed the Clean Water Act – legislation requiring that all the nation's waters be safe for fishing and swimming and clean enough to sustain healthy aquatic plant and animal



Ph.D. student Jason Todd retrieves water samples from an automated sampler installed within the Little River near Tifton. The samples are analyzed for a dye tracer that provides an understanding of how water flows through large in-stream swamps in the Coastal Plain.



A water quality sensor shows a dissolved oxygen concentration of 2.39 mg/L in an Alapaha River tributary in early April. The Georgia standard for dissolved oxygen is a minimum of 4 mg/L.

life. The law requires each state to establish water quality standards for surface water – the maximum amount of various pollutants that a water body can tolerate without jeopardizing the health of the aquatic ecosystem. Waters that do not meet these standards must be brought up to standards by reducing sources of pollution.

Aquatic organisms require oxygen, which they take in a dissolved form (DO) from the water. DO levels in a river can affect the types of animals found there and the way the river functions.

If DO levels get too low, certain species of fish can't survive. So, states also have established standards for the minimum level of acceptable DO. In general, all fresh waters in Georgia

have the same DO standard. Only trout streams have higher standards.

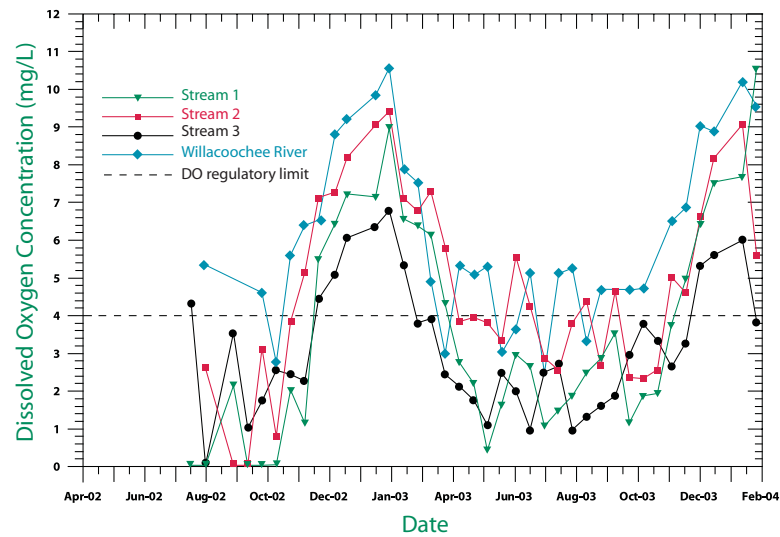
The majority of the smaller rivers and practically all the streams in Georgia's coastal plain have low DO during spring, summer and fall, violating Georgia's water quality standards. By law, these rivers and streams must be managed to comply with water quality standards. But regulators and scientists don't yet completely understand the causes of low DO in this area.

Slow-moving, dark, tea-colored rivers characterize the coastal plain – conditions ideal for naturally occurring low DO. The region is also the most intensively farmed region in Georgia. It's not clear if low DO conditions are a natural phenomenon or a result of human activity.

To better understand this problem, a team of agricultural scientists, ecologists and graduate students from the University of Georgia and the U.S. Department of Agriculture undertook a project designed to understand the complex processes that determine DO levels in the coastal plain.

We have come to understand that natural and human activities can affect the dissolved oxygen level in a river. Natural conditions such as high temperatures, large amounts

Dissolved Oxygen in the Willacoochee Watershed



Dissolved oxygen concentrations are consistently below the 4 mg/L standard during summer months in most of Georgia's Coastal Plain rivers and streams as shown in these data from four different streams and rivers in the Willacoochee River watershed.

of leaves and woody debris from nearby forests and an absence of waterfalls or riffles to aerate the water can reduce DO concentrations.

Nitrogen and phosphorus added to rivers from point sources such as wastewater treatment facilities or from non-point sources such as runoff from agricultural or urban areas provide nutrients for algae in streams and rivers. As algae complete their life cycle and die, they become a food source for bacteria that consume oxygen as they decompose the algae. Large populations of bacteria feeding on algae are able to use all the oxygen available in water. This leads to the death of other aquatic organisms such as fish, often referred to as a fish kill in the popular media.

Ultimately, the team hopes to understand these complex

processes enough so that they can simulate them with mathematical models. These models will let scientists and decision makers evaluate the causes of low DO in individual rivers and streams without spending years collecting data.

Anna Cathey, a CAES biological and agricultural engineering graduate, applied one of these models to approximately 25 miles of the Little River that begins near Ashburn and flows into the Willacoochee River near Valdosta. Her work identified many of the individual processes the team must understand better to meet their goals.

To fill information gaps, several studies are being conducted concurrently. Ecology student Richard Carey recently found that several of the streams contained nutrient levels that could lead to excessive algal growth. However, he also discovered that forests shading coastal plain streams exclude light and limit the growth of algae.

To further understand the role of streamside forests, Andrew Mehring, a doctoral ecology student, is studying tree leaf decomposition and its effects on DO levels. When tree leaves and wood drop into the water from streamside forests, bacteria and fungi feed on them and consume oxygen in the process as they do when feeding on dead algae. This natural source of oxygen demand can lower DO levels in streams and rivers.

Graduate engineering and ecology students Barb Crompton and Jason Todd have evaluated the importance of DO consumption by biological and chemical processes that take place in the river bottom as well as the role played by in-stream swamps which dramatically reduce the flow rate of the water. In the end, the team hopes to help environmental decision makers establish DO standards reflecting the natural conditions of the coastal plain. ■



M.S. student Richard Carey installs a passive diffusion periphytometer in a tributary of the Satilla River to determine if the stream contains enough nutrients to promote algae growth.

George Vellidis, is a professor and coordinator of research, extension and instruction — Tifton campus biological & agricultural engineering department.

Assessing pollution sources in the Chattooga River

BY SUSAN VARLAMOFF

People who live in the Chattooga River watershed in northeast Georgia may have had mixed feelings when their river became the setting for the 1972 movie “Deliverance.” But probably no one was happy when the river became part of a national precedent-setting court case.

In 1999, several environmental groups successfully sued the Georgia Environmental Protection Division under the Clean Water Act to require Georgia’s polluted streams, including several flowing into the Chattooga, to meet water quality standards.

Of the streams in the watershed, 32 miles are contaminated with fecal coliform bacteria and sediment. These pollutants can cause illness in both humans and aquatic creatures. The water is often unfit for drinking or recreation.

Fecal contamination can come from many sources such as leaking septic and wastewater treatment systems and wild or domestic animals. Sediment in streams may alter the habitat and reduce aquatic biodiversity. It usually enters the stream from nearby construction sites, deforested land or unpaved roads.

Congress designated the Chattooga River a wild and scenic river in 1974. It’s an economic engine for Rabun County, drawing people from around the region for whitewater rafting, boating, fishing, hiking and camping. The rolling hills are dotted with farms and vineyards. The Chattahoochee National Forest attracts tourists to explore the Appalachian Trail as it winds its way through hardwood trees populated with black bear, deer, bobcat and foxes. Many retirees and city dwellers longing for a breath of fresh mountain air are building homes in Rabun County, causing a population boom.

