DIVINING ROD

NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE

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In 2003-2004, twelve New Mexico undergraduate and graduate students conducted water-related research projects funded by the WRRI Student Water Research Grant Program. Three of those research projects are highlighted in this issue. Proposals for 2005-2006 student grants are due April 1, 2005.

UNM graduate student works to understand geochemistry of travertine-depositing springs

by Steve Carr, UNM Public Affairs Department

University of New Mexico graduate student Dennis Newell is interested in the quality of groundwater and the origin of contaminants that impact its purity. Newell is conducting research involving travertine-depositing springs along the Rio Grande valley from Socorro north to the Colorado border. His project is supported by New Mexico Water Resources Research Institute located at New Mexico State University and the NSF IGERT program.

"Travertine is essentially the 'lava' from a chemical volcano, formed by degassing of spring water and chemical precipitation of travertine," said Newell. "It's often very beautiful and used as building stone."

The origin of poor quality groundwater in our aquifers is an ongoing debate, a debate Newell and his faculty advisor Professor Laura Crossey of Earth and Planetary Sciences hope to shed some light on. Newell was inspired by Crossey's work and it provided a springboard to his research.

"She conducted similar research with colleagues in the Grand Canyon," said Newell. "She was intrigued by the huge volumes of travertine in the Grand Canyon and began investigating the chemistry of travertine-depositing springs. She discovered that the chemistry of these springs told a very interesting story about the mixing of very deep fluids with shallow groundwater."

Trish and Dennis Newell sampling active gases in the Grand Canyon.

Newell says the Rio Grande valley is an excellent location to test the hypotheses developed in the Grand Canyon, but in a very different geological setting.

"Whereas the Grand Canyon is a deeply eroded cross-section of the Earth's upper crust in a fairly stable tectonic setting, the Rio Grande valley is a filled valley in a still active continental rift setting," he said.

Newell is testing water and gas samples to see what quantity of solutes important to our water quality (salts, trace

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metals) is traveling from very deep in the Earth to its surface. He collected and analyzed 29 samples from spring locations along the Rio Grande valley. The sampled springs were cool to hot, ranging in temperature from 6 – 57°C. Most springs were located along major faults in the region.

Dennis Newell is sampling a place called Pumpkin Spring in Grand Canyon National Park, Arizona.

"These springs are also unique ecological environments," said Newell. "They are often located in arid parts of the state and can be the only surface water for miles. Even though they are often very salty, life is present in the springs."

Water chemistry results included major, minor, and trace elements, and stable isotopes, while gas analysis included major and trace gases, and helium isotopes. Results from the travertine-depositing springs show a range from calcium, magnesium-bicarbonate to sodium chloride, sodium sulfate type waters. The gas and water chemistry supports the hypothesis of a deep-seated source for Rio Grande valley travertine-depositing springs linked to mantle-derived magmatism.

Newell hopes to show that travertine-depositing springs are actually 'windows' to investigating groundwater-mixing processes occurring within the ancient rocks buried deep along the Rio Grande valley.

He and Crossey hypothesize that travertine-depositing springs along the Rio Grande valley are linked to deeply circulating fluids associated with mantle magmatism deep inside the Earth. They believe that as the geochemistry varies along spring locations, so does the salinity and trace metals present in aquifers and surface water. Newell thinks the fluids are moving along fault systems.

"My research is showing that gases are present in the spring water that can only come from the Earth's mantle, at a depth of approximately 30 kilometers," said Newell. "The Rio Grande rift is an active tectonic environment as evidenced by the relatively young volcanoes along its course (Albuquerque Volcanoes)."

"I believe the spring gases are related to the processes that create the volcanoes and lava flows we see in the rift. In a way, travertine springs can be considered 'chemical volcanoes', and instead of erupting lavas, they issue gases and dissolved chemicals."

Newell also plans on characterizing the microbial community in the springs. Since the cool springs being studied are similar to hot springs in many chemical respects, and have widely varying water and gas chemistry, the microbial community could show links to very primitive ancestors, he says. For example, hot springs in Yellowstone have primitive microbes believed to be descendants from the earliest forms of life on Earth.

