New Waves
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TCU, Baylor, BRA Team Up to Field Test Treatment System

Often, university research consists of a handful of scientists from the same academic department studying a specific problem at one site. It's difficult to foster collaborative projects that involve scientists at different universities, locations and disciplines.

But that's just what happened last Summer in Waco. Ray Drenner of the Texas Christian University Biology Department teamed up with student Laura Rectenwald of the Baylor University (BU) Environmental Studies Department and Tom Clark at the Brazos River Authority (BRA) regional wastewater treatment plant. Rectenwald's graduate studies at BU were supervised by Merle Alexander of the Environmental Studies and Physics Department. Owen Lind of the Biology Department was a member of her committee.

The goal was to field test the performance of an ecological based treatment system to lower levels of nutrients from secondary treated wastewater. This technology, which Drenner developed at TCU, involves using algae and fish to remove many pollutants. The fish consume the algae and transfer pollutants into fish tissue and fecal matter. The feces can later be easily collected and used for fertilizer. Results from previous studies show that water quality often improves as water flows through these systems.

Laura Rectenwald studied the use of a system that uses fish to improve water quality.

"Everyone involved in this project felt it was beneficial for many reasons," Drenner says. "Laura was looking for a research topic and heard about our work. We're always looking for opportunities to gain more data from other sites so we can evaluate how well this technology works. We were able to work with the BRA and see how well the system treats wastewater in the real world."

Rectenwald utilized a system consisting of 12 interconnected, 500-liter fiberglass "mesocosms." Each mesocosm contained wastewater and eight to 14 fish (*Tilapia mossambica*). Water was pumped from a clarifier at the Waco plant, dechlorinated, and fed through the system at a rate of 250 gallons per day for six weeks. Rectenwald collected data on inflows, outflows, incoming and outgoing water quality, sediment and algae levels, and fish mass. She hopes to publish her work and graduate with a BU Master of Science degree in May.

Preliminary research results suggest that the system lowered phosphorous levels by nearly 90%. Drenner is now supervising studies at TCU to test the ability of this technology to remove heavy metals and other toxic chemicals present in wastewater. For details, contact Drenner at (817) 921-7165 or Rectenwald at (903) 753-8200.

USGS Announces $800,000 RFP

The U.S. Geological Survey has recently announced guidelines for a regional water research program that will be administered by the National Institutes for Water Research. This regional program largely replaces water research programs funded by water institutes in each state.

For the first year, the program is being operated on a regional basis. For example, Texas is now part of a 13-state western region. It is expected that roughly $800,000 in grant funds will be available. "This is an exciting time for TWRI and researchers in Texas," said TWRI Director Wayne Jordan. "Previously, each institute played a large role in determining which projects would be funded but were limited in the amount of funds they could award in their states. Now, we have less control but the opportunities for funding have increased."

Since guidelines were only recently provided by the U.S. Geological Survey (USGS), the regional request for proposals (RFP) has not yet been approved by USGS. TWRI will distribute basic information about the application process as soon as the RFP is published for the Western Region. However, some features are clear at this time. For example, all potential projects with principal investigators from Texas must be submitted through TWRI. Multi-state projects are preferred. A 2-to-1 non-federal to federal match is required, but projects requesting up to $350,000 in federal funds will be considered. Projects may extend to up to 3 years. Texas scientists should start planning now, because an early May deadline to submit proposals to TWRI is likely.

TWRI will keep up with information on this program and will be happy to supply information to any researchers that may be interested in participating.

Estimating the Volume, Duration, and Frequency of Floods in Ungaged Texas Watersheds

Researchers: Ravi Devulapalli, Carter and Burgess, Inc., Fort Worth, TX, and Juan Valdes, Civil Engineering Dept., Texas A&M University, College Station, TX.

Problem: The magnitude and frequency of floods are important considerations. From an engineering standpoint, knowledge of these factors is needed to properly design bridges, embankments, culverts and drainage ways. From a socioeconomic perspective, this information is needed to assess flood damages, establish flood insurance rates, and to form flood evacuation plans. Data on the duration of floods is needed to determine how long roads and bridges are likely be inundated. This information is especially critical in areas where watersheds are not gaged and water levels are not recorded.

Objectives: To determine relationships between volume, duration, and frequency of floods for rural, unregulated, Texas watersheds.

Methodology: Daily flow volumes were estimated from a daily mean flow database maintained by the U.S. Geological Survey at several hundred Texas watersheds. Total flood volumes for different durations were computed by aggregating daily flow volumes over these durations. Maximum daily flows were assumed to be maximum 24-hour flows. Computed flood volumes include baseflows and represent total flows. The underlying philosophy of this research is that the response of medium and large watersheds is spread over many days, and that daily means are good estimators of daily volumes. A time series was constructed for annual maximum flow volumes for various durations at each gaged site. Then, a probability distribution is fit to this time series to estimate extreme flow volumes. Finally, extreme volumes at all gaged sites are regressed with basin and hydrological characteristics to develop regional equations. A pilot study was conducted to assess how much and what type of Texas data are available from USGS records. The pilot study identified 671 gages that cover non-urban, unregulated watersheds, the range of areas they cover, and the period for which records were collected. The pilot study also identified the durations over which flood volumes are to be estimated. A computer program was developed to read daily means and estimate daily flood volumes. Flood volumes for different recurrence intervals were calculated for both small and large unregulated watersheds.

Results: This research developed a technique to estimate flood volumes over different durations directly from recorded runoff data, without resorting to rainfall-runoff modeling. This method was successfully used to estimate volumes at most non-urban, unregulated, gaged watersheds in Texas. Extreme flood volumes were estimated for different flood frequencies. These extreme flood volumes were extended to ungaged watersheds using multiple regression analysis and basin and climate factors. Meaningful equations to account for these relationships were developed for most, but not all, regions of Texas. The research developed flood-volume-frequencies for 207 rural, unregulated sites in Texas with drainage areas of at least 300 square miles, an equation to estimate flood volumes at ungaged sites with watersheds of less than 300 square miles, and regression relationships to estimate flood volume duration frequencies at ungaged sites in 7 of 12 major regions of Texas.

Reference: Devulapalli, R., and J. Valdes, *Volume-Duration-Frequencies for Ungaged Catchments in Texas (TR-173: Volume I): Calculation of Regional Regression Equations,* and *Volume-Duration-Frequencies for Ungaged Catchments in Texas (TR-173: Volume*

II): Computations of Flood Volumes of Varying Durations and Frequencies for Catchments with Areas Greater Than 300 Square Miles, TWRI, Texas A&M University, College Station, TX. **NOTE:** This two volume report is available free by calling TWRI at (409) 845-1851. Please specify which volume, or both, that you need.

A Biological System to Monitor and Rapidly Detect Toxicity in Texas Rivers

Researchers: Tom Waller, Miguel Acevedo, Joel Allen, and Fritz

Schwalm, Institute for Applied Sciences, University of North Texas, Denton, TX.

