New Waves
The Research Newsletter of the Texas Water Resources Institute
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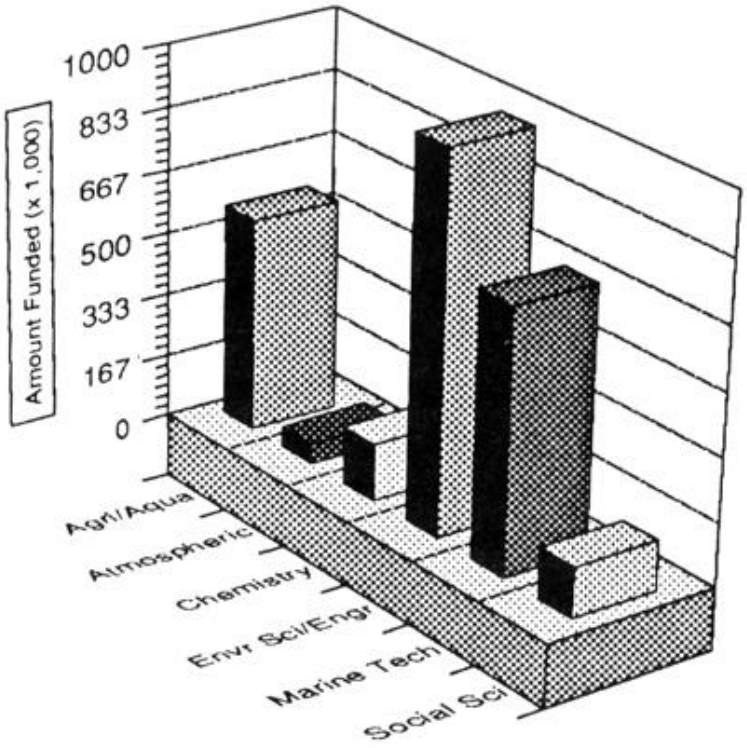
## *24 Water-Related Projects Funded Through TATRP*

Universities throughout Texas learned in October that 24 water- related projects worth roughly $2.1 million will be funded through the Advanced Research and Advanced Technology Program (TATRP). The programs, which awarded 469 projects worth more than $64 million overall, are administered by the Texas Higher Education Coordinating Board.

Future issues of *New Waves* will have additional information on many of these projects. For more information on any project, please contact the scientists directly. Some of the projects that received TATRP funding include the following studies.

Agriculture and Aquaculture "Biology and Public Health Significance of Vibrio Vulnificus in Texas Oysters," John Schwarz, Donald Lewis, and William Fisher, Texas A&M University at Galveston and Texas A&M University; "Hormonal Enhancement of Growth and Development in Red Drum," Duncan McKenzie and Delbert Gatlin, Texas A&M University; "Texas Native Range Species: Unique Sources of Drought Resistant Genes," Ronald Newton and Ed Funkhouser, Texas A&M University; and "Economic Evaluation of Risk Reduction in New Aquaculture Systems in Texas," Wade Griffin, Texas A&M University.




Atmospheric Science "Remotely Sensing Rain: Problems in Nonhomogeneous Fields of View," Charles Graves, Texas A&M University; and

"Numerical Prediction Error Dependence on Circulation Regimes: Assessing Reliability of Medium Range Numerical Forecasting," Steve Lyons, Texas A&M University; "Investigations of Potential Man Induced Climate Change: Guidance for the Planning of New Technology," Tamara Ledley, Rice University.

Chemistry "Interfacial Water Surfaces, Pores, Bubbles and Biology," Wilse Robinson, Texas Tech University.

Environmental Science & Engineering "Methanogenic Bacteria in Deep Aquifers: Distribution and Impact on Groundwater Chemistry," Ethan Grossman and James Ammerman, Texas A&M University; "Detoxification of Hazardous Liquid Wastes," Richard Timmons, University of Texas at Arlington; "Improved Biodegradation of Chlorinated Solvents Using a Methane Degrading Microorganism," Gerald Speitel and George Georgiou, University of Texas at Austin;"Sulfate Reducing Bacteria: Metal Metabolism and Biological Removal of Toxic Heavy Metals," Neal Guntzel and Stuart Birnbaum, University of Texas at San Antonio; "Stabilization and Pasteurization of Municipal Sludges with Lime," Joseph Malina, University of Texas at Austin; "Evaluation of Low Pressure Ceramic Membranes for Potable Water Treatment," Mark Wiesner, Rice University; "Statewide Ground Water Protection Mapping Using Geographic Information System Modeling," Samuel Atkinson and Ken Dickson, University of North Texas; "Natural Salt Pollution and Reservoir Yield," Ralph Wurbs, Texas A&M University; "Using Remote Sensing Techniques to Monitor the Distribution and Abundance of Oyster Reefs Along the Texas Coast," Frank Judd, Pan American University, and "Urban Irrigation Scheduling: A Management Technique for Municipal Water Supply Systems," John Borrelli and Richard Zartman, Texas Tech University.

Marine Technology 'What Maintains the High Finfish Productivity in the Laguna Madre Fishery?", Paul Montagna, Anthony Amos, and Ronald Benner, University of Texas at Austin; "Salinity Effects on Molting and Calcification in Blue Crabs," James Cameron, University of Texas at Austin; "The Shallow Water Mesocosm as a Tool for Fishery Research: An Application for Enhancing Texas' Recreational Fishery," Lee Fuiman, University of Texas at Austin; "Natural Radioactivities as Indicators of Marine Biological Productivity," David Schink and Luis Cifuentes, Texas A&M University.

Social and Behavioral Sciences "Chaos Theory and the Houston Housing Market: Assessing the Social Cost of Toxic Waste Sites," Steven Craig and Janet Kohlhase, University of Houston; "Third Party Tactics for Environmental Dispute Resolution," James Esser and Richard Marriott, Lamar University.

