



2011-2012
ANNUAL REPORT

www.nckri.org

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Cover Photo

This 1963 photo of rare gypsum chandeliers in Cottonwood Cave, New Mexico, is one of many taken by the late Bob Trout that were donated this year to NCKRI. Gifts such as this have incredible value, in this case because this spectacular speleothem was senselessly destroyed by vandals. It now only exists in a few images like this, which NCKRI strives to collect, preserve, and make available for research and education.

Back Cover Photo

Entrance of Scărișoara Ice Cave, Romania. Over 10,000 years of valuable climatic history have been recovered from ice deposits in this cave, and demonstrate the importance of NCKRI's proposed cave project (see page 4). Photo by George Veni.



Vision and Values

The National Cave and Karst Research Institute (NCKRI) will be the world's premier cave and karst research organization. NCKRI promotes and performs projects of national and international application, of the highest quality and integrity, through dedicated staff and partners.

Organization and Mission

NCKRI is a non-profit 501(c)(3) corporation. It was created by the U.S. Congress in 1998 in partnership with the National Park Service, State of New Mexico, and the City of Carlsbad. Federal and state funding for NCKRI is administered by the New Mexico Institute of Mining and Technology (aka New Mexico Tech or NMT). Funds not produced by agreements through NMT are accepted directly by NCKRI.

NCKRI's enabling legislation, the National Cave and Karst Research Institute Act of 1998, 16 U.S.C. §4310, identifies NCKRI's mission as to:

- 1) further the science of speleology;
- 2) centralize and standardize speleological information;
- 3) foster interdisciplinary cooperation in cave and karst research programs;
- 4) promote public education;
- 5) promote national and international cooperation in protecting the environment for the benefit of cave and karst landforms; and
- 6) promote and develop environmentally sound and sustainable resource management practices.

NCKRI Annual Report Series

NCKRI produced this publication as part of its annual reporting of activities. The reporting period covers NCKRI's fiscal year, from 1 July to 30 June of the following year. Digital copies of this and previous reports are available for free at www.nckri.org.

NCKRI is a proud institute of:



EXECUTIVE DIRECTOR'S REPORT



My photo shows how I spent Thanksgiving this year, teaching a workshop on environmental management of karst systems for Brazil's Instituto do Carste. I am thankful for that opportunity. I'm especially thankful for the enthusiasm I saw in the students, Brazilian land managers, scientists, consultants, and graduate students, working to understand and protect caves and karst. In my many travels for NCKRI, I keep seeing that same wonder for caves and karst and the desire to better manage their priceless resources, and am thankful NCKRI is playing a growing role in that sentiment.

Such progress isn't the product of one person's work. Dr. Penny Boston, our most senior employee, continues cutting-edge research and magnificently stretching grant dollars for students. Dr. Lewis Land continues superbly expanding our research capabilities, this year through cooperative agreements and project development in microgravity and cave ice. Debbie Herr, our unfaltering Administrative Coordinator, solidifies NCKRI's administrative foundation through new software tools and procedures to greatly increase our efficiency and abilities. Dianne Gillespie, who married to become Dianne Joop, is excellently multitasking in building NCKRI websites, exhibit designs, and other educational programs. Our most recent employee, Ann Dowdy, was only able to stay with NCKRI a short time but successfully completed the critical task of setting up our Advancement Program. We will now be ready to launch our capital campaign when our new Advancement Director, Suzanna Langowski, begins work in the next fiscal year. I'm confident that she will be another outstanding member of the NCKRI team.

I often talk about the importance of NCKRI's partnerships, and how thankful I am for them. But the most important partnerships start at home. I'm extremely thankful for my fantastic NCKRI staff and our multi-talented Board of Directors. The fruits of their labors are highlighted in this Annual Report. With such a team and progress, I'm confident our work and partnerships around the country and world will continue to grow.

A handwritten signature in black ink, appearing to read "G. Veni".

George Veni, Ph.D.