Problem: Water managers rely on standard numeric criteria to

measure water quality. While chemical specific analyses provide needed information, living organisms can integrate exposure. While biological field assessments may be used to measure impact to biological communities, these methods only indicate that unfavorable conditions have occurred. There is a need for minimally invasive systems that measure the responses of aquatic organisms to pollution in near real time. Clams are an ideal organism for these studies because they close shells as levels of toxic substances increase.

Objectives: 1) To develop and test a system that utilizes gape measurements of the Asiatic clam (Corbicula fluminea) to assess toxicity of Texas rivers, and 2) To develop a way to gather and transmit this information to a central receiving point.

Methodology: A biomonitoring system was developed that contains the following components: 1) a device that can be deployed in the field to continuously measure clam gape; 2) a means to transmit the gape data via telemetry to a central receiving station, 3) an alarm system that is activated when clams close their shells to a critical level; and 4) a method to retrieve water quality samples when toxic events occur and test them for biotoxicity using the water flea (Ceriodaphnia dubia). A non-shielded, inductive proximity sensor was developed to detect clam gape. A plexiglas frame was developed to hold the clams in place in laboratory and field conditions so that gape can be measured. An amplifier and an analog/digital computer circuit board were modified to record gape data. Four field biomonitoring systems were constructed and deployed as part of ongoing studies at Bayou Chico, FL. In these studies, buoys were developed to house the biomonitoring system and a solar panel was used to provide power. Data were transmitted using wireless transceivers. Datasondes were utilized to measure chemical water quality concentrations. Other field studies were conducted in the Upper and Middle Trinity River and other Texas sites.

Results: Scientists are now analyzing data to detect gape closing patterns and responses that can specifically be linked to pollution. Some relationships between flows, water quality and gape measurements have tentatively been established. When clams in this system were exposed to large increases in flow they generally closed their shells very rapidly, then opened them for a short time, and gradually reopened to normal conditions.

More research needs to be done before this system can be used as an accurate measure of aquatic toxicity. If these studies are successful, remote biosensors may be successfully deployed to help distinguish toxic events and to identify pollution problems. Results of Florida field tests suggest this system was successful in gathering and transmitting water quality data.

Reference: Waller, W.T., M.F. Acevedo, H.J. Allen and F.U. Schwalm,

Use of Remotely Sensed Bioelectric Action Potentials to Evaluate Episodic Toxicity Events and Ambient Toxicity, TR-172, TWRI, Texas A&M University, College Station, TX. **NOTE:** This report is available free while supplies last by calling TWRI at (409) 845-1851.

Developing an Expert Geographic Information System for Water Supply Planning

Researchers: Daene McKinney, John Burgin, and David Maidment, Civil Engineering Department, University of Texas, Austin, TX.

Problem: The Texas Water Development Board (TWDB) is the state agency charged with the responsibility for long-term water supply planning. The TWDB's planning process involves the following steps: 1) Water demands are estimated for a base planning year and 10-year intervals for periods up to 50 years; 2) Available water supplies are estimated for reservoirs, rivers, and aquifers; 3) Supplies and demands are reconciled on a county-by-county basis and deficits are noted; 4) When deficits occur, a search is conducted for nearby supply sources that could be allocated and potential new projects that could be developed to meet these shortfalls; and 5) An initial plan is developed and comments are requested from regional and statewide inputs. This process is very tedious and difficult. It is heavily dependent upon the expertise and judgement of a few professional staff members. Planning efforts developed by this process may produce results that cannot be rigorously documented or replicated. Previously, TWDB senior staff have expressed a strong desire that this planning process be automated, without abandoning the assumptions and philosophies traditionally used by Board staff.

Objectives: 1) To develop a computerized integrated planning method that combines a geographic information system (GIS), an expert system, and a network balancing system; and 2) To test this system in a case study using real world conditions.

Methodology: A water allocation model was developed that includes a GIS, an expert system, and a network balancing system. The GIS stores, retrieves, manipulates, updates, and displays spatially-oriented data, and creates geographic displays of alternative water allocation plans. The expert system consists of a set of rules and a rules interpreter. The expert system implements a set of logical rules that replicates the process employed by a professional analyst. The network balancing flow solver finds the least-cost resource allocation solutions. In this system, reservoirs, aquifers, counties, cities, and other supply sources and demands are conceptualized in a lumped parameter system. Planning problems are represented by a series of points, lines, nodes and arcs. Line coverages or

potential arcs (PARCs) describe ways in which water can be transmitted from supplies to users. Abstractions were developed so that problems could be represented geographically, functionally, and in a planning mode. The model was initially tested using a hypothetical example developed by TWDB. The system was later tested using a case study of the Corpus Christi region for the 50-year planning horizon (1990-2040). This region includes such water supplies as the Guadalupe, Navidad, Lavaca, San Antonio, San Marcos, Medina, Frio and Nueces rivers and the Gulf Coastal, Carrizo-Wilcox, Sparta Sand and Queen City aquifers. Groundwater costs were developed based on information on well depths and drilling costs supplied by TWDB staff. Surface water costs were estimated for each reservoir based on construction and operations and maintenance costs and firm yields. Demands were estimated for Corpus Christi and other municipalities in the region as well as for agricultural and industrial use.

Results: The case study was analyzed using four sets of operating rules: 1) baseline or existing conditions or no rules; 2) a slightly modified set of statewide rules that corrects obvious problems; 3) regional rules that incorporate specific water supply and demand conditions that apply to this area; and 4) a combination of statewide, regional and PARC rules. The accuracy of the model was improved as specific considerations were incorporated. For example, fine tuning of model parameters allowed simulations to not allow large volume water users to mine a groundwater supply; to reserve up to 20% of groundwater supplies for municipal users; to more fully reflect use of surface waters from Choke Canyon reservoir; and to adjust for specific agricultural irrigation needs. In general, the results from the use of the model closely match the water planning estimates developed by TWDB using conventional methods. This system was shown to be faster, less tedious, better documented, and more rigorous and scientifically defensible than current methods. Future efforts could involve fine-tuning the model for the Corpus Christi region, applying this method to other regions, and incorporating hydrologic and economic models within this framework.

References: McKinney, D., J. Burgin, and D. Maidment, *Water Supply Planning Using An Expert Geographic Information System* (TR-162), TWRI, Texas A&M University, College Station, TX. **NOTE:** TR-162 is available free while supplies last by calling TWRI at (409) 845-1851. A Ph.D. dissertation was published at UT about this research: Burgin, J., *Automating the Allocation of Water in Texas Using an Expert System to Control the Interaction of a Geographic Information System and a Linear Programming Solution Algorithm*, 1995. Details about the dissertation can be obtained by contacting McKinney at (512) 471-8772.