## *Gulf Coast Hazardous Substance Research Center Announces New Projects*

The Gulf Coast Hazardous Substance Research Center at Lamar University has announced that it will fund a number of projects this year concerning waste minimization and the development of alternative technologies. The center is funded in part by the Texas Legislature and the U.S. Environmental Protection Agency (EPA). Researchers from Texas A&M University, Lamar University, the University of Houston, the

University of Texas at Austin, Mississippi State University, Louisiana State University, the University of Central Florida, and the University of Alabama are eligible for research funding from the center.

This year's projects include such areas as recycling and reuse, the development of genetically engineered organisms to degrade hazardous wastes and others. Many of the projects chosen for funding have direct application to water research. A partial list of the studies selected for funding includes the following projects.

Studies funded at Texas A&M University include: "Design of Biodegradation Systems of Onsite Remediation of Contaminated Riverine Sediments Employing Thermal Chromatography and Rapid Toxicity Analysis" by T. Rick Irvin; "Binding Chemistry and Leaching Mechanisms in Solidified Hazardous Waste," by Bill Batchelor and David Cocke, and "In- Situ Soil Remediation through Contaminant Mobilization by Vacuum Stripping Combined with Biodegradation," by Aykin Akgerman, Robin Autenrieth and James Bonner.

Studies funded at the University of Texas at Austin include: "Fate of Volatile Organics in Soil," and "Migration Potential of Constituents in Contaminated Soils at Closure," both by Raymond Loehr; "Facilitated Transport and Remediation of Hazardous Waste Sites," by Randall Charbeneau; "Anaerobic Degradation of Halogenated Phenolics in Granular Activated **Carbon Packed Bed Reactors,"** by Joseph Malina; "Electrokinetic Detoxification of Contaminated Soils," by David Daniel and Howard Liljestrand; "Biodegradation of Organic Pollutants by a Lignin- Degrading Enzyme System," by George Georgious; "Development of a Microreactor Technology - Destruction of Toxic and Hazardous Materials under Supercritical Water Oxidation Conditions," by Ernest Gloyna, and "Decision Analysis: Physical and Chemical Technologies for Aqueous Organic Hazardous Waste," by Desmond Lawler.

Studies funded at the University of Houston include: "Reactor Modeling and Simulation for Deep Well Oxidation of Aqueous Hazardous Wastes," Harry Deans and Vemuri Balakotaiah; "Hydrogen Peroxide/ Ultraviolet Irradiation Process for the Treatment of Contaminated Groundwater," Jerry Symons and Howard Prengle; "Performances of Fractured Clay under Hazardous Waste Environments," C. Vipulanadan, O.I. Ghazzaly, and M.W. O'Neill; "Choosing Landfill Sites: Stable Isotope Analysis of Groundwater as an Evaluation Tool," James Lawrence, and "An Operator Splitting, Domain Decomposition Numerical Model for Contaminant Transport in Aquifer Flow," John Killough and Mary Wheeler.

C. Vipulanadan of the University of Houston and Saeed Daniali and Dale Ortego of Lamar University are collaborating on a project titled "Leaching Mechanisms and Performance of Solidified and Stabilized Hazardous Waste Substances in Modified Cementitious and Polymeric Matrices."

Studies funded at Lamar University include the following: "Biological Treatment of Hazardous Wastes and Leachates," by William Morgan; "Electrocatalytic Detoxification

of Halogenated Compounds Solubilized in Microemulsions," by Shyam Shukla; "Assessing Attitudes and Obstacles Involved in Siting Hazardous Waste Disposal Facilities," by Stuart Wright, and "Treatment of Chloro- Hydrocarbon Contaminated Groundwater by an Integrated Method of Stripping, Adsorption and Bioregeneration," by KuYen Li.

For additional information on any of these projects, contact: Gulf Coast Hazardous Substance Research Center, PO Box 10613, Lamar University, Beaumont, TX 77710. The phone number is (409) 880-8768.

## *Classifying Texas' Aquatic Communities to Protect Endangered Species*

Researchers: Edwards, Robert, Biology Dept., Pan American University, Edinburg, TX; Glenn Longley, Edwards Aquifer Research and Data Center, Southwest Texas State University, San Marcos, TX; Randy Moss, Texas Parks and Wildlife Dept., Austin, TX; John Ward, Texas Water Commission, Austin, TX; Ray Matthews, Texas Water Development Board, Austin, TX; and Bruce Stewart, Biology Dept., Murray State College, Tishomingo, OK.

Problem: Many of Texas' aquatic species have become threatened by limited water supplies in portions of the state and by increasing use of water by human activities. Species near springs are especially vulnerable.

Objectives: To develop a system to classify which species are most threatened in particular geographic regions or among similar ecosystems to enhance conservation efforts.

Methodology: The classification system incorporates two main components: environmental requirements of animal species and types of aquatic habitats present in Texas. Aquatic habitats were broken down into headwaters and creeks, springs, spring-fed systems, streams, rivers, sinkholes, playa lakes, aquifers, natural lakes (manmade reservoirs were not included in this study), swamps and coastal aquatic systems. Lists were compiled for both endangered and threatened vertebrates that required aquatic resources at some point during their life cycle (migratory birds) and for fish, reptiles, and amphibians that were undoubtedly members of aquatic communities.

Results: The greatest number of endangered and threatened organisms inhabit either large river or permanent stream habitats, followed closely by spring and spring- fed systems. Swamps, aquifers, lakes and intermittent creeks had the fewest threatened species. Two regions of the state- far west Texas and east Texas forests - contained the largest number of endangered species. This reflects the diversity of species in east Texas and the lack of water in west Texas. More than half of native fishes in far west Texas are threatened with extinction, a rate four times greater than any other region. Much of the danger comes from declining levels of springflow.

Reference: Edwards, Robert, Glenn Longley, Randy Moss, John Ward, Ray Matthews, and Bruce Stewart, "A Classification of Texas Aquatic Communities with Special Consideration toward the Conservation of Endangered and Threatened Taxa," *Texas Journal of Science,* Austin, TX, Vol. 31, No. 3, 1989.