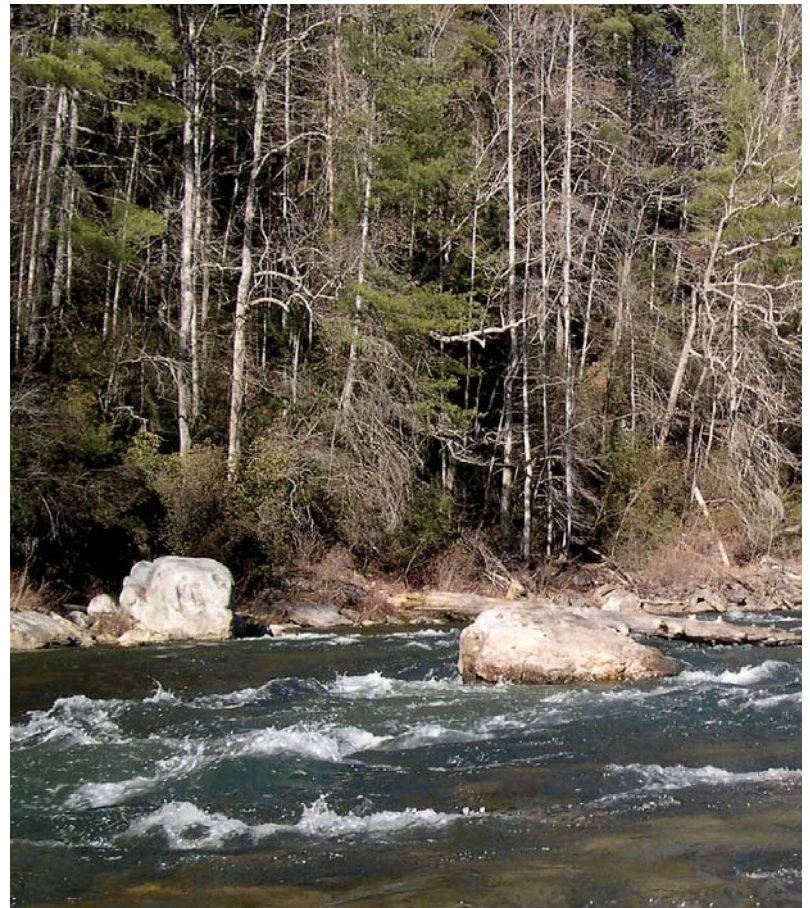
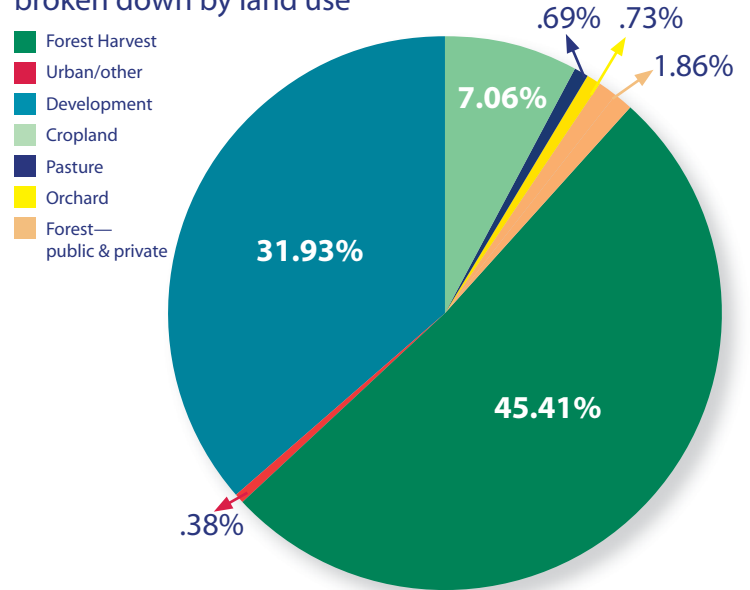
In 1999, local citizens became concerned about the impact contaminated streams can have on the recreation industry. They turned to experts with the Natural Resources Conservation Service and UGA’s College of Agricultural and Environmental Sciences for help.

Early modeling studies conducted by the Georgia Environmental Protection Division estimated that 85 percent of the water quality impairments stemmed from agriculture-related activities. Suspected sources were cattle depositing fecal matter as they crossed the streams and sediment eroding from the banks. Rainfall washing nutrients off farmlands that had been fertilized with manure was also noted as a possible source.

Jimmy Bramblett, NRCS water resources specialist, invited CAES researchers to help develop a watershed assessment for the Chattooga River Watershed with funding from a U.S. Environmental Protection Agency 319(h) grant. The grant aimed to more accurately determine the sources of the pollution.

Over the next four years, NRCS and CAES conducted the watershed assessment with help from, among others, the U.S.

Percent of Total Erosion in Chattooga Watershed broken down by land use



Forest Service, Georgia Forestry Commission, City of Clayton, Stekoa Creek Steering Committee, Blue Ridge Mountain Soil and Water Conservation District, U.S. Department of Agriculture Farm Services Agency, Georgia Department of Natural Resources and UGA Cooperative Extension.

They surveyed local farmers to see how they managed livestock and crops, conducted modeling studies, walked the streams to look for obvious contamination sources and held public hearings. The long process revealed that farmers had little impact on the watershed.

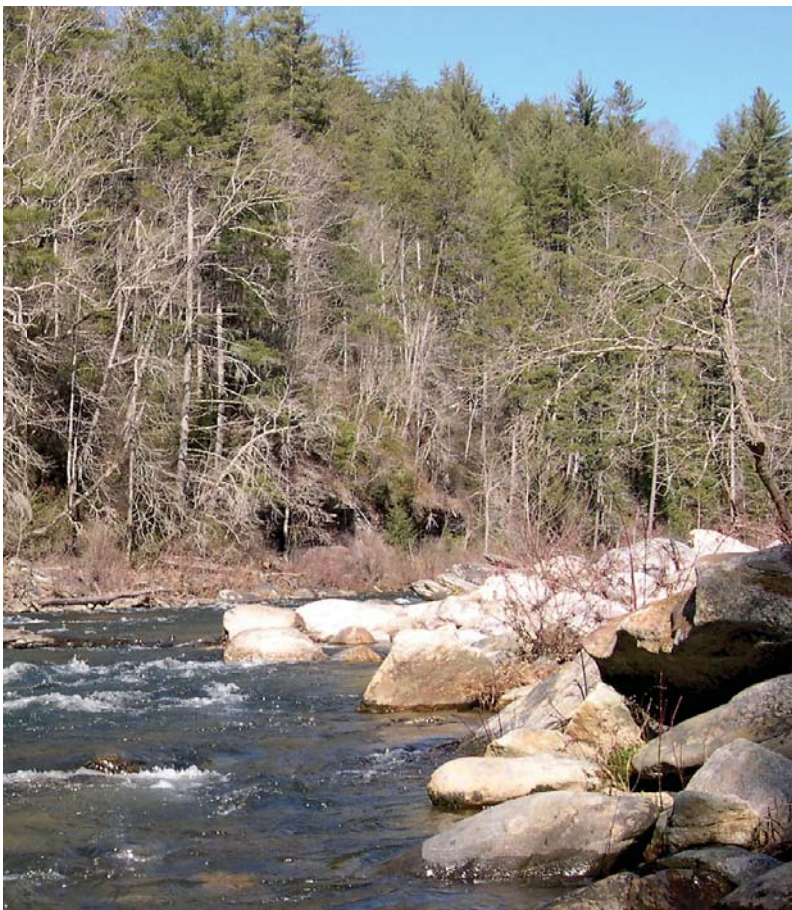
The study led to some surprising discoveries. A land-use inventory showed that 96 percent of the land is forested. Only 3 percent is used for agriculture.

With the local forest industry dying and development on the rise, private forest land is being converted into subdivisions and shopping malls. In the process, sediment from construction activity is washing into nearby streams. During the heyday of gold mining and logging from the early 1830s to

Land Cover in the Chattooga Watershed

Land Cover	Acres	Percent
Cropland	849	0.34
Pasture	5,623	2.27
Grazed Woodland	650	0.26
Forest – private	78,061	31.45
Forest – public	152,053	61.26
Forest – harvest	7,096	2.86
Wetlands	88	0.04
Open Water	871	0.35
Urban	1,781	0.72
Other Lands	1,156	0.47
TOTAL	248,228	100

Chattooga River located in Rabun County



Ivan Varlamoff

the late 1840s, dirt roads were built close to streams, releasing sediment into them.

After walking the streams and monitoring them for fecal coliform, the local watershed group noticed that the collection system for the City of Clayton’s wastewater treatment facility was leaking. The outdated collection system was releasing fecal matter into Stekoa Creek, a tributary of the Chattooga. According to local sources, when one leak is fixed, another one springs open. The facility is overtaxed and not big enough to treat the current population’s waste. It needs major repair.

The local NRCS representative continues to work with farmers in the area to set up best management practices to correct any problems that may cause future water pollution. The City of Clayton has received grant funding from the EPD to determine where septic systems are leaking and educating developers and builders about erosion and sediment control practices. In addition, city officials are trying to secure funding from Georgia Facilities Authority to repair or rebuild the waste water treatment facility.

