New Waves
The Research Newsletter of the Texas Water Resources Institute
Volume 12, Number 1, March 1999

TWRI Funds Studies on Fecal Coliform, Trinity Aquifer

Investigations that will explore fecal coliform contamination in Texas rivers and how groundwater levels in the Trinity Aquifer respond to rainfall are the focus of new studies funded through the Texas Water Resources Institute (TWRI).

The research awards are significant, according to TWRI Director Wayne Jordan, because this represents a renewal of TWRI's authority to administer a competitive grants program and select and fund investigations. "For the past few years, the granting process under the National Water Resources Institute program was administered at the regional level and TWRI wasn't able to have a lot of control over which areas should be studied or which projects would be chosen," Jordan says. "We are very happy that this year, and in the foreseeable future, the Institute will be able to identify, select, and fund research that needs to be done in Texas under this program."

SWTSU graduate students Brian Creutzburg and Rita Setser will gather rainfall and aquifer data.

In one project, Marty Matlock and Saqib Mukhtar of the Texas A&M University Agricultural Engineering Department will utilize state-of-the-art testing methods to measure levels of fecal coliform bacteria in upstream and downstream segments of Leon and Salado Creeks, which flow through San Antonio. The research will complement an ongoing study that Matlock is conducting for the U.S. Environmental Protection Agency, in which a team of TAMU scientists are monitoring other pollutants in the San Antonio watershed.

According to Matlock, this project is unique because it will attempt to correlate fecal coliform levels in streams with point and non-point source contaminants. As part of this effort, Matlock and Mukhtar will utilize the Hydrologic Simulation Program - FORTRAN to simulate the growth and persistence of fecal coliform bacteria throughout these watersheds. The goal is to incorporate this data into the process of developing total maximum daily loads (TMDLs) for the region.

"The TMDL process is becoming widely implemented throughout Texas, resulting in the need for more accurate techniques to assess how fecal coliform and other contaminants are transported to rivers and streams," Matlock explains. "Because fecal bacteria contamination has many potential sources, identifying and controlling the most significant origins is critical."

In another study, Lance Lambert and Marshall Jennings of Southwest Texas State University (SWTSU) will work with the Texas Water Development Board to develop an improved model to calculate recharge rates for the Trinity Aquifer, which is located in Central Texas. In this project, Lambert, who is with the Geology and Planning Department, and Jennings, who is a researcher with the Edwards Aquifer Research and Data Center, will develop an expanded network of as many as 20 groundwater observation wells. These wells will be located throughout the Glen Rose and associated formations, which receive recharge to the Trinity Aquifer group.

Lambert and Jennings hope to equip many of these observation wells with data recorders, rain gauges, modems and cell phones. The goal is to transmit changing groundwater levels and precipitation data during storm events from these remote sites to computers used for data collection at SWTSU.

"We hope to correlate when individual groundwater wells throughout the region rise following rainfall events as well as the extent that aquifer levels change," Jennings says. "This should give us a better idea of how individual sections of the aquifer respond to rainfall patterns and magnitudes."

For details, contact Matlock at mmatlock@agen.tamu.edu or (409) 862-7476, Lambert at LL07@swt.edu or (512) 245-2917, or Jennings at mj09@swt.edu or (512) 245-3544. These projects were slated to begin March 1, 1999.

TAMU Researchers Try to Tame Waterweed

The Giant salvinia fern (*Salvinia molesta*), previously discovered in several countries across the world, has recently been located in Texas. Ordinarily, a fern growing in Texas would not be a problem. However, the Giant salvinia is a threat because it grows so rapidly.

"It can double its size in four to ten 10 days," said Michael Masser, an extension specialist with the Texas A&M University (TAMU) Wildlife and Fisheries Science Department. As the fern grows, it can cover the surface of a body of water. After it covers a lake or a stream, the Giant salvinia continues to grow vertically, creating great masses of growth. Another complication is that this fern grows vegetatively. When a piece is broken off the original plant, it forms a new plant and continues to grow. This rapid growth depletes the oxygen when the plant covers the surface of a lake or stream, thus preventing oxygen transfer from the atmosphere. Often, this stresses, and may even kill, the aquatic plants and fish that live there.

Kelly Duffie of Estes Chemical, Inc., samples Giant salvinia near Tomball, TX.

To respond to this widespread infestation, a task force has been developed which includes the Texas College Sea Grant Program, the U.S. Fish and Wildlife Service, the U.S. Geological Service, the Texas Parks and Wildlife Department, the U.S. Army Corps of Engineers, the Sabine River Authority, and the Louisiana Parks and Wildlife Department. They are working to control this noxious fern and stop it from spreading any further. Giant salvinia has been sited in the Toledo Bend Reservoir, oxbows of the Lower Sabine River, Galveston Bay, in the Houston area, and at the Colorado River near Garwood. The first Giant salvinia in Texas was spotted in Toledo Bend in September, 1998.

"The difficult part about this fern is that it is attractive, but people don't know the harm it can cause," Masser said. The fern was traced to nurseries in Dallas, Houston and Wichita Falls. All these nurseries had no idea that the Giant salvinia was noxious nor did they know that it is illegal to sell this plant or import it from other countries." It is illegal to transport Giant salvinia across state lines.