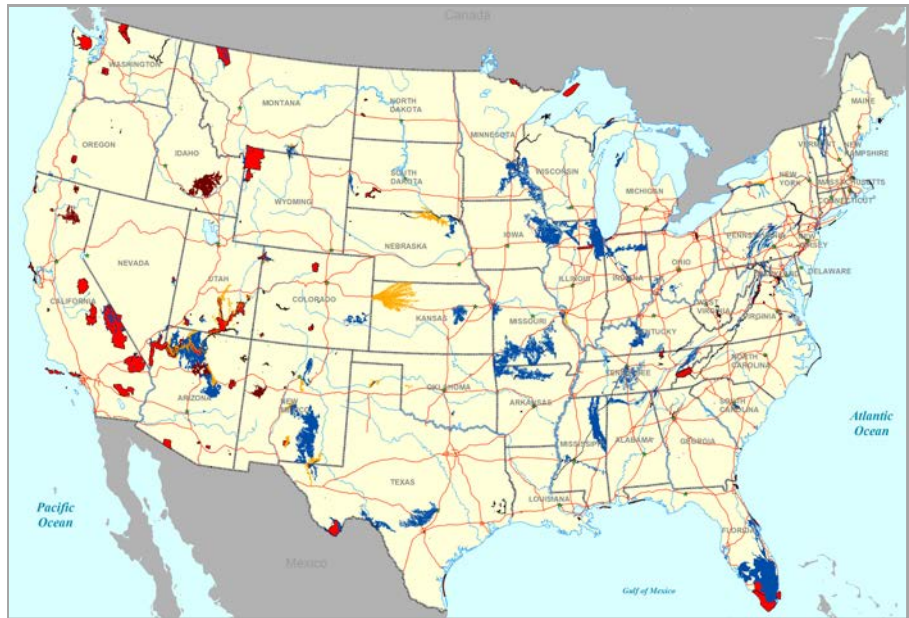
NCKRI RESEARCH

National Park Service Karst Resources

Dr. Lewis Land is the lead investigator on a survey of cave and karst research, management, and educational resources within the National Park Service (NPS). This NPS-funded project is conducted in collaboration with the Mammoth Cave International Center for Science and Learning. The project includes developing a questionnaire about karst resources that will be sent to all National Park units identified as having the potential for caves and karst features within their boundaries. The first phase of the study is complete: identification of these NPS units based in part on GIS (geographic information system) data from the US Geological Survey's National Karst Map project.

Southern Sacramento Mountains watershed

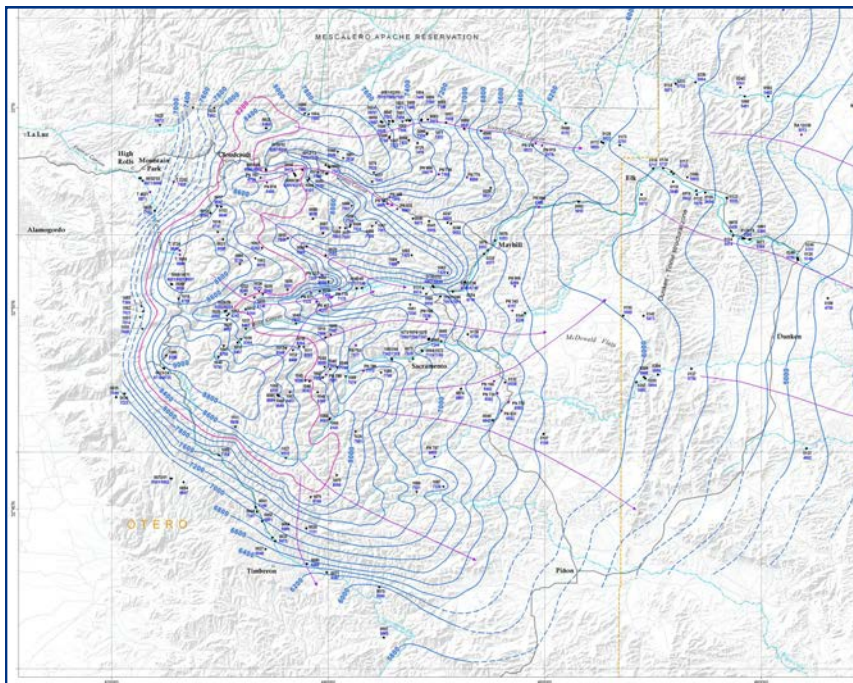
In May 2012, Dr. Land attended the Rocky Mountain Section Meeting of the Geological Society of America,



Preliminary data for ArcMap figure provided by Dr. Dan Doctor, US Geological Survey GIS map showing areas with potential karst and pseudokarst that underlie National Park Service properties (red). Blue areas: carbonate bedrock; yellow: evaporite bedrock; brown: volcanic bedrock.