Newell, who has a B.S. in geology from New Mexico Tech and a master's in geology from Colorado State, started his Ph.D. in the summer of 2003 and has approximately two years remaining before completing his dissertation at UNM.

WRRI legislative update

The New Mexico WRRI is asking this year's legislators to approve statutory authority for its state program, similar to its federal authority. WRRI is also requesting a permanent annual increase of $200,000 for new research projects. New Mexico State University has designated the combined legislative initiatives as the university's top priority: Senate Bill 117 and House Bill 193, requesting statutory authority; and Senate Bill 113 and House Bill 192, requesting an appropriation increase. As we go to press with this issue of *The Divining Rod*, the bills are pending, having received unanimous support by both houses. We are optimistic the bills will be approved and sent to the governor for signature.

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conserving the limited precipitation available in an arid environment.

Finally, there were no significant differences in the ceramic dates, especially in the broad scheme of archaeological periods. One problem with ceramic dating is the potentially long period a particular type might endure. The collected ceramics by Moore would have to be re-analyzed to be placed into the other scheme more definitively.

As climate conditions dictated, populations that were unwilling or unable to expand into other areas continued to grow, and intensified their efforts to produce crops in their own locale. A group whose existence is so closely tied to the land and what it produces will have a culture that reinforces that relationship and be very aware of the available choices, and the selective adaptations that will best support the lifestyle. This may come through water control intensification, differential planting, and settlement patterns. No one group was inherently better, or smarter, than the other. Some groups are just better equipped to adapt to lifestyle changes in certain environments and this ability comes largely through their culture, according to Ms. Galassini.

New Mexico WRRI receives favorable review

Every five years, the U.S. Geological Survey (USGS) evaluates each of the 54 institutes authorized by the federal Water Resources Research Act of 1964. Each state and several territories have a water institute that administers research funding provided by a USGS grant, and in New Mexico's case, state funding as well.

Under the authorizing legislation, all states must undergo an evaluation to determine their eligibility to continue receiving federal funding. In the most recent review, which covered the period from 1998 through 2002, USGS evaluators recommended recertification of the Institute's eligibility for continued support.

Specifically, the evaluators noted: "The New Mexico Institute remains strong and fully meets the standards for continued 104B funding. The research program is well focused and of high quality, and the information dissemination program continues to be excellent. Discretionary support from the State of New Mexico and the University is very good, as is the follow-on funding of 104B seed money projects. There is significant involvement of non-host universities in the Institute's program and the development of new scientific expertise through the involvement of students and junior faculty is very good…."

2005 New Mexico Water Research Symposium

Advances in Hydrology: Methods and Instruments

August 16, 2005
Macey Center, New Mexico Tech

Go to the WRRI website at
wrri.nmsu.edu/conf/tc05/symposium.html
to view the
Call for Abstracts
Presentations and Posters
Registration Information

Deadline for abstracts: July 15, 2005

NMSU students research water conservation

by Natisha Hales, NMSU University Communications

Each year thousands of New Mexicans travel to Elephant Butte Reservoir for fishing, water skiing, and other water sports. But it's not just a recreational area; Elephant Butte is the main water supply to the Mesilla, El Paso, and Juarez valleys.

What most visitors don't realize is that a large portion of Elephant Butte's average inflow is lost due to evaporation. In the interest of water conservation, three engineering students at New Mexico State University have conducted research aimed at more accurate measurement of evaporative loss from Elephant Butte. A more accurate knowledge of evaporation would lead to better predictions for determining water allotments and allocation.

Alex Herting, Tim Farmer, and Jordan Evans took the first step toward more reliable mapping of the evaporative loss at Elephant Butte by combining what is known as the bulk-aerodynamic method with remote sensing and Geographical Information Systems (GIS) technology.

"The existing method for estimating evaporation is pretty crude," explained civil engineering professor Phillip King. King was the students' adviser during the research project.