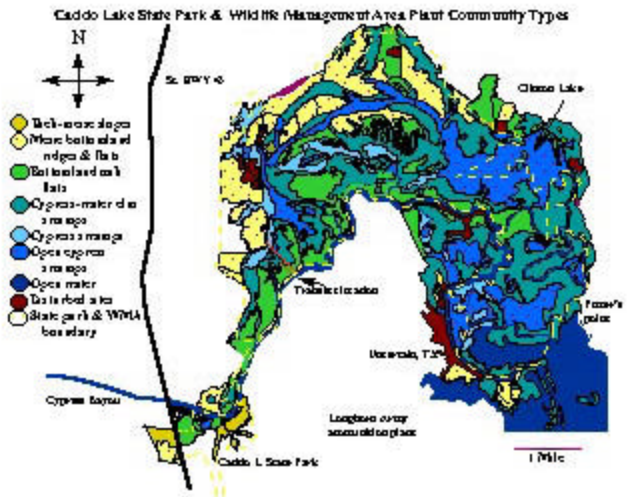
Masser says there are three ways the Giant salvinia can be controlled - it can be removed mechanically, biologically or chemically. "To control it mechanically, we would need to skim the surface of the water, but this is difficult since much of the fern tends to grow in shallow waters," Masser said. Biologically, a way may have been found to control the fern. The "salvinia weevil" (Cyrtobagous salvinae) is a natural predator to the Giant salvinia. The weevil lays eggs on the fern and then the larvae eat the plant. The weevil, along with the Giant salvinia, are found in southern Florida, where the plant was discovered. "I have two concerns with the weevil," said Masser. "One is that the weevil does not fly and will stay on only one patch of the fern. It will not move to another section of fern 50 feet away. I don't know if the weevil will survive in Texas year after year because of climate differences between Texas and Florida." Giant salvinia can also be controlled chemically through using different types of herbicides, but Masser says he would like to stay away from chemicals if possible.

The task force will begin to put weevils in affected areas this spring. Masser recommends that people should report observations of the Giant salvinia to the Nonindigenous Aquatic Species' hotline at 1-877-STOP-ANS. For details, visit the USGS WWW site at http://nas.er.usgs.gov/ferns. Masser can be contacted at (409) 845-7473 or mmasser@wfscgate.tamu.edu.

Measuring and Evaluating the Wetlands Vegetation Surrounding Caddo Lake

Researchers: James Van Kley and Douglas Hine, Biology Department, Stephen F. Austin State University, Nacogdoches, TX.

Problem Statement: In Eastern Texas, it is estimated that only 37% of the forests which existed before Anglo-American settlement in the 1800s still remain. It is thought that much of these losses can be attributed to the conversion of forests to agricultural production. In addition, the development of such dams as Lake of the Pines, Toledo Bend, and Sam Rayburn permanently flooded bottomland forests. Caddo Lake, on the Texas-Louisiana border is one of the most significant remaining wetlands resources in Texas. Only limited information describing the wetlands of Caddo Lake is available.



Objectives: To provide a quantitative description and gradient analysis of wetland plant communities of Caddo Lake.

Methods: Two transects were located throughout the Caddo Lake State Park and Wildlife Management Area. The transects followed a moisture and elevation gradient from a natural levee through a bottomland oak flat to a cypress swamp. Vegetation samples were taken at 30 points along this transect. Some of the sampling methods included measuring the diameter of trees, noting the number of stems on shrubs, and counting the occurrence of ground vegetation. The depth of water covering inundated areas was also measured. In a related effort, the researchers drew polygons representing distinct patches of vegetation on color infrared aerial photographs taken in 1993. In 1994-95, 119 of these areas were visited and surveyed. Data were analyzed using two methods - Two Way Indicator Species Analysis (TWINSPAN) and Detrended Correspondence Analysis (DCA). Both these methods provide a way to summarize and compare complex data about natural vegetation.

Results and Discussion: A map was created showing the location of major wetland vegetation types which are located near the lake. The research suggests that wetland vegetation at Caddo Lake corresponds to a flooding and elevation gradient from mesic, rarely flooded, terraces and levees to nearly continuously flooded cypress swamps. While the removal of the Great Raft (a naturally occurring logjam which created the lake) and the creation of a man-made dam may have modified the hydrology of the lake, modern vegetation appears to have closely adjusted to the current flooding regime. This is evidenced by the correspondence between normal water levels and the boundaries between semi-permanently flooded swamps and seasonally flooded bottomland oak flats.

Reference: Van Kley, J., and D. Hine, "Wetland Vegetation of Caddo Lake," *Texas Journal of Science*, November 1998.

NOTE: Van Kley can be contacted at jvankley@sfasu.edu. A presentation about this research can be viewed on the WWW at http://144.96.212.68/Mapserve/SchoolSciMath/Biology/Vankley/Caddo/sld001.htm.

Are Spatial Data About Environmental Health on the WWW?

Researcher: Susan Macey, Geography and Planning Department, Southwest Texas State University, San Marcos, TX.

Problem Statement: As a general rule, data acquisition is one of the most time-consuming parts of the research process. The World Wide Web (WWW) has the potential to bring vast new resources instantly to the reach of researchers and the general public at virtually any location throughout the world. Many WWW sites which pertain to environmental health already exist. However, these sites vary greatly in both the types and depth of information they contain. A special concern to geographers relates to the amount of maps or spatial data which exists.

Objectives: To inventory major WWW sites which relate to environmental health, and to classify them according to the amount of spatial information they contain as well as their ease of use.

Methods: Initially, a series of environmental health-related WWW sites was identified. These were grouped into broad categories (data sets and data access tools, educational materials, health atlases, medical data, and sites with multiple links). Each of these sites were ranked according to the region they cover, whether they contain spatial information, and which types of "tools" they include which may enhance the ability of users to view or manipulate electronic maps. Detailed verbal descriptions of roughly 35 WWW sites were developed.

Results and Discussion: Although the scope and extent of spatial information relating to environmental health on the WWW continues to grow rapidly, Macey suggests that much of this material is not yet in a form where it can be directly used in association with mapping software programs or geographic information systems (GIS). In many instances, specialized software is being developed which allows individuals to convert data into spatial displays for specific uses (to map river water quality, for example). Also, the time users need to invest to search the WWW for appropriate information and then importing it into a GIS is still great. This hinders the use of the WWW as a reference tool.

Reference: Macey, S., "Spatial Data for Environmental Health Analysis - A Web Survey," Presented at the 1998 Conference for Geographic Information Systems and Land Information Systems (GIS/LIS)), Fort Worth, TX, 1998.

NOTE: Macey can be e-mailed at sm07@swt.edu.

Integrating Geographic Information Systems and Computer Models to Generate Better Floodplain Maps

Researchers: Daniel Sui, Geography Department, and Robert Maggio, Mapping Sciences Laboratory, Texas A&M University, College Station, TX.