where he presented the results of his research on groundwater residence time in karstic aquifers of the south-

ern Sacramento Mountains watershed in southern New Mexico. Dr. Land also presented a poster showing his regional water table map of the southern Sacramento Mountains (map, below left), now available as New Mexico Bureau of Geology and Mineral Resources (NMBGMR) Open-File Report 542. As is the case with many karst aquifers, the mapping was complicated by the presence of multiple levels of perched groundwater above the actual water table. Dr. Land's work is part of a larger investigation of the regional hydrology conducted by the NMBGMR Aquifer Mapping Program, which was initiated in 2005 and funded by the Otero Soil and Water Conservation District. Results of this study were published as NMBGMR Open-File Report 543, and indicate that conduits are a significant factor controlling groundwater flow paths and residence times within the karstic Yeso and San Andres limestone aquifers in the southern Sacramento Mountains.



NCKRI

Water table map of the southern Sacramento Mountains, New Mexico.

NCKRI Bat Roost

NCKRI Headquarters is the world's first building where an artificial bat roost is part of the building's design. The roost offers a safe home for bats, as well as bat research and educational opportunities. It was designed in 2007 and 2008 by Mylea Bayless, Artificial Roosts Coordinator for Bat Conservation International (BCI), and Dr. George Veni, NCKRI's Executive Director. NCA Architects adjusted that design to accommodate construction and attachment to the building. The roost has an optimal design for bats and offers flexibility for study and education. Ms. Bayless estimates the roost could hold up to 7,500 bats, with 5,000 bats as a likely average high.



Photo by George Veni

Volunteer Pam Cox downloads bat roost data from the iButton probes.

The roost is made of concrete and has six crevices that bats will live in. Each crevice is 60 cm high, 6.7 m long and 1.9 cm wide. The crevices are divided by 3-cm thick panels. Horizontal slots near the bottom of the panels let bats move from crevice to crevice without leaving the roost. The outer walls extend 10 cm below the roost and serve as landing pads for bats to easily access the roost. Lechuquilla plants were placed in front of the roost; as they grow, they will discourage people from going under the roost and disturbing the bats. Educational signs will be placed along the sidewalk near the roost, which will also ask people to not disturb the bats.

The top of the roost is accessed through six doors in the floor of the

offices at the southeast end of the building. The doors are only opened to download data, conduct maintenance, and to modify the types or arrangements of probes. The doors open to reveal the tops of 12 rows of holes for probes. Each row has six holes, one for each crevice along that section of the roost. If unoccupied by a probe, each hole is plugged with an air-tight cork. Eight video ports expose the tops of all crevices for video cameras that will be installed later.

Two infrared cameras mounted below the crevices will record video images of bats examining, entering, or exiting the roost. Any motion is automatically detected and saved to a DVD recorder. Also, digital iButton probes are set in 18 of the 72 probe holes to measure temperature and relative humidity every 10 minutes. Data and power ports are available in the bat roost but the iButtons are not designed to plug into those ports. NCKRI volunteer Pam Cox removes the probes every two weeks and saves their data in Excel spreadsheets.

The roost was installed early in the building of NCKRI Headquarters, but construction noise kept bats away. The first chance for bats to occupy the roost came in 2011, but a drought that year and in early 2012 kept bat populations low in the region and reduced the odds of its discovery. BCI's statistics show that bats usually need 2-5



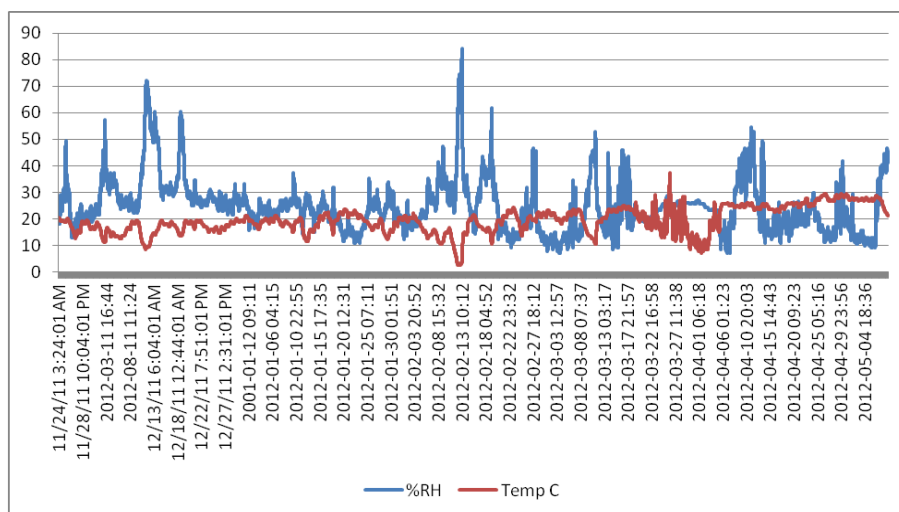
NCKRI Photo

Infrared camera's view of the NCKRI bat roost, waiting for bats to find a new home.

years to find a new roost. While it will be great when the bats arrive, developing a good record of roost conditions before occupation is valuable to its long-term study.

