tx H_2O

A Publication of the Texas Water Resources Institute

Winter 2011

Environmental disaster or just a drop in the bucket?

Also in this issue . . .
Urban Living Laboratory, Saltcedar beetles invade, and much more!

Texas AgriLife Research
Texas AgriLife Extension Service
Texas A&M University College of Agriculture and Life Sciences

Working to make every drop count

As I write this, I am on my way to the 77th Annual Convention of the Texas Farm Bureau. It's common for organizations, associations, and others to hold annual meetings to assess the status of their membership and realign or set priorities and goals for the upcoming year.

We often do the same in our personal lives at the beginning of each year—we review the previous year and resolve to improve ourselves for the next.

When making this year's resolutions, I challenge you to step outside of the typical weight loss and financial goals and think about our water resources and what you can do to make every drop count.

- What is the source of that glass or bottle of water you are enjoying?
- Do you need to get your soil tested?
- What changes in your landscape can you make to save water? Should you install a rainwater harvesting system?
- Is it time to install low-flow devices in your home?
- Do you know how to properly dispose of chemicals and other household wastes so you are not polluting the water?
- On a broader perspective, what can you do to ensure there is adequate water for the future, to protect and improve water quality, to manage invasive species, or to mitigate and adapt to climate change?

As you can see from the diverse topics covered in this issue, much is being done around the state to address these challenges. But your help is needed.

I wish you a Happy New Year and look forward to working with you in 2011.

Kevin Wagner

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Published by
Texas Water Resources Institute

Editor
Kathy Wythe
Texas Water Resources Institute

Art Direction
Mary-Margaret Shread
Texas A&M AgriLife Communications

Assistant Editors
Danielle Supercinski
Leslie Lee
Texas Water Resources Institute
Linda Anderson
Texas A&M AgriLife Communications

Contributing Writers
Courtney Swyden
Melanie Orth
Texas Water Resources Institute

On the Cover:
Workers clean oil off of a Gulf of Mexico beach. Photo manipulation by Mary-Margaret Shread.

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Texas Water Resources Institute
make every drop count

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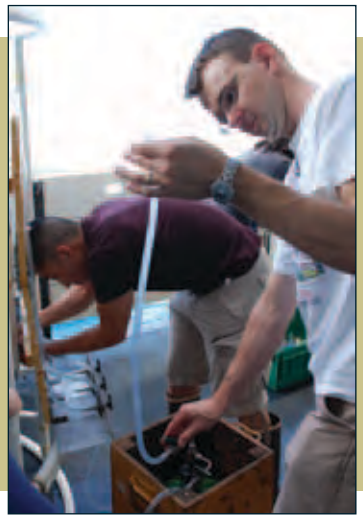

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Story by Leslie Lee

Environmental disaster

or just a drop in the bucket?

Texas scientists on the real effects of the Deepwater Horizon oil spill

What if gasoline pumped into cars, seafood eaten at restaurants, and waste thrown away or flushed all eventually called the same place home?

Welcome to the Gulf of Mexico.

Dr. Larry McKinney, executive director of the Harte Research Institute (HRI) for Gulf of Mexico Studies at Texas A&M University–Corpus Christi, likes to say that the Gulf of Mexico is "America's gas station, sushi bar, and waste disposal."

McKinney and his colleagues sometimes call the Gulf "the Forgotten Coast," but on Earth Day 2010—April 22—it was anything but forgotten as the wreckage of the *Deepwater Horizon MC252* drilling platform sank into its waters.

A crude awakening

Like any large oil spill, this one took its toll in many ways. Eleven BP employees on the rig died in the explosion that caused the leak. Thousands of barrels of oil leaked from the well each day until it was capped on July 15, 2010. The National Oceanic and Atmospheric Administration's (NOAA) final total estimate, contested by BP for being too high, was 4.9 million barrels or 205.8 million gallons.

Wildlife were harmed by both the smothering capacity of the oil and its toxicity. As of early November, NOAA Natural Resource Damage Assessment response teams had documented 2,263 visibly oiled dead birds, 2,079 visibly oiled live birds, 18 visibly oiled dead sea turtles, and 456 visibly oiled live sea turtles.

A major concern after the spill was the possibility of the oil seeping into Louisiana's wetlands. About half of the wetlands in the United States are in Louisiana, according to McKinney, who added that the heart of wetland areas was not impacted by the oil, but some impacts to wetlands are yet to be seen.

"People were really worried about keeping the oil out of the marshes in Louisiana and Mississippi," said Dr. Piers Chapman, professor and head of the Department of Oceanography at Texas A&M University. "The edges of the marshes served as a barrier, and luckily no hurricanes pushed the oil deep into those wetlands."

At a public lecture at Texas A&M, McKinney predicted that Gulf beaches, shrimp, and crabs would be fully recovered within one to two years, but oysters would take longer to recover. McKinney was particularly concerned about bluefin tuna populations, as the spill occurred during their spawning season.

Cleaning up the spill presented more complexities. The type of oil spilled and the particulars of the Gulf's ecosystem are important to consider, Chapman said during an October community conversation event at Texas A&M. "This was very light crude, and the spill occurred during summer in the Gulf, so much of it evaporated," he said.

This type of oil also contained large amounts of methane, creating huge plumes, McKinney said.

Skimming the oil, using dispersants, and using bioremediation are all artificial processes for breaking down oil. Natural processes, such as photo-oxidation, physical breakdown from waves, and biodegradation by bacteria, also exist to break down oil. Approved by the U.S. Environmental Protection Agency (EPA), 1.84 million gallons of chemical dispersants were used to break up the oil, and more than 40,000 personnel were involved in the extensive cleanup, Chapman said.

"More dispersants were used in this spill than any other in history," said McKinney, who in a previous position oversaw the State of Texas' oil spill response for 20 years.

"EPA has an elaborate system for evaluating dispersants and consciously used huge amounts of dispersants for this spill," McKinney said. "I think that open ocean systems have taken a hit because of the use of these dispersants."

The Gulf is tough, but sensitive

"Humans have been extracting oil from the Gulf for 50 years or so, but bacteria have been chewing up oil for millions of years," Chapman said, referring to the 2 million barrels of oil that naturally seep from the Gulf's floor every year. The ecosystem there has adapted to it.

Naturally occurring microbes thrive on those small amounts of crude, and acres of deep coral forests live off of the seeps, McKinney said. However, massive amounts of oil released in a short amount of time, such as the *Deepwater Horizon* spill, are very dissimilar from the smaller natural seeps, as are organisms' reactions to them. When dispersants break up oil, the particles do not disappear but sink instead —becoming deceptively out of sight and out of mind, McKinney said.

And these oil particles can harm certain organisms, Chapman said.

"These tiny particles are bite-sized for the zooplankton (small floating organisms), which is a concern," said Chapman, who has tested oil spill dispersants for toxicity and effectiveness in the past.

One major effect of the spill was the huge economic loss in the Gulf fishing industry, McKinney said.

"The realization that you must have a healthy environment to have a healthy economy was made in spades by this spill," McKinney said.

"Public perception was that seafood from the Gulf was contaminated, though tests have not shown that," Chapman said. "Louisiana's economy loves fishing and oil, and you could argue that those are conflicting."

This spill could only cause irrevocable harm if it somehow acted as a sort of tipping point on natural habitat loss or on climate change in the Gulf, which is the most vulnerable region to climate change in the United States because it is basically a shallow, subtropical sea, McKinney said.

Researchers flock to the Gulf

"One good thing that resulted from the spill is that the Gulf of Mexico is finally getting some of the research attention it deserves," McKinney said at an October 2010 event honoring Texas A&M scientists involved with the spill research. "We have neglected much research for decades, but now it is finally happening, and with BP promising that it will spend $50 million a year for the next 10 years on Gulf research, we can do some very valuable work for years to come."

Much of this needed research is happening in Texas and within The Texas A&M University System.

Dr. John Kessler, assistant professor of oceanography at Texas A&M, was awarded a National Science Foundation (NSF) grant to examine methane gas in the spill, and also received additional funding from the U.S. Department of Energy and NOAA. His crew first visited the oil spill site June 11-21, 2010, aboard the research vessel *Cape Hatteras*, operated by Duke University and the University of North Carolina.

Kessler and his crew—including fellow scientists, students, and technicians from Texas A&M, the University of California at Santa Barbara, and NOAA—found plumes of highly concentrated methane from the disaster dissolved in the Gulf's deep waters. UC Santa Barbara's Dr. David Valentine and Kessler led the expedition. They found that three gases—ethane, propane, and butane—were responsible for most of the oxygen loss in the deep plumes.

In September, the team returned to the site to collect additional information about the impact of hydrocarbon gases in the water column, focusing specifically on the longer-term fate of methane.

"Dissolving these gases in the ocean is a bit of a double-edged sword," Kessler said to Texas A&M News & Information Services in September. "On the one hand, these gases influenced both the air quality and the radiative budget of the atmosphere, so trapping them within the ocean is a good thing. But their eventual marine biodegradation leads to the consumption of dissolved oxygen, which is an annual problem in the northern Gulf of Mexico."

Kessler's team also found that although methane gas was initially consumed by bacteria very slowly, the rate increased as other gases were depleted. They estimated that ultimately two-thirds of the bacterial productivity and respiration in the deep-water plumes will be linked to these gases.

Calling the results "extremely surprising," in January 2011 the team announced that methane concentrations had returned to near normal levels because of consumption by bacteria.

Dr. Thomas Bianchi, another Texas A&M oceanography professor who has spent time studying the oil spill, had conducted research on Louisiana marshes for years. His oil spill work, funded by a NSF Division of Chemistry (Environmental Chemical Sciences) grant, also included scientists from Louisiana State University, Georgia Tech, and the Louisiana Universities Marine Consortium.

After returning to the marshes in September 2010, he said that areas he examined around Barataria Bay—east of the city of Houma—showed that river diversions helped keep oil out of marshes. However, Bianchi said, he did observe a change in the overall ecosystem as measured by a significant increase in dissolved organic carbon (DOC). He observed that oil was still present in some wetland areas, and it often gets caught by particles and settles in marshes' bases, where it can't be seen by the human eye, unlike oil floating in the ocean.

"One thing to point out is that some of these marshes have not rebounded, and they have, in part, been also impacted by the 'cleaning' approach used by some oil companies," Bianchi commented to Texas A&M News & Information Services in November. "They use high pressure water systems, which on rocks is fine, but not on plant material. So this has likely cut them [the plant material] back so short that changing water levels with tides and storms will make them more vulnerable in the upcoming months. The high DOC we are observing also was likely impacted by this 'washing' technique."

Another major player in research following the oil spill, Texas Tech's Institute of Environmental and Human Health (TIEHH) faculty members made multiple trips to the coast, collecting samples ⇨

to analyze impacts of the oil and dispersants on the area's wildlife and environment. In August 2010, Dr. Ron Kendall, director of TIEHH, testified before the U.S. Senate Committee on Environment and Public Works at the "Oversight Hearing on the Use of Oil Dispersants in the *Deepwater Horizon* Oil Spill."

"We have very limited information on the environmental fate and transport of the mixture of dispersant and oil, particularly in the deep ocean," Kendall said during the hearing. "We have very little information on the ecological effects of this particular oil and dispersant mixture in terms of acute, chronic, and indirect effects on marine and coastal organisms. And given the volume of oil and dispersant that have been released into the Gulf of Mexico, we have a very poor understanding of the ultimate ecosystem level effects which may occur in the weeks, to months, to years ahead."

Will anything change?

When considering the future of oil-spill technology, McKinney reflects on the past.

"I was there for the Ixtoc spill," McKinney said of the 1979 Ixtoc spill in the southern Gulf. "BP called a well-cap a 'top hat,' while at Ixtoc it was called a 'sombrero'—30 years later, most of the approaches we had for BP were the same ones we had for Ixtoc. There was very little learned from Ixtoc that was ready to apply to *Deepwater Horizon*."

The area mostly recovered from the Ixtoc spill in two to four years, but 30 years later, researchers are still finding inert Ixtoc oil in Mexican coral reefs, McKinney said.

"The Gulf is resilient and has tremendous natural variability, to which its organisms adapt," McKinney said. "Forty percent of the U.S. drains into it, providing a huge nutrient supply, which is a good thing in moderation. It is a high-energy ecosystem, with incredibly complex interconnectivity."

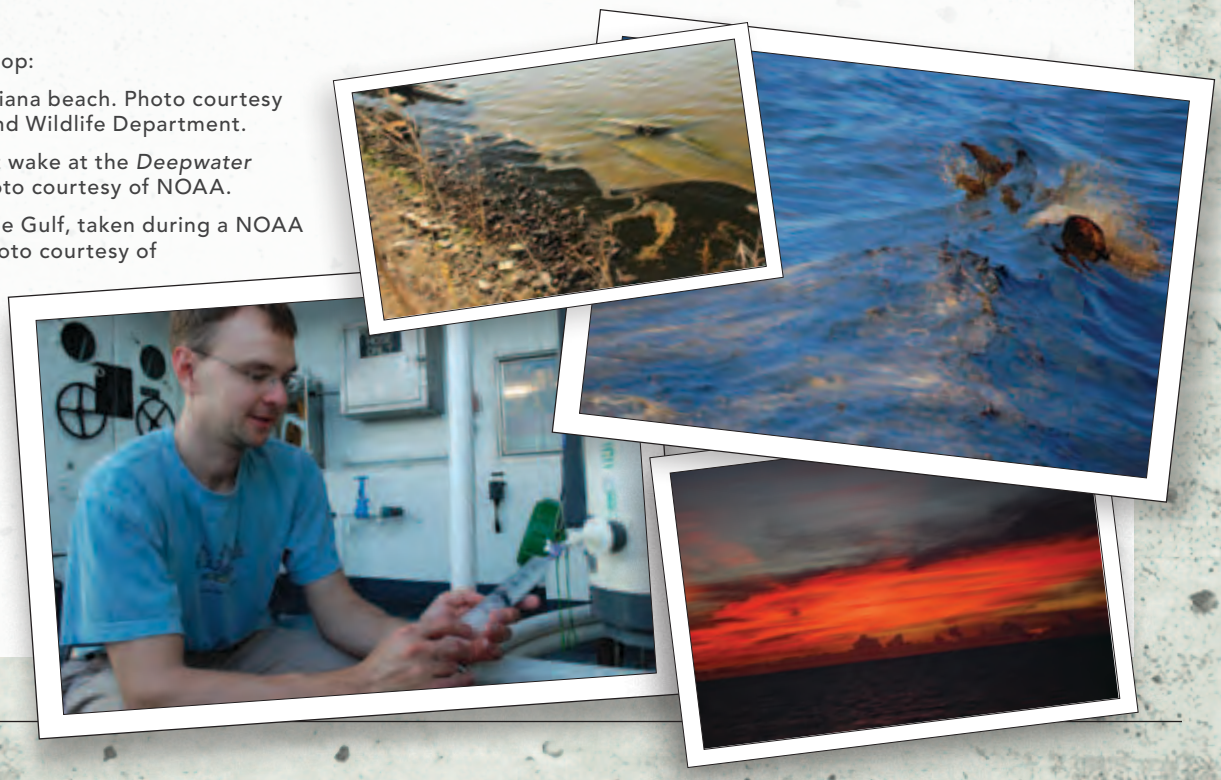
Though Texas largely did not feel the physical effects of the spill, Texas researchers' work related to the spill drew media attention nationally and internationally. Texas A&M researchers were featured in the *New York Times*, Discovery Channel, BBC, Fox News, and many others. Texas A&M's Department of Oceanography and Department of Petroleum Engineering, HRI, TAMU-Galveston, the Geochemical and Environmental Research Group, and the Texas Sea Grant College Program were all recognized in October 2010 with the university's Newsmaker Award for their faculties' and staffs' assistance in responding to media inquiries about the oil spill.

"The media tends to like answers right now about the long-term effects of the spill," McKinney said at the award event. He had helped HRI field more than 250 media inquiries. "But there are a lot of questions that will take months, if not years, to answer.

"We all have a stake in the Gulf of Mexico—if you use plastic, need gasoline, eat seafood, or enjoy fishing, you have a stake in it," McKinney said. "The Gulf is magnificent, hugely diverse, and hugely worth saving."

Please visit *twri.tamu.edu/txH2O* for a full listing of links and resources.

Note: Information from Texas A&M news releases was used in this story.



Clockwise from top:

1. An oiled Louisiana beach. Photo courtesy of Texas Parks and Wildlife Department.

2. Oil in the boat wake at the *Deepwater Horizon* site. Photo courtesy of NOAA.

3. Sunset over the Gulf, taken during a NOAA research trip. Photo courtesy of NOAA.

4. Kessler extracts a Gulf water sample from a CTD (conductivity, temperature, depth) device while aboard a NOAA research vessel. Photo courtesy of NOAA.

Story by Courtney Smith

Developing solutions for sustainable living—the Urban Living Laboratory

The world's largest 'living laboratory' for research on green living

With many new innovative and green technologies emerging in the 21st century, how do manufacturers really know if their products are making a difference in the environment? And how do they know if these so-called green products are being used correctly by consumers to decrease their water usage or electricity bill, or even improve air quality?

The answer: the Urban Living Laboratory (ULL)—a mixed-use, multifamily research community in which green technologies will be monitored daily for 75 years. The ULL is being developed through a public-private partnership between The Texas A&M University System and Realty Appreciation, LTD, and is slated to break ground in late 2011.

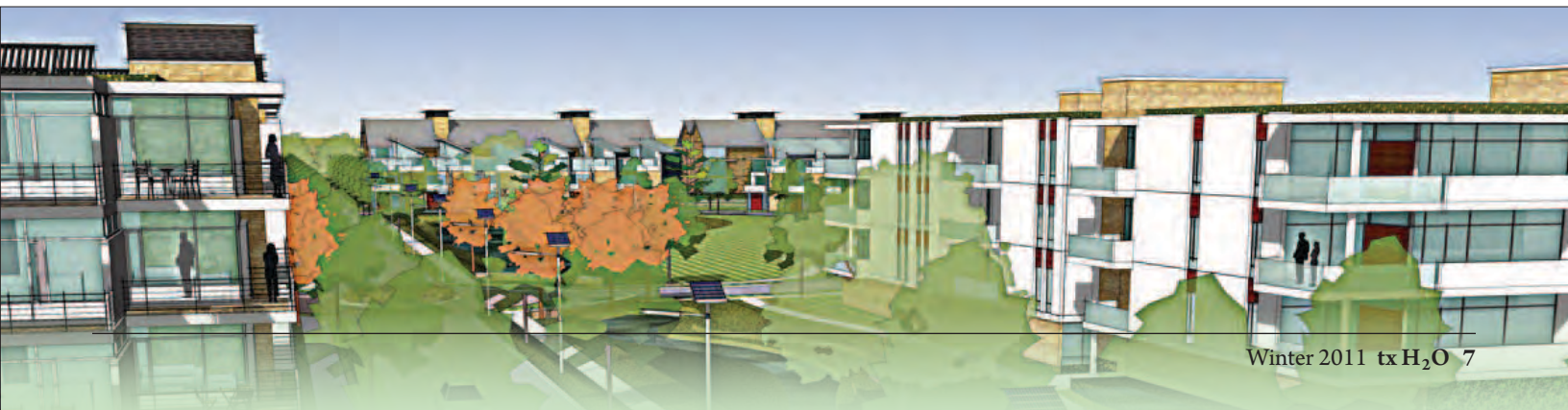
The idea of an urban research laboratory began with land that was not being utilized at the Texas AgriLife Research and Extension Center at Dallas, which was originally situated in a rural setting. Over the years, Dallas has expanded and the center now sits in the middle of one of the nation's largest urban environments; this rapid growth has created a greater need for research on urban issues.

"Therefore, why not use this land for urban research," said Dr. Allan Jones, associate director and professor at the center. This sprawling 73-acre, 1.1 million square foot, 36-building community in Dallas, considered to be the world's largest "living laboratory," will feature five Leadership in Energy and Environmental Design, or LEED-certified building types including multifamily housing, office and retail space, two hotels, and a visitors center. All buildings will be designed to meet LEED Silver standards, and some may achieve LEED Gold or Platinum status. ULL researchers will record and observe how families live and work in this environment, testing elements from water resources management to urban design and economics to transportation and logistics.

At first read, it almost sounds like a scene from *The Truman Show*, a movie about a man whose everyday life is recorded as a television show while he is oblivious to it. However, research at the ULL will be completely noninvasive, focusing on three important resources—air, water, and energy—as well as transportation and human behavior.

"The ULL itself represents the world's largest LEED-certified research, demonstration, and teaching laboratory for research related to water, air quality, transportation, and human behavior to help enhance the viability and sustainability in urban environments," said Kevin Rogers, Realty Appreciation director of real estate.

More than 20 companies have jumped on board to either donate products or provide products at a discounted cost—from lighting to fixtures, roofing to concrete—and in turn have access to the ULL's research results. As part of the ULL's "Technology Refresh" program, these LEED-certified buildings will be constructed to evolve over time, and companies have agreed to upgrade their products every seven to 10 years. ⇨



The Urban Living Laboratory will include multifamily apartments.

The 73-acre, 1.1-million-square foot property will also house a retail district as shown in the two illustrations above.

With the research results provided from the ULL, companies such as the LG Electronics and General Electric can improve and enhance their appliances and consumer electronic products with data that has never before been accessed or researched on this scale.

"It's really an intelligent research platform where businesses, universities, and government entities can install, test, research, and implement the best ideas for sustainable living in the 21st century," Rogers said. "Johnson Controls Inc. will develop a state-of-the-art technology platform to collect and transport data to the ULL's main hub, the Sustainability Center, which will also act as a visitors center for manufacturers to showcase their products."

Rogers said the project will bring together interdisciplinary experts from 14 major universities, not just Texas A&M University, to develop, deploy, test, and evaluate new and emerging green technologies in an actual living environment.

"The grand idea is to make this a catalyst for research in the urban area," Jones said. "This is going to be a fertile environment to bring different groups together on a repeated basis with everybody committed to working together. From the A&M System's point of view, over time we will be able to insert faculty ideas into this process and share in intellectual property, as well as enhanced research and education."

With 800 apartment units, 200,000 square feet of office space, and 100,000 square feet of retail space, nearly 3,500 people will live and work in this environment full time. Rogers predicts residents will not only have significantly lower utility bills (30 percent to 50 percent less) than anywhere else in the Dallas-Fort Worth Metroplex because of the technologies employed at the ULL, they will also have access to their own energy- and water-use data. In a nonintrusive manner, millions of bytes of data will be collected every second on indoor and outdoor water and energy use for each apartment, office, retail space, and so on. A technology panel in each unit will generate data that is sent to a network operating center.

"The ULL will track all electricity and water usage—every outlet, every plugged-in appliance,

Other facts about the Urban Living Laboratory:

- **The ULL will provide economic opportunities with the creation of 1,800 jobs and potential major research and education funding for scientists in Texas AgriLife Research, the Texas AgriLife Extension Service, The Texas A&M University System, and other universities.**
- **This community will create the world's largest "living laboratory" for research and education on energy efficiencies, emerging technologies, and green living in urban environments.**
- **The ULL will advance the viability of urban sustainable environments that can be replicated throughout the nation.**
- **The Dallas Area Rapid Transit—DART—is planning to build a station near the ULL.**
- **The goal of this project is to change the way cities are built and operated by creating a compelling business case (backed-up by science-based data) for the benefits of green buildings, and by developing a sustainable model that can be replicated in any region (and in any city) that is striving to accommodate accelerated urban growth.**

every drop of water used—and where it is used will be monitored," he said. Once occupants see results of their day-to-day activities, they could be motivated to lower their utility bills even more by monitoring their own daily water and energy use.

"We want to see if residents will make a conscious effort to conserve water and energy because they have this data in their hands," he said.

One of the primary goals of the ULL is to reduce indoor water use by at least 30 percent. Buildings will include low-flow showerheads, efficient washing machines that use 60 percent less water and energy than the conventional top-load washers, and energy-efficient dishwashers as well as other energy-efficient fixtures and appliances.

For outdoor water conservation, the ULL will use a greywater recycling system. Greywater is any used wash water (except from toilets). Wash water comprises 50 percent to 80 percent of wastewater generated from buildings, and after proper treatment, it can be reused for landscape irrigation and wetlands purposes.

Overall, the ULL aims to reduce outdoor water use by at least 50 percent by designing an integrated stormwater management system, which will include structures to capture stormwater flow for irrigation purposes. Sources of stormwater including precipitation, floodwater, lawn irrigation runoff, and surface water used for such purposes as car washing and window washing will be captured by ponds, reservoirs, and rain gardens. The ULL will then take conservation a step further by implementing water-efficient landscapes. Strategies will include using native and adapted plant species, contouring the land to direct rainwater to maximize capture and retention, and minimizing the use of turfgrasses that require regular irrigation.

"The next step is to replicate what we're doing at the ULL throughout the United States and throughout the world," Rogers said. "We want to build a mini-city, basically, that works environmentally, economically, and socially, and one that we are able to replicate."

For more information about the ULL, visit *urbanlivinglaboratory.com*.

The architect's rendering depicts the community. Construction is slated for late 2011.

Story by Kathy Wythe

Invited Invaders

Beetles used successfully in biological control of saltcedar

They are tiny. They are hungry. And thousands are successfully devouring an invasive tree that grows in dense stands along streams and rivers in West Texas.

Since 2004, scientists with the Texas AgriLife Extension Service, Texas AgriLife Research, U.S. Department of Agriculture's Agricultural Research Service (ARS), Sul Ross State University, and other agencies have used varieties of saltcedar leaf beetles to defoliate miles of the invasive saltcedar tree in the Colorado, Red, Brazos, Canadian, and Rio Grande (including the Pecos River) river basins.

The non-native saltcedars, brought to the western United States from Asia and the Mediterranean area in the early 1800s, were planted as ornamentals in landscapes and along stream banks to prevent erosion. With no natural enemies in the country, the exotic tree spread to more than 2 million acres of land along streams and lakes from the central Great Plains to the Pacific and from Montana into northern Mexico.

Scientists in Texas are using the saltcedar beetle to control invasive saltcedar trees. No species of saltcedar or its close relative, athel tree, are native to North or South America. Photo by Jerry Michels, Texas AgriLife Research.

Their growth, however, has "produced one of the worst ecological disasters in the recorded history of the region [western United States]," according to a 2000 review of the problem by Dr. Jack DeLoach, an ARS entomologist in Temple, and other scientists involved in combating saltcedar in Texas.

These trees often displace native plants, degrade wildlife habitats, and contribute to the population decline of animal and plant species. They also increase soil salinity and the likelihood of wildfires, lower water tables, and reduce recreational usage of parks and natural areas, the report stated.

To fight this invasion, ARS scientists imported saltcedar beetles first from China and then Greece, Tunisia, and Uzbekistan to test their use and safety as biological control agents. These tiny beetles—about a quarter-inch long—chew the leaves of the saltcedar trees, and after three to four years of repeated defoliation, the trees begin to die.

In April 2004, DeLoach and Dr. Allen Knutson, Texas AgriLife Extension Service entomologist at the Texas AgriLife Research and Extension Center at Dallas, released 38 Crete (Greece) beetles at a research site along Beals Creek near Big Spring in West Texas. Over the summer of that year, the scientists released an additional 2,200 beetles.

"Since then, no additional beetles have ever been released [at this particular site]," DeLoach said. Those beetles and their offspring established themselves and began defoliating the saltcedar.

In 2005, the beetles defoliated 2 acres of trees; the next year, 20 acres, and they kept going. By 2009, the beetles had "just exploded" and had moved 38 miles along Beals Creek, defoliating about 500 to 1,000 acres, DeLoach said.

The time was right, Knutson said, to move the project from research to implementation. "We felt we had enough research and a large source of beetles to begin implementing biological control of saltcedar in the major river basins of West Texas," he said.

Knutson, in partnership with ARS and the USDA's Natural Resource Conservation Service (NRCS), established a statewide *Saltcedar Biological Control Implementation Program*. The program provides technical assistance and beetles to agencies and landowners interested in saltcedar biological control and educates people on this project.

Working with the Colorado River Municipal Water District, Knutson has established saltcedar beetle populations at four locations on the upper Colorado River Basin, and, in 2010, released beetles at Lakes Ivie and Spence. This project is funded by Wal-Mart Stores Inc. and the Texas Parks and Wildlife Foundation, Knutson said.

Knutson also works closely with NRCS in establishing new beetle populations in the saltcedar-infested regions in the Southern and Rolling Plains of Texas. During 2010, the AgriLife Extension program provided 90,000 beetles to NRCS personnel for release in five counties.

"When we say 'established,' that means the beetle population has overwintered and come back and defoliated trees," Knutson explained. "It takes quite a bit of effort, heart, and science to establish beetles."

During the past two years, Knutson collected about 550,000 beetles from the Big Spring area and distributed them throughout West Texas, from Big Bend National Park on the Rio Grande as far north as White River Lake near Crosbyton. By 2010, the AgriLife Extension program had released beetles at 23 sites in 17 counties.

"These new beetle populations are now defoliating saltcedar at these sites. The defoliated areas range from 1 to 2 acres to 80 acres and will expand as beetle populations increase each year," Knutson said. ⇨

Working closely with Knutson is Dr. Mark Muegge, AgriLife Extension entomologist at Fort Stockton. He concentrates on sites along the Pecos River and sites in Big Bend National Park. He has found that the Crete beetle works for the northern part of the Pecos River, and the Tunisian beetle from Northern Africa survives better in the southern portions of the Pecos and the Rio Grande.

"We released Crete beetles from a field cage along the Pecos in the summer of 2006," Muegge said, "and the beetles now cover an area from Mentone down to near Barstow, and they have defoliated probably 25 to 30 river miles of saltcedar."

After four years, Muegge said, the trees close to the original release site are definitely showing signs of decline from repeated defoliation by the beetles. "We believe these trees will start dying and may be dead in another couple of years," he said.

Beetles continue to feed on new growth season after season. After each defoliation, the saltcedar resprouts but with decreasing green foliage each year.

"The beetles never are expected to kill all the trees," DeLoach said. "They will decrease as green foliage decreases, and both beetles and green saltcedar are expected to reach a low, nondamaging and fluctuating equilibrium after five to eight years."

Even if the trees are not dead, Knutson said, defoliated trees are stressed and their canopies are greatly reduced. "Branches die, and as more sunlight reaches the soil, other plants begin to grow as the saltcedar dies back," he said. "The stressed trees stop producing flowers and seeds. Fewer seeds result in less reinfestation."

Dr. Chris Ritzi of Sul Ross works with DeLoach, the Rio Grande Institute, and NRCS in parts of the Rio Grande Basin, which has the "largest, continuous stretch of saltcedar in the state," he said.

Ritzi said they initially tested three beetle species—Crete, Tunisian, and Uzbekistan—to determine if one would work in that area. Over time, they determined that the Tunisian beetle was best suited to this area.

To date, about 14 research sites established by Ritzi and DeLoach are along the Rio Grande, including one well-established site at Alamito Creek, from which beetles have defoliated more than 20 miles of saltedar trees along the Rio Grande between Lajitas and Candelaria.

Besides finding the right beetles for the different areas, Ritzi said, another problem was protecting the sites while the insects were established, such as preventing ants from eating the pupae and carrying away the larva. "The ants ate the beetle larvae like candy," he said. "It was very difficult to get the beetles to take to this area."

Research by Knutson and Muegge found that applying ant bait at the release site helps prevent ants from eating the beetles until the beetle population has grown large enough to handle the ant attacks.

The periodic flooding of the Rio Grande has also caused problems in getting the beetles established, Ritzi said. In the beetles' pupal stage, they drop to the ground to go into metamorphosis, and if the river floods, they drown.

"Flooding can really hurt the beetles, and can kill off an entire generation," he said.

In the Texas Panhandle, Dr. Jerry Michels of Texas AgriLife Research also has had trouble finding the right beetle strain that can survive the conditions of the Panhandle's unique environment. Because of the northern location of the Canadian River, Michels tried to establish beetle species used successfully in Utah, Nevada, and Colorado. He found, however, that none of those species overwintered well in the sites on the Canadian River.

In 2010, Michels released 17,000 Crete beetles. He is hoping that spring 2011 brings better results with the beetles overwintering and coming out of hibernation.

"We are waiting until next spring to see if these beetles will be established," Michels said of the anticipated breakthrough. "We saw some defoliation even this summer, but we need the beetles to make it through winter to say they are established."

What is the most important reason to establish these beetles and get rid of saltcedar? The answer really depends on who you ask, and where the saltcedar is growing.

"We are very concerned about the impact of saltcedar on water more than anything else," Michels said, adding that he believes saltcedar has contributed to the depleted water reservoirs of Lake Meredith, north of Amarillo.

In an April 2010 U.S. Geological Survey (USGS) report requested by Congress, scientists from USGS, U.S. Bureau of Reclamation, U.S. Forest Service, and other agencies conducted a review of scientific literature on saltcedar. According to a USGS news release, scientists found that native trees such as cottonwoods and willows consume as much water as saltcedar on a leaf-area or soil-area

basis, and that other vegetation that replaces saltcedar after its removal consumes "roughly equal amounts of water."

"Therefore, removal of saltcedar from these areas is unlikely to produce measurable water savings once replacement revegetation becomes established," the authors wrote.

DeLoach and Michels said although plant-for-plant that statement may be true, the difference is that healthy habitats don't have the huge, dense stands of cottonwoods and willows taking up large amounts of water as saltcedar-invaded habitats do.

Adult cedar beetles are about 5 mm long and feed on saltcedar flower buds. Photo courtesy of Agricultural Research Service.

"With a healthy habitat, you have a mix of cottonwoods, willows, other trees, some woody plants, broadleaf plants, and grasses," Michels said. "But with solid stands of saltcedar there is almost nothing else, especially when the canopy becomes dense."

DeLoach said, "If you look at the whole floodplain of a river, deep-rooted saltcedar occupies a lot more land across the floodplain, while shallow-rooted cottonwoods and willows stay close to the stream. If you consider that, then saltcedar uses a lot more water than cottonwoods and willows do."

But for DeLoach, the reasons for controlling saltcedar depend on the damage caused by saltcedar in different environments. "The reasons might be to improve native plant communities and wildlife and fish habitat, to increase water quantity and quality, to reduce wildfires and soil salinity, or to improve recreational values in parks and natural areas—all are important," he said.

"Plants are going to use water—that's a given," Ritzi agreed, "but the question is what sort of plants are going to grow, and what type of organisms can base their community around those plants. The truth is very few things want to make a home out of saltcedar.

"Saltcedar really does reshape the entire river system and how everything seems to work within that system," he said. "We are ultimately looking to reshape and restore the habitat. We are hoping that the renewal of the natural system will get the river ecosystem closer to what it used to be."

Late last summer, this program, called one of the most successful biological control programs for invasive weeds in the United States, hit a potential bump in the road in the Rio Grande area of Texas. The Tunisian beetles, released at several sites along the river in 2009, had increased so rapidly that they defoliated almost all of the saltcedar along 20 miles of the Rio Grande near Presidio. In August 2010, the beetles jumped to a close cousin, the athel tree, used as a shade tree in Presidio and northern Mexico. The beetles defoliated about 20 athel trees in Presidio.

Previous extensive tests by ARS had shown that the beetles feed on athel trees, but prefer saltcedar.

DeLoach believes, based on the few cases of biocontrol insects attacking nontarget weeds in other areas, the damage to athel will drop over the next two to three years. Since the beetles have defoliated all the desirable trees, next year the beetle population will be lower and the beetles will concentrate more on the preferred saltcedar and less on the athel, he said.

"A few more years of careful monitoring will be critical to discover if that will really happen in the field," he said.

Because the athel tree survives only along the Rio Grande in Texas, Knutson said, it is not an issue for the saltcedar biocontrol efforts in the other West Texas river basins.

The scientists said the next step for this program is to wait for the beetles to do what they do best.

"My goal is to get large populations established on each of these major river basins and then let beetles disperse naturally," Knutson said. "The beetles can fly long distances in search of saltcedar trees. We hope to have beetles in all areas of West Texas within three more years. That doesn't mean there will be a beetle in every saltcedar tree, but over time, they will disperse throughout the region and have an area-wide impact on saltcedar."

"I think saltcedar beetles are going to be a long-term solution to controlling and managing saltcedar along all the watersheds where it occurs," Muegge said. "Once the beetles are established, it's the cheap way to go, and it's environmentally sound."

Michels said agencies and others have used herbicides and mechanical control to remove saltcedar, but those practices are very expensive. "If we can get biological control established, it's self-renewing," he said. "You don't have to pay more money each year."

Judging from the success of the program in other western states that began before the Texas program, DeLoach predicts "spectacular and very rapidly increasing success."

Nevada has 340 river miles of almost total defoliation, and beetles released on the Colorado River have done well, defoliating about 1,000 river miles in Utah, western Colorado, and northwestern New Mexico since 2005.

"This gives us a perspective of what we could have here," DeLoach said. "We could have 1,000 miles or more defoliated in another two or three years."

For more information on saltcedar control in Texas, visit *twri.tamu.edu/txH2O.*

Story by Danielle Supercinski

Battling Golden Algae

Results suggest preventative lake management approaches

Golden algae blooms, or the explosive growth of algae, are known to be toxic, but recent findings from three university researchers from Texas provide potential methods to prevent these harmful algal blooms.

Dr. Daniel Roelke with Texas AgriLife Research at Texas A&M University, Dr. James Grover with the University of Texas at Arlington, and Dr. Bryan Brooks at Baylor University, working jointly, recently completed the Lake Granbury and Lake Whitney Assessment Initiative project studying the biology and ecology of golden algae (*Prymnesium parvum*) in Texas lakes. First appearing in Texas in 1985 in the Pecos River, golden algae has since appeared in most of the 25 major river systems throughout the state. Although it can exist in waters without being harmful, the algae caused major fish kills in five of the state's river systems.

As a result of their research, they discovered three approaches to lake management that seem to work in preventing and/or reducing golden algae blooms in Lake Granbury.

"We were able to effectively utilize pH manipulation; hydrologic flushing manipulation, where we used water deeper within the lake and brought to the surface; and ammonia addition manipulation," said Roelke, associate professor in Texas A&M's Departments of Wildlife and Fisheries Sciences and Oceanography. "All three treatments prevented blooms from developing in prebloom conditions, and an experiment during a bloom lessened the effect of the bloom."

Roelke said that pH manipulation is the most promising lake management approach, and it wouldn't cost as much to implement as other approaches. "We only reduced the pH down to seven, so those conditions are not stressful to other organisms (within in the lake), and we quantified that. It negatively affected the *P. parvum* but didn't affect other plankton."

Brooks, associate professor in Baylor's Department of Environmental Science and Biomedical Studies, added: "These relationships between lower pH and reduced toxicity were consistent with our previous experiments with *P. parvum* in the laboratory and observations in Lakes Granbury and Whitney."

For the hydrologic flushing, Roelke said, "We took water from deeper within the lake, using the lake's own water for the treatment and moving it around within the lake. That seemed to work too, but the downside would be the infrastructure costs would be high."

While the ammonia treatment worked, it does have some pitfalls, Roelke said. "The low level of ammonia stimulated the bloom, and it became more

toxic. When more ammonia was added, that quickly killed the *P. parvum*. However, the downside with that higher level of ammonia addition is there was a four-fold increased production of other algae, which could be bad because of downstream effects."

In addition to the three treatments researched during in-lake experiments, their research showed that inflows of river and stream water also have an effect on golden algae blooms.

"We were very fortunate in observing a clear example of how a strong inflow event can terminate blooms, and this inspired us to look closely at historical data and discover strong relationships between flow and the occurrence of blooms," said Grover, a professor in UT-Arlington's Department of Biology. "Basically a period of low flow is a prerequisite for bloom formation. This was also demonstrated some in the mathematical models we developed. The spatial model we developed treats inflow more realistically than our other models."

While the model has not been extensively calibrated against observations, Grover said, in general it shows that high inflow has a very strong potential to terminate blooms and suppress or remove *P. parvum* populations. The model also suggests that high inflow events can have a long-lasting effect with many months passing before *P. parvum* becomes abundant again.

"First, (the model) provides us a way to examine the role of processes, such as inflows, we hypothesize to be important," Grover said. "We can build models with and without the process to see what happens. Second, modeling can allow forecasting, prediction, and evaluation of management and treatment scenarios.

"Achieving this with a model is challenging, and it usually requires several rounds of building models and comparing them to observations to have credible forecasting and prediction. We have at least been able to move our modeling in the right direction during this project."

Roelke said when they started these studies, they knew very little about golden algae. Information from the Texas Parks and Wildlife Department (TPWD) and the Brazos River Authority (BRA), combined with the extensive monitoring efforts of this research team, revealed the influence inflow and salinity have on bloom formation, and added historical context and extended the researchers' ability to reach conclusions about the factors of inflow and salinity.

An inflow event during winter of 2006-2007 eliminated the toxic bloom in Lake Granbury and lowered salinity, resulting in golden algae not blooming.

"This event demonstrated in a striking way that inflow has an important influence," Grover said. "Additionally, we were able to verify that some of the equations used in our modeling approaches can make short-term forecasts of the influence of such events."

Roelke added that the time scales under which salinity and inflow work are different.

"Salinity, when it gets reduced, stays low for years," he said. "Salinity increases happen over years, typically during extended periods with low precipitation. The really wet winter during 2006-2007 lowered lake-wide salinity, below a bloom threshold for golden algae. The salinity has not gone back up from that year, and *P. parvum* is even further removed from its growth optimum."

Grover said when they first started this research, they had two important questions about golden algae. "First, we had noted that within the Brazos River basin, Lake Waco had never experienced blooms, even though a sparse population was present, while Lakes Possum Kingdom, Granbury, and Whitney had experienced fish-killing blooms. We also had reason to suspect that cyanobacteria in Lake Waco were producing something that suppressed growth of *P. parvum*."

From that information, their two main questions were: 1) What is keeping *P. parvum* out of Lake Waco, and is it something produced by cyanobacteria? and 2) What factors allow *P. parvum* to bloom in cool weather while keeping it sparse during summer?

The researchers generalized their hypothesis about cyanobacteria and allelopathy (chemical warfare between species) keeping *P. parvum* from blooming in Lake Waco to say that whenever cyanobacteria are abundant, they will limit growth of *P. parvum*.

"We didn't get a clear answer to our questions about the allelopathy of cyanobacteria towards *P. parvum*," Grover said. "When we tested microcystin, a chemical commonly produced by cyanobacteria, it did not have a negative effect on *P. parvum*, and small amounts were even positive. However, cyanobacteria produces a variety of other chemicals that remain to be examined."

When looking at how seasons affect the blooms, they were able to gather some helpful information using current and historical information regarding inflows and salinity.

"In Texas waters, *P. parvum* blooms occur in relatively cool weather, usually starting in autumn or winter and then ending in late winter or spring," Grover said. "*P. parvum* populations are consistently low during summer. In contrast, laboratory growth ⇨

Through previous funding, researchers conducted in-lake experiments using limnocorrals at Lake Granbury focused on mitigation of golden algae blooms.

experiments have consistently shown very rapid population growth at temperatures characteristic of summer, and slow to moderate growth at the cooler temperatures of other seasons."

Roelke, Grover, and Brooks have learned a great deal more than was previously known about golden algae and their blooms through these past six years of research. However, more information is still needed.

"We know of many factors that influence golden algae blooms, but we need to understand them better to put into the model to better enhance our predictive availability," Roelke said. "The bulk of our human population in Texas is centered around our urban centers; our urban centers are growing, and they're not located in areas where there is a lot of water. So what that means is there is going to be less flow through our reservoirs and rivers."

He added that since inflows strongly influence blooms, if urbanization causes less inflow, then there is the risk of having stronger golden algae blooms.

"Lessons learned from our work in these heavily impacted Texas reservoirs are now supporting efforts in the northeastern United States, where *P. parvum* blooms have recently caused devastating fish kills in Pennsylvania and West Virginia," Brooks said. "For example, salinity and instream flow thresholds for harmful *P. parvum* blooms are critical in Pennsylvania and West Virginia, too. In fact, the approach employed in this project, which couples laboratory and in situ experiments with field monitoring and predictive modeling, is applicable to other regions of the United States."

Roelke said, "What we can do right now with very limited funding is get a detailed morphology of Lake Granbury. We need to know the contours of the coves because we need a better feel of hydrologic residence times in the coves, because if we pursue pH manipulation, we need to know the volume of the cove and how much chemical to add."

The researchers continue to study the effects of these treatments and management options using experiments and models working toward a larger in-lake demonstration, implementing some of these treatments to see their large-scale effects.

"We are in a strong position to plan careful pilot experiments at scales larger than those we've used before," Grover said.

The *Lake Whitney and Lake Granbury Assessment Initiative* was congressionally funded through the U.S. Department of Energy. The current, ongoing initiative is congressionally funded through the U.S. Army Corps of Engineers.

For more information about this research, please visit *twri.tamu.edu/txH2O*.

Story by Leslie Lee

Stakeholders (that's you!) hold the key to improving Texas water

Why public participation matters and stories from a few folks who've proved it

It's been said a thousand times for a thousand different causes: "Get involved!"

It may be a cliché that goes in one ear and out the other. However, when it comes to improving local water quality, public participation makes or breaks an effort. Stakeholders—local residents and landowners who affect or are affected by water improvement efforts in their communities—are essential, according to those involved.

"Stakeholder involvement is the only way to achieve successful implementation and eventual improvement of water quality," said Kevin Wagner, associate director of the Texas Water Resources Institute (TWRI).

The watershed approach, advocated by the U.S. Environmental Protection Agency (EPA), routinely culminates in a stakeholder-developed watershed protection plan (WPP) in Texas. Formed from science-based information, a WPP is a voluntary effort developed by local stakeholders to protect unimpaired surface waters and to restore impaired surface waters.

Helping develop a WPP is one way to participate in improving local water, but it's not the only opportunity available.

Everyone from teenagers to seasoned ranchers can participate in local water efforts. A college degree or extensive writing experience are not required. The following three people have proved that all that's required to make an impact is a little time and the willingness to learn.

The County Commissioner

Dickie Clary, who serves as a Hamilton County Commissioner, first started learning about water quality issues and regulations so he could best serve his constituents, who were faced with two impaired water bodies: the Leon and Lampasas rivers.

After identifying certain parts of the Leon River below Lake Proctor as impaired, in 2002, the Texas Commission on Environmental Quality (TCEQ) initiated a total maximum daily load (TMDL).

"I got involved with the Leon River TMDL process several years ago when TCEQ told us that there was an impairment," Clary said. "I didn't know anything about water quality issues, so I educated myself, went to meetings, and studied how TMDLs work."

The resulting TMDL report suggested that bacteria loadings into the Leon River needed to be reduced by about 21 percent to meet water quality standards and support contact recreation use. According to the Texas State Soil and Water Conservation Board (TSSWCB), local stakeholders wanted to take an active role in developing management strategies to reduce bacteria loadings ⇨

As Hamilton County Commissioner, Dickie Clary continues to be involved with local water quality.

and, in 2006, the board and the Brazos River Authority (BRA) began facilitating the WPP process.

"Now I'm learning about watershed protection plans," Clary said. "Community involvement in developing the WPP has been extremely positive and everyone has felt like their input was valuable. I feel that when the WPP is made public, people won't see it as intrusive, but see it as our best ideas, our plan."

The Leon River WPP final draft will be released for public comment soon, and the neighboring Lampasas River WPP is still in stakeholder development, Clary said.

"Mr. Clary has been very active in the Leon River and Lampasas River WPPs and has become a spokesperson for rural Texans on bacteria water quality issues, especially the TMDL and bacteria water quality standards revision processes administered by TCEQ," Wagner said.

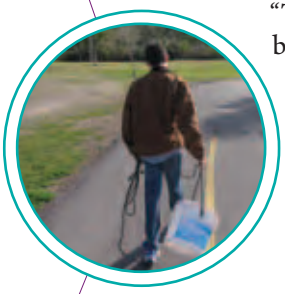
As he and other stakeholders continue to work toward implementing the WPPs, Clary said he will continue learning and working with the community to improve local water quality.

"Our community and I fully support the WPP, and I think it's just the right focus," Clary said. "It's ultimately up to the stakeholders to implement it. It gives us the opportunity to solve our own problems."

The High School Student

Regularly measuring local water quality isn't exactly a popular activity for most teenagers, but it is a normal routine for 14-year-old Weslaco resident Ruben Saldaña Jr. In November 2009, Saldaña started volunteering with Texas Stream Team, and his interest in water quality has only grown since.

Texas Stream Team is a network of more than 1,400 trained volunteers who collect water quality data on rivers, streams, wetlands, bays, bayous, and estuaries across the state. Established in 1991, it is administered through a cooperative partnership among Texas State University, TCEQ, and the EPA.



"Through my 4-H club, I got trained by Texas Stream Team, and I really started getting involved with it," Saldaña said. "They told me to pick one sampling site, so I chose three—one each in the upper, middle, and lower Arroyo Colorado."

The Arroyo is an impaired water body because of its bacteria levels, and Saldaña said that his findings have supported that. After testing samples at each site once or twice a month, the high school freshman has observed fluctuations in water quality.

"*E. coli* counts were really high after Hurricane Alex," Saldaña said.

Saldaña's eighth-grade science project focused on his volunteer water sampling. He earned first place in district and regional fairs, and eventually competed at the state science fair. He also presented his findings to a stakeholder meeting of the Arroyo Colorado Watershed Partnership, which is managed by TWRI.

"When I went to the state science fair, I told other kids about Texas Stream Team and tried to get them involved," Saldaña said. "Organizations need kids' input too, because we have good ideas to contribute."

On Aug. 15, 2010, he had an opportunity to influence a wider audience. Saldaña and Jaime Flores, watershed coordinator for the Partnership, were featured on "Inside the Valley," a news segment on KRGV Channel 5 in the Rio Grande Valley. Flores and Saldaña discussed pollutants contaminating the Arroyo Colorado and how residents could help improve water quality.

From top:

Arroyo Colorado Watershed Coordinator Jaime Flores (right) congratulates Ruben Saldaña Jr. for winning first place in a science contest for water conservation at the Texas Irrigation Expo in October 2010. Saldaña received $1,500 for his water quality study of the Arroyo.Photo courtesy of Ruben Saldaña Jr.

As a member of the Texas Stream Team, Ruben Saldaña Jr. regularly takes water quality samples from the Arroyo Colorado. Photo courtesy of Ruben Saldaña.

Ruben Saldaña Jr. collects water samples from three different Lower Rio Grande Valley cities. Photo courtesy of Ruben Saldaña.

Saldaña said he plans to study biology at Texas A&M University, but is also considering a field involving water. For now, he will keep studying and advocating for youth involvement in water quality and the Texas Stream Team.

The Rancher

Burl Brim grew up near Buck Creek in the Texas Panhandle. He and his wife, Mary, have witnessed the evolution of the creek's flow and quality since they moved back to his family's farm near Wellington.

"I've known Buck Creek since I was in preschool," Brim said. "I've fished it, I've swum in it, I grew up in it, and it has been a wonderful place for me over the years. But I've seen Buck Creek go from a very, very nice creek to a part-time creek."

Burl and Mary Brim first read about the WPP development for Buck Creek, a small water body within the Red River Basin, in the Wellington newspaper. The WPP project was initiated because water quality monitoring data showed elevated bacteria levels in the creek, possibly making it unsafe for recreation.

The project team identified sources of *E. coli* in the creek using bacterial source tracking, evaluated potential management alternatives for restoring the water body, and taught landowners like the Brims the benefits of best management practices.

"We learned some really important things through this process," Brim said. "My dad farmed cotton and grain sorghum for many years, but when we came back to the farm, which was inevitable, we turned it back into grass and trees. I knew that soil conservation was very important and that water was tough to control, because I grew up in agriculture."

Local water may be difficult to control, but Buck Creek stakeholders have helped improve it. When TCEQ released the draft of the 2010 *Integrated Report* (previously known as the *Texas Water Quality Inventory and 303(d) List*), it proposed removal of Buck Creek from the list.

"The removal of Buck Creek is a direct result of the efforts of local landowners," said Lucas Gregory, the TWRI project manager coordinating the Buck Creek project. "Stakeholders have adopted and implemented numerous management practices discussed during stakeholder meetings and educational workshops; these practices have certainly influenced the quality of water in Buck Creek."

In addition to participating in the Buck Creek project, the Brims sometimes host elementary school class field trips at their ranch. After working as a professional watercolor painter and teacher for 40 years, Brim appreciates children's interest in nature and sees a need for youth water education.

"Kids are drawn to what's here in creation, and I really believe that we have to teach kids about these things and get them involved in helping the environment—kids enjoy that," Brim said. "Every school ought to have kids learning about water firsthand by regularly monitoring water quantity and quality."

Currently, the draft Buck Creek WPP is being reviewed by TSSWCB and will then be reviewed by stakeholders. In the meantime, the Brims will continue to implement what they've learned.

"I think getting involved with local water issues is an opportunity to learn," Brim said. "It's an important opportunity to find out what other folks are doing to protect the environment and how you can help."

The Solution

Thanks to opportunities such as EPA's Clean Water Act Section 319(h) grant program, water quality improvement projects are being funded and implemented through TCEQ, TSSWCB, and other agencies and universities across the state—combining financial and scientific support with grassroots efforts and local decision making.

"I'm a firm believer in local decision making," Wagner said. "There's nobody better qualified to identify the 'fixes' to local issues than local residents and decision makers."

"Landowners and stakeholders usually already have a pretty good idea about what is causing local water quality issues in the first place," Gregory said. "Including their ideas into a project saves time and money more often than not."

Every WPP project begins and continues with stakeholder involvement, and TWRI and agency personnel value the input, observations, and wisdom that locals have to offer.

"Stakeholder involvement in a project gives it local credibility," Gregory said. "One of the most helpful things that stakeholders can do to help enhance the success of local implementation efforts is to become an advocate for the project—participating, providing honest thoughts and comments, and encouraging other people in the watershed to participate."

To learn how to impact local water quality, see the list of programs and resources at *twri.tamu.edu/txH2O*.

From top:

Burl Brim along with his wife, Mary, are active in the watershed protection plant for Buck Creek.

Buck Creek, according to landowner Burl Brim, has gone "from a very, very nice creek to a part-time creek."

Story by Kathy Wythe

Deep in the forests

Program works to protect water quality through forestry practices

The Texas Forest Service works with forestry professionals to implement best management practices to help protect water quality, which is critical for people and wildlife to survive. Photo courtesy of Texas Forest Service.

Deep in the forests of East Texas and scattered in pockets of other parts of the state are more than 12 million acres of commercial timberland. Providing protection for the water quality of the streams, rivers, and lakes throughout these forests is a successful Texas Forest Services (TFS) program.

Through TFS's Water Resources Program, forest service staff members educate forest landowners, professional foresters, harvest contractors, and others about threats to water quality, and provide technical assistance for best management practices (BMPs) that minimize erosion and nonpoint source water pollution in the forests.

"We target a wide range of forestry professionals to encourage and promote forestry BMPs," said Hughes Simpson, program coordinator. "We believe it's everyone's responsibility to protect water quality, so we try to promote these practices to the entire forest sector."

Since the beginning, the forest industry and landowners have supported the adoption of BMPs, and implementation has grown annually. As of December 2008, Simpson said, 91.5 percent of all forestry operations monitored by TFS are following BMPs, representing a 20 percent increase since a monitoring program began in the early 1990s.

The program began in 1989 after the reauthorization of the federal Clean Water Act shifted more attention to nonpoint source pollution programs, Simpson said. Nonpoint source pollution is caused by water moving over the ground, picking up natural and manmade pollutants and depositing them in lakes, rivers, wetlands, coastal waters, and underground water. BMPs offer site-specific practices to control potential nonpoint source pollution.

As part of the program, the TFS and Texas Forestry Association jointly published a 123-page guidebook, *Texas Forestry Best Management Practices*, which gives detailed specifications for more than 60 described practices. Simpson said the book is updated frequently—the latest update was in August 2010—to reflect current research and knowledge of operational methods. A task force with members from state and federal agencies, landowners, academia, foresters, and loggers meets periodically to review the program.

One of the key management practices the forest service recommends is establishing streamside management zones. This entails leaving a buffer strip of trees, preferably 50 feet wide, along both sides of the stream.

"This buffer helps to filter runoff water, to provide wildlife habitat, and to maintain bank stability," Simpson said. "It also maintains internal stream temperatures by providing shade to the stream, which helps aquatic species."

Other recommended practices include using portable or permanent bridges across streams and installing erosion control structures on forest roads, which help minimize the amount of sediment flowing into the water. An example of an erosion control structure, Simpson said, is a water bar, which is a berm of soil installed on the road to divert runoff water from the roadway back onto the forest floor. This slows runoff water and allows the removal of sediment before the water reaches the stream, he said.

For 10 years, Thom Karels, a landowner in Leon County and president of the Texas Forestry Association, has put into place some of the recommended BMPs, including streamside management zones, water bars, and wing ditches, on his 3,300 acres of forests. He follows the BMPs because he wants to keep them voluntary, but he also realizes the importance of protecting the environment and keeping water quality high. "Growing up and living in the country, you appreciate the environment a lot more," Karels said.

The program educates the various segments of the forest industry through several avenues.

The Texas Professional Logger Program, a continuing education program for loggers, includes training on forestry BMPs. Since the training program began in 1995, TFS has trained 3,000 logging contractors on BMPs, Simpson said.

Program staff members also speak to county forest landowner associations throughout the state, he said, providing information and technical assistance on these practices.

"We also install BMPs as demonstrations on some of the state forests, so people can see how BMPs are implemented in the field," he said. ⇨

Texas has more than 23 million acres of forests, most of it in East Texas. Photo courtesy of Texas Forest Service.

Other public outreach includes displays at trade shows and county fairs, highway billboards, and radio and television commercials.

Even with its success, Simpson said, the staff is focused on continually improving the program. Through monitoring, randomly selected forestry operations are evaluated to determine the level that these practices are applied. "Monitoring results provide us with a clear assessment of the effectiveness of our education, outreach, and technical assistance efforts, as well as identify areas that need improvement," said Simpson.

Because of this monitoring, they have developed two additional continuing education BMP-focused workshops on stream crossings and forest roads to address these areas. Every three years, the BMP program publishes a report, *Voluntary Implementation of Forestry Best Management Practices in East Texas*, which describes the level at which BMPs are being applied. Since 1991, the TFS has completed seven BMP implementation surveys. The 2008 survey showed the 91.5 percent level.

The program has also conducted a study designed to measure the effectiveness of the BMPs in preventing nonpoint source pollution. The project monitored and compared the chemical and biological properties of four East Texas streams before and after forestry operations.

"We were looking to see if there were any differences in stream properties before and after these operations," Simpson said. "With the use of BMPs, we found no differences in water quality. Based on these findings, we felt confident in stating that not only are these practices being implemented wide-scale, but they also are effective at protecting water quality."

For more information, visit *twri.tamu.edu/txH2O* or visit the TFS's website at *texasforestservice.tamu.edu/*.

Texas Forestry Facts:

Computer models predict that the each year Texas Forest Service Water Resources Program prevents 91,520 tons of soil from eroding off of East Texas forests and 12,387 tons of soil from reaching East Texas streams. This is enough soil to cover a football field, end zone to end zone, over 30 feet high.

The 77th Texas Legislature passed the Texas Reforestation and Conservation Act of 1999 that provided property tax incentives for landowners protecting water quality by installing buffer strips, or streamside management zones (SMZs), on their property.

The program has won numerous awards including the 1993 EPA Region 6 Regional Administrator's Environmental Excellence Award, 1995 Texas Forestry Association's President's Citation Award, 1998 Texas Environmental Excellence Award, and the 1998 USFS Conservation Education Outstanding Achievement Award.

The new BMP guidebook is available at *texasforestservice.tamu.edu/bmp.*

From TFS materials

Story by Melanie Orth

Rainwater for the future

Rainwater harvesting increases in popularity across the state

Richard Green constructed an underground 20,000-gallon concrete tank for a rainwater harvesting system for his business. Photo by Richard Green.

As the need for water conservation becomes more apparent, residents across Texas are incorporating rainwater harvesting into their everyday lives. This innovative conservation technique involves capturing, diverting, and storing rainwater for later use.

Reducing water costs and lessening the demand on water resources are the two main reasons people become interested in rainwater harvesting, said Billy Kniffen, Texas AgriLife Extension Service water resource specialist.

"Most people who get involved just want to make a difference and be a part of the green effort to use less energy and water," he said.

Kniffen, who has statewide responsibility for rainwater harvesting education for AgriLife Extension, said interest in rainwater harvesting mostly begins by word of mouth.

"Master Gardeners are influential in spreading information about local programs," Kniffen said. Master Gardeners receive 16 hours of rainwater harvesting training and are armed with educational materials to contribute a minimum of 50 hours of volunteer service to earn the title of Master Gardener—Rainwater Harvesting Specialist. The training allows them to volunteer through local AgriLife Extension offices to provide horticultural-related information to communities.

In 2004, AgriLife Extension and the Texas Water Resources Institute (TWRI) established the Rainwater Harvesting Task Force, a multidisciplinary group of 18 or more members whose goal is to teach and train others about capturing and managing rainfall, according to B.L. Harris, TWRI acting director.

Since its inception, the rainwater harvesting education group has developed several courses geared towards rainwater stewardship, published peer-reviewed Extension publications including a new rainwater harvesting manual, developed video clips teaching rainfall capture techniques, and created a rainwater harvesting website, *rainwaterharvesting.tamu.edu*. The team has also installed rainwater harvesting demonstrations at 37 different locations across the state, including more than 20 locations in West Texas and the Rio Grande Valley. ⇨

Richard Green's commercial rainwater harvesting system involves running the water through an ozone treatment recirculation system and a UV light, making the water readily available. Photo by Richard Green.

For its efforts, the team was awarded the 2008 Superior Service Award from AgriLife Extension.

Kniffen said the cost of implementing a rainwater harvesting system varies depending on the system.

"A simple rain barrel can be built for $20-$35," he said, "or bought for $100. Many who get involved have 1,000 gallons of storage, which costs less than a $1,000."

The cost also depends on the type of tank installed and who the installer is. Having a company install the system costs about twice as much, he said.

Kniffen, who lives exclusively on rainwater in dry West Texas, said his system cost $10,000.

He and his wife decided to capture rainwater while building their house because they had no access to city water and the groundwater was of questionable quality. Kniffen collects water off his house and barn roof, which is about 5,900 square feet of catchment area.

Like Kniffen, when John Kight began building his house in Boerne, he decided to use rainwater as the sole source of his water supply because the groundwater in his area was too hard and contained iron and sulfur.

"Installing a well would have cost $26,000, and I spent $14,500 on the rainwater system," Kight said.

His rainwater harvesting system includes a 7,826-square-foot roof area, and seven 5,000 gallon, three 1,550-gallon, and one 1,000-gallon above-ground polypropylene tanks for water storage. "With this system I can collect close to 4,800 gallons of rainwater per inch of rain," he said.

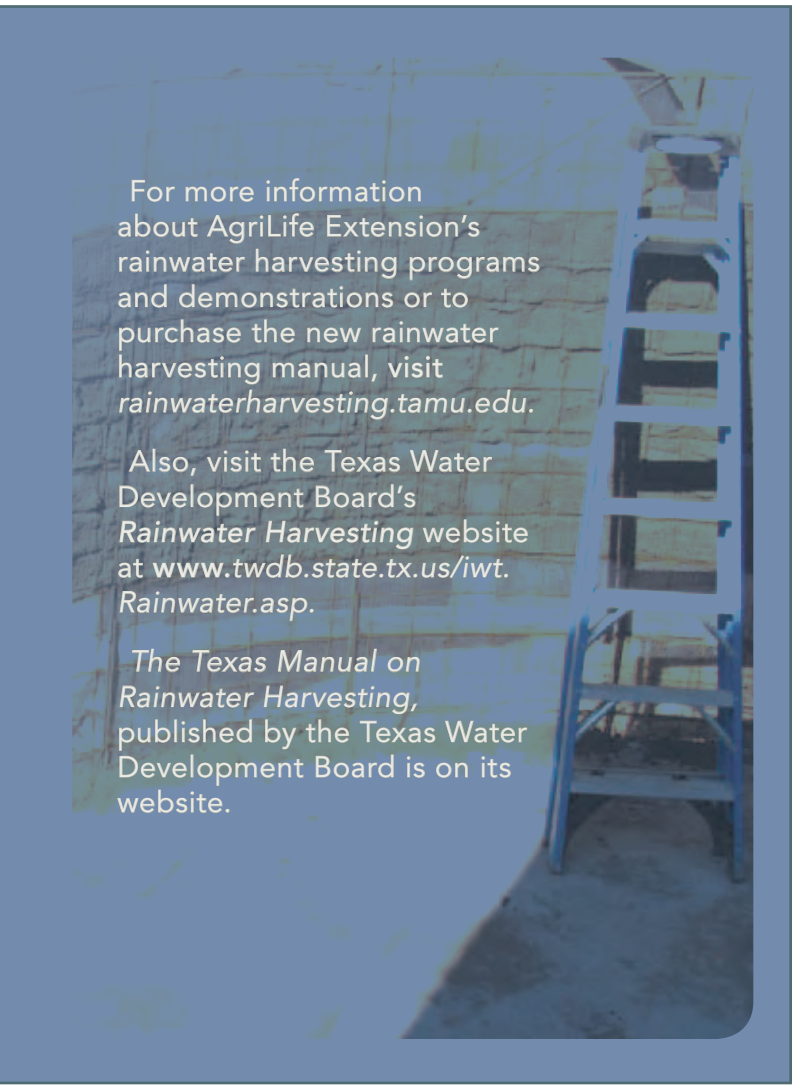
Kight said he sees many benefits in rainwater harvesting.

"It's as close to pure water as you can get," he said, "and I don't have to deal with lime build-up or water bills."

Kight has always been conservation-minded and gives numerous presentations and workshops to the community to encourage rainwater harvesting.

He was awarded the 2008 Texas Rain Catcher Award from the Texas Water Development Board, which recognizes excellence in the application of rainwater harvesting systems in Texas.

Although most rainwater harvesting systems are for private use, about 25 percent are for commercial use, Kniffen said.



For more information about AgriLife Extension's rainwater harvesting programs and demonstrations or to purchase the new rainwater harvesting manual, visit *rainwaterharvesting.tamu.edu.*

Also, visit the Texas Water Development Board's *Rainwater Harvesting* website at **www.***twdb.state.tx.us/iwt.Rainwater.asp.*

The Texas Manual on Rainwater Harvesting, published by the Texas Water Development Board is on its website.

Richard Green, owner of Magline Inc. in Plainview, began his commercial rainwater harvesting project after his company's building burned down.

Magline Inc. is a small manufacturing resource lab that develops foliar fertilizers or liquid solutions that are sprayed directly onto leaves.

When it came time to rebuild, Green decided to collect rainwater instead of drilling a well. "The water that is needed to make the fertilizers has to be soft and clean," he said. "The quality of water that rainwater provides is better for our products."

"It would have been cheaper to put in a well, but the water table in this area is declining," he said. Plainview is over the Ogallala Aquifer, which is depleting at rates of 1 to 3 feet per year.

His system is an underground 20,000 gallon concrete tank that runs rainwater through an ozone treatment recirculation system to disinfect the water and then through an ultraviolet light, making the water readily available and up to drinking water standards.

Green said it has always been a dream project for him, and he is anxious to get rainfall in the recently completed system.

Local governments are incorporating rainwater harvesting into their policies. Some cities and counties provide financial incentives for rainwater capture systems to encourage residents to conserve water.

The City of Austin Water Conservation Department promotes both residential and commercial rainwater harvesting by offering rebates from $30 to $5,000, depending on the system.

Rainwater harvesting projects in San Antonio are eligible for up to a 50 percent rebate of the installed cost of the system under the San Antonio Water System's Large-Scale Retrofit Rebate Program.

Universities across Texas are also catching on to the idea of rainwater harvesting. As new buildings are constructed on the Texas A&M University campus, rainwater harvesting systems are being implemented in accordance with Leadership in Energy and Environmental Design (LEED), which is a national rating scale developed by the U.S. Green Building Council to encourage sustainable buildings.

Texas A&M recently completed the George P. Mitchell '40 Physics Building and the George P. and Cynthia Woods Mitchell Institute for Fundamental Physics and Astronomy building. These buildings include a cistern that collects and stores both air conditioning condensate and rainfall that is used to irrigate exterior landscapes and the university's first rooftop garden.

The four-building Agriculture Headquarters Complex currently being constructed will capture roof rainwater into four 9,000-gallon cisterns that are part of the canopy structure. Water will flow into a 40,000-gallon underground tank that will be used for irrigation.

Two cisterns were installed at Texas Tech University on the east/west sides of the new Raider Park parking facility across from Jones AT&T Stadium. Each cistern can hold up to 14,700 gallons of rainwater that is used to supply the landscape irrigation system at Raider Park.

Rainwater harvesting is a promising alternative for supplying water in the face of increasing water efficiency needs. "Incorporating rainwater harvesting into everyday lives," Kiffen said, "can potentially ensure sufficient water quantity for years to come."

For more information on rainwater harvesting resources, visit *twri.tamu.edu/txH2O.*

Story by Melanie Orth

Controlling invasive weed

Center begins evaluating giant salvinia-eating weevils

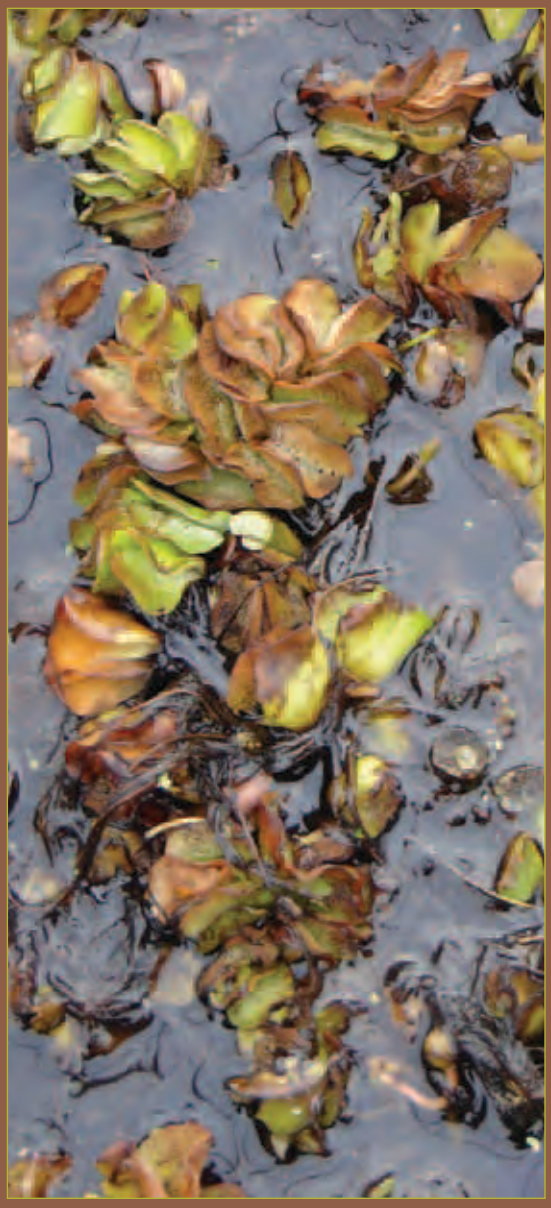
Project members of the recently funded Center for Invasive Species Eradication (CISE) have been hard at work managing the center's first undertaking, the *Caddo Lake Giant Salvinia Eradication Project*.

Giant salvinia is a free-floating aquatic fern that has aggressively invaded Caddo Lake and other lakes in Texas. The project, funded through the U.S. Department of Agriculture's Natural Resources Conservation Service and managed by the Texas Water Resources Institute (TWRI), is evaluating and demonstrating multiple control methods—biological and chemical—and assessing their effectiveness in killing giant salvinia.

In the fall of 2010, project members constructed weevil-rearing tanks covered by two large greenhouses at the Caddo Lake National Wildlife Refuge. Lucas Gregory, TWRI project manager, said the two greenhouses hold four large tanks, 48 feet long and 15 feet wide, and are infested with the plant's only biological enemy, the salvinia weevil. The weevil prefers warm temperatures and eats the giant salvinia as its only food source. These tanks are being used to grow giant salvinia and propagate salvinia weevils for release on Caddo Lake.

"Currently, water quality evaluations are being conducted to improve water chemistry and salvinia

Caddo Lake is the focus of the first project for the Center for Invasive Species Eradication. Scientists will demonstrate and evaulate different methods for controlling and preventing the growth of giant salvinia. Photo by Lucas Gregory.



Clockwise from left: Example of dead and dying giant salvinia in tanks at the Caddo Lake National Wildlife Refuge.

The project staff has constructed greenhouses with growing tanks with salvinia weevils and giant salvinia.

This invasive species has invaded Caddo Lake and other lakes in Texas. Photos by Lucas Gregory.

growing conditions in the beds, thus refining the science of growing the weevils," Gregory said. Eventually, when weevil numbers reach sufficient levels, they will be released on salvinia in the lake.

Other experiments with the tropical bugs are beginning as well. "We just initiated a 'weevil overwintering' study to evaluate impacts of cold weather on the weevils," said Patrick Ireland, Texas AgriLife Extension Service assistant and project coordinator for the center. Ireland and Dr. Allen Knutson, AgriLife Extension entomologist, have placed 40 small floating cages containing weevils in Caddo Lake near Goat Island and will monitor them throughout the winter. They will periodically remove the cages to determine what effect the cold weather has on weevil mortality, Ireland said.

Gregory said the project members, including Knutson; Dr. Michael Masser, AgriLife Extension fisheries specialist; Dr. Paul Baumann, AgriLife Extension weed specialist; Howard Elder, aquatic habitat biologist, and other Texas Parks and Wildlife Department staff will test this and other strategies to fight giant salvinia.

"Integrated pest management and herbicide experiments to control the invasive plant are being planned for next growing season," Gregory said.

State Legislature may consider few water issues

With the start of the 82nd Texas Legislature, water could be on the agenda but may be overshadowed by budgets, redistricting, and the sunset review of state agencies, according to those involved in water issues and law in Texas.

Groundwater rights versus desired future conditions

Groundwater rights may be the biggest water issue that comes before the Legislature because of a court case that has made its way to the Texas Supreme Court and because of a state bill passed in 2005.

The Texas Supreme Court is set to rule on Edwards Aquifer Authority v. Day, a case concerning vested groundwater rights and takings. Coupled with the pending (at press time) court case is the issue of desired future conditions (DFCs), which, some say, could threaten property owners' groundwater rights. In 2005, the Legislature passed a bill that requires groundwater conservation districts (GCDs) to work with others in their groundwater management areas to develop a joint management plan that establishes DFCs, or aquifers' conditions in 50 years for each aquifer. The Texas Water Development Board (TWDB) will use these DFCs to help determine the managed available groundwater for use by both GCDs and regional water-planning groups. Some groups are concerned that this process may result in restrictive DFCs, caps on overall production, and denial of permits once the cap is reached.

During the first week of the 82nd Legislature, Sen. Troy Fraser filed Senate Bill 332, which stated that landowners have a vested ownership interest in the groundwater beneath their property. According to Fraser's news release, he filed the legislation because some entities are challenging the Rule of Capture, established in 1904, in court. "For over 100 years, landowners have believed that the Rule of Capture gives them a vested private property right in the groundwater beneath their land," said Fraser in his release.

Fraser went on to say that the legislation is intended to work in conjunction with local groundwater conservation district regulation. Under the legislation, groundwater conservation districts could still require a landowner to get a permit and limit the amount of groundwater that can be produced. However, the legislation would prevent a district from "taking" a landowner's right to capture the water beneath the land.

Sunset review

During the interim, the Sunset Advisory Commission reviewed TWDB, the Texas State Soil and Water Conservation Board, and the Texas Commission on Environmental Quality. The Legislature will review the commission's recommendations for these water agencies.. The commission's reports on each agency may be viewed at www.*sunset.state.tx.us/.*

Resources

Keep track of bills filed in the 82nd Texas Legislature: *www.capitol.state.tx.us/.*

Several organizations have published position papers or fact sheets on water issues that may become before the Legislature. Please visit *twri.tamu.edu/txH2O* for a list of these resources.

CIRE ranks priority irrigation issues

The Consortium for Irrigation Research and Education (CIRE) recently compiled responses from a survey to determine priority irrigation research and education issues facing water users. Texas Water Resources Institute (TWRI) led this task.

TWRI used survey responses to develop a list of 16 irrigation research and education topics. That list was sent to the CIRE listserv and to irrigation district managers, state agencies, agricultural producers, and others to be ranked by order of importance. Responses were returned from Texas AgriLife Research, the Texas AgriLife Extension Service, agricultural producers, underground water conservation districts, licensed irrigators, U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service, Texas A&M University–Kingsville, Texas Tech University, Texas Water Development Board, and USDA Agricultural Research Service.

The group's top five priority irrigation issues are:

- Research on water-use efficiency and on irrigation amounts, timing, and conservation relative to yield and crop quality impacts, and water-use efficiency
- Deficit irrigation, crop adaptation to drought stress, optimizing irrigation for pest and disease stress (IPM), primed acclimation, and precision irrigation
- Designing cropping systems, new drought-tolerant varieties, and selecting cultivars to minimize irrigation demands
- Practices for using limited quality water for irrigation on a sustainable basis
- Research and education on precision irrigation and sensing practices and technologies, efficacy, and economics

TWRI and CIRE experts hope this information will help better focus irrigation research and educational programs, assist commercial firms with equipment needs, and help to better target available funding, according to B.L. Harris, TWRI's acting director.

For the full list of all 16 priorities and additional information on CIRE, please visit CIRE's website at *cire.tamu.edu.*

TWRI welcomes new staff

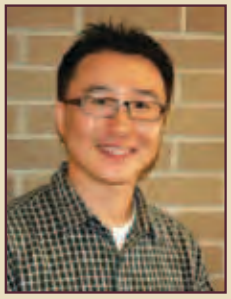
Brian VanDelist became a project manager for Texas Water Resources Institute in September 2010. He is responsible for several projects focusing on water quality impairments. Before joining the institute, VanDelist was a graduate teaching assistant in soil science at Sam Houston State University. He previously worked as a soil conservationist for the U.S. Department of Agriculture's Natural Resources Conservation Service. He earned a bachelor of science degree in animal science and is currently completing a master of science degree in agriculture with an emphasis in animal and plant sciences, both from SHSU. After completing his master's degree, he plans to begin working on his doctorate in rangeland ecology and management at Texas A&M University.

Patrick Ireland also joined the institute in September 2010 as a Texas AgriLife Extension Service assistant for the Center for Invasive Species Eradication's *Caddo Lake Giant Salvinia Eradication Project*. He coordinates and facilitates activities that are carried out near and at Caddo Lake. He manages the salvinia weevil-rearing facility and monitors the effectiveness of the weevils on the giant salvinia after they are released into the lake. Prior to joining the institute, he was a fisheries intern for Texas Parks and Wildlife Department and a graduate teaching assistant for fisheries management and animal ecology courses at Texas A&M. Ireland earned a bachelor of arts degree from the University of Mississippi and a master of wildlife and fisheries science degree from Texas A&M.

Water-related faculty join AgriLife Research

Dr. Nithya Rajan joined Texas AgriLife Research in July as the assistant professor in cropping systems and is stationed at the Texas AgriLife Research and Extension Center at Vernon. Rajan provides agronomic leadership to an interdisciplinary team that is developing and evaluating cropping systems for water-limited environments. She earned a bachelor's degree in agriculture from Kerala Agricultural University in India, a master's degree in soil science and agricultural chemistry from the Acharya N.G. Ranga Agricultural University in India, and a doctorate in agronomy from Texas Tech University. Previously, she was a post-doctoral research associate for the Texas Alliance for Water Conservation Demonstration Project with Texas Tech's Department of Plant and Soil Sciences.

Dr. Srinivasulu Ale is the new assistant professor of geospatial hydrology at the Texas AgriLife Research and Extension Center at Vernon. He will also have an academic appointment with the Department of Biological and Agricultural Engineering at Texas A&M University. Ale investigates water and nutrient balance under complex cropland and rangeland management systems and develops management strategies to increase water-use efficiency and protect water quality. Ale earned a bachelor's degree from Andhra Pradesh Agricultural University in India, a master's degree from the G.B. Pant University of Agriculture and Technology in India, and a doctorate from Purdue University in Ale joined Texas AgriLife Research in December 2010.



Dr. Seong Park joined Texas AgriLife Research in September 2009 as a research economist for both the Vernon and Amarillo centers. He works with crop and livestock production, watershed protection, groundwater modeling and nitrates in the water, the Ogallala Aquifer program, an air quality federal initiative, and irrigation water management and bioenergy feedstocks. Park earned a bachelor's degree in economics from Kyungpook National University in South Korea, a master's degree in agricultural economics from West Texas A&M University in 2005; and a doctorate in agricultural economics from Oklahoma State University in 2009.

Texas AgriLife Extension Service

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