Problem Statement: In Texas and elsewhere, flooding is a major problem. It is critical that accurate maps be developed which show sites which are likely to be flooded under storms of various intensities. Flood maps are used by the Federal Emergency Management Agency (FEMA), other agencies, and insurance companies for a variety of purposes, including specifying which areas can be developed for various uses, setting insurance rates, and preventing flood damage. However, many experts believe the current system being used to develop floodplain maps is overly time-consuming and costly. With the advent of new technologies, there may be improved methods to develop such maps.

Objectives: 1) To develop a new methodology to create floodplain maps which utilizes geographic information systems (GIS) and computer simulation models, and 2) To test this method on the Greens Bayou watershed near Houston.

Methods: A database of Greens Bayou was created using a digital elevation model with 1-foot contours, based on a map from the U.S. Army Corps of Engineers (USACE). A contour map, which included the hydrography and cross-sections, was scanned and converted into ARC/INFO coverages which can be used in a GIS. Hydrology and hydraulics data were acquired from the U.S. Geological Survey and USACE field gaging stations. Historical rainfall data were obtained from the National Weather Service. Precipitation data were converted to runoff values using the USACE HEC-1 model. Peak flood flows derived from HEC-1 simulations were then input into the HEC-2 computer model to develop calculations of how storm flows would flood lands at various elevations. The study area was divided into five sub-basins according to land use patterns and soil types. Floodplain boundaries were automatically generated using the GRID module of ARC/INFO. After floodplain boundaries were determined, individual land parcels were laid over the new floodplain maps. Queries were made to assess the amount of flooding that may occur under storms of various intensities.

Results and Discussion: Floodplain boundaries and flooding maps were created for 50-, 100-, and 500-year floods using this new method. The new boundaries correspond well to existing Flood Insurance Rate Maps now used by FEMA. The researchers suggest that using this new method substantially reduced the time to develop floodplain maps, compared to traditional techniques now being used. They also report that this new method will greatly expand the capabilities of planners, regulatory agencies and consultants to model "what-if" scenarios based on future development, to update maps as conditions change, and to resolve controversies about the precise location of floodplain boundaries.

Reference: Sui, D. and Maggio, R., "A GIS-based hydrological/hydraulic modeling approach for floodplain mapping," *1998 American Society for Photogrammetry and Remote Sensing Technical Papers*, Vol. 54: pp. 169-179.

NOTE: For more information, contact Sui at d-sui@tamu.edu or Maggio at rmaggio@silva.tamu.edu.

Detecting Hourly and Daily Water Quality Fluctuations Within the Salado Creek Watershed

Researchers: Melanie Humphrey and Joe Yelderman, Geology Department, Baylor University, Waco, TX; and Tom Conry, David Collinsworth, and Robert Fuentes, Brazos River Authority (BRA), Waco, TX.

Problem Statement: The small Central Texas town of Salado lies within the Salado Creek Watershed. The watershed includes surface waters (Salado Creek) as well as groundwater supplies (it is part of the northern segment of the Balcones Fault Zone of the Edwards Aquifer). Recently, elevated levels of fecal coliform bacteria and higher than normal concentrations of nitrogen and phosphorus have been found in Salado Creek. In addition, increased levels of nitrate have been found in wells in the area. However, the specific sources and amounts of contaminants have not been precisely identified.

Objectives: 1) To sample surface and ground waters for nitrate, phosphate, and fecal coliform both during rainfall events and baseflow conditions, and 2) To conduct diurnal (daily and hourly) studies to see if human lifestyle trends may influence water quality.

Methods: The study was conducted from April to August 1998. Diurnal sampling was conducted in May and July. Because of the drought, it was impossible to sample rainfall events. Two sites on Salado Creek - sited upstream and downstream of the town - were chosen to measure how streamflows may affect water quality. A well and spring - located between the two creek locations - were also monitored. Data were obtained using four automated samplers (used to gather diurnal information), four bubble flow meters (used to initiate the automated samplers and record water levels), and two Hydrolab recorders and data sondes (used to measure and record field data on such parameters as specific conductance, pH, temperature, and dissolved oxygen every 15 minutes). In addition, a fluorometer was utilized to determine if brighteners (used in laundry detergents) were present in area streams. This was done to screen specific sites for the presence of potentially failing on-site wastewater systems.

Results and Discussion: In general, the average levels of fecal coliform increased over time, while baseflows decreased. Average counts of fecal coliform bacteria were generally greater in the stream than in groundwaters. The spring played a key role in influencing chloride concentrations at downstream sites. The well consistently had higher levels of chlorides and lower concentrations of nitrate than the spring, but did not appear to influence chloride concentrations in the stream. It appears that stream pollution may come from the shallow aquifer, although the deeper groundwater formation seems to

have less of an influence. Finally, use of the fluorometer as a screening tool successfully identified many sites where individual on-site wastewater treatment systems may be failing.

Reference: Humphrey, M. A., and J. Yelderman, *Diurnal Water Quality Fluctuations in Salado Creek*, Final report to BRA, 1998.

NOTE: This study was funded by the Texas Clean Rivers Act. Yelderman can be contacted at Joe_Yelderman@Baylor.edu.

Determining Total Pollutant Loads and Water Quality in the Corpus Christi Bay System

Researchers: Ann Quenzer, David Maidment, Ferdinand Hellweger, Nabil Eid, George Ward, and Neal Armstrong, Center for Research in Water Resources, University of Texas, Austin, TX.

Problem Statement: The purpose of the National Estuary Program (NEP), which sponsored this research, is to study conditions which influence both the hydrology and water quality of coastal water bodies, including the greater Corpus Christi Bay region. The relative contribution of potential point and non-point source pollutants needs to be determined so that the watershed feeding into the Bay system can be better managed and water quality can be protected.