NCKRI's Adopt-A-Bat program helps fund maintenance and future research in the roost. Some of NCKRI's research plans include:

- video and audio monitoring within the roost;
- more advanced monitoring of roost conditions; and
- automatic downloading of the data to NCKRI's server (freeing the iButton probes for use in caves and other remote sites); and putting live video, sound, and data on NCKRI's website, www.nckri.org, where you can also learn more about the Adopt-A-Bat program.



NCKRI

Relative humidity and temperature in Crevice 3 of the NCKRI Bat Roost, November 2011 through May 2012.



Photo courtesy of Kenneth Ingham

Crystal Ice Cave, Lava Beds National Monument, California, USA, one of the caves considered for ice core sampling.

Cave Ice and Paleoclimate

NCKRI has begun investigating funding sources and assembling a team for a research project that will involve collecting cores of ice deposits in caves in Europe and North America to study the paleoclimate record preserved in the ice. Collaborators thus far are ice cave experts Dr. Aurel Persoiu (University of Suceava, Romania) and Dr. Edward Brooke (Oregon State University), and cave climatologist Dr. Andreas Pflitsch (Ruhr-University Bochum, Germany). Cave ice is melting due to climate change and NCKRI hopes to save and study its valuable climatic record before it is lost.

The initial phase of NCKRI's research will involve a 12-month program of water sampling and baseline data collection from selected ice caves where we are considering collecting cores. Later phases will decide which sites to core and then conduct that field work and analyses.

Naica Cave Geomicrobiology

Dr. Penny Boston, in collaboration with Dr. Diana Northup and Michael Spilde, both of University of New Mexico, Albuquerque, and Cameron McMillan, Northern Arizona University, Flagstaff, continue to analyze materials collected during the 2008 and 2009 Naica expeditions to Chihuahua, Mexico. Based on anal-

yses of DNA, the nearest relatives to microorganisms found in this remarkable cave system include microbes from other caves elsewhere in the world, volcanic soils, heavy metal environments, and other unique environments. New results show that some of the cultured strains have extreme tolerance to high osmotic pressure conditions

that may fit them uniquely for life in the hot calcium sulfate saturated fluid environment of the Naica caves.

Bureau of Land Management Cave Assistance Agreement

Fort Stanton Cave's Snowy River Passage project continues while addressing concerns about White-nose Syndrome which has otherwise closed the cave to general access. Some permits were granted for entry and samples collected for us by members of the Fort Stanton Cave Study Project (FSCSP) during their April 2012 expedition. Dr. Penny Boston and NCKRI Scholar Daisy Morgan continue developing methods to separate and analyze the mud deposits for biological and climate signals.

Drs. Land and Veni also continue working with the FSCSP by evaluating hydrogeologic information and its implications in the origin and management of the cave.

NASA Infrared Instrument Development

In the fourth and final year of this project, the unique, tunable acousto-optical laser spectrometer was lab-tested and moved for integration with a time-of-flight mass spectrometer at Goddard Spaceflight Center later in the summer of 2012. Plans for deployment of the small field unit under construction call for a fall 2012 test in caves in New Mexico and California.

NASA Minority Engagement Project

A new project in collaboration with Dr. Nancy Chanover at New Mexico State University, Las Cruces, and Scott Halliday at Navajo Technical College (NTC) Crownpoint, New Mexico will enable us to produce a fully workable field unit of the acousto-optical spectrometer mentioned above, and digitally and physically model cave walls using the Light Distancing and Ranging (LiDAR) mapping capabilities and rapid-prototyping technology at NTC. The resulting physical model will be used to investigate microbiological, mineralogical, and micrometeorological properties of cave walls at small scales.

LiDAR Studies

NCKRI is also starting to study the use of LiDAR in cave research at larger scales. LiDAR essentially shoots thousands to millions of laser beams that measure the distance and direction to objects. Computers plot those locations as points that three-dimensionally map the