The bulk-aerodynamic method may provide a more accurate estimate and uses a variety of factors such as the temperature of water, relative humidity, wind speed, and air temperature to estimate evaporation.

With the use of remote sensing, satellite images that contain large amounts of data may be used to estimate evaporation more accurately. GIS technology will use satellite images and other data to determine the area of the lake. When all of the data are combined, evaporative loss can be analyzed.

A method known as pan evaporation is currently used at Elephant Butte. With this method, a pan near the reservoir is used to take readings as water evaporates from the pan. The measurement is multiplied by a pan coefficient to estimate the depth of lake evaporation.

However, there is an assumption that evaporation is the same over the entire surface area of the lake and that the relationship between pan and lake evaporation remains the same throughout the year. In addition, extra heat through the walls of the pan during certain times of the year yields unreliable, inaccurate results.

False color Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite images of Elephant Butte and Caballo reservoirs in 2002

Although the students concluded that pan evaporation is not the most accurate method, they also concluded that further research is needed on using the bulk-aerodynamic method.

King said follow-up research is in progress, conducted by Max Bleiweiss, an atmospheric scientist at White Sands Missile Range. "He is a local expert and put the most work into this study and helping the students," he said. "We are very grateful for his input."

Supplements to this research include ground-based measurements and the use of spectral bands to map evaporative loss.

The final report on this project is available via the WRRI website. Go to *wrri.nmsu.edu/research/rfp/studentgrants03/reports/herting.pdf*

The students' project was partly funded by the New Mexico Water Resources Research Institute at NMSU through the 2003 Student Water Research Grant Program. The deadline for the 2005 student awards program is April 1, 2005. See page 7 for details on the program.

Upcoming Conferences

March 21-24, 2005 New Mexico Rural Water Association, 27th Annual Conference, Sheraton Old Town, Albuquerque (www.nmrwa.org)

March 29-30, 2005 Water Educators' Conference, Hotel Colorado, Glenwood Springs (www.cfwe.org)

April 6, 2005 Arizona Water Resources Research Center 2005 Water Conference, Water and the Environment: The Role of Ecosystem Restoration, Radisson Hotel City Center, Tucson (ag.arizona.edu/AZWATER/conf2005/mainframe.html)

April 6-8, 2005 Lower Colorado River Tour presented by the Water Education Foundation; tour begins in Las Vegas and ends at Ontario International Airport (www.watereducation.org)

May 19-20, 2005 CLE Conference, Law of the Colorado River, Drought and Shortage Management, Venetian Resort Hotel Casino, Las Vegas (cle.com/dev)

June 27-29, 2005 American Water Resources Research Association, Institutions for Sustainable Watershed Management: Reconciling Physical and Management Ecology in the Asia-Pacific, Honolulu (www.awra.org/meetings)

August 16, 2005 Water Research Symposium, New Mexico Tech, Socorro (wrri. nmsu.edu)

September 6-8, 2005 River Basin Management 2005, Bologna, Italy (www.wessex.ac.uk/conferences/2005/rm2005/3.html)

September 12-14, 2005 Second International Conference on Sustainable Planning and Development, Bologna, Italy (www.wessex.ac.uk/conferences/2005/spd2005/2.html)

October 18-20, 2005 50th New Mexico Water Conference, New Mexico Water: Past, Present and Future *or* Guns, Lawyers and Money, New Mexico State University, Las Cruces (wrri.nmsu.edu)

November 6-10, 2005 AWRA's 2005 Annual Water Resources Conference, Seattle, Washington (www.awra.org/meetings)

November 7-10, 2005 8th Biennial Conference of Research on the Colorado Plateau, Northern Arizona University (www.usgs.nau.edu/conf2005/index.htm)

WRRI publishes new report

Terrestrial Vegetation Inventory of Water Delivery Systems Between San Acacia Diversion and the Bosque del Apache National Wildlife Refuge (Technical Completion Report 333) by Jon Boren, Terrell T. "Red" Baker, David Cowley, Glenn Mason, Summer Eaton, Brian Hurd

This inventory was designed to quantify the habitat associated with Middle Rio Grande Conservancy District (MRGCD) drains and canals and provide a baseline for evaluating structural operational changes in the water conveyance system. The inventory was designed to provide vegetation data to compliment a larger research study entitled "Agricultural Irrigation Systems and Conservation of Native Fishes" by Dr. David Cowley. The current project was conducted in cooperation with the ESA Workgroup Collaborative Program for Rio Grande silvery minnow (*Hybognathus amarus*) and southwestern willow flycatcher (*Empidonax traillii extimus*).