## *Controlling Asiatic Clams Without Creating THM Problems*

Researchers: Cameron, Guy, Biology Department, University of Houston, James Symons, Civil Engineering Department, University of Houston, Stephen Spencer, Texas Parks and Wildlife Department, Seabrook, TX, and Julius Ma, Hekimian Assoc., Huntington Beach, CA.

Problem: Asiatic clams have invaded many water utilities in the central and southern U.S., but are difficult to control without damaging other aquatic organisms. In the Houston area, the clams have infested the Coastal Water Authority water distribution system which transfers water from the Trinity River to Lynchburg Reservoir. Damage caused by the clams often includes clogging transmission systems, valves, screens and meters; damaging centrifugal pumps, and causing taste and odor problems. Previously, the clams were controlled with free chlorine because the water was used for industrial purposes. However, Houston is now proposing to use this water for drinking water and free chlorine is no longer an acceptable control method because it produces trihalomethanes (THMs).

Objectives: To evaluate five chemicals (biocides) which could effectively control the asiatic clams without producing THMs and which would not interfere with industrial uses of CWA water.

Methodology: Experiments were conducted with juvenile and adult asiatic clams in aquaria. The clams were subjected to varying doses of biocides including free chlorine, monochloramine, chlorine dioxide, potassium permanganate, cupric sulfate and bromamine. Other clams were stocked in aquaria which simulated reservoir water quality. Biocide effectiveness was computed by comparing the numbers of clams that were killed.

Results: Monochloramine and chlorine dioxide were the two chemicals which most effectively controlled asiatic clams without producing THMs. However, monochloramine was recommended over chlorine dioxide because it costs less to produce, less of the chemical is required, and it is less dangerous to work with. The cost to implement an asiatic clam control program for a water treatment plant with a flow of 150 million gallons per day (MGD) was estimated at roughly $700,000.

Reference: Cameron, Guy, James Symons, Stephen Spencer, and Julius Ma, "Minimizing THM Formation During Control of the Asiatic Clam: A Comparison of Five Biocides," *Journal of the American Water Works Association,* Denver, CO, October 1989.

## *Impacts of Stormwater Detention on Water Quality*

Researchers: Liscum, Fred, R.L. Goss and E.M. Paul, U.S. Geological Survey, Austin, TX.

Problem: Floodwaters in Barker and Addicks Reservoirs, west of Houston, can only be detained a short time because of urbanization in the watershed. As a result, water quality in the reservoirs often suffers from high levels of phosphorous, suspended solids, turbidity, and coliform bacteria, and low levels of dissolved oxygen.

Objectives: To describe water quality above, in and below Barker and Addicks Reservoirs and to document changes in water quality that result from detention of storm runoff for different durations in those reservoirs.

Methodology: Data were collected during both storm events and low- flow conditions at sites above, at and below each of the reservoirs and samples of water discharged from the reservoirs were collected. Field measurements gathered data on water temperature, pH, dissolved oxygen and other factors. Laboratory analyses included biochemical oxygen demand (BOD); fecal coliform and streptococci bacteria, total suspended solids (TSS), turbidity, color, total nitrogen, total phosphorus and total organic carbon (TOC). Water quality of reservoir discharges was analyzed by calculating mean and average values for BOD, TSS, turbidity, color, dissolved solids, total nitrogen, total phosphorus and TOC. Other constituents were also analyzed.

Results: Results suggest that detaining stormwaters in the reservoirs for more than 8 days may significantly improve water quality. Levels of BOD, TSS, turbidity, colors total nitrogen, TOC and fecal bacteria were all reduced significantly when the waters were detained in reservoirs for more than 8 days.

Reference: *Effects on Water Quality Due to Floodwater Detention by Barker and Addicks Reservoirs* (Water Resources Investigations Report 86-4356), USGS, Austin, TX, 1987.

## *Modeling the Transport of Pollutants in Aquifers*

Researchers: Rainwater, Kenneth, Civil Engineering Dept., Texas Tech University, Lubbock, TX.

Problem: The transport and fate of pollutants in groundwater is an important environmental concern. Processes such as cation exchange affect the movement of many contaminants. Accurate models of cation exchange are needed to improve both *in situ* treatment of contaminated aquifers and to remove and treat contaminants in groundwater systems.

Objectives: To develop a mathematical model to estimate aquifer absorption parameters, to simulate two- and threedimensional flow in groundwater systems, and to test the procedure with a physical model in controlled laboratory experiments.

Model Development: Flow going into and coming out of the aquifer system was represented by a series of stream tubes, each of which carries some portion of the total flow. Breakthrough curves were developed using tracers to represent the time it takes for non- reactive pollutants to travel through the system. With this information, solute concentrations can be predicted for individual wells. The streamflow tube system was also utilized to model contaminant flow. The model also reflects cation exchange relationships in which clay particles with negative charges attract positively charged cations. By measuring changes in cation levels, movement of pollutants can be inferred.

Methodology: Laboratory experiments measured the impact of cation exchange on the movement of sodium, potassium, and calcium from an injection to a production well using a physical model. The flow rate was controlled creating a two- dimensional flow field which allowed for significant variations in travel time.

Results: The contaminant transport model proved to be appropriate for the planning of aquifer restoration efforts and was easily coupled with existing routines that estimate groundwater parameters. The physical model successfully simulated an aquifer with a two- dimensional flow field. The model has been used to simulate restoration of aquifers contaminated with waste from uranium mining activities.

Reference: Rainwater, Kenneth, "Cation Exchange in Groundwater Solute Transport," *Journal of Hydraulic Engineering,* New York, NY, February, 1988.

## *Influence of Storms on Bacteria Production in Lake Arlington*

Researchers: Hubbard, James, and Thomas Chrzanowski, Biology Department, University of Texas at Arlington.

Problem: Bacteria serve as a primary pathway that makes dissolved organic materials available to higher levels of the food chain. Planktonic bacteria exhibit activity levels that may vary seasonally and in response to changing environmental conditions such as storms. The impact of storms on plankton bacteria has not been addressed because of the irregular occurrence and severity of storm events and because of hazards of being on open water during storm conditions.