Objectives: 1) To determine total pollutant loads to the Corpus Christi Bay system, and 2) To develop predictive and analytical tools which can be used to estimate the effect of various human impacts on water quality within the Bay. Methods: In this study, the regional bay system was divided into three components: 1) The north system, including Copano and Aransas bays, 2) The middle region, consisting of Nueces and Corpus Christi bays, and 3) The lower system, including the Laguna Madre and Baffin Bay. The study was divided into three major tasks - 1) Determining the water balance of inflows, outflows, rainfall and evaporation, 2) Assessing the total loadings of pollutants from point sources, land surfaces, the atmosphere and the Nueces River basin, and 3) Developing a mass balance for each constituent in the bay system. The research in this study involved creating and utilizing a geographic information system (GIS) and linking it to computerized simulation models. To develop the water balance, the researchers developed a grid-based watershed model using digital elevation data, which connected the bay system with the river network. They used an eight direction "pour point" model to simulate how waters are likely to flow throughout the watershed . The researchers calculated rainfall/runoff relationships and established mathematical correlations between land use and streamflows. The study team estimated annual pollutant loads, and computed loadings from land surfaces, point sources, upstream watersheds, the atmosphere, and sediments. They calibrated a water quality model. Mass balance work was carried out by examining the bathymetry of the bay system, inflows, water balance data, and using the GIS to determine how pollutant loads are distributed in the bay system.

Results and Discussion: Mean annual rainfall varies from 40 inches per year at the northern bay system to 24 inches per year in the south. Total inflows to the bay system are estimated to be 2500 cubic feet per second, of which 56% enters the north bays, 34% the middle bays, and 10% the southern bays. Average direct rainfall onto the surface the bays is estimated to be roughly 31 inches per year, while average evaporation is estimated to be approximately 63 inches per year. Nitrogen and phosphorus loadings were estimated to be 8,190 pounds per day (ppd), while loadings for metals were much smaller (49 ppd for zinc, 14 pounds ppd for copper, and 12 pounds per day for chromium). For total phosphorus and metals, it is estimated that half to two-thirds of loads originate from the land surface. For nitrogen-based pollutants, it is thought that half the loads originate from non-point sources on land surfaces, a third stems from the atmosphere, and one sixth comes from point sources. Using a water quality model and the GIS, the research analyzed and displayed the effect of pollutant loads throughout the bay system. Results suggest the simulation models under-predict metals levels actually found in the bay system, perhaps because the bays do not flush frequently and since industrial discharges may have deposited large amounts of metals in the bays over time. Event mean concentrations of nutrient and phosphorus levels in agricultural runoff were less than half of those originally assumed, based on sampling done outside the region. The researchers suggest that the GIS developed for this study will be a useful tool for analyzing the potential impact of the use of best management practices on water quality throughout the bay system.

Reference: Quenzer, A., D. Maidment, F. Hellweger, N. Eid, G. Ward, and N. Armstrong, *Total Loads and Water Quality in the Corpus Christi Bay System* (Report CCBNEP 27), Corpus Christi Bay NEP, 1998.

NOTE: This report can be obtained from the Corpus Christi Bay NEP at (512) 980-3420. It is on-line on their World Wide Web site, which is http://www.sci.tamucc.edu/ccbnep. Maidment can be contacted at maidment@danube.crwr.utexas.edu.

UT, TAMU, Team up with GLO, DEM, to Update Texas Coastal Hazards Atlas

If all goes smoothly, local government officials, regulators, and the general public in Southeast Texas may soon have an updated, user-friendly, digital atlas which will help them plan for and deal with natural disasters.

The project to develop the digital atlas is a cooperative effort involving Jim Gibeaut of the University of Texas Bureau of Economic Geology (UT BEG), Greg Schumann of Texas A&M University Hazard Reduction and Recovery Center, and Mike Peacock of the Texas Division of Emergency Management (DEM). It is being funded by the Texas Coordination Council.

The atlas focuses on the region stretching from Galveston Bay to Sabine Lake. The work builds upon the *Atlas of Coastal Hazards*, a printed report generated by UT BEG in 1974. The new atlas will retain many of the same concepts presented in the previous version,

including information on transportation and evacuation routes that may be needed if hurricanes hit the coast, areas likely to be flooded by strong tropical storms, and shoreline erosion. Information on many of these categories will be updated and new data will be developed about such issues as fault lines, wetlands areas, and subsidence trends.

The atlas will be printed and made available as a report as well as a geographic information system (GIS). This GIS will be made available to local agencies utilizing user-friendly ARC/VIEW software. The text of the atlas will present information in a way that can be easily understood by local agencies and the public.

For more information about this project, contact Gibeaut at (512) 471-0344 or gibeautj@begv.beg.utexas.edu, or Schumann at (409) 845-4669 or schu@taz.tamu.edu. For more details on the Coordination Council, contact Diana Ramirez of the Texas General Land Office at (512) 463-2893.

Preventing Soils from Becoming Hard as Concrete is Goal of Study by Texas Tech, Israeli Scientists

TTU graduate student Katy Williams examines these soils in the High Plains.

At many sites in semi-arid and arid regions, soils which are structurally unstable can literally become hard as concrete. The effect of this pavement-like soil is obvious - water cannot flow into the soils to plant roots, while crops have a difficult time penetrating through these soil crusts so they can grow.

Now, scientists in Texas and Israel are studying if amendments can make the condition of these problem soils more amenable to plant growth. The goal of these studies, which are funded by the Texas Department of Agriculture, determine how the addition of polymers can minimize crusting and increase the amount of infiltration that flows through these soils and thus encourage plant growth.

The research is being carried out by Richard Zartman of the Texas Tech University Plant and Soil Science Department and Guy Levy of the Israel Ministry of Agriculture. The project involves field trials in which two polymers - "AT" and "Pristine" - were applied to cotton soils in Texas in 1997. In 1998, one linear and one cross-linked polymer were evaluated at two locations. Similar studies are being carried out on soils in Israel used to grow onions and wheat.

According to Zartman, the use of polymers holds considerable promise, especially if heavy rains occur shortly after planting. That's when conditions are most ripe for soils to crust and harden. To make sure these conditions are tested, Zartman plans to irrigate research plots to simulate heavy rains.

For details, contact Zartman at (806) 742-1626 or zrich@ttacs.ttu.edu.

TAMU, Israeli Scientists Study Whether Use of Drip Irrigation Can Boost Watermelon Yields

How can farmers grow a bigger watermelon? How can they increase the number of melons they produce? One possible way, scientists in Texas and Israel suggest, may be to combine the latest advances in drip irrigation systems with an irrigation schedule that gives these crops water when they get the biggest benefit from it.