The specific objectives of this project were to 1) inventory aquatic and terrestrial vegetation associated with the water conveyance structures for agricultural irrigation, and 2) provide a quantitative assessment of the habitat types and availability associated with water conveyance structures for fish and wildlife.

The complete report is online at wrri.nmsu.edu/publish/techrpt/browse.html#2005

Prehistoric Water Management in the American Southwest

by Shelley Gilmore, ENMU Communication Services

Eastern New Mexico University student Stacy Galassini has completed her study of prehistoric water management. Stacy is a third-year master's student conducting her study under Dr. John Montgomery of the Department of Anthropology and Applied Archaeology.

The study was funded by the New Mexico Water Resources Research Institute's 2003-2004 Student Water Research Grant Program.

Water control and management issues have been persistent through time in the American Southwest, according to Ms. Galassini. Many areas remain environmentally marginal for agricultural purposes even in a technologically advanced era. For prehistoric cultures, devices to enhance and control unpredictable precipitation and perennial water sources were crucial to successful crop production. To this end, the Anasazi of the Four Corners area developed many techniques that allowed them to inhabit harsh environments for centuries. These included contour terraces, check dams, and strategic field locations.

Between AD 900 and 1300, ancestors of the modern Pueblo Indians inhabited the middle Rio Puerco valley of New Mexico. The Anasazi culture that lived in the valley is considered to be an outlying community culturally and materially associated with the larger community of the Chaco Canyon area to the northwest.

Using like areas and populations as analogues, water control techniques were compared in this study. The

View of the southern tip of Guadalupe Mesa with the Rio Puerco valley on the left. Photo by Stacy Galassini.

increasing entrenchment of the Rio Puerco is considered to be a contributing factor to agricultural degradation. Population estimates through time and agricultural yield were analyzed to assess the level of sustainability. A more recent dating method indicates that water control devices in the valley were in use earlier than previously thought. The abandonment of the valley was discussed in relation to environmental and social factors that occurred throughout the northern Southwest before the Spanish Entrada. Finally, issues of sustainability through time, environmentally and culturally, were explored to compare different views of land and water use.

To determine whether the water control features around the Guadalupe Mesa were dated correctly, or reduced down

View of the top of Guadalupe Mesa and Ruin, 160 feet above the Middle Rio Puerco valley floor in Sandoval County, New Mexico. Photo by Stacy Galassini.

to the most precise dates possible, researcher James Moore used a total of 17 ceramic groups with temporal periods of 30-plus years spanning the years AD 800-1258. While the full technique employing multidimensional scaling is rather complicated and mathematical, the basic concept is that "chronological inference using seriation assumes that the seriated groups function as cultural historic, stylistic classes."

By comparing the two sets of data, it was hypothesized the tested features might produce more specific and earlier dates when the more refined chronology was applied. The revised dates could then be compared to known climatic conditions, which in turn influenced settlement patterns and agricultural intensification. This could be compared cross-culturally or geographically to determine whether the Rio Puerco populations were invoking similar adaptive techniques in similar conditions as other prehistoric native populations.

The prehistoric adaptive strategies are compared to strategies the subsequent European populations employed. Their relative success can be compared by way of occupation time and preferred methods of diverting and

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2005-2006 Student Water Research Grant Program

The New Mexico Water Resources Research Institute is pleased to announce the 2005-2006 Student Water Research Grant Program. This program is intended to encourage and support graduate and undergraduate student research in disciplines relevant to water resources issues, and to assist New Mexico institutions of higher education in developing student research expertise and capabilities. Full-time graduate and undergraduate students enrolled in degree programs at institutions of higher education in New Mexico (NMSU, UNM, NMT, ENMU, WNMU, or NMHU) are eligible. Applicants must indicate a faculty sponsor.