Objectives: To assess the impact of storm conditions (rainfall greater than 1 inch over a 24- hour period) on heterotrophic activity of plankton bacteria in Lake Arlington.

Methodology: Water samples were collected over the deepest portion of the lake immediately following storm events and were filtered and analyzed. Particulate Organic Carbon (POC) and Dissolved Organic Carbon (DOC) were measured. Bacteria populations were counted with fluorescent dyes. Heterotrophic activity was determined. Three storm events were sampled between September 1984 and April 1985.

Results: Storm conditions stimulated heterotrophic activities to levels 45% to 75% higher than those obtained during calm conditions. Cells were nearly twice as active four hours after storm conditions than during calm conditions, activity levels peaked roughly 24

hours after the storm event, and returned to normal levels after 48 hours. Results suggest that storm events may be an additional factor to consider in models of bacterial activities in lakes. If aquatic bacterial populations are held in check by the carrying capacity of the lake and predator levels, storms may pulse the ecosystem with a brief surge in activity.

Reference: Hubbard, James, and Thomas Chrzanowski, "Impact of Storms on Heterotrophic Activity of Epilimnetic Bacteria in a Southwestern Reservoir," *Applied and Environmental Microbiology,* Washington, DC, June, 1986 (pp 1259- 1263).

## *Texas Voters OK Aid to Colonias, Other Measures, in November Elections*

When Texans went to the polls in November, they approved funds for a number of water-related programs.

Two of the issues were decided in statewide elections. Voters passed constitutional amendment 2 with a 60% approval rating. The amendment authorizes $500 million in water development bonds. Up to $100 million of that amount will be used to provide water and wastewater service for the first time to roughly 175,000 residents of colonias in south Texas. In a related development, the City of Eagle Pass made the first request for the newly created funds when it requested $28 million to develop wastewater and water treatment facilities to serve 25,000 people living in colonias outside the city limits. The remaining $400 million would be used to provide loans and grants for water and wastewater projects throughout the state.

Voters also narrowly approved constitutional amendment 18 (by 423 votes) which extends the time limit for issuing $200 million of loans for improving irrigation efficiency. Passage of the measure will allow the Texas Water Development Board to continue to issue such loans and grants to local water districts who administer the program.

A number of local elections should also be noted. Voters in Houston overwhelmingly approved a $130 million Harris County bond issue to enlarge the Houston Ship Channel as 63% of the voters favored the bonds. The bond money will pay for Houston's share of the project which will not begin until 1994 at the earliest. In Dallas, voters gave a 77% approval to a measure allowing for $17 million in bonds for flood control programs in southern Dallas County. In Medina and Uvalde counties, voters approved the creation of underground water conservation districts by 7- to- 1 margins. A spokesman for the Texas Water Commission said that the districts are not being "officially recognized by the TWC. Finally, voters in Bandera County passed a measure that would form the Springhills Water Management District - the first entity in the state that could facilitate conjunctive management of both groundwater and surface water supplies.

## *LCRA to Gauge Flow of Water to Rice Farmers; Proposes Runoff Controls*

The Lower Colorado River Authority (LCRA) recently enacted a program to monitor the amount of water being delivered to rice producers and proposed a set of ordinances to control nonpoint source pollution.

LCRA's Board of Directors approved the first phase of a project to measure the amount of water going to individual rice farms. The purpose of the project is to implement new Texas Water Commission standards that limit rice producers to 5.25 acre- feet of water for every acre that's irrigated. That could save roughly 65,000 acre feet (AF) of water per year or enough water to supply the Austin area for six months. If successful, this could make water levels in the Highland Lakes rise by 2 feet within six years. The goal is to reduce overall water use by rice farmers by 40% by 1995.

In another matter, LCRA announced a proposed plan to combat runoff pollution. The policy is unique in that it would be performance- based: regulations to combat nonpoint source pollution are usually based on limiting the density of new developments. The plan would require developers to control 80% of the pollution that would otherwise wash into the lakes, but would not place limits on the number of dwellings that could be constructed as long as runoff requirements were met.

For more information, contact the LCRA Public Information Department at Box 220, Austin, TX 78767 or call (800) 776-5272.

## *'Underground Stream' Lawsuit Sent to State Court*

The San Antonio region continues to be the center of a number of waterrelated developments, all of which revolve - in one form or another - around management of the Edwards Aquifer.

First, the lawsuit filed by the Guadalupe Blanco River Authority has been sent back to state district court in San Marcos, where it was filed (the suit had been sent to federal court because some military bases in the region were to be defendants). The next important issue will be to determine if a change of venue will be needed.

Secondly, controversy continues to surround the development of Applewhite Reservoir. Officials from the San Antonio City Water Board demonstrated processes that will be utilized in a $48 million water treatment plant that will make water from the reservoir drinkable. Some San Antonio residents have objected to the proposed reservoir saying water quality would be poorer than groundwater from the Edwards Aquifer. Opponents of the project have also indicated they may file suit to block construction of the dam. They claim permits for the project were issued illegally because the number of wetlands to be flooded was underestimated.

Third, a special committee of Texas legislators chaired by Terral Smith and Cyndi Krier is studying the Edwards aquifer. The committee is reviewing scientific data on the

aquifer, considering priorities for use, exploring alternative water supplies, and examining institutional structures for water resources management in the region. The committee will consider modifications to water rights and policies affecting the watershed and will determine the feasibility of pumping to augment springflow.

Finally, the San Antonio City Council gave the Alamo Conservation and Reuse District the authority to seek 43,000 acre feet of water rights from Lake Texana. The project could cost up to $180 million. However, officials with the Lavaca Navidad River Authority, which has first claim to water from the lake, indicated it will seek to buy the water rights from the Texas Water Development Board.