The research, which is being funded by the Texas Department of Agriculture, is a joint effort between Daniel Leskovar of the Texas A&M University Agricultural Research and Extension Center in Uvalde and Avraham Meiri of the Colcani Center in Israel.

The guiding principle is to ascertain if drip irrigation can save water while, at the same time, improving the quality and maximizing yields of a wide array of fruits and vegetables. So far, the scientists have conducted a number of trials in which both above-ground and subsurface drip irrigation systems have been used to apply saline and fresh water. Corps have been established through conventional methods (direct seeding) as well as by first being grown in containers and then being transplanted.

Early results suggest that this crop production strategy may have some payoffs. For example, the experiments with watermelons suggest that drip irrigation my increase the size of the melons and help them mature earlier than conventional methods. Leskovar hasdeveloped fact sheets discussing this technique and is introducing this strategy to farmers throughout the Texas Winter Garden region.

For details, contact Leskovar at (830) 278-9151 or d-leskovar@tamu.edu.

WTAMU Expert Lends Helping Hand to Clean Up Mercury Pollution in Azerbaijan

It's difficult to imagine two places more contrasting than the rural, West Texas town of Canyon and Sumgayit, a city in the nation of Azerbaijan, which was part of the former Soviet Union.

Ironically, pollution is the issue which has brought these places together. Jim Rogers, an instructor of environmental science at West Texas A&M University in Canyon, is one of many people within The Texas A&M University System who is helping the Azerbaijani government and the people who live there clean up pollutants and restore the environment. Rogers' work is performed within the framework of the A&M System,

which has created a multi-university team, the Texas A&M Education and Research on the Caspian Sea effort.

Jim Rogers of WTAMU is assisting pollution cleanup efforts in Azerbaijan.

Rogers and others have been traveling to Azerbaijan to examine problems associated with mercury pollution. During each of the past few years, Rogers has often visited the region in his capacity as the lead technical expert of the World Bank mercury initiative and has monitored the progress of environmental restoration efforts. Goals of the mercury cleanup team are to remove virtually all of this contaminant from the region's environment, to educate the public about whether waters are safe to drink, to evaluate if toxic levels of mercury have built up in fish and wildlife tissue, and to remediate polluted soils.

Rogers hopes to expand the opportunities for researchers and students to help out with the regional pollution problem. For example, Rogers is working with Gilbert Rowe of the TAMU Oceanography Department and John Bickham of the TAMU Wildlife and Fisheries Sciences Department. They hope to establish a research laboratory in Sumgayit and send environmental science students from the A&M System and Azerbaijan there to study these issues and perform internships.

For details, contact Rogers at (806) 651-2581 or jrogers@mail.wtamu.edu, Rowe at rowe@astra.tamu.edu, or Bickham at jbickham@wfscgate.tamu.edu.

Rice U. Develops Cleanup Methods for Defense Department

Results from groundwater pollution remediation studies have identified a series of innovative methods that may effectively clean up contaminants at U.S. Department of Defense (DOD) sites and other locations.

The research was carried out by a multi-university program, the Advanced Applied Technology Demonstration Facility (AATDF), which is headquartered at Rice University. The program is directed by Herb Ward of the Rice University Civil Engineering Department. "Traditionally, most of the easy environmental remediation problems have been addressed with readily available technology," Ward says, "but we have had no affordable technology which can solve the most difficult subsurface and groundwater problems. Because of this research, we now have many new and innovative technologies for hazardous waste cleanup."

Projects funded through AATDF encompass a variety of strategies including phytoremediation, an experimental controlled-release system, and laser fluorescence. Scientists from Texas universities have researched many of these issues. George Hirasaki and Clarence Miller of the Rice University Chemical Engineering Department worked with Gary Pope and Bill Wade of the University of Texas at Austin (UT) to study the use of surfactants and foams to remediate aquifers, David Daniel of UT explored enhanced soil vapor extraction with radio frequency heating, and Kathy Balshaw-Biddle of Rice University's Energy and Environmental Systems Institute was part of a team which examined a portable remediation technology that facilitates the controlled release of pollutants.

For more information, visit the AATDF World Wide Web site at http://www.ruf.rice.edu/~aatdf/index.htm.

UNT Photojournalist Documents Sources of Trash on Texas Beaches

Susan Zavoina of UNT is photographing how commercial shipping may influence pollution on South Texas beaches.

An old and well-known truism says, "A picture is worth a thousand words." With that in mind, a photojournalism researcher at the University of North Texas (UNT) is documenting, through photographs and interviews, pollution trends along the Texas Gulf Coast. The project is undertaken by Susan Zavoina of the UNT Center for Community and Environmental Journalism. The study began in 1998 as an effort to determine if MARPOL (an international treaty that is designed to prevent coastal pollution) is curbing the amount of plastic and pollutants that reach coastal areas. Zavoina has been documenting trends in the amount and type of garbage which wash onto beaches at North and South Padre Island. Through photographs and interviews, Zavoina has learned that a plethora of junk finds its way to beaches, including onion sacks, bleach bottles, and rubber gloves. In many cases, Zavoina and colleagues believe, a good deal of the waste may originate from commercial shrimpers. For details, contact Zavoina at (940) 565-2272 or zavoina@unt.edu.

Texas Tech Publishes New Report Describing How to Develop Playa Lake Hydrologic Budgets

A new report from the Texas Tech University (TTU) Water Resources Center helps users create water balances for the many playa lakes found throughout the Texas High Plains. The report, *WaterBalance: Hydrologic Budgets for Playa Lakes*, describes a computer program written in FORTRAN that computes water movement through playa lake bed sediments into the underlying Ogallala Aquifer. It was developed as part of the environmental research effort conducted by TTU for the Department of Energy at the Pantex Plant located near Amarillo.

The report was developed by researcher David Thompson of the TTU Civil Engineering Department and former TTU graduate students Alan Reed and James Greer. WaterBalance is designed to apply the conservation of mass equation to playa lake water budgets. The function of WaterBalance is to read a long-term time series of meteorological and hydrologic variables for a playa basin and to compute the water balance between infiltration and evaporation for individual playas. This information can be used to assess the impact of playa lake infiltration on groundwater resources.