Budgets may include, but are not limited to, expenditures for student salaries, supplies, and travel. Institutions are encouraged to participate with project costs although cost sharing is not required.

WRRI's goal is to fund a minimum of two research projects at each New Mexico institution, with each award no greater than $5,000 for the one-year project period. Awards may be effective as early as May 1, 2005 and should be completed by September 30, 2006. Upon completion of the research project, recipients will be required to submit a brief final project report.

The deadline for projects is **April 1, 2005**. Proposals are to be submitted online at wrri.nmsu.edu/research/rfp/studentgrants05/stgr.html

USGS recent publications

The U.S. Geological Survey has recently published several reports of interest to New Mexico water experts. Copies are available for inspection at the USGS District Office in Albuquerque (5338 Montgomery Blvd NE, Suite 400; 505-830-7923). The Water Resources Research Institute library also has the reports on file. They may be ordered from the USGS, Federal Center, Box 25286, MS 517, Denver, CO 80225. You may call 1-888-ASK-USGS for price information or go to www.usgs.gov. Complementary copies of the recent journal publications can be obtained by contacting Rika Lashley at rlashley@usgs.gov.

Estimated Use of Water in the United States in 2000 by Susan S. Hutson, Nancy L. Barber, Joan F. Kenny, Kristin S. Linsey, Deborah S. Lumia, and Molly A. Maupin (USGS Circular 1268)

USGS Scientific Investigations Reports

Simulation-optimization approach to management of ground-water resources in the Albuquerque area, New Mexico, 2006 through 2040 by Laura M. Bexfield, Wesley R. Danskin, and Douglas P. McAda (SIR 2004-5140)

Selected Hydrologic Data for the Upper Rio Hondo Basin, Lincoln County, New Mexico, 1945-2003 by Lisa C. Donohoe (SIR 2004-5275)

Precipitation; Ground-Water Age; Ground-Water Nitrate Concentrations, 1995-2002; and Ground-Water Levels, 2002-03 in Eastern Bernalillo County, New Mexico by Paul J. Blanchard (SIR 2004-5189)

Recent Publications on Volatile Organic Compounds (VOC) by USGS scientists

Volatile organic compounds in ground water from rural private wells, 1986 to 1999 by Michael J. Moran and others examined the occurrence and concentrations of VOCs in samples of untreated ground water from rural private wells. *Journal of the American Water Resources Association*, October 2004, pp. 1141-1157.

VOCs in Shallow Groundwater in New Residential/ Commercial Areas of the United States by Paul J. Squillace, Michael J. Moran, and Curtis V. Price investigated the occurrence and concentrations of VOCs in samples from monitoring wells in new residential and commercial areas. At least one VOC was detected in 88% of the samples, however, less than 1% of the samples exceeded a U.S. EPA Maximum Contamination Level or Drinking Water Advisory. *Environmental Science & Technology*, Vol. 38, No. 20, 2004, pp. 5327-5338.

New Mexico Water Resources Research Institute Celebrates 50 Years of New Mexico Water Conferences

October 18-20, 2005
New Mexico State University
Las Cruces

New Mexico Water: Past, Present, and Future *or* Guns, Lawyers, and Money

Join us on October 18th for a tour of Elephant Butte Dam in conjunction with the Bureau of Reclamation's 100th anniversary of the Rio Grande Project
Followed by a reception at NMSU's new Stan Fulton Athletics Center

The conference begins Wednesday, October 19 at NMSU's Corbett Center and will include the Albert E. Utton Memorial Water Lecture to be presented by Charles DuMars

Evening banquet includes entertainment by Cowboy Poet Baxter Black

Conference continues on Thursday with luncheon speaker, former WRRI Director, Tom Bahr
Personal Reflections on the WRRI Program

Check the WRRI website at wrri.nmsu.edu for updates on the conference

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