## *Bald Eagles Found Near Site of Wallisville Reservoir*

The discovery of endangered bald eagles may serve as another postponement of the much delayed Wallisville Reservoir project. The reservoir project, which will supply water for the City of Houston, has been stalled by numerous environmental issues since 1973, but recently obtained a commitment that $4 million would be released by the Federal office of Management and Budget to begin construction.

Officials with the U.S. Fish and Wildlife Service say they found two pairs of nesting sites in cypress trees deep within the area to be flooded by the reservoir. As a result, a biological assessment now must be prepared by the U.S. Army Corps of Engineers which is developing the project. One solution could be to limit the depth of the reservoir to 1 foot, except when special research is being conducted.

In a related matter, there are signs that an underground pipeline to carry water from the Sabine River through the Big Thicket National Preserve and eventually to Houston may not be fought by environmentalists if the preserve is expanded by 14,000 acres. A bill has been introduced in Congress to authorize construction of the water line. How does this tie in to Wallisville? To agree not to fight the pipeline, several environmental groups originally said that they would oppose the pipeline if Wallisville were built.

## *Austin Freeway Expansion May Threaten Edwards Aquifer, Critics Charge*

Expansion of a freeway loop around the City of Austin will pass over part of the Edwards Aquifer. The project has come under fire from environmental groups who say more detailed ecological impact studies need to be performed to protect the aquifer. The matter is now in federal court.

Critics of the project including U.S. Rep. Henry Gonzalez say they are upset that there are not plans to conduct an environmental impact statement for a 12mile segment of the freeway in Hays County that passes over the Edwards Aquifer. State funds will be used to build this part of the project and thus no federal environmental impact statement would be needed.

State highway officials have released a plan that they say will protect the area which feeds Barton springs and many private groundwater wells. The strategy includes replanting disturbed vegetation as soon as possible, diverting stormwater runoff into ponds where pollutants would settle out, and vacuuming the highway to remove pollutants.

## *Algae Causes Fish Kills in Colorado, Mission Rivers*

State biologists say a rare algae that thrives in salty fresh water may be responsible for this fall's massive fish kills that struck the Upper Colorado, Pecos, and Brazos river basins. The algae, scientifically known as *Prymnesium parvum*, gives the water a yellowish tint.

The hardest hit area was between E.V. Spence Reservoir in west Texas and San Saba County in central Texas where an estimated 200,000 fish died. Officials called it the "worst fish kill in history" along that stretch of the river.

Officials say that the algae may have been caused in part by unprecedented heavy rains over the past two years that have washed hundreds of thousands of tons of salt out of an ancient natural lake at Big Spring down the Colorado River and Spence Reservoir.

Meanwhile, fish kills near Refugio in November were also apparently caused by algae. Some complaints had suggested the fish kills may have resulted from dumping raw sewage into the river. However, state biologists confirmed that drought conditions probably led to the formation of algae in the river which lowered oxygen levels and killed the fish.

## *EPA Charges Battery Recycling Plant Polluted Water Supplies*

The U.S. Environmental Protection Agency has ordered a battery recycling plant located less than 2,000 yards from the site of the proposed Lake Eastex reservoir to begin cleaning up its site and to prevent the discharge of more hazardous wastes from the plant.

EPA and the Texas Water Commission have been investigating charges that Poly- Cycle Industries of Whitehouse, TX, had contaminated ground and surface water with lead, cadmium and zinc at their facility outside of Jacksonville. EPA fines could total up to $25,000 per day.

Meanwhile, the Occupational Safety and Health Administration fined the firm $281,000 for exposing workers to lead in concentrations that were 35 times greater than permissible levels and other offenses.

Tests conducted by state health officials suggest that a majority of former Poly- Cycle workers, and some of their children, had potentially dangerous levels of lead in their blood.

## *West Texans Vow to Fight Nuclear Waste Dump Near El Paso*

The Board of Directors of Texas' Low- Level Radioactive Waste Disposal Authority have approved a 3,600- acre site in Hudspeth County near El Paso as the "preferred" site to store up to 3 million cubic feet of radioactive waste during the next 30 years, but area residents vow they will fight the recommendation.

Officials with the waste authority say they believe a license for the site will be granted by the Texas Department of Health in 1990. However, an El Paso county judge said that the facility could pose a risk to the Hueco Bolson aquifer and there is an additional risk because the area lies in a 100- year floodplain.

## *Groundwater Contamination Being Investigated at Pantex Plant Near Amarillo*

Decades of dumping industrial chemicals and testing explosives may have contaminated soil and groundwater at the Pantex weapons plant near Amarillo.

Last year, the U.S. Energy Department reported that Pantex was the second most serious threat to public health among federal weapons facilities across the nation. Major concerns were that toxic and cancer-causing chemicals could leach into the Ogallala Aquifer. The City of Amarillo's drinking water wells are also situated near the plant.

Earlier surveys by the EPA and the Texas Water Commission found examples of potentially serious contamination including concentrations of chemicals from leaks, improper storage, and leaking underground storage tanks. The Energy Department is seeking $95 million to begin environmental cleanups that would run through 1995, but the program could cost more than $1.7 billion over the next 20 years.

Ironically, Pantex has no nuclear reactors and produces little of the radioactive waste that has caused serious problems at other Department of Energy facilities.

## *Proceedings of Water for Texas Conference, Annual Report, Available from TWRI*

The proceedings from the 1988 Water for Texas conference and an annual report are now available from the Texas Water Resources Institute.

Managing Texas' Waters: Stewardship in a Regulatory Environment is the title of the proceedings from TWRI's 22nd *Water for Texas conference* . The 276-page proceedings includes nearly 50 papers on such broad issues as ground water management and quality, surface water management, nonpoint source pollution, and the Gulf Coast and Galveston Bay. Specific topics the papers address include global warming, the Galveston Bay program, contamination in the Gulf of Mexico, water management strategies for the Edwards Aquifer, the relationship between agriculture and groundwater quality, nonpoint source pollution, and many other issues. The proceedings is available for $25.