The report is available by contacting the Center at (806) 742-3597. For details about the research, contact Thompson at (806) 742-3485 or thompson@shelob.ce.ttu.edu.

Aquifer Pathogens Are Topic of Book by TAES Scientist

A new book discussing groundwater contamination issues has been edited by Suresh Pillai, a microbiologist with the Texas Agricultural Experiment Station in El Paso. The book, published by Springer-Verlag, Inc., is titled *Microbial Pathogens Within Aquifers - Principles and Protocols*.

The book is targeted at professionals, academics and students interested in the microbial characterization of aquifers, and provides fundamental facts on hydrogeology and groundwater contamination. The books describes microbial sampling methodologies; detection of bacterial, protozoan, viral and microbial pathogens; microbial modeling and transport; DNA fingerprinting and other microbial characterization approaches, and microbial risk assessment for groundwater applications.

To order the book, call Springer-Verlag at (800) 777-4643. Pillai can be contacted at s-pillai@tamu.edu.

UTA Historian Authors Book on Texas Maritime History

A researcher at the University of Texas at Arlington (UTA) has published a new book describing Texas maritime history. The book, *From Sail to Steam, Four Centuries of Texas Maritime History 1500-1900*, was written by Richard Francaviglia, of the History Department and the Center for Greater Southwestern Studies and the History of Cartography at UTA.

This book provides a historical account of the first four centuries of Texas' merchant and military marine history. The book provides fascinating accounts of the wreck of the Spanish flotilla off Padre Island in 1554, LaSalle's expedition to Texas in the 1680s, the role of the Texas Navy in the fight for independence from Mexico in 1835-36, Civil War battles at Galveston and Sabine Pass, developments made to aid navigation, and the Galveston hurricane of 1900.

This book can be ordered from the University of Texas Press at (800) 252-3206. To contact Francaviglia, e-mail him at francaviglia@library.uta.edu.

UTPB, Roosevelt U., Political Scientists Compile Database on Federal Water Rights Court Cases

In what seems to be a daunting undertaking, a pair of political scientists in Texas and Illinois are compiling a comprehensive database about what the U.S. Supreme Court, Federal courts, and Congressional hearings have said about water rights. The project covers most of the history of the United States Supreme Court (from 1789 to 1995). The effort is the work of Robert Perry of the University of Texas-Permian Basin (UTPB) and Kelly Tzoumis of Roosevelt University in Chicago.

"The reason we wanted to do this project," Perry explains, "is that we hope to develop a tool researchers can use to gain some insights into how the agendas of Congress and the courts may have changed over time. We want to quantify how the process of resolving water rights issues may have changed throughout the years, including the extent to which dominant special interests have controlled policy making. We think this project will be unique because most studies of environmental policies, including those concerning water rights, have been based on legislation passed in the 1970s."

In the project, Perry and Tzoumis will study roughly 150 Supreme Court cases, 400 Federal court trials, and more than 2,000 hearings. For each case, they will code the witnesses who testified or provided information on whether they were associated with government agencies, businesses, or environmental groups. They will also code the stance each group presented at these proceedings. Ultimately, Perry and Tzoumis hope to make the database available to other researchers, possibly in an electronic form or on the World Wide Web.

For details, contact Perry at perry_r@utpb.edu or (915) 552-2343.

PVAMU Researcher Studies Gulf of Mexico Water Temperatures Using NASA Satellite Data

Safwat Shakir of PVAMU is compiling NASA satellite images which document Gulf of Mexico water temperatures.

In an innovative, high tech project, a researcher at Prairie View A&M University (PVAMU) is working with scientists from the National Aeronautics and Space Administration (NASA) to collect, analyze, and disseminate remotely sensed images. The goal of this on-going effort, which began in 1995, is to utilize satellite data to provide new clues about many issues, including changes in the sea surface temperature of the Gulf of Mexico and the water use of agricultural crops.

This work is a collaborative effort between Safwat Shakir, the Director of the PVAMU Texas Gulf Coast Environmental Data Center, NASA researchers at the Stennis Space Center, and scientists at TRW, Inc. TRW developed the "Hyperspectral Imaging System" which is a satellite which obtains remotely sensed images. In the sea surface temperature study, NASA transmits twice-daily satellite images of the Gulf to PVAMU. Shakir is now storing the images and making them available for other researchers. In the future, he hopes to put many of the images on the Center's World Wide Web site.

"There is a significant opportunity to utilize this data to increase our understanding why and how often sea surface temperatures in the Gulf fluctuate, and what the consequences may be for the environment, the likelihood of coastal flooding, and other issues," Shakir says. He explains that you can use this system to examine "hot spots" that often flare up in the Gulf during summer months, to measure variations in temperature in specific regions of the Gulf, and to learn more about possible effects of global climate change throughout the region.

For details, contact Shakir at (409) 857-2654 or sshakir@texged.ips4.pvamu.edu.

Lamar U. Scientist Tracks Temperature Trends in Texas Lakes

To the casual observer, it may seem as though most Texas lakes are pretty much alike. However, a researcher at Lamar University suggests that Texas contains many different types of lakes and that these variables may influence how water temperatures change within these water bodies.

Xing Fang of the Lamar University Civil Engineering Department has been gathering data on 27 types of hypothetical lakes which are found throughout Texas. Using weather data from 16 sites and a year-round water temperature model, Fang simulated the possible effect of seasonal climate changes on these different types of lakes.

Fang explains that, in order to understand this problem, many factors need to be considered including the size, shape, and depth of a reservoir, weather problems that may affect specific regions (high winds and tropical storms in coastal areas), and water clarity. Many climate parameters, including air temperatures, humidity, annual temperature variations, and historical extremes, need to be factored into these analyses.

Fang is examining how water temperatures vary within individual lakes. During summer months, heat is often transferred from lake waters to sediments while, during the winter, the opposite effect occurs. Fang is also exploring the extent to which high temperatures cause stratification and reduce mixing between zones or layers within individual lakes. As a result of the studies, Fang has generated data about maximum and minimum surface temperatures, water temperatures at lake bottoms, and in-lake differences for many regions of Texas.