Recycling Sand from Dredging Operations to Replace Beach Losses at South Padre Island

Researchers: Daniel Heilman and Nick Kraus, Conrad Blucher Institute for Surveying and Science (CBI), Texas A&M University-Corpus Christi (TAMU-CC).

Problem: Many coastal Texas areas experience significant erosion. To combat this, beach quality sand produced during dredging activities conducted by the U.S. Army Corps of Engineers can be recycled. In the Padre Island area, the Corps' dredging from

the jetties near the Brazos Santiago Entrance Channel produces roughly 500,000 cubic yards of sand that is available every two years to replenish beaches. This sand can be applied by pumping it directly onto the beach or by placing it in near-shore underwater mounds Site-specific scientific studies need to be conducted to make sure the appropriate amount of sand is placed at the most critical locations, taking into account such factors as wind and wave action and other forces.

Objectives: 1) To utilize previously available information and new data to determine coastal processes that influence erosion and beach transport at South Padre Island; 2) To develop a coastal sediment transport budget, and 3) to establish and calibrate a numerical model of shoreline change and a long-shore transport of sand at the site.

Methods: The town of South Padre Island requested that CBI provide a functional design for a beach fill that would include the length, location, and cross-sections of new sand to be imported. Historical shoreline positions were analyzed based on data from the Bureau of Economic Geology at the University of Texas at Austin. A local sediment budget for the shoreline along South Padre Island was developed based on hindcast data, records of Corps' dredging activities at Brazos Santiago Pass, a recent beach profile survey, and historical shoreline position data. The Corps' shoreline change numerical model (GENESIS) originally developed by Kraus and others was used to determine the most beneficial placement of dredged material. Optimal cross-section configurations that minimize costs while providing maximum beach enhancement were developed.

Results: The research recommends that beach fill should be placed for a length of 1.1 miles at the northern end of the Town of Padre Island. The area to be filled is rectangular shaped. It will initially extend 200 feet from the existing shoreline at its midsection, but will taper to the existing shore at each end. The research also suggests that recycled sand should be pumped onto the existing beach. It is expected that changes in water levels will initially cause a rapid adjustment of the filled material (the visible beach will suffer some losses) as sand moves across the profile of the filled area. During construction, it is expected that the initial shoreline will move back from 100 to 200 feet of the original shoreline. Over time, the recycled sand will become stable and behave like the existing beach. It will furnish sand to nearby beaches, provide a wider beach for recreation and provide additional shoreline protection.

Reference: Heilman, D., and N. Kraus, *Beach Fill Functional Design for the Town of South Padre Island*, TX, CBI, TAMU-CC, Jan. 1996.

Use of Soil Amendments to Increase Infiltration in Soils Irrigated with Municipal Wastewater

Researcher: Duane Gardiner, Texas A&M University-Kingsville, Kingsville, TX.

Problem: Using wastewater for crop irrigation is an attractive alternative water source for many regions. Typically, municipal wastewaters are high in sodium and elevated sodium adsorption ratios (SAR) reduce soil permeability and lessen infiltration. Research is needed to test the use of soil conditioners and tillage practices that may prevent the formation of soil crusts and increase the amount of water percolating through soils. If these problems can be overcome, irrigation with municipal wastewater may become more common.

Objectives: To evaluate the effect of treated wastewater on the permeability and surface crusting of soils, and to quantify the beneficial effects of applying gypsum and anionic polyacrylamide (PAM) in solution to reduce soil problems associated with wastewater irrigation.

Methods: Field experiments were established at the Kingsville wastewater treatment plant that discharges an average of 1.2 million gallons of effluents daily. Studies were conducted on a Victoria clay soil. The study consisted of three phases: 1) field preparation (December 1992) to last data collection (June 1993) at the wastewater plant; 2) field preparation (July 1993) to last data collection (May 1994); and 3) laboratory studies (July 1994). Gypsum was applied at rates of 0 and 5 tons per acre after fields were disked. PAM was added to irrigation water at rates of 25 parts per million and applied during every irrigation or each second irrigation. In the phase I studies, broccoli was sown in December 1992 and no fertilizers were used. Four irrigation treatments were applied from February to April 1993 at rates of 0, 4 and 8 inches. Field saturated infiltration rates were measured in the center furrow of each treatment using the constant head well permeameter method. In the phase 2 experiments, five soil treatments were established including: 1) gypsum applied at 5 tons/acre; 2) PAM injected into wastewater at rates of 25 parts per million in each irrigation; 3) PAM injected into wastewater at the same levels as treatment 2, but applied only on every other irrigation; 4) irrigation with no use of PAM or gypsum; and 5) no irrigation was applied, but enough water was supplied for germination. Common bermudagrass was sprigged in August 1993. Gypsum was applied twice by disking. Soil samples were collected at depths of 12 inches from sites along the center furrow of plots. Composite samples were used to determine soil moisture using a microwave oven. Field saturated infiltration rates were measured using the constant head permeameter. Column experiments were performed in laboratories to measure hydraulic conductivity. In one laboratory study, PAM was applied to undisturbed soil profiles at rates of 4, 8 and 12 parts per million. In another laboratory study, two levels of PAM (0 and 25 parts per million) and three levels of wastewater (0.8, 1.6 and 2.4 inches) were applied to disturbed soil profiles.

Results: Field saturated infiltration rates of plots treated with PAM were roughly double those of the control (untreated) plots, and were

significantly greater than those plots that were not irrigated. Gypsum was modestly beneficial in increasing infiltration, but not as effective as PAM. Data showed that the positive effects of irrigating with PAM persisted many weeks after irrigation had ceased. This research suggests that soil crusting and poor infiltration rates typically associated with municipal wastewater irrigation can be avoided if soil conditioners like PAM and gypsum are utilized. Results also suggest that lower or less frequent applications of PAM may be effective, thereby lessening the cost of using this technology. The ability of PAM to improve infiltration in column studies was variable and could not always be correlated with levels of soil conditioners that were added.

Reference: Gardiner, D.T., *Gypsum and Polyacrylamide Soil Amendments Used with High Sodium Wastewater* (TR-174), TWRI, Texas A&M University, College Station, TX. **NOTE:** This report is available free while supplies last by calling TWRI at (409) 845-1851.

UT Engineer to Develop Computer Model to Simulate Groundwater Remediation Strategies

Developing a computer model to simulate benefits and costs of groundwater remediation strategies is the goal of an advanced technology project awarded to a researcher at the University of Texas at Austin.

Bob Gilbert of the Civil Engineering Department will lead the project. The overall goal is to develop a computer model that can simulate and evaluate the consequences of site investigation strategies for groundwater remediation.

The effort involves developing a three-dimensional, numerically simulated site where groundwater has been contaminated. The model will include time steps from the time contamination initially occurred to the present. The program will include options to characterize sites based on the flow at site boundaries, contamination sources, subsurface characteristics, and contaminant transport. Users will be able to interact with the program to investigate the simulated site using conventional methods, such as boreholes and wells. The program will track both the investigation results and the associated costs. Case history data will be provided to make the hypothetical site more realistic and to make the pollutant transport and remediation efforts more reliable.

Gilbert hopes this type of research may make it easier to select the best and most cost-effective methods to investigate, and ultimately clean up contaminated aquifers. Eventually, Gilbert hopes that this research will be presented in hands-on training workshops and that it can be converted into develop a commercially available software package professionals and educators and students can use to learn more about groundwater cleanup methods.

For details, contact Gilbert at (512) 471-4929 or "Bob_Gilbert.cemail@cemailgate.ce.utexas.edu"

SMU Researcher Hopes to Recycle Industrial Waste Products for Wastewater Treatment

A researcher at Southern Methodist University is trying to modify a promising, innovative wastewater treatment method so it can be used in pilot demonstrations and, eventually, commercial applications. The technology transfer grant was awarded to Ed Smith of the SMU Mechanical Engineering Department.

Waste-shot blast fines are byproducts created when cast iron is manufactured. Previously, Smith conducted laboratory and bench-scale studies to determine if these fines can be used to remove heavy metals from industrial and hazardous wastewaters. In this effort, Smith hopes to develop a process to recycle waste shot-blast fines from cast iron manufacturing and use these materials to remove heavy metals from industrial and hazardous wastewater. Eventually, he hopes to design and operate a pilot treatment facility at an industrial site to demonstrate how this process works in field conditions.

Smith believes the use of fires for wastewater treatment may be most effective when contaminants have pH levels of 5 or higher and when pollutant levels are relatively low. The process could potentially be used to pretreat industrial wastewater, to clean up groundwaters extracted from hazardous waste sites, and to intercept and improve the quality of contaminated streams. The process is especially beneficial, Smith notes, because it is an inexpensive treatment method and it uses a material that is usually sent to landfills.

For details, contact Smith at (214) 768-3122 or edhsmith@seas.smu.edu.

Baylor Geologists to Develop New Method to Survey Sediment Build-Up Texas Reservoirs

Developing a new method to survey reservoirs and measure sedimentation rates is the goal of an advanced technology project awarded to researchers at Baylor University. The project leader is John Dunbar of the Geology Department.

The research will develop a multi-channel surveying system designed specifically for use in reservoir sedimentation work. Recently, new technologies such as acoustic fathometers and satellite navigation have been improved to lower the survey costs. Still, high equipment costs and the lack of a practical way to measure the thickness of sediment buildup have limited the use of these methods.

The goal of this study is to develop an integrated reservoir survey system that combines satellite navigation for accurate positioning, a fathometer to measure the depth of water or bathymetry, and a sub-bottom profiler to measure sediment thickness. Methods will be developed and tested to collect and interpret data. Demonstration surveys will be conducted on many types of lakes in Central Texas. Sediment cores will be collected to verify acoustic data.

These elements would be combined into a suitcase-sized system and an instrument that can be mounted on a boat. Dunbar hopes the system will be lightweight, compact, and able to be deployed by small skiffs as well as larger boats. His goal is to make the complete system cost only about 25% of comparable systems built from separate components. Ultimately, the use of this technology may help reservoir managers who must be aware of the amount of sediments that build up in their lakes.

For details, contact Dunbar at (817) 755-2361 or "john_dunbar@baylor.edu"

Texas A&M to Study Aquifer Geochemistry, Microbiology

A Texas A&M University researcher has been awarded a Texas Advanced Research Program grant to investigate the geochemistry and microbiology of Central Texas aquifers. The project will be led by Ethan Grossman of the Geology & Geophysics Department.

Microbial activity in aquifer systems controls the biodegradation of hazardous contaminants and the fate of organic matter. This research focuses on the distribution, character, and isotope ratios of dissolved and sedimentary organic matter. The goals of the study are to determine the source (terrestrial, marine, bacterial) and bioutilization potential of dissolved and sedimentary organic matter (DOM and SOM) in aquifer systems. Specifically, the study will explore (1) the relative roles of DOM transported from soils versus DOM derived from aquifer sediments in sustaining subsurface microbial activity, and (2) diagenetic change in SOM caused by microbial degradation.

In the research, Grossman and colleagues will collect groundwater and sediment samples at various depths in six wells along the Yegua Formation in Brazos County. Samples will be analyzed for organic acids, lignin, lipids, and carbohydrates, and carbon isotope analyses of specific compounds. Microbiological assays will be performed in conjunction with a study funded by the Department of Energy's Subsurface Science Program and will include total aerobic and anaerobic heterotroph counts, iron and sulfate reducers, methanogens, and iron and sulfur oxidizers.

Grossman explains this research is important because it is one of the first studies to consider the interrelationships between microorganisms and organic geochemistry in aquifers. It will provide vital information on organic matter sources and bioutilization potential and will examine the relative roles of transported versus *in situ* DOM and SOM in controlling microbial activity and survival. For details, contact Grossman at (409) 845-0637 or "e-grossman@tamu.edu"

TAMU-G Biologists Work on System to Photo ID Dolphins

Biologists at Texas A&M University at Galveston (TAMU-G) have been awarded an advanced technology grant to identify bottlenose dolphins with high tech photography. The research will be led by Phillip Levin and Bernd Wursig of the Marine Biology Department. Others participants include Dave Weller and Bill Evans of TAMU-G and Gill Hilman of the University of Texas Medical Branch at Galveston.

Dolphins often develop unique notches, scars, and nicks on their dorsal fins as they interact with other dolphins, predators and humans. Wursig has shown that these patterns are as unique as human fingerprints and can be used to identify specific dolphins.

The goals of the research are to create an efficient and accurate computerized image program that is capable of recognizing individual bottlenose dolphins from photos of dorsal fins, and to develop a digital system to retrieve and store large numbers of dolphin images from the Texas coast and around the world. The ultimate benefit of the research is that it will make it easier and more accurate to monitor dolphin populations and behavior. This will provide more information about these species that natural resource managers can utilize. This technology will also be immediately useful for other scientists who need to identify large numbers of bottlenose dolphins. For details, contact Levin at (409) 740-4704 or "levinp@tamug2.tamu.edu"

Environmentally Sensitive Plan Developed to Slow Erosion at Washington-on-the-Brazos

Washington-on-the-Brazos State Park is one Texas' most important historical sites -- it's where Texas Declaration of Independence from Mexico was signed and was the first capital of the Republic of Texas. The park, which is located at the confluence of the Brazos and Navasota rivers, is suffering from severe erosion. Floods in 1991 and 1992 washed away 20 acres of park lands and an overlook platform and threatened many other facilities.

As a result of the flooding, a broad based effort has been undertaken to develop an environmentally sensitive plan to lessen the effects of erosion at the park. Some of the lead participants in the effort include Sheryl Franklin of the Brazos River Authority, Terri Hershey of the Texas Parks and Wildlife Department, Gene Rice, Jr., of the U.S. Army Corps of Engineers Fort Worth District Office, and many elected officials.

The strategy consists of three parts -- enhancing drainage, establishing a toe protection plan, and stabilizing slopes. The erosion control plan calls for 12 lifts of pillows that are terraced up the bank slope. The drainage improvements involve joining two existing 12-inch surface drains and relocating them to a new 18-inch outflow line. The toe protection consists of hard points constructed of riprap with a height of 12' at the bank and will extend 25' into the river. The plan calls for them to be installed at 500' intervals along the west bank of the Brazos River and planted with trees to enhance visual aesthetics. The slope stabilization strategy consists of using willow pillows, willow posts, and dressing on nearly 800 feet of banks that are vulnerable to erosion. Willow pillows consist of fabric materials and live cut willow branches.

This unique bioengineering plan was approved by Corps Headquarters but is awaiting federal funding. Once federal funding of $500,00 has been secured, TPWD has committed to securing $300,000 needed to complete the project. For details, contact Franklin at (817) 776-1441.

Hardin Simmons Uses Bioassessments to Gauge Water Quality

Throughout semi-arid portions of West Texas, the value of water is never taken for granted. The problem is two-fold: there isn't much water in the region and much of the water that is present is plagued by high levels of salinity and other water quality problems.

Recently, a research project at Hardin-Simmons University (HSU) used rapid bioassessment techniques to examine the water quality of two intermittent streams, Deep Creek and the North Fork of the Salt Prong, in Shackleford County that flow into Hubbard Creek Reservoir near Breckenridge. The goal was to compare the water quality in those streams to an unimpaired reference site and to assess if manmade pollution may be occurring.

The studies were led by Gary Stanlake of the HSU Environmental Science Center, students Martha West and Donald Williams, and staff of the West Central Texas Municipal Water District. Samples were collected in the Spring and early Winter of 1994 to correspond to high flow periods. Data on habitats and macroinvertebrates were collected at both times and were assessed using a work sheet provided by the Texas Natural Resource Conservation Commission. Water quality data was gathered only in the Winter. Macroinvertebrate samples were collected from riffle segments of streams using a kick net. Taxonomic data were fed into a computer program which is designed to work with EPA assessment protocols.

Stanlake says the results show that there was little difference between the stream beds and riparian habitats of the two creeks. Macroinvertebrate communities differed from stream to stream and season to season and both streams were classified as being moderately impaired when rapid bioassessment protocols were used. Significantly, the North Fork of the Salt Prong scored as less impaired than Deep Creek, despite the fact that it has a relatively high chloride level of 686 parts per million. Stanlake believes that the low scores from the rapid bioassessments may result from the fact that the streams are intermittent, rather than any man-made contamination. For details, contact Stanlake at (915) 670-1394.

UT SPH Researchers Investigate Risks Cryptosporidium Poses of Infecting Healthy Adults

Cryptosporidium became a major public health concern in 1994 after an outbreak in Milwaukee caused 400,000 people to become ill. The disease, which often causes diarrhea, is transmitted in drinking water contaminated with oocysts by young animals like calves and infected humans. For water managers, the worst part of dealing with *Cryptosporidium* is that the parasite is resistant to chlorine and disinfection. Researchers at the University of Texas School of Public Health in Houston recently completed studies to assess how infectious the disease is in healthy adults. The studies were led by Herbert DuPont and Cynthia Chappell of the Center for Infectious Diseases.

The research consisted of providing volunteers with doses of *Cryptosporidium* ranging from 30 to 1 million oocysts. More than 62% became infected, regardless of dose levels. A level of 132 oocysts caused half the volunteers to become infected. In contrast, it takes as many as 10 million cholera bacteria for a healthy person to become ill. "This study demonstrates just how infectious this parasite is," Chappell said. "We now understand why so many people became ill in Milwaukee -- it's because such low doses are capable of causing large-scale infections," Chappell said. The study may have implications for water managers. Because low doses can cause outbreaks, extra care may have to be taken to make sure that *Cryptosporidium* levels are minimal.

For details, contact Chappell at (713) 792-4452 or "sph0385@utsph.sph.uth.tmc.edu"

USGS Tests "Transient River Model" to Simulate Effects of Stormwater Runoff

Scientists at the U.S. Geological Survey Austin District are evaluating the use of a new computer model that may better simulate the combined effects of point and non-point source pollution on water quality in receiving streams.

Currently, the Texas Natural Resources Conservation Commission (TNRCC) uses the "Qual-TX" simulation model to set stream standards. However, Qual-TX can only be used to simulate steady-state low flow conditions. Many experts believe that modeling tools are needed that can simulate nonpoint source pollution and a wide range of flows.

As an alternative to Qual-TX, Joy Sisolak Lizarraga began applying and evaluating the combined use of a one-dimensional transient river flow model (diffusion analogy flow model) and a water-quality transport model (the branched Lagrangian transport model or BLTM). The new model is referred to as "DAFLOW/BLTM." Lizarraga first tested the transient model against Qual-TX to simulate water quality in a segment of the Angelina River, north of Sam Rayburn Reservoir. The model was also used to simulate the effects of a hypothetical storm on water quality in this stream segment.

Lizarraga says the DAFLOW/BLTM model fairly accurately duplicated QUAL-TX low-flow simulations on the Angelina River when similar inputs and hydraulic parameters were used. DAFLOW/BLTM was able to simulate the effects of the hypothetical storm

superimposed on the low-flow conditions. Results from the model can be shown as spatial or temporal water quality profiles.

Lizarraga is now with the USGS in Towson, MD. More information about this research can be obtained by contacting Marshall Jennings at the USGS Austin District at (512) 873-3068 or "mejennin@dtxast.cr.usgs.gov" or Lizarraga at (410) 512-4902.

Texas A&M Biologist Listens to Sounds Shrimp Make to Learn More About Them

Texas A&M scientists deploy hydrophones off the Gulf coast to listen to sounds marine animals are making.

Movie fans will tell you that Dr. Doolittle in "My Fair Lady" wanted to talk to the animals to see what they had to say. Robert Benson of Texas A&M University's Center for Bioaccoustics is taking a different approach. He's listening to sounds marine animals make to learn more about them. The goal is to record sounds that dolphins, shrimp and other marine species make to learn more about their populations and movement.

In these studies, Benson and colleagues take Texas A&M University research vessels into the Gulf of Mexico and near coastal waters. Typically, crew members plunge a 1,200-foot long array of hydrophones into the water. The hydrophones are implemented to pick up specific sounds and frequencies that animals make in open waters. For example, whales make a clicking sound like the hammering of carpenters framing a house. These sounds are analyzed using digital signal processing, which is similar to geophysical techniques used to search for oil reserves. In an ongoing project, Benson and graduate student Ilona Berk hope to develop statistical relationships between the types, frequency and volume of sounds shrimp make.

This photo is a close up showing the devices which will be used to gather data on sounds made by many marine and aquatic species.

So far, they have monitored shrimp in laboratory conditions and found they often make noises similar to sounds detected with the hydrophone array. Large numbers of shrimp in the wild make sounds like bacon frying or brush burning. These noises appear to come from the movement of body parts during feeding behavior or from the rapid movements associated with escape from predators.

The group has recently conducted studies to learn more about shrimp in Galveston Bay using a pontoon boat. A major challenge will be to distinguish sounds shrimp are making from other marine noise. Benson believes that this technology may eventually be useful to help resource managers and commercial fishermen locate shrimp beds and detect other trends.

For details, contact Benson at (409) 845-5195 or "benson@entc.tamu.edu"

Geologist Says Edwards Aquifer Boundary May Need Changes

A San Antonio hydrogeologist believes that the boundaries of the Edwards Aquifer now used by regulatory agencies may need to be changed to better reflect how water flows in and out of the system.

George Veni, a groundwater consultant, believes that lower members of the Glen Rose Formation in the Cibolo Creek watershed, and some parts of the Glen Rose formation's upper members in the northern part of the recharge zone should be included as parts of the Edwards. Veni developed a potentiometric map of the Lower Glen Rose using 391 data points and plotted them with a 3-dimensional software package called Surfer. His results show that the entire lower Glen Rose Formation near Cibolo Creek may recharge the Edwards.

Veni also investigated many caves in Bexar, Comal, and Medina Counties. He identified 19 recharge caves that extend through the Edwards Limestone and into the Glen Rose Formation, including one of Texas' largest caves, Natural Bridge Caverns. Veni believes waters from the Upper Glen Rose Formation are flowing into the Edwards, although the exact amount of flow is not known. Finally, Veni theorizes that water may be leaking from the Austin Chalk formation into the Edwards, especially through San Antonio Springs when they do not flow, and possibly through the Austin's outcrop in Bexar County.

The results are important because they could provide more accurate estimates of the total amount of water in the Edwards, and could be used to better protect the recharge zone. For details, contact Veni at (210) 558-4403 or "kveni@tenet.edu"

UCOWR Meeting is in San Antonio, July 30 - August 2

The Universities Council on Water Resources (UCOWR) annual meeting will be July 30 - Aug. 2 in San Antonio. The theme of the meeting is "Integrated Management of Surface and Ground Water." Topics that will be covered include legal and policy issues that may constrain integrated use of ground and surface water, water quality impacts of integrated use, how to incorporate groundwater supplies into watershed protection efforts, and

artificial recharge. For more details about the meeting, contact TWRI at (409) 845-1851 or "twri@tamu.edu" Updated information about the meeting will also be posted on the WWW at http://twri.tamu.edu/.

New Technical Reports Available from TWRI

Four new technical reports are available from TWRI. *Gypsum and Polyacrylamide Soil Amendments Used with High Sodium Wastewater* (TR-174) was written by Duane Gardiner of the Agronomy and Natural Resources Department at Texas A&M University-Kingsville. *The Use of Remotely Sensed Bioelectric Action Potentials to Evaluate Episodic Toxicity Events and Ambient Toxicity* (TR-172) was written by Tom Waller, Miguel Acevedo, H.J. Allen and F.U. Schwalm of the Institute of Applied Sciences at the University of North Texas. *Volume-Duration-Frequencies for Ungaged Catchments in Texas* (TR-173, Volume I and TR-173, Volume II) were written by Ravi Devulapalli and Juan Valdes of the Civil Engineering Department at Texas A&M University.

Other recent TWRI technical reports include: *Water Supply Planning Using an Expert Geographic Information System* (TR-162) by Daene McKinney, John Burgin, and David Maidment of the University of Texas at Austin and *Flow, Salts, and Trace Elements in the Rio Grande* (TR-169) by Seiichi Miyamoto and Lloyd Fenn of the Texas Agricultural Experiment Station at El Paso, and Dariusz Swietlik of the Texas A&M University-Kingsville Citrus Center.

Also, the proceedings from the 1995 TWRI Water for Texas conference are still available for $30. For details on any of these publications, contact TWRI at (409) 845-1851 or "twri@tamu.edu"

"Legacy of Service" Details History of North Texas MWD

A history of the North Texas Municipal Water District has recently been published. The book, *Gift of Water: Legacy of Service*, was written by Bill Sloan, who is a well-known writer in the Dallas-Fort Worth area.

The book covers many topics that have affected the District and the area it serves. These include the drought of the 1950s, construction of Lake Lavon, work by U.S. Senator Sam Rayburn and other politicians to support the District and its projects, developing wastewater treatment plants, work to plan and construct Cooper Dam, and environmental issues.

The book was published by Taylor Publishing Inc. of Dallas. A limited number of individual copies of the book are available from the District at (214) 442-5405.

TNRCC Reports Focus on Water Quality, Water Rights

Many reports have recently been published by the Texas Natural Resource Conservation Commission (TNRCC). The reports cover a variety of topics, including water quality in Texas streams, water rights, and other topics.

Titles and report numbers of some of these recent publications include the following: *The Local Government Guide to the TNRCC: Partners in Environmental Protection (GI-145); Fish Community Structure in Relation to Water Quality and Habitat in the Upper Pecos River (AS-095); Wetlands Flora and Associated Environmental Conditions in Monahans Draw (AS-096); Toxic Contaminants Survey of the Lower Rio Grande, Lower Arroyo Colorado, and Associated Coastal Waters* (AS-69); *Report of the Investigation of Claims of Water Rights in the Upper Rio Grande (above Fort Quitman) Segment of the Rio Grande Basin, Texas* (AS-79); *A Survey of the Sediment, Chemistry, Instream Toxicity, and Aquatic Life Use Within the Days Creek Watershed During 1994* (AS-67/SR).

Other recent TNRCC studies include: *Waste Load Evaluation for Dissolved Oxygen in the Pedernales River in the Colorado River Basin Segment 1414* (AS-74), *Waste Load Evaluation for Dissolved Oxygen in the Concho River in the Colorado River Basin Segment 1421* (AS-78), *Waste Load Evaluation for Dissolved Oxygen in Salado Creek in the San Antonio River Basin Segment 1910* (AS-77), *Waste Load Evaluation for Dissolved Oxygen in the Aransas River Above Tidal in the San Antonio-Nueces Coastal Basin Segment 2004* (AS-76), and *Waste Load Evaluation for Dissolved Oxygen in the Leon River Below Belton Lake in the Brazos River Basin Segment* (AS-75). To order any of these reports, contact the TNRCC at (512) 239-0028. Some of these reports are available only in limited quantities.

Texas A&M Publishes Book on Changing Texas Climate

A new report has been published by Texas A&M University that describes how climate change may affect Texas. The book, *The Changing Climate of Texas: Predictability and Implications for the Future*, was edited by Jim Norwine of the Geosciences Department at Texas A&M University-Kingsville, and three Texas A&M University researchers (Rick Giardino of the Geography and Geology Departments, Gerald North of the Meteorology Department, and Juan Valdes of the Civil Engineering Department). Chapters of the book cover such topics as Texas' existing climate, future climates and effects, and spatial patterns. The book was published by GeoBooks and can be purchased from the Cartographics Division of TAMU at (409) 845-7144 or "wcs4697@tamzeus.tamu.edu"

Book Details History of Sour Lake Springs, Health Spa

A new book takes a close look at the colorful history of Sour Lake. The book, *Sour Lake, Texas: From Mud Baths to Millionaires*, was written by W.T. Block. Sour Lake is fed by a natural spring and is located east of Houston near the Big Thicket. The book describes the Sour Lake Springs Hotel and health spa, which were active from 1848 to 1909. It discusses pioneers and early settlers to the region, the boom town atmosphere that sprang

up after petroleum was discovered, race riots, and murders. The book was published by published by the Atascosito Historical Society. Orders can be placed by contacting the society at (409) 336-8821.

UT-Arlington Develops Method to Use Titanium Dioxide, Sunlight, to Treat Drinking Water

Methods to produce clean, safe drinking water are essential to protect public health and reduce such threats as bacteria, protozoans and pollutants. Researchers at the University of Texas at Arlington (UT-A) are developing and testing a system that utilizes a common chemical compound and sunlight to destroy a wide range of drinking water contaminants.

Krishnan Rajeshwar of UT Arlington is developing a system that utilizes a common chemical and sunlight to destroy drinking water contaminants.

The studies are led by Krishnan Rajeshwar and Russell Smith of the UT-A Chemistry and Biochemistry Department. The scientists are examining the use of titanium dioxide (a chemical substance widely found and mined in Texas that is utilized in paint and pigment industries) as a photo-catalyst that generates hydroxyl radicals. These radicals simultaneously destroy or inactivate many contaminants including a large array of microorganisms (bacteria and viruses), organic compounds (pesticides, benzene and formaldehyde), and heavy metals (arsenic, mercury and lead). This process is not suspected of producing cancer-causing by-products. Rajeshwar says it may be less expensive and use less energy than reverse osmosis and ultraviolet radiation. Radicals created in this process typically survive for only two hours. This makes this technique ideal for remote, short-term, decontamination needs like camping and military operations. Rajeshwar and Smith are now testing if sunlight can be used to power the reaction. They believe this technology has a potential for widespread use in tropical areas that receive a lot of sunlight.

For details, contact Rajeshwar at (817) 273-3810 or "rajeshwar@uta.edu" or Smith at (817) 273-3804 or "rlsmith@uta.edu"

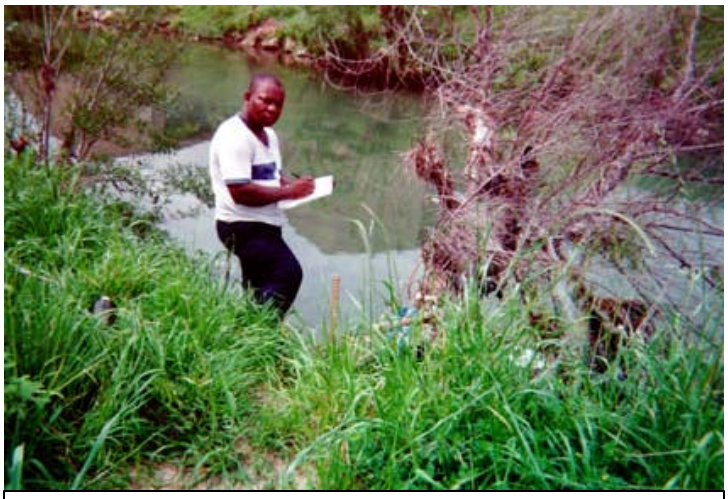
UT Develops Method to Simulate Atmospheric Water Balance

Researchers at the University of Texas at Austin are developing methods to simulate the atmospheric water balance of Texas that may provide new insights into such processes as precipitation, evaporation and solar radiation. The research is being led by David Maidment and Jerome Patoux of the Civil Engineering Department.

The overall goal of the studies is to better understand and simulate how water is transported in the atmosphere over Texas. Maidment hopes to develop mass balances that account for precipitation, evaporation, horizontal transport of water in the atmosphere (atmospheric moisture flux), surface water runoff, streamflows, infiltration and groundwater recharge. In this project, historical atmospheric flow data were obtained from the National Meteorological Center (NMC). A geographic information system (GIS) was used to link atmospheric data to regional trends in precipitation and evaporation. To use the GIS, Maidment modeled Texas' atmosphere as a three-dimensional area that extends from just above the surface of the earth to the top of the atmosphere. The vertical transport of water is represented as the interaction between evaporation and precipitation. Maidment says results of this modeling effort are fairly consistent with real world conditions. Maidment is now working on a related project to develop a grid-based water balance for Texas that is funded by TWRI. This research is on the WWW at "http://www.ce.utexas.edu/prof/maidment/gishydro" For details, contact Maidment at (512) 471-4620 or "maidment@batza.crwr.utexas.edu"

Texas Southern Examines Sediment Runoff in Houston Bayou

When heavy storms occur, runoff waters often transport sediments and suspended solids into nearby rivers and streams. These sediments can build up in culverts, drainage ways, and reservoirs and can reduce the amount of water that can be transported and stored there. Researchers at Texas Southern University recently carried out preliminary studies to evaluate sedimentation rates in Brays Bayou in Houston. The research was performed by Ray Agbanobi of the Civil Engineering Department, who sampled many sites along Brays Bayou from January to August of 1994.



Ray Agbanobi of TSU collects sediment and water quality data in Brays Bayou in the Houston area.

Sediments transported in the bayou build up on the bottom of the bayou or flow into the Houston Ship Channel. Agbanobi says the studies show that sediment transport is directly related to water levels in the Bayou. When stormwater runoff and water levels in the bayous are high, suspended solids levels increase. Geophysical studies show that most of the subsoil erosion in the bayou occurs at depths of less than 1.5 feet. Agbanobi says the research suggests that as much as 2,000 tons of sediments are transported in the bayou annually. For details, call Agbanobi at (713) 527-7681.

TAES, TAEX Assess Effectiveness of Agricultural BMPs

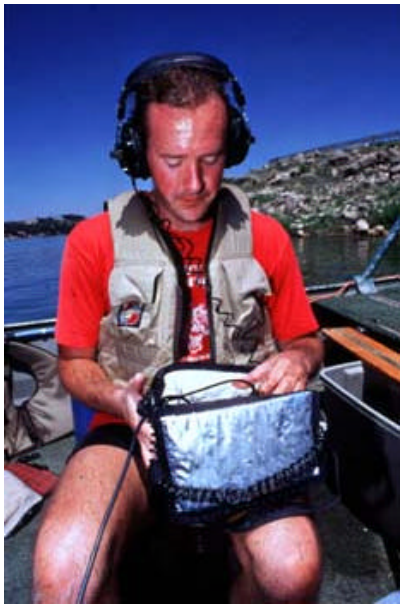
When water quality in such coastal ecosystems as wetlands, bays, and estuaries declines, many people first blame agricultural activities. After all, farming operations often utilize pesticides that may contribute chemicals, nutrients and other non-point source pollutants. A study now being carried out by Texas A&M University System scientists is assessing whether that's actually the case in the Corpus Christi area. The study, which is being funded by the Corpus Christi Bay National Estuary Program, is measuring stormwater runoff from typical agricultural operations in the Odem Ranch Watershed.

The study is led by Bobby Eddleman and Juan Landivar of the Texas Agricultural Experiment Station (TAES) at Corpus Christi. Others taking part include Larry Falconer of the Texas Agricultural Extension Service (TAEX), Darwin Ockerman of the U.S. Geological Survey, and Gene Lindemann and Leroy Wolff of the U.S. Department of Agriculture/ Natural Resource Conservation Service. The goal is to determine runoff water quality from small agricultural watersheds now used to grow cotton and grain sorghum. Initial activities included gathering data on the watershed and its habitats, and instrumenting three monitoring sites. Data are being collected on management practices, crop yields, and levels of nutrients, pesticides, suspended solids and trace elements from storm events.

The researchers want to examine how effective specific best management practices (BMPs) may be at reducing pollutant loads. BMPs being assessed in this study include selecting crop varieties that can be planted early in the growing season and those that are pest resistant; targeted use of fertilizers and pesticides; integrated pest and crop management; and stalk destruction and tillage practices that increase infiltration and reduce runoff. For details, contact Eddleman or Landivar at (512) 265-9201 "B-Eddleman@tamu.edu"

Texas Tech Introduces Predators to Control Gizzard Shad

During the past 20 years, gizzard shad were deliberately introduced into many West Texas reservoirs. The idea was that these fish would be a good food source for native game and sport fish like large-mouthed bass. The stocking effort may have worked too well. The gizzard shad have become abundant and grown so much in some West Texas lakes that predators can't control them. Now, a Texas Tech University researcher is investigating methods to reduce gizzard shad populations by introducing two predatory fish species, hybrid striped bass and striped bass, into Tanglewood Lake south of Amarillo and Buffalo Springs Lake near Lubbock. The studies are led by Jimmy Winter of the Range and Wildlife Management Department and Texas Parks and Wildlife Department biologists.



Winter says the main problem is that many shad have grown to more than 1 foot in length, which makes them too large for native predators to feed upon. Shad populations are growing and many reservoirs are dominated by these fish which are not very beneficial for the ecosystem. The research consists of assessing the effects of stocking predatory fish in these lakes. Winter and TPWD professionals began sampling both lakes in 1991. In 1992 and 1993, Tanglewood Lake was stocked with 25,000 hybrid-striped bass and Buffalo Springs Lake was stocked with 25,000 striped bass. Later, fish from both lakes were sampled using gill netting and electroshocking to determine which species were present, their size, and other statistical data. Winter says the surveys show that stocking these lakes with predators is successful. The numbers of gizzard shad seem to be declining. Still, the average size of the remaining gizzard shad is increasing. That may be because predators can't feed on the larger shad and fewer shad are reaching large sizes. Winter says many of these large shad could die off in two years or less. These efforts to control gizzard shad naturally may be more cost effective than strategies that use toxic chemicals to kill them. For details, contact Winter at (806) 742-1983 or "c7wjd@ttacs.ttu.edu"

Austin Center to Produce Rainwater Catchment Manual for Texas Conditions

An Austin group has been awarded a grant to develop a rainwater harvesting manual and video with site specific information for Texas. The work will be led by Gail Vittori of the Center for Maximum Potential Building Systems, Inc. This organization works on sustainable design and development and other appropriate technologies.

The manual will be a primer for understanding, constructing, operating, and maintaining rainwater catchment systems in Texas. It will be produced in both English and Spanish. Both site-built and off the shelf systems will be described. The manual will be written in an easily understood manner and will include many graphics, but will provide technically sound information.

Major sections of the manual will provide an overview of the basic principles of rainwater catchment. The equipment, building codes, and safety considerations needed for new construction or to retrofit existing buildings will be described and a list of current vendors will be provided. Typical rainwater harvesting systems will be identified for specific regions of Texas based on 50-year average rainfall data. Background information on water conservation will be provided.

Vittori will also produce a video in English and Spanish that will accompany the manual and display how these systems can be built and operated. For details, contact the Center at (512) 928-4786 or "max_pot@txinfinet.com"

NOTE: The manual has NOT been produced YET. It is being produced now. When the manual is available, it will be distributed by the Texas Water Development Board. To place an order for the manual, contact Patsy Waters of TWDB at 512/ 463-7955.

Medina County Water District to Study Social Impacts, Economics of Edwards Aquifer Water Transfers

A comprehensive examination of the social and economic impacts effects of water transfers on the Edwards Aquifer region is now being conducted by the Medina County Underground Water Conservation District (MCUWDC) and a team of consultants.

The study is being funded by the Texas Water Development Board and is co-sponsored by the Uvalde County Underground Water Conservation District. It is coordinated by MCUWDC general manager Luana Buckner. Lead researchers in the project include David Keen of BBC Consultants, Inc., of Denver, CO; Gregory Rothe, a consulting engineer from Hondo; and Russell Masters, a former general manager of the Edwards Underground Water District who is now a consultant in San Antonio.

The first step of the research is to review existing literature, including case studies from regions that have experienced water transfers. Existing data on agricultural production, economics and demographics will be examined. Particular focus will be given to regional crop budgets, crop prices, agricultural production and income, prices for land sales and leases, employment, individual incomes, government programs, the amount of acreage in crop production, water use by crops, local government spending, tax rates and revenues. These data will be used to develop a framework to examine social and economic impacts in the region. Computer simulation models will be applied to the region using actual data from agricultural areas that depend on irrigation. A case study will be conducted of a hypothetical water transfer in the Edwards Aquifer region that will examine social and economic effects, the cost of alternative municipal supplies, and values urban users may be willing to pay to acquire agricultural water rights and supplies.

A goal is to examine "third parties" that may be impacted by water transfers including farmers who have to reduce irrigation, landowners, local agricultural-related businesses, changes in the local labor force, households, and local utilities and government units. For details, contact Buckner at (210) 426-3162.