“Water in a mountain community is expected to be clean and that is what we are working toward,” said Scott Dills, City of Clayton marshal. “We have to clean up Stekoa Creek so people can enjoy it. Tourism is the backbone of this community.” ■

Susan Varlamoff is the director for the University of Georgia College of Agricultural and Environmental Sciences Office of Environmental Sciences.

Constructed wetlands remove pollutants

STORY AND PHOTOS BY ELIZABETH LITTLE

The Orange Trail watershed on the State Botanical Garden of Georgia's property has long served as an open-air classroom and laboratory for environmental studies. In April 2004, members of the Upper Oconee Watershed Network (UOWN), a nonprofit watershed group, found high levels of nitrates in one of the streams. Further investigations by Dave Wenner, a retired UGA geology professor and UOWN volunteer, found high nitrate levels at the origins of several streams. The suspected source was contamination from nearby swine and poultry facilities.

The UGA animal research farms have been on South Milledge Avenue near the Botanical Garden for 50 years. The outdated facilities will soon be moved to the new UGA CAES Double Bridges Farm in Oglethorpe County. Animal waste at the new facility will be recycled and reused using modern technologies. However, waste in the original facility was managed using a combination of anaerobic lagoons and spray applications onto fields. Both can contribute to groundwater contamination.

In fall 2004, CAES funded a project led by David Radcliffe, professor of crop and soil sciences, to trace the source of the high nitrate levels in the groundwater. After extensively testing the well and surface water, Radcliffe found that the contamination came from the fields near the poultry and swine farms and from at least one of the swine waste lagoons.

The nitrate levels don't directly endanger humans. But high nitrate and phosphate levels can contribute to downstream eutrophication, resulting in algal blooms and low oxygen levels. Therefore, CAES funded a second project in 2006 to enhance the wetland at the bottom of the watershed to capture and treat the nutrients before they reached the river.

Constructed and natural wetlands function as natural filters to help maintain water quality in rivers, lakes and streams. They can remove 70 percent or more of the nitrates and other excess nutrients in water. They're also valued for their ability to absorb floods, provide wildlife habitat and enhance humans' quality of life. The Orange Trail wetland project was a response to long-term impacts of nutrients from the farms along South Milledge Avenue, but the wetland will also increase wildlife diversity and add recreational and educational opportunities at the Botanical Garden.

In June 2007, a team of UGA faculty members, students, staff and physical-plant employees built a water-regulation device at the outlet from the wetland. The concrete structure raised the level of the wetland by several feet, providing enough surface to allow for denitrification as the water moves slowly through it. The low-oxygen conditions in wetlands, combined with aquatic plants that use nitrates for growth, enhance the denitrification process.



(Top) The wetland before it was enhanced to remove contaminants from water entering the area. (Bottom) The constructed wetland that will be used as an instructional resource for UGA students in water resource classes.

Future investigations will track the nitrate levels in the streams and groundwater above the wetland. Once the swine facility has been moved and all active sources of contamination removed, measuring the ground and surface nutrient levels over time will provide valuable information that can be used when making waste-management decisions in other watersheds.

CAES will plant native vegetation in and around the wetland to enhance wetland function and quality of the wildlife habitat. The National Audubon Society designates the Botanical Garden as an important birding area, and the wetland area has long been a favorite spot for bird watchers. Other viewing areas are planned on the ridge above the wetland and streams.

Botanical Garden signs, literature and programs will help visitors become more aware of the important role wetlands play in improving water quality. The wetland will also be an instructional and research resource for students in water-resource courses at UGA. ■

Co-investigators for the wetland project are Elizabeth Little, plant pathology; Mark Risse, biological and agricultural engineering; and Valentine Nzengung, UGA geology department.

For more information, contact Elizabeth Little at elittle@uga.edu.

Cutting greenhouse water use in half

BY STEPHANIE SCHUPSKA

The well could eventually run dry. The water from a city main could stop flowing. As Georgia's population keeps increasing — up more than 25 percent from 1990's numbers — so does the demand for water. A University of Georgia professor is looking for ways to preserve this resource.

Marc van Iersel, a horticulture professor in the UGA College of Agricultural and Environmental Sciences, focuses on managing greenhouse irrigation. For growers who use thousands of gallons of water a day, controlling their irrigation can be critical. And van Iersel is researching ways to make it easier.

"We're putting plants in charge of their own irrigation," he said.

In his greenhouse, a soil-moisture sensor placed in each of 16 test containers sends a signal to an irrigation system when the moisture drops below a certain level. Later, he and fellow researchers can translate these numbers to advise growers of the best amount of water to use.

"That way, we can water plants based on the amount they really need," he said.

Stephanie Schupska



Marc van Iersel uses a two-prong soil moisture sensor at his lab in Athens, Ga. A charge is sent between the prongs, allowing the sensor to send data to his computer, telling it when a plant needs more water.

Growers commonly test a plant's water needs by the finger-poke method or by irrigating on a timer. Neither technique is very precise. Van Iersel figures growers could save up to 50 percent of irrigation water by using an automated approach like the one he's researching.

"One greenhouse in Georgia spent \$50,000 a year on electricity to pump water on plants," van Iersel said. "It takes a lot of power because water is heavy."

Using less water would significantly increase greenhouse growers' profits. And as new greenhouses open and older ones expand to meet homeowners' and businesses' needs, the water supply available to them is subject to increasing demand.

"We need to learn to use water as efficiently as possible," van Iersel said. "As long as the state keeps growing, the urban areas will get all the water they want, leaving less for the rest of the state."

Georgia really doesn't have enough water to support both the growing population and agricultural industries, he said.

Another water concern specific to greenhouses is runoff. When growers irrigate, they feed their plants through fertilizer added to the water. If they use more water than needed, the fertilized water runs out of containers and eventually onto the ground. Over time, the U.S. Environmental Protection Agency will tighten its restrictions to prevent environmental impact. For greenhouse growers, keeping water in the pots could help meet these standards.

The system van Iersel has developed isn't complicated. "We can always use a really fancy system to do our research. But I'm more interested in doing something that can be used by growers," he said. "We're really close to being able to implement this approach. Seeing that this system will make it to the greenhouse industry in the next few years makes it exciting."

In the future, the system may have even broader applications. "People can use it anywhere they water," he said. "With lawn irrigation, specifically, if someone used a system like this, it could put them in compliance with state water restriction standards. Homeowners are often the worst offenders."

Van Iersel has been working with Brower Electronics Laboratories to develop an irrigation controller as an add-on to existing irrigation systems that can be automated through current computer programs. ■

Stephanie Schupska is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

For more information, contact Marc van Iersel at mvanier@uga.edu.

LAND

“Today we are faced with a challenge that calls for a shift in our thinking, so that humanity stops threatening its life-support system. We are called to assist the Earth to heal her wounds and in the process heal our own.”

— Nobel Lecture by Wangari Maathai, Founder of the Greenbelt Movement, 2004

Photos provided by Robert Tate

UGA adds organic agriculture certificate program

BY STEPHANIE SCHUPSKA

Sales of organic foods have exploded, moving the industry from a niche market to a nationwide phenomenon. In 1989, organic foods accounted for \$1.25 billion in U.S. sales. By 2005, that number had jumped to \$14 billion.

This booming industry needs a steady stream of skilled, educated workers like Erica Mehan. Mehan has graduated from the University of Georgia, but wanted a few more classes before entering the job market. She plans to work toward a certificate in organic agriculture, a UGA College of Agricultural and Environmental Sciences program that started in the fall of 2007.

Before changing her major to horticulture, Mehan was studying sculpture. “I took a course in sustainable agriculture that resonated within me so deeply that I began to plot my future with agriculture as the foundation,” Mehan said of her dramatic shift.

Organic farming is growing between 15 percent and 25 percent a year, said Alice Rolls, executive director of Georgia Organics. Food businesses typically grow 2 percent to 3 percent annually.