For details, contact Fang at (409) 880-2287 or fangxu@hal.lamar.edu.

Studying Air Quality Near Port of Corpus Christi is Focus of Investigation by A&M-Kingsville Researcher

A researcher at Texas A&M University-Kingsville is now studying air quality in and around the Port of Corpus Christi. The lead scientist, Kurvilla John of the A&M-Kingsville Environmental Engineering Department, hopes the project will not only provide a more thorough analysis of air pollution throughout the Coastal Bend region, but may also shed some new light on air pollution problems which specifically affect the port.

The study began in August 1998 and will continue until June 1999. The overall goal of the project is to identify which types and amounts of emissions are found in air samples in and around the Port, and to inventory and identify which sources may be worsening potential air pollution problems.

So far, John has discovered that there may be special air pollution problems in the Port area. He notes that the big ships and barges which often travel into and out of the Port often are not well outfitted to control air pollution from heavy-duty diesel generators and other equipment.

In general, John suggests, the size of the ship determines, to a large extent, how much air pollution they may generate. He notes that ships in the Corpus Christi Port area emit contaminants, including unburned hydrocarbons and oxides of nitrogen. These pollutants are precursors for the formation of compounds which reduce atmospheric ozone. They originate when fuel is burnt on the ships. In addition, fine particulate matter is created by man-made activities.

"If air pollutants are cleaned up in the Corpus Christi Port area, it will probably bring some benefits to the coastal waters, but the improvements may only be marginal," John

said. Air pollutants from the Corpus Christi Port area are often carried by currents to other regions of the state and this may also affect air quality in urban areas.

For more information, contact John at k-john@tamuk.edu.

A&M-Corpus Christi Project Aims to Rebuild Beachfront So It Can be Used for Research, Recreation, Education

Dan Prouty of A&M-Corpus Christi surveys an area where the university will create a new beach. Deidre Williams, in the background, collects sediment and water quality samples.

Developing a multiple use beach park that can be utilized for research, education, and recreation is the goal of a comprehensive project now being undertaken at Texas A&M University-Corpus Christi. In addition, the effort may also increase biodiversity at the site by adding to existing habitats.

This initiative is led by the A&M-Corpus Christi Conrad Blucher Institute for Surveying and Science (CBI). Research and development was supported by the A&M-Corpus Christi administration. Project leaders are Jim Bonner and Deidre Williams of CBI. Final engineering specifications and permitting are being supported by the Texas General Land Office and the National Oceanic and Atmospheric Administration through a Coastal Management Plan grant.

The goal of this program is to replace a 1,200-foot section of Corpus Christi Bay shoreline, which is now largely inaccessible and unusable by the public because the existing timber bulkhead is deteriorating, with a new beach. To replace this section of the beach, Bonner and Williams developed a proposal to construct groins and detached breakwaters to limit sand losses, to place gaps between structures to enhance water quality and promote circulation, and to incorporate an arched design which will lessen the extent that wave energy pounds on nearby shores. The researchers propose that roughly 60,000 cubic yards of coarse sandy fill material will need to be imported to create this new beach.

Eventually, Bonner and Williams believe this project could fill a number of purposes. They hope to use the site to provide public education by displaying on-line data about currents, waves, winds, sediment and particulate transport, and water quality parameters. The site may also provide opportunities to study such issues as how beaches respond to coastal structures, how benthic organisms recover once a beach has been nourished, and the extent of biodiversity changes that may occur when environmental conditions are enhanced.

Bonner and Williams hope that final engineering specifications can be completed by the end of 1999 and with construction beginning in 2000. These dates are tentative, pending the identification of funding sources and sponsors.

For more information, contact Bonner at (512) 994-2376 or bonner@envcs00.tamu.edu or Williams at (512) 994-2714 or williams@cbi.tamucc.edu.

Significant Opportunities Exist to Conserve Water in Valley Irrigation Districts, TAEX Study Suggests

How much water could be conserved if irrigation districts in the Lower Rio Grande Valley become more efficient at delivering water to agricultural producers in the region?

In the Lower Rio Grande Valley, canals convey irrigation water from the river to agricultural fields. There may be significant opportunities to make these canals more efficient and to conserve valuable water resources.

Preliminary results of a new study from the Texas Agricultural Extension Service (TAEX) suggest that there may be opportunities for saving significant amounts of water throughout the region, if methods to deliver water from the Rio Grande to individual farmers can be improved. In addition, working with agricultural producers and encouraging them to adopt efficient irrigation methods will also result in major water savings, the report suggests.

The study was led by Guy Fipps, an agricultural engineer with the Texas Agricultural Extension Service (TAEX). Others who played key roles include former and current Texas A&M University students Craig Pope, Jalal Bashai, Kyle Chilek, and Shad McDaniel. The project was funded through the U.S. Bureau of Reclamation with assistance from the Lower Rio Grande Development Council and individual irrigation districts.

The Texas Water Resources Institute (TWRI) brought Reclamation and Fipps together. TWRI is also administering the project and will publish a final technical report when the effort is completed. The main goal of the project, Fipps says, was to gather data on the efficiency at which 28 irrigation districts in the Valley deliver water to the field, to identify specific sources of inefficiency, and to suggest possible improvements. The study involved regular visits by Fipps and other team members to gather first-hand field data and to interview irrigation managers and farmers in the region. The team measured seepage losses in canals and gathered and developed data on the specific characteristics of water distribution systems (mains and laterals). They also identified soils throughout the region which are adjacent to canals and mains and how water flows through them, and charted much of this data on a geographic information system.

The data, at this point, are not complete. For example, the team has only been able to assemble data on less than half of the lined and unlined canals so far. Still, the results suggest that there are opportunities for substantial water savings if more efficient methods can be introduced.

The most striking finding of the report is that water savings of up to 223,000 acre feet (AF) per year could be achieved, if conveyance systems (which send the water from the river to farmers fields) could be improved to 90% efficiency. It should be noted that the 223,000 AF in savings would occur in years with high water use in which 85% of existing agricultural water rights are utilized.