TWRI has also produced an annual report for FY 1989 which describes the Institute's recent efforts in research, and the disseminating information about water-related research in Texas' universities through newsletters, video tapes and conferences, and the training of future scientists. The report provides information about each project funded by the Institute in 1988 and 1989, and lists publications available to the public.

To order a copy of the proceedings or the annual report, contact: Texas Water Resources Institute, Texas A&M University, 301 Scoates Hall, College Station, TX 77843-2118 or call (409) 845-1851.

## *Springs of Texas Details Hydrology, History, Flora, Fauna, Future Trends*

What may be the most comprehensive book on Texas' numerous springs has been written by Gunnar Brune, a scientist who worked for 40 years for the Texas Water Development Board and the Soil Conservation Service.

The 566- page book, *Springs of Texas*, includes sections describing general characteristics of springs, physical settings, quality of spring waters, prehistoric settings of springs, flora and fauna that live near springs, historical significance, and the decline of springs, and how Texas water law affects springs.

The book also provides detailed information on individual springs in 183 Texas counties. Provided with the book are maps depicting the location of springs and seeps, hot and warm springs, spring aquifers, archaeological features found near springs, mineral springs used for health purposes, and how springs served as trails used by explorers and settlers in the 15th-19th centuries.

The book is available from: Gunnar Brune, 2014 Royal Club Court, Arlington, TX 76017 or by calling 817-465-3171.

## *GAO Reports Cover Groundwater Pollution, Irrigation Subsidies*

The General Accounting Office (GAO) has recently released two reports that investigate water issues of interest to Texas.

Drinking Water: Safeguards Are Not Preventing Contamination from Injected Oil and Gas Wastes (RCED-89-97) evaluates the risks posed to groundwater supplies from leaking oil and gas wells. The study noted that roughly 37% of all underground injection wells in the U.S. are in Texas. Incidents of groundwater contamination from underground injection wells in Tom Green and Howard counties were cited in the study. The accident In Howard County near Knott contaminated public drinking water and irrigation supplies and local officials are now tracking a plume of salt-contaminated water that they suspect was caused by improperly plugged oil wells. Six contaminated plumes in Howard and Martin counties are also now being monitored. The report also noted that Texas plugged 177 abandoned wells in 1984, but because of declining revenues the Texas Railroad Commission cannot keep up with the need to plug all the abandoned wells that pose risks

to groundwater quality. The study recommends that EPA require states to regulate injection wells that were in operation before 1980.

Water Subsidies: Basic Changes needed to Avoid Abuse of the 960-Acre Limit (RCED-90-6) reports that some farmers have reorganized their farms into several smaller landholdings in order to take advantage of a loophole in the Reclamation Reform Act of 1982. Although the smaller units are still operated as one large farm, each one is entitled to receive federally subsidized water up to the 960-acre limit. Existing regulations allow the GAO to charge farmers with multiple landholdings the full cost of all water delivered to more than 960 acres, but so far no one had been charged. To close the loophole, GAO recommends that Congress amend the Act to apply to farms and farming operations as well as to landholdings.

To order the reports, write: GAO Distribution Center, P.O. Box 6015, Gaithersberg, MD 20877, or call (202) 275- 6241.

## *Texas Agricultural Simulation Models Featured in Proceedings*

Agricultural simulation models developed by Texas scientists were featured in a new proceedings published by the Society for Computer Simulation. The study, *Proceedings of the 1989 Summer Computer Simulation Conference*, includes a section on simulation of agricultural processes.

Mathematical models detailed in the proceedings include papers by scientists with the Texas Agricultural Experiment Station and Texas A&M University on such topics as weather simulation, soil and water conservation, energy and water balances, hydrology and runoff, rangeland modeling, and others.

For more information, contact: Society for Computer Simulation, P.C Box 17900, San Diego, CA 92717-1800 or call 619-277-3888.

## *Book Details Shipwrecks at Padre Island, Other Texas Sites*

Details of shipwrecks at South Padre Island and other Texas sites are contained in a new book titled *Ships and Shipwrecks of the Americas.* The book was edited by George Bass of the Institute of Nautical Archaeology at Texas A&M University.

In 1554, three ships sailing from Veracruz, Mexico to Spain with cargoes of gold, silver and spices were driven aground off the coast of Padre Island near Port Mansfield. Wrecks of two steamboats - the *Black Cloud* in Liberty County in 1864 and the *Mittie Stephens* in Caddo Lake - are also described.

To order a copy, contact: Thames and Hudson, Ltd., 500 5th Ave., New York, NY 10010 or call 800-233-4830.

## *Water, Wastewater Rank as High Priorities for Texas Cities, Survey Says*

Results of a survey published by the Texas Engineering Extension Service show that water and wastewater issues are among the most important challenges facing Texas municipalities.

The survey, which was featured in the October 1989 issue of *Local Government Agenda*, covered topics such as the percent of Texas cities (by size) with financially self-sufficient water systems, base residential water rates and the implementation of water conservation plans, and included a listing of base residential water and wastewater rates for many Texas cities. Results of the survey showed that roughly 70% of the cities that were surveyed did not have conservation plans and that most of the cities with conservation programs had populations of more than 60,000. Cities with populations from 30,000 to 60,000 had the greatest percent of financially non self-sufficient water systems.

To receive a copy, contact: Technology Resources Center, Public Works Training Division, Texas Engineering Extension Service, The Texas A&M University System, College Station, TX 77843-8000. The phone number is 800-824-7303.

## *Agricultural Extension Reports Discuss Groundwater, Irrigation*

The Texas Agricultural Extension Service recently produced a number of new reports dealing with water quality and irrigation. *Protection of Groundwater from Fertilizers and Pesticides* (B- 1642) provides information on how to prevent losses of nitrogen and phosphate fertilizers and includes check lists for proper pesticide use. *Composting Manure and Sludge* (L-2289) summarizes advantages and disadvantages of composting and describes composting systems. The following pamphlets deal with irrigation: *Irrigation Systems for Forage Crops* (B-1611), Corn *Irrigation* (B1614) and *Water Management Strategies for Cotton* (L-2297).

To order any of these publications, contact: Agricultural Communications Dept., Texas A&M University, College Station, TX 77843 or call 409-845-2211.

## *Report Recommends Additional Funds to Fight Oil Spills*

More money, equipment and emergency training are needed to make sure Texas can combat a major offshore oil spill and prevent an environmental disaster, according to a report of the Governor's Oil Spill Advisory Committee.

The report, *Governor's Oil Spill Advisory Committee: Status Report,* was printed in October. The report recommends that the U.S. Coast Guard and the oil industry locate additional spill fighting equipment in Corpus Christi and Beaumont to guarantee quick response times, that the Texas Spill Response Fund be increased from its current level of $700,000 to $5 million and that additional monies be allocated to university and private sector research in state-of-the-art cleanup technologies.

The report is available from: Texas Department of Public Safety, Emergency Management Division, 5805 North Lamar, Box 4087, Austin, TX 78773-001. The phone number is 512-465-2138.

## *Corpus Christi State University Scientists Delve Into Baffin Bay Ecosystem*

Two scientists at Corpus Christi State University recently received a $25,000 grant from the U.S. Fish and Wildlife Service to study the biology and ecology of Baffin Bay.

David McKee of the Biology Department, Jennifer Prouty of the Geology Department, and graduate student Beau Hardegree are measuring baseline productivity in the Baffin Bay system and will examine the probable impact of development (such as the effect of a tidal pass) on the bay's productivity. The research will pay particular attention to serpulid reef communities. These reefs create abundant habitat and provide food and cover for small aquatic organisms which are a vital part of the food chain. The studies are important because Baffin Bay is one of the few natural bay systems along the Texas coast that is largely undeveloped and because the bay produces more than half the total finfish population on the Texas coast.

For more information, contact: Jane Roetzel, Public Affairs Dept., Corpus Christi State University, 6300 Ocean Dr., Corpus Christi, TX 78412 or call (512) 994-2427.

## *Texas A&M University Scientists Study Prehistoric Life Near Pecos River*

Rock art on sheltered walls in limestone caverns of the lower Pecos River and other artifacts offer a glimpse of what it was like for native Americans who inhabited the area as long ago as 6,000 B.C.

Harry Shafer, a scientist in the Anthropology Department at Texas A&M University, has conducted extensive studies at Hinds Cave in Val Verde County near Amistad Dam.

Although the Pecos area today looks like a rugged, rocky, arid, wasteland, Shafer said it was actually an oasis and garden for ancient hunters and gatherers. The waters of the Pecos, Devil's and Rio Grande rivers and numerous springs and potholes meant that water was never too far away. Water was so essential that campsites were rarely established unless a river or spring was nearby, Shafer said. Camping near water sources usually meant that seasonal fruits, vegetables, game and fish were also available.

The end of the prehistoric period was marked when these ancient inhabitants met with Spanish explorers and missionaries in roughly 700 A.D.

Texas A&M University sponsored an exhibit of photographs of art from the cave walls and other artifacts earlier this year. For more information, contact: Harry Shafer, Anthropology Dept., Texas A&M University, College Station, TX, 77843. The phone number is (409) 845-5271.

## *Ogallala Aquifer Studied at Texas A&M, University of North Texas*

Two recent studies by researchers at Texas A&M University and the University of North Texas focus on management strategies for the Ogallala Aquifer. One study, "Land and Water Management Issues: Texas High Plains," was coauthored by Ron Lacewell of Texas A&M University's Agricultural Economics Department and John Lee of Louisiana State University and is part of a new book titled *Water and Arid Lands of the Western United States* published by Cambridge University Press. Lacowell says the amount of water in the aquifer could be 20% less than 1980 levels by the year 2000 if current pumping trends continue. Eventually, he predicts, agriculture in the region will shift from irrigated to dryland crop production as water becomes scarce and expensive to pump. Lacowell says that plans should be made to supplement groundwater supplies through secondary recovery and that increased water use efficiency should be encouraged. Impacts of the declining groundwater supply on the overall economy and environment of the region are identified and policy options to slow overpumping are reviewed. For more information, contact: Ron Lacewell, Agricultural Economics Dept., Texas A&M University, College Station, TX 77843 or call (409) 845- 8476.

In another study, Michael Nieswiadomy of the Economics Department at the University of North Texas worked with C.S. Kim, Michael Moore and John Hanchar of the U.S. Department of Agriculture Economic Research Service to develop a model that simulates the effects of mining the Ogallala Aquifer. As simulated levels in the aquifer decline, the model incorporates changes that farmers could be expected to make such as use of more efficient irrigation systems, and more widespread planting of high- value crops. Results suggest that groundwater management strategies could save the region roughly $15 million over the useful life of the aquifer. The researchers predict that farmers will still grow grain sorghum in the area, even after the optimum time to switch to less water-intensive crops has passed. The article, "A Dynamic Model of Adaptation to Resource Depletion: Theory and an Application to Groundwater Mining," appeared in Volume 17 (1989) of the *Journal of Environmental Economics and Management.* For details, contact: Michael Nieswiadomy, Economics Dept., University of North Texas, PO Box 13408, Denton, TX 76203 or call (817) 565- 2573.

## *Agricultural Experiment Station Releases New Water Saving Buffalograss*

Researchers with the Texas Agricultural Experiment Station (TAES) in Dallas have recently released a new variety of buffalograss called "Prairie" that they say may use considerably less water than turfgrasses that are currently being used.

Milt Engelke, a TAES scientist, developed Prairie. He said that Prairie buffalograss can be utilized in residential landscapes, golf course roughs, highway right of ways, and industrial parks.

Engelke said that experiments where Prairie was grown and evaluated in residential lawns in the Dallas area and botanical gardens in Dallas and San Antonio. Findings indicate that the grass performs well with limited irrigation. Some of the experiments suggest that use of Prairie could lower irrigation requirements by 60% to 80% compared

to conventional warm season turfgrasses. The grass also survives in heavily trafficked areas.

Prairie is being released by the Foundation Seed Services, which is part of The Texas A&M University System. For more information, contact: Paul Sebesta, Foundation Seed Services, Texas A&M University, College Station, TX,77843 or call (409)845-4051.

## *San Antonio-Area Universities Studying Regional Water Management*

Researchers and students from universities in the San Antonio area are trying to determine if institutional changes could result in better management of surface and groundwater systems in the San Antonio area. Richard Howe of the University of Texas-San Antonio, Glenn Longley and Billy Moore of Southwest Texas State University, Tucker Gibson and Cathy Powell of Trinity University, and Henry Flores of St. Mary's University are among the professors participating in the project.

The team is studying if laws, policies and organizational structures could be modified to better manage the Edwards Aquifer and rivers, including the Guadalupe, Nueces, and San Antonio, from their headwaters to the Gulf of Mexico. Reports will be prepared on such topics as institutional and legal issues, irrigation, hydrology, groundwater flow, and public attitudes. For more information, contact: Richard Howe, College of Science and Engineering, University of Texas- San Antonio, San Antonio, TX 78285 or call (512) 691-4490.

## *Effluent Irrigation Focus of SW Research Institute Study*

A study of air samples near a wastewater irrigation farm near Lubbock has shown that levels of potentially disease-causing microorganisms can be significantly reduced if the effluents are detained before being applied.

The research was conducted from 1980 to 1985 by David Camann and H. Jac Harding of the Southwest Research Institute and Barbara Moore of the University of Texas Medical Branch in Galveston. Residents were tested for evidence of infection both before and after the study. The study compared application of effluents both directly from a pipeline and after they had been held in a large on-site reservoir. When the effluents were stored for roughly three months before being applied, fecal coliform levels in air samples were reduced by 90% and other organisms including mycobacteria, coliphage and fecal streptococci were reduced 100-fold compared to direct application.

The research was featured in an article titled "Yesterday's Water for Tomorrow's Crops" in the June 1989 issue of *Technology Today.* To receive a copy, contact: Southwest Research Institute, PO Box 28510, San Antonio, TX, 78228-0510.

## *UT-Dallas Forms Institute for Environmental Sciences*

A research center that will focus on water resources and environmental research has been formed at the University of Texas at Dallas. The center, the Institute for Environmental Sciences (IES) will be headed by John Warwick.

Recently, scientists with IES including Warwick, Steve Haness, and Roger Dickey began investigating the effect of urban stormwater runoff on surface water quality in the upper Trinity River watershed. The project, which is being supported by the North Central Texas Council of Governments and the Fort Worth District of the U.S. Army Corps of Engineers, is integrating a geographic information system with two hydrodynamic models developed by the Corps of Engineers. Results will help classify stormwater outfalls and watersheds that are sensitive to urban runoff. The project will also be used to assess the effectiveness of stormwater management programs.

For more information, contact: John Warwick, Director, Institute for Environmental Sciences, University of Texas at Dallas, Box 830688, Richardson, TX, 75083, or call (214) 690-2571.

## *Houston-Area Universities Team Up to Study Houston Area Water Quality*

Results of a water quality study involving researchers from the University of Houston, Rice University, the University of Texas Health Science Center at Houston, and the Baylor College of Medicine were recently featured in the August 1989 issue of the *Journal of the American Water Works Association.*

Researchers working in the project included James Symons of the Civil and Environmental Engineering Department at the University of Houston, Philip Bedient of the Environmental Science and Engineering Department at Rice University, Ernst Davis and C.M. Valentino of the UT Health Science Center at Houston, and Theodore Metcalf of the Baylor College of Medicine.

The study, titled "Managing an Urban Watershed," sought to determine the source of high fecal coliform levels in Lake Houston which forced authorities to ban contact water sports in the lake in 1984 and 1985. Densities of indicator organisms were measured in Lake Houston, its tributaries, and selected wastewater treatment plants shortly after rainfall events. Analyses suggest that some of the problem came from nonpoint pollution including dry weather septic tank discharges and runoff from pastures and other agricultural land.

## *'Not in My Back Yard' (NIMBY) Syndrome is Focus of Lamar University Study*

A scientist in the Sociology Department at Lamar University is investigating the "Not in My Back Yard" (NIMBY) syndrome to learn about social and psychological components of public opposition to hazardous waste sites.

Stuart Wright is conducting a case study of public attitudes concerning a proposed facility near Dayton that would store hazardous wastes in a salt dome. Opponents of the facility claim it could potentially contaminate nearby aquifers and Lake Houston. Wright's work consists of attending weekly review hearings and interviewing members of a local review committee, city elected officials, community leaders, and opposition

groups. A scientific opinion poll to determine public attitudes is scheduled for early in 1990.

Wright's goals are to determine the extent of opposition, the substantive content of apprehensions of citizens, and the conditions under which communities might accept reasonable levels of risk.

For more information, contact Stuart Wright, Sociology Dept., Lamar University, Beaumont, TX 77710. The phone number is (409) 880-8538.

## *UT Marine Science Institute Probes Laguna Madre*

Scientists with the University of Texas Marine Science Institute at Port Aransas recently received a $490,000 TATRP grant to continue studies to investigate ecosystem productivity in the upper Laguna Madre Estuary. There has been interest in the Laguna Madre because the estuary produced 53% of Texas' commercial finfish even though it's very salty and receives less freshwater inflow and nutrients than other Texas estuaries. It is speculated that the Laguna Madre is very efficient in recycling nutrients.

Findings suggest that nutrient levels are high and may be generated locally by growth and decay of beds of seagrasses, according to Paul Montagna, the leader of the project. Research has involved cruises to investigate physical conditions of the estuary; chemical isotope analyses, and surveys of nutrients, phytoplankton, zooplankton, seagrasses,and other samples.

For details, contact: Paul Montagna, University of Texas at Austin, Marine Science Institute, Port Aransas, TX 78373-1267. The phone number is (512) 749-6711.