“Go to Kroger or Wal-Mart and see how many products



Horticulture farm project coordinator Robert Tate displays a harvest of ‘Provider’ bush beans. The seeds were inoculated with a specific rhizobacterium that fix nitrogen, enhancing the yield of bean plants.

they now offer that mention organic,” said CAES horticulturist David Berle. “Students are interested in this subject for many reasons and need somewhere on campus to get science-based information.”

The UGA certificate will work like a minor program. Students with majors in science-related fields or who have completed enough science classes can tack this certificate onto their course of study. To earn it, students must complete a research project and classes such as organic agricultural systems, said Emillie Skinner, a UGA horticulture research technician. She and CAES horticulturist Marc van Iersel are helping launch the program. “A lot of students are really interested in organic agriculture,” van Iersel said. “And until now, they haven’t had the chance to study it here.”

The CAES plant pathology, agricultural and applied economics, crop and soil sciences, agricultural and biological engineering, animal and dairy sciences, poultry science and entomology departments all add to the program, as does UGA’s Odum School of Ecology. The Franklin College of Arts and Sciences also contributes through its anthropology department.



Horticulture Graduate Student Association marketed organic produce from the Organic Certificate Program at a local farmers' market in Comer, GA. It was a big hit with the public who enjoyed interacting with the students at the market.



Horticulture Research Farm manager Ryan McNeil (in front of wheelbarrow) and undergraduates came out on a Sunday afternoon in October to help plant elephant garlic and three other varieties of garlic which will all be harvested in June 2008.

Ecology professor Carl Jordan has been teaching a summer-semester organic agriculture class for several years. "My class generally is filled up by March," he said. "And by April, I begin turning away applicants for the course."

Before the UGA program starts up in the fall, the only option students had for studying organic agriculture was to transfer to schools like the University of California at Davis, North Carolina State and Colorado State. UGA's program differs from the others because it's the only one that teaches

students about the unique problems affecting Georgia agriculture such as the state's humid climate, which intensifies pest and disease pressures.

The certificate program is two-fold. In addition to teaching students about organic agriculture, the students' coursework includes conducting research that could benefit Georgia growers. Students and researchers grow plants organically and conventionally in the same greenhouses and then compare them for nutrients, growing practices and other factors. Growing more organic vegetables may be a way for Georgia growers to receive a premium for their products.

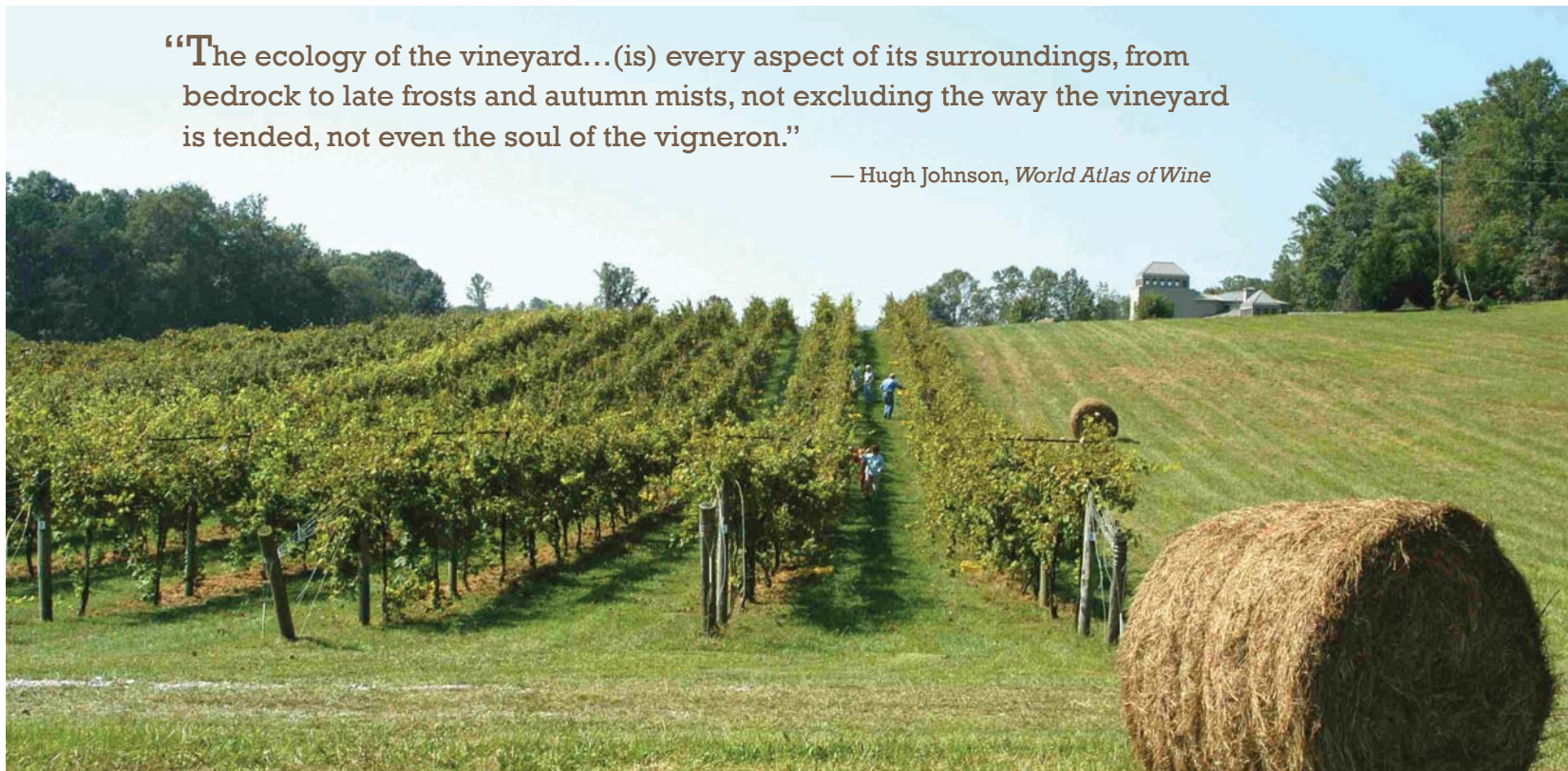
"The principles of organic agriculture such as reducing inputs, reducing environmental impact and adding value to agricultural products are something we work on every day with all our clients," said Mike Lacy, CAES poultry science department head. The college has "contributed more in this area than the general public knows. Bringing research-based knowledge to this area will benefit consumers and farmers." ■

Stephanie Schupska is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

For more information visit <http://www.uga.edu/organic>.

“The ecology of the vineyard... (is) every aspect of its surroundings, from bedrock to late frosts and autumn mists, not excluding the way the vineyard is tended, not even the soul of the vigneron.”

— Hugh Johnson, *World Atlas of Wine*



Grape growers conserve land

TEXT AND PHOTOS PROVIDED BY MARTHA M. EZZARD

Renown wine expert Hugh Johnson would be proud of grape growers (vignerons) like my husband, John, whose passion for saving a five-generation-old family farm led him to plant European wine grapes in Rabun County in 1995. Our special piece of earth, 100 acres at Tiger Mountain, has been part of John's soul ever since he grew up milking cows on the Arrendale-Ezzard dairy farm.

John and I are hardly the only grape growers who care about the preservation of historic farmland. In 2000, our Tiger Mountain Vineyards winery partners, Bill and Leckie Stack, transformed part of their nearby apple orchard into a vineyard.

Today there are nine members of the Winegrowers Association of Georgia and approximately 250 acres of mostly European vinifera and hybrids thriving in vineyards that stretch from the Dahlonega Plateau to Habersham and Rabun counties. It's no wonder. The ancient soils of the Appalachians, largely decayed granite, are about as close to those of the wine regions of France as you can get in the eastern United States.

The acres of north Georgia wine grapes represent only a small portion of rolling farmland and green space being preserved by this thriving new agricultural industry. Second home development encroaching on pastoral mountain vistas is, in itself, a plug for crucial land and water conservation.

Irrigation is rarely a factor for grape farmers in our region.

We covet a drought year like 2007 when vines must struggle deep in the ground to get water, resulting in high quality grapes, intense juice and a potentially outstanding vintage. Most years are not like '07, of course, and too much rain and humidity can result in leaf disease, specifically downy mildew. In addition, wine growers face the annual July onslaught of Japanese beetles that can make lace of leaves overnight. The beetle is a special challenge to those of us who would like to move toward more organic growing practices.

According to Phil Brannen, UGA Cooperative Extension fruit disease specialist, that will be tough in our environment. But he suggests new treatments with ProPhyates, rather than more harmful fungicides, may help fight mildews. In addition, a lesson we can take from biodynamic growing being pursued in arid regions of Europe and the west coast is the using more organic materials to build up soils in place of artificial fertilizers.

One of our early decisions was to plant grape varieties that seemed the most compatible with a southeastern terroir — climate, geology and soils. We didn't want to compete with Napa Valley style wines, rather to be unique. John consulted a Virginia vintner, Dennis Horton, who had experimented with unusual French and Portuguese varieties. On Horton's advice, we also planted the American Norton (known also as

Cynthiana) grown during the time of Thomas Jefferson and brought back by to prominence in Virginia about 25 years ago. Norton, cultivated by several Georgia growers, doesn't have to be grafted onto American rootstock as do vinifera, so we rooted ours in a high school greenhouse from cuttings we gathered from Horton's winter prunings. Ever since, we have enjoyed beautiful native grapes that make a fruity dry red wine and are more disease resistant than the European ones.

The vinifera John chose for our vineyard are Cabernet Franc, Malbec, Tannat, Touriga Nacional, Tinta Cao, Mourvedre, Viognier and Petit Manseng.

As wine growers, if we could make one wish for the future it would be for a viticulture and enology program at the UGA College of Agriculture and Environmental Sciences. That is no



John Ezzard's grandfather, John V. Arrendale, pictured with his wife Tallulah, was in the first graduating class from the College of Agriculture at the University of Georgia.

longer a pipe dream. Under the leadership of Dean Scott Angle, the first viticulture course will be taught abroad in the university's facility in Cortona, Italy, next May. In cooperation with the winegrowers association, there is also a new student internship program. In addition, a fundraiser to support an enology chair with private donations will take place next September in Atlanta.

Above all, fine wine growers are farmers and conservationists, and for Georgia, that is an exciting new chapter in a proud agricultural tradition. ■

Martha Ezzard is a former environmental columnist for the Atlanta Journal Constitution and co-owner of Tiger Mountain Vineyards.

For more information, visit www.tigerwine.com

Today there are nine members of the Winegrowers Association of Georgia and approximately 250 acres of mostly European vinifera and hybrids thriving in scenic mountain vineyards that stretch from the Dahlonega Plateau to Habersham and Rabun counties.

Ivan Varlamoff



(Left) Susan Varlamoff enjoys a glass of wine in the Ezzard's vineyard. (Right) John Ezzard's grandfather built this red barn about 65 years ago. Recently redone, it is now a familiar landmark.

Imported foods cause for concern

BY SHARON OMAHEN

A University of Georgia expert says the challenges in ensuring a safe U.S. food supply will continue to grow to unprecedented heights unless solutions are provided quickly.

“Although most foods Americans eat are safe, with odds of greater than one in a million of becoming hospitalized from a serving of food, the dynamics of the U.S. food system are rapidly changing,” said Michael Doyle, director of the UGA Center for Food Safety. “Consumers are much more vulnerable now to large episodes of foodborne illnesses.”

Hundreds of illnesses from contaminated spinach, lettuce, tomatoes and even peanut butter have made U.S. newspaper headlines in recent months. Other reports tell of tainted shellfish, pet food and a variety of foods and food ingredients imported from countries such as China.

“There will likely be major increases in the occurrence and size of foodborne illnesses with increased U.S. food imports from countries in which risky food production, harvesting and processing practices exist.”

— Michael Doyle

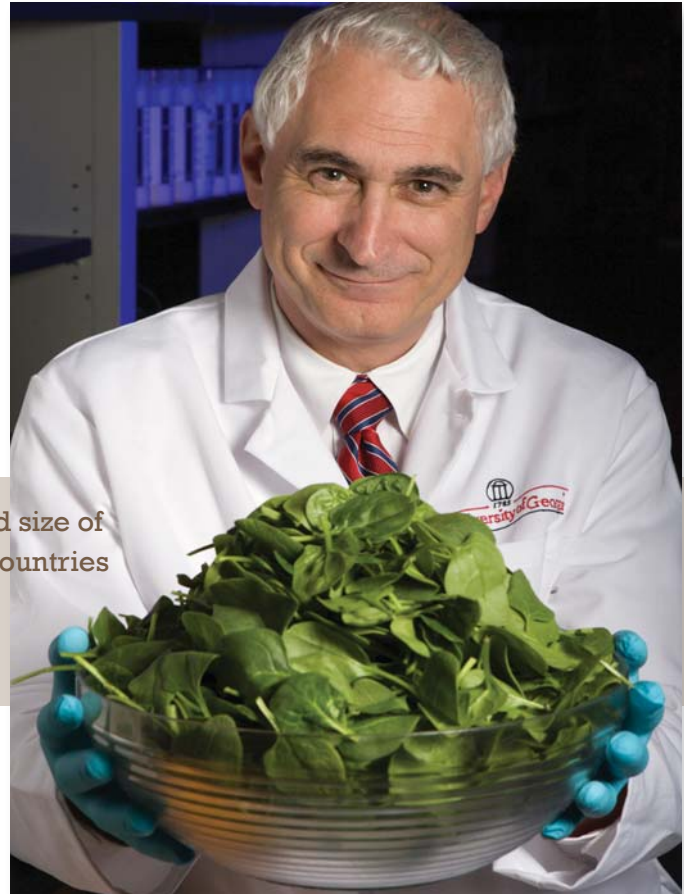
Imported foods and inadequate testing methods at U.S. ports are significantly affecting the safety of America’s food, and 15 percent of the food Americans eat is imported from other countries. “That may sound like a small amount,” Doyle said. “But it represents 80 percent of the seafood and 45 percent of the fresh fruit consumed in the U.S.”

The problem isn’t where the food comes from, but how it’s grown or processed before it reaches American soil. “The centuries-old tradition of using human excreta on farmland is widespread in East Asia, especially in China and Vietnam,” Doyle said. “And unsanitary polluted water is used in production and processing. The result of these practices is contamination by harmful microbes such as Salmonella.”

Imported food also comes from Asian countries where growers are allowed to use pesticides banned by the U.S. “They’re not only using these pesticides, they’re using them in excessive levels,” Doyle said. “This leads to residue contamination in foods.”

The solution to problems surrounding imported foods, Doyle said, lies in the hands of food producers, processors and such regulatory agencies as the U.S. Food and Drug Administration. “Solutions to today’s food safety issues will not come easy,” he said. “They will require a major research commitment to developing state-of-the-science methods to detect, control and eliminate harmful substances in foods.

“The food industry, whether it be growers, manufacturers or distributors, is responsible for providing safe foods,” he said. “And regulatory agencies need more rapid and robust



Rick O'Quinn

UGA expert Michael Doyle says for the safety of the American food supply, Congress needs to take a close look at imported foods from foreign countries.

sampling and detection methods to verify that foods, especially those that are imported, are safe from harmful microbes and chemicals.”

The percentage of food imported into the U.S. doubles about every 10 years. At this rate, the U.S. will be a “net food-importing country within 20 years,” Doyle said. “There will likely be major increases in the occurrence and size of foodborne illnesses with increased U.S. food imports from countries in which risky food production, harvesting and processing practices exist.”

“Considering the dramatic changes occurring in our sources of food and the weaknesses present in our current food safety system, Congress needs to step up its funding of research to ensure the safety of the U.S. food supply. The longer we must wait for solutions, the more challenging it will be to make effective corrective actions.” ■

Sharon Omahen is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

Organic produce purchased by all income levels

BY STEPHANIE SCHUPSKA

When organic produce flies off the grocery store shelf, it's not necessarily the upper class doing the picking. In fact, in a recent study, University of Georgia professor Chung-Liang Huang found that income seems to have little effect on organic produce purchases.

Huang should know. An agricultural and applied economics professor in the UGA College of Agricultural and Environmental Sciences, he began studying organic produce trends in 1989. At that time, only 3 percent of U.S. produce was certified organic, accounting for \$1.25 billion in sales. By 2005, sales had jumped to \$14 billion.

"I think we do have a preconceived notion that it's the wealthy, better-educated consumer that would buy organic," he said. "The perception is just that: a perception. Looking at the data, it doesn't show that kind of stereotype. The data shows that the consumers are very diverse."



"I think we do have a preconceived notion that it's the wealthy, better-educated consumer that would buy organic. The perception is just that: a perception. Looking at the data, it doesn't show that kind of stereotype. The data shows that the consumers are very diverse."

— Chung-Liang Huang

Between 2001 and 2004, he said, Hispanics emerged as the largest ethnic group of organic produce consumers. Asian Americans were the most likely group to buy organic produce, spending 133 percent more than Caucasians in 2001. African Americans showed the largest difference between 2001 and 2004, spending 61 percent more in 2004 than three years earlier.

The years Huang chose to study are significant. It wasn't until October 2002 that the U.S. Department of Agriculture put its certified seal on organic products. By doing so, they took pains to make sure what consumers were eating was actually organic. "2002 was a benchmark," he said. "From then on, anything that meets USDA approval can be labeled as organic. It gives consumers some kind of confidence."

Ten to 15 years ago, organic food was considered a niche product and was mainly found in specialty foods stores. Today,

shoppers can find organic produce and foods containing certified organic ingredients in supermarkets anywhere.

With an increased supply of organic produce and the ability to expand, "the growth in organic sales has been increasing 20 percent in the last five years," Huang said. "It's been a very rapid increase. The growth will continue, but not as fast as before."

Tomatoes, potatoes, carrots, onions, lettuce, apples, oranges, bananas, grapes and strawberries are the organic fresh vegetables and fruits that shoppers most often buy. For these foods, average spending increased by 22 percent between 2001 and 2004.

Fresh produce still accounts for most organic foods, with 40 to 45 percent of total sales. Looking at 2005 numbers, organic produce pulled in \$6.3 billion. Huang did find that households earning more than \$100,000 a year buy more

organic produce than people in other income brackets.

But "there was no significant difference between any group in the amount spent on organic fruits and vegetables relative to total produce expenditures," he said. "The findings suggest that high-income households are no more likely to be users of organic produce than low-income households."

Huang said people have many reasons for buying organic. "It goes back to motivations," he said. Those motivations, he found even back in 1989, center mainly on consumers' desire to avoid chemicals and be more environmentally friendly and their perception that organic produce is more nutritious and tastes better. ■

Stephanie Schupska is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

For more information, contact Chung-Liang Huang at chuang@uga.edu.

Center for Urban Ag addresses environmental issues

BY SHARON OMAHEN



The idea to create a University of Georgia program focused on urban, not traditional row-crop agriculture has grown into an official university sanctioned center — The Georgia Center for Urban Agriculture.

Located on the UGA College of Agricultural and Environmental Sciences campus in Griffin, the center began as the brainchild of the state's urban agriculture leaders. "The idea for the center was first discussed in the late 1980s," said Gil Landry, center director. "Industry leaders were the impetus for having a center, and they were the power behind it happening."

CAES approved the center concept in 1996 and determined the mission to be providing extension, research and teaching programs to better serve the growing urban agriculture industry and consumers across the state. More than 10 years later, the center has grown into a university, not just a CAES, program, Landry said.

The center's multi-disciplinary program now involves eight UGA academic departments and 15 urban agriculture industries and professional associations.

"The enhanced recognition as a university center will facilitate collaborations with other UGA colleges and other universities locally, nationally and internationally," Landry said. "There's strength in collaboration and with the added brain thrust, we can address more complex issues and develop broader programs for the state's urban agriculture industry."

Landry said the center helps people understand urban agriculture in its simplest form. "Urban agriculture is the practice of agriculture and related sciences within or surrounding urban areas," he said. "In Georgia, this includes managing landscapes, forestry and wildlife, stormwater and on-site waste water."

Urbanization often faces negative comments from an environmental standpoint, he said. "The urban agriculture industry is becoming more recognized for its beneficial environmental impacts. For example, landscapes and other green spaces are proven to regulate air quality and climate, reduce energy consumption, reduce soil erosion, recharge groundwater supplies and protect surface waters from polluted

runoff."

To help clients in Georgia's urban areas, the center relies on a team of 32 UGA Cooperative Extension agents located in these regions. They deliver research-based information through training programs and the center's extensive Web site, www.gaurbanag.org. Urban agriculture industry leaders are trained through the center's leadership program and landscape business operators are trained through the Georgia Certified Landscape Professional Program.

Some 9,000 visitors from the public and industry also learn by visiting the theme gardens and research areas at the Georgia Research and Education Garden. Located in Griffin, the garden is operated by the center and serves as an outdoor classroom. Indoor classes will soon be an option as an educational training building is currently construction at the garden.

"We are currently working to expand our information delivery system," Landry said. "We were the first in the college to use live Internet-based training simultaneously with 17 counties in Georgia and we are now piloting podcasting. We are also increasing the number of bilingual materials we produce since the majority of the workforce in urban ag industries are Spanish-speaking people."

Gerald Arkin, Griffin campus assistant dean, looks forward to how the center's official status will affect the urban agriculture industry, which is currently valued at more than \$8.1 billion. The urban agriculture industry includes more than 8,000 businesses and employs 80,000 Georgians.

"Through the center, urban ag leaders now have a direct portal to the university,"

Arkin said. "Urban agriculture encompasses everything from golf courses to septic systems to stormwater management. It's not a commodity that you can put in a bushel basket and sell, but it's invaluable to the state and impacts the environment tremendously." ■

Sharon Omahen is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

For more information, visit <http://gaurbanag.org>.

Bird-friendly chocolate a sweet deal for rain forest

BY SHARON OMAHEN

Would you buy a particular chocolate brand if it helped save a rain forest? Some struggling Ecuadorian cacao growers are banking you will. A team of University of Georgia researchers is helping a 400-grower co-op in the Choco-Andean corridor of Ecuador find ways to market their crop while saving the surrounding rain forest. The project began five years ago with funding from the World Bank in Ecuador.

“The main goal of the project is to conserve the biodiversity of the area,” said Rebeca Justicia, a doctoral student working with UGA Odum School of Ecology professor Ron Carroll. “Our secondary goal is enhancing the potential of existing crops.”

An Ecuador native, Justicia said 700,000 acres of her country are devoted to cacao plantations. About 5,000 of these acres are within the Choco-Andean Corridor. Normally, cacao trees grow on large parcels of clear-cut land. To help preserve the rain forest’s plant and animal life, some growers are planting them in the shade, leaving surrounding trees and plants. The grower co-op harvests their shade-grown cacao beans by hand.

“Shade-grown cacao trees share space with the trees of the forest and create a friendly habitat for migratory bird species like the summer tanager,” she said. “But they also generate lower yields per acre than sun-grown cacao trees. Therefore, we must find ways to make the chocolate business worthwhile for farmers.”

One way would be to market chocolate rather than beans, she said. But processing their own chocolate isn’t feasible. Instead, the researchers and growers hope to develop a partnership with an existing processor in Ecuador. To further market their chocolate, the growers plan to focus on their environmentally friendly growing practices and the high quality of their beans. Following advice from UGA researchers, the growers now sort their beans for quality, which increases profit.

“We are calling the chocolate ‘bird-friendly organic’ and emphasizing that it’s a socially responsible product,” Justicia said. “This is extremely high-quality chocolate, as this region is known for producing high-aroma chocolate. It’s the finest quality in the world.”

Shoppers will find bird-friendly organic chocolate in two products: a chocolate dunking sauce and a chocolate syrup. Both were developed by UGA food science students using the Ecuadorian growers’ beans. Professors Rob Shewfelt and Yao-Wen Huang, food scientists with the UGA College of Agricultural and Environmental Sciences, led the new product development.

“Shade-grown cacao trees share space with the trees of the forest and create a friendly habitat for migratory bird species like the summer tanager. But they also generate lower yields per acre than sun-grown cacao trees. Therefore, we must find ways to make the chocolate business worthwhile for farmers.”

—Rebeca Justicia



A grower is shown harvesting a cacao pod from a tree in Ecuador.

“One of my former students, Joy Dubost, is now at Penn State, so she connected us with Greg Ziegler, the chocolate expert there,” Shewfelt said. “We sent him the beans, and he processed them and sent us solidified chocolate liquor. It’s a very highly flavorful chocolate that smells great and tastes really good.”

In 2005, Brooke Bradshaw volunteered to develop a marketing plan as part of a course assignment. Bradshaw, who graduated that year with a degree in agricultural communications, came up with the bird-friendly chocolate name and designed a logo for the products.

“The growers are trying to develop products they can market with an organic label and sell upscale,” Shewfelt said. “This way they can get more money for their crop.”

Besides the UGA formulations, the growers hope to market their chocolate to high-end chefs. “We’re also negotiating with one of the largest chocolate producers in Europe,” Justicia said. “Chefs could use the chocolate for cooking, or small chocolate shops could use it for baking or making high-quality chocolate candies.”

Justicia said a rain forest educational package incorporating the chocolate is being developed with funds from a U.S. Fish and Wildlife Service grant. The package will include lesson plans for elementary and middle school children. “The students will learn about the birds of the rain forest and taste the chocolate,” Shewfelt said. “This would tie the birds and the chocolate together.”

The researchers are also investigating developing a high-quality organic chocolate bar that schools and other groups could sell for fund-raising. ■

Sharon Omahen is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

Time

“Will those responsible for decisions in the field of climate change at the global level listen to the voice of science and knowledge, which is now loud and clear?”

— Nobel Lecture by R. K. Pachauri, Chairman of the Intergovernmental Panel on Climate Change (IPCC), 2007

PhotoDisc.com

Carbon sequestration among the pines

BY FAITH PEPPERS

Monique LeClerc is testing a theory that could turn the science of carbon measuring on its ear. If her theory proves true, it could have far-reaching implications stretching from Wall Street to rain forests.

“For more than a decade, I’ve studied the exchange of carbon between ecosystems and the atmosphere with some of the best minds in the world. My experience tells me that the common approach needs substantial rethinking,” said LeClerc, a University of Georgia College of Agricultural and Environmental Sciences biometeorologist.

“The current model of quasi ad hoc carbon-exchange monitoring stations limits in-depth studies,” she said, “particularly for terrestrial ecosystems of large extent, including forests, wetlands and grasslands ecosystems that cover a large portion of the Earth’s surface.”

Expanding the way data on carbon sequestering is gathered

could drastically change the common conclusions that feed into air quality decisions and even the basis for carbon credits traded on international markets.

To improve the data-collection system in the southeastern United States, the U.S. Department of Energy awarded more than \$900,000 to LeClerc and colleagues at the Savannah Research Ecology Laboratory and the National Oceanic and Atmospheric Administration.

The group will harness cutting-edge technologies to generate insights leading to new, highly relevant biological and physical process information about the carbon cycle. “This will give us more solid, valid data,” LeClerc said.

The data will be entered into regional models. This will enable scientists to create more accurate simulations of how the climate changes as a result of increased atmospheric carbon dioxide concentrations.



Monique LeClerc

“My greatest hope is that this project will help us get a more robust, true picture of what our situation is so we can work now to eliminate the problems that could come from doing nothing. We don’t want to wait until problems are out of hand to find out that our data-gathering method was flawed, and we get caught by surprise.”

– Monique LeClerc

Central to their project is the creation of a unique carbon superflux site at UGA’s Savannah River Ecology Lab near Augusta. Scientists contend this area is one of the most productive regions of the U.S. and accounts for 48 percent of the carbon uptake in country.

The lab “has an excellent existing infrastructure and presents a genuine opportunity to refine our understanding, measurement methods and protocols of data analysis associated with the magnitude of carbon uptake by terrestrial ecosystems,” LeClerc said.

Sites are already in place, but where they’re placed and how they operate and collect data has created a knowledge gap. The researchers contend that measurements at this new location add value to the national monitoring network by filling that gap for the region. Also, they provide value-added information on net ecosystem exchange along the North-South ecological and climatological transect between the existing flux monitoring stations at Duke University and Florida.

LeClerc plans to address why current collection methods don’t measure at night. “Plants don’t stop working at night,” she said. “We need to measure what’s happening at night because we already know that’s when they give off the most carbon dioxide.”

“My greatest hope is that this project will help us get a more robust, true picture of what our situation is so we can work now to eliminate the problems that could come from doing nothing,” she said. “We don’t want to wait until problems are out of hand to find out that our data-gathering method was flawed, and we get caught by surprise.” ■

Faith Peppers is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

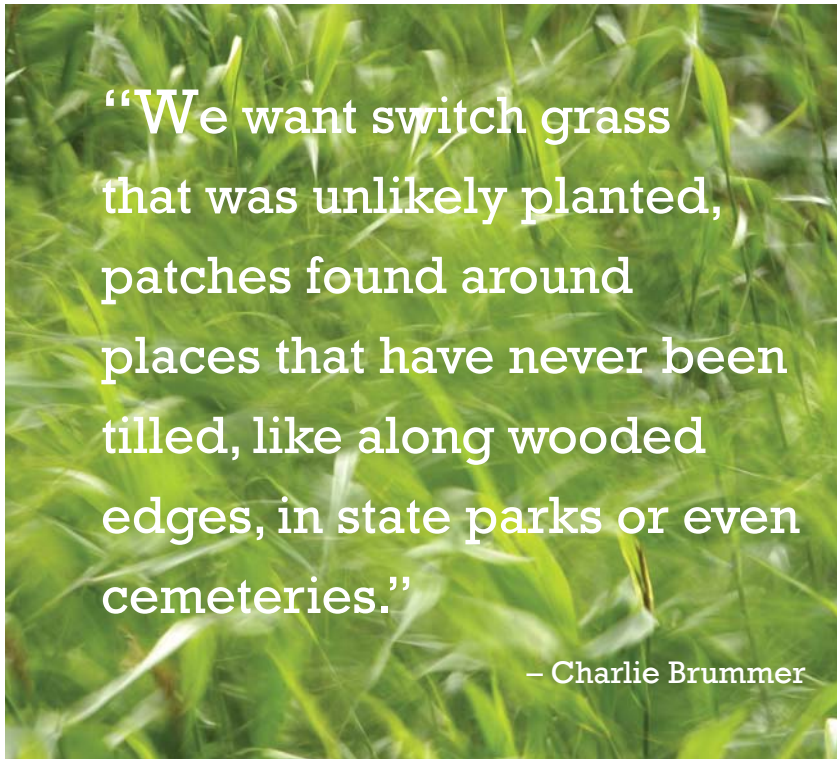
Pictured is a high speed omni-directional fast response sonic anemometer/thermometer that measures wind speed and temperature in the streamwise, lateral and vertical directions. It is co-located with another instrument that measures carbon dioxide emitted. When used together, these instruments determine the amount of carbon absorbed by a unit of foliage over time, i.e. the CO2 flux.

For more information, visit www.biometeorology.uga.edu.

Developing biofuel grass, scientists seek samples

BY BRAD HAIRE

Charlie Brummer wants to develop switch grass that can be used to make ethanol. If you've seen a patch growing in the wild, let him know. You may help the University of Georgia researcher and his colleagues fuel the United States in the future.



Switch grass is a hardy perennial grass commonly grown for cattle feed in the Midwest, said Brummer, a forage and biomass crop researcher with the UGA College of Agricultural and Environmental Sciences. It also can be fermented to produce ethanol, a biofuel alternative to gasoline.

Corn and sugarcane can also be converted to ethanol. These two crops have been studied for many years, and hundreds of domesticated varieties are available for human use. But the full potential of switch grass hasn't been captured, Brummer said. The few varieties cultivated in the U.S. are still considered wild.

"We're not necessarily looking for high yielding switch grasses," he said. "Our approach is to develop high-ethanol-yielding switch grass varieties that are more easily fermentable, or more economical and viable for ethanol production in the United States."

But right now, Brummer needs switch grass samples, or germ plasm, that he and other UGA scientists can study. He'd like to collect 100 different cultivars. He'll get about 35 of them from the Plant Genetic Resource Unit on the UGA Griffin

campus. He hopes to find the rest growing wild around the Southeast in the fall of 2007.

"We want switch grass that was unlikely planted," he said, "patches found around places that have never been tilled, like along wooded edges, in state parks or even cemeteries."

Hunters, hikers, campers or anyone who spends much time in nature are likely to see the switch grass he wants, he said. By fall, switch grass can be found in large clumps with flowers, stems and leaves as tall as 6 feet. It will have tiny, shiny teardrop seeds, too. The foliage turns a pale yellow.

Brummer will use standard breeding and field evaluation to study the different cultivars. Project partner Katrien Devos, a CAES plant geneticist, will study switch grass at the genetic level.

"There is very little known about the genetics of switch grass," Devos said. "The mode of inheritance is not known with certainty. We will build the genetic resources to bring switch grass up to the level with other crops so breeding can be done in a more efficient and targeted manner."

For example, she said, a line may be found that produces a good ethanol yield but not much biomass. With genetic mapping and markers, the gene, or genes, can be identified and placed into a plant that produces a lot of biomass, capturing the best of both plants.

"In the end, we'll breed switch grass varieties that the market, or the U.S. bioenergy industry, will demand in the future," Brummer said.

Devos and Brummer are part of a UGA team led by Alan Darvill, director of the UGA Complex Carbohydrate Research Center. The group also includes Shavannor Smith, a molecular geneticist in the department of plant pathology, and Wayne Parrot, a crop and soil sciences professor.

The team was recently awarded a Department of Energy grant that will partner UGA with other universities, national laboratories and private companies to create bioenergy centers. These centers will push research to find and develop plants with cell walls more easily converted into sugars and microorganisms that can efficiently break down those walls and convert the sugars into fuel.

UGA will receive \$20 million over the next five years to conduct the work. ■

Brad Haire is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.

For more information on the project directed through the Complex Carbohydrate Research Center, visit www.ccruc.uga.edu.

John Goodrum: Pioneer in biodiesel research

BY SUSAN M. VARLAMOFF



John Goodrum 1981

John Goodrum has conducted biodiesel research at the University of Georgia since 1980. The following interview looks back over his 27 years of research, which made him a pioneer in the biodiesel field, and forward to the future of the industry.

What prompted you to do research in biodiesel many years ago?

In 1960, petroleum-producing countries in mostly the Middle East formed the Organization of the Petroleum Exporting Countries. And by 1982, with OPEC gaining control of most of the world's production, the price of oil had gone from \$3 per barrel in the 1960s to more than \$30. This played a role in the gasoline shortages in the United States in the late 1970s. A group of six or seven U.S. biological agricultural engineers formed an energy committee of the American Society of Agricultural Engineers to look for an alternative to petroleum from oilseeds to make up for the shortages. Several engineers looked at the properties of the fuels in the laboratory. Others tested the various oils in vehicles, and a few looked at producing oilseeds. We were a good team. We were a maverick group. We didn't understand that we couldn't make a viable alternative to petroleum. Now we have no choice.

In the early years, what did your research consist of?

I tested different oils in diesel engines. I wanted to see how they would perform on cold winter mornings like those you see in North Dakota and hot summer days like those we see in south Georgia. I found out that vegetable oil is not good in the long run. But peanut oil right from the supermarket shelf works well for several months. We tried to find a substitute for petroleum diesel that works in an unmodified engine.

Over the years, what kinds of oil did you use? What feedstocks do you see for the future?

We looked at peanuts, soybeans, canola and sunflowers and at poultry fat. In 1981, we ran peanut oil in two campus

buses. Now we're running the campus fleet of 43 buses on B-20, a blend of 80 percent diesel and 20 percent chemically processed chicken fat. For the future, we see the possible use of wood-based biodiesel. We've made successful laboratory demonstrations of this at UGA engineering. We see the possibility of breeding of innovative plants such as cuphea as a new oil-bearing plant. It's native to the Southeast and requires little water and chemical inputs such as fertilizer or pesticides.

What are the benefits of biodiesel?

It's an alternative to petroleum that can be grown and processed locally. Growing crops and processing them in a nearby biorefinery will invigorate rural economies. Biodiesel has dramatically less emissions than diesel. B-20 has 20 percent less emissions than pure diesel. Biodiesel is biodegradable and carbon neutral and has no effect on global warming. You also don't have to modify an engine to use B-20.

In Georgia, how much petroleum diesel can we replace with biodiesel?

Right now, I think it's reasonable to say we can replace 15 percent of petroleum diesel with biodiesel. However, there are acres and acres of empty fields in south Georgia that can be planted in oil crops to increase our potential amount of biodiesel.

Do you think alternative fuels are here to stay?

Yes. When I look at the growing economies of India and China and know their population is seven times greater than ours and that they want to live like us, we will need to share the oil reserves. The world's oil production peaked 8-10 years ago, so now we're bringing up lower quality oil. British Petroleum just announced that for every two barrels of oil the world consumes, only one barrel is discovered. We need alternatives to petroleum, and we need to plan ahead in case there's a major cutoff. Today, we import 62 percent of our oil. Brazil just declared it no longer imports petroleum for its vehicles – agricultural products supply sufficient fuel. We need to do the same.

What was your best moment during your years of research at UGA?

Seeing the University of Georgia campus buses fill up with biodiesel this past spring. ■

Georgia honeybees safe from virus so far

BY STEPHANIE SCHUPSKA

It was not the best year to be a Georgia beekeeper.

On top of worries about colony collapse disorder, a newly detected virus, varroa mites and hive beetles, Georgia honey producers had to deal with south Georgia fires, drought and poor honey flows in 2007.

Despite the many problems, one bad thing is missing from the list for most Georgia beekeepers. The Israeli acute paralysis virus hasn't affected the state's bees the way it's hit the rest of the United States.

Scientists have pinpointed the virus, new to the U.S. via Australia, as one of the causes of colony collapse disorder, which was first found in fall 2004. CCD's symptoms are disappearing bees that flee normal-looking hives without leaving dead behind to autopsy.

The researchers who identified Israeli acute paralysis virus in the U.S. are "very careful to call it a marker" of colony collapse disorder, said Keith Delaplane, a University of Georgia Cooperative Extension entomologist and honeybee researcher. "But the stats are very convincing, with literally every colony showing symptoms of CCD also harboring the virus. We don't find data that plain usually."

Thanks to Georgia's status as a queen bee producer, very few IAPV-carrying Australian queens are coming into the state. But that doesn't mean the virus isn't going to spread.

When the embargo was lifted on bee imports in 2004, it was the first time Australian bees had entered the U.S. since the 1920s. With no signs of problems, Australian colonies were presumed safe. And they were, even with IAPV, because the varroa mite hasn't made it to Australia.

"There's evidence that the virus doesn't express symptoms until the varroa mites feed on the bees," Delaplane said. The varroa mite first showed up in the U.S. in 1987.

With no vaccines for IAPV and no cure for varroa mites, the next best thing might seem to be to keep sick bees separate. But for some beekeepers, that would spell economic death.

"The tail that wags the dog is the California almond industry," Delaplane said. "It's a huge mixing pot." Tractor-trailers cart beehives to acres-wide parking lots early every spring, allowing billions of bees to mingle. Besides diseases and mites, the constant work that starts with the almond crop wears bees out.

As beekeepers nationwide worry about what's next, the USDA is setting aside \$4 million to study the problem. Delaplane is hoping it will allow entomologists to focus more attention on bee viruses and "bring us up to speed where we need to be with viruses."

"Old Israeli literature shows that some of their bees have a genetic resistance to IAPV. We always keep coming back to genetic resistance. It's a powerful tool the industry is slow to adopt because bee breeding is seen as neither profitable nor effective."

Delaplane and his U.S. colleagues faced the 163-page USDA grant paperwork together in October. If awarded the grant, they'll divide their responsibilities according to expertise. "Mine is treatment thresholds for damaging pests," such as varroa mites, he said, "and the impacts these parasites have on pollination." ■

Stephanie Schupska is a news editor with the University of Georgia College of Agricultural and Environmental Sciences.



*Jennifer Berry,
apicultural
research
coordinator*



Photos by Stephanie Schupska