Throughout the region, the report suggests, there may opportunities to increase conveyance efficiency through a number of methods including reducing seepage and leakage from main canals, lateral lines, and pipelines, more accurately estimating actual field deliveries through metering, and controlling spills at the end of canals. Data from this project suggest that conveyance efficiencies in the region range from 40% to 95%.

The report also examined on-field water use and how individual farmers apply water to their crops once it reaches their land. Again, Fipps suggests, there are opportunities for increasing water savings by adopting more efficient irrigation strategies.

Based on work with individual farmers sited in six irrigation districts. Fipps and colleagues examined current methods and calculated how much could be saved if fields were metered, if field ditches and siphon tubes were replaced with gated pipe, and if improved irrigation technologies were introduced. The preliminary results suggest that water savings of up to 40% could occur in individual districts and that, if efficient techniques were used throughout the region, as much as 271,00 AF per year could be conserved.

What's the importance of this work? Will increased efficiency just result in more water for farmers in the Valley? Fipps suggests that the study is important for many reasons. First, the amount of water available for irrigation is projected to decrease by as much as 14% by the year 2050. During the same time, population in the Lower Valley is expected to jump by 228% and non-agricultural water use is projected to by as much as 170%. Therefore, if current agricultural acreage is to be maintained, farmers and irrigation districts will have to become more efficient. As a result, it's important for all water users in the region - especially agriculture which now uses the most water - to conserve as much as possible.

For details on this project, contact Fipps at g-fipps@tamu.edu or (409) 845-7454. For more information on TWRI, contact us at (409) 845-1851 or twri@tamu.edu.

Texas Tech WWW Site Describes International Program Which Addresses Arid, Semi-Arid, Lands

The International Center for Arid and Semiarid Land Studies (ICASALS), located at Texas Tech University, has developed a World Wide Web (WWW) site which discusses issues related to the interdisciplinary study of arid and semiarid environments as well as how humans relate and adapt to those environments.

The purpose of ICASALS is to stimulate, coordinate, and implement teaching, research and public service activities concerning many aspects of the world's arid and semiarid areas, their peoples and problems. The Center focuses on applied research and education concerning regions where declining water resources and sustaining agricultural productivity are significant problems.

The WWW site features on-line versions of recent Center newsletters, a list of Center technical reports, information about the Association for Arid Land Studies, and statements describing the purpose and goals of ICASALS.

The WWW site address is http://www.iaff.ttu.edu/ICASALS/default.htm. For more information, e-mail Kristopher Gersbach of the Center at k.gersbach@iaff.ttu.edu.

Border EcoWeb WWW Site Features Resources About U.S. - Mexico Environmental Activities

A new World Wide Web (WWW) site, the Border EcoWeb, is designed to facilitate public access to environmental information for the U.S.-Mexican border region.

Border EcoWeb features a directory that contains contact information and project descriptions for government agencies and other groups involved in activities dealing with the border environment. The WWW site contains information on such issues as water resources, the environment, watershed management, and sustainable development. Ecological data on many Texas sites is presented including information on such border communities as El Paso, Presidio, Del Rio, Eagle Pass, Laredo, McAllen, and Brownsville.

According to this WWW site, the project will develop an arena where community members can find out what other people and groups are doing to understand and resolve border environmental problems. It will provide access to the agencies and people working on solutions. It will also serve as a road map of how to find basic environmental data for the trans-border region.

Border EcoWeb is a collaborative project between several institutions including the Institute for Regional Studies of the Californias at San Diego State University, the U.S. Environmental Protection Agency, the U.S.-Mexico Border Information Institute, the Border XXI Environmental Information Resources Work Group, and the Autonomous University of Baja California in Mexico. For more information, please visit the Border EcoWeb WWW site at http://www.borderecoweb.sdsu.edu/.

USGS National Atlas Lets Users Create Custom Maps of Water, Environmental, Resources

The National Atlas of the United States is a new World Wide Web (WWW) site which has been developed by the U.S. Geological Survey (USGS) and its partners.

The atlas lets people use the WWW to instantly search for spatial information about the environment, and related topics about virtually any site within the United States. A strength of the atlas is that it allows users to incorporate selected natural resources criteria into searches. For example, users can choose to find water bodies such as lakes and rivers, aquifers, dams, and canals. The WWW site includes multimedia maps about such topics as exotic plant and animal species, terrain relief and elevation, and the growth of vegetation.

According to the USGS, goals of this WWW site are to promote greater geographic awareness, and to develop and deliver products which provide easy to use, map-like views of natural and sociocultural landscapes.

The USGS states that the atlas is designed to serve the interests and needs of a diverse populace in many ways - as an essential reference, as a framework for information discovery, as an instrument of education, as an aid in research, and as an accurate and reliable source for scientific information.

The address of the atlas is http://www-atlas.usgs.gov.

Rice University WWW Site Discusses Conservation Biology

The Center for Conservation Biology Network (CCBN) at Rice University has developed a World Wide Web (WWW) site which contains detailed information on ecology and biodiversity. The WWW site was by Alan Thornhill, a researcher in the Rice University Ecology and Evolutionary Biology Department. The Center is a joint effort with the University of California-Irvine.

CCBN has become an international meeting place for issues focusing on ecology and biodiversity. CCBN's purpose is to help develop the technical means for protecting, maintaining and preserving biodiversity, and to disseminate information on those topics.

The CCBN home page directs the visitor to nine main sites. Some of the these areas include the Virtual Library of Biodiversity and Ecology, Native Americans and the

Environment, and the Society for Conservation Biology, and resources for undergraduate and graduate students.

The Virtual Library catalogs and organizes Internet sites related to biodiversity and the environment. It contains a wealth of information on such issues as endangered plant and animal species, the impact of pollution, threatened habitats, and biodiversity and conservation restoration efforts. Native Americans and the Environment is a guide to environmental issues faced by American Indian communities.

Thornhill notes that the site includes interactive software which makes it easy for users to contribute new resources, suggest experts in these subject areas, and add new links to related WWW sites.

For more information contact CCBN at http://conbio.rice.edu or e-mail Thornhill at athornhi@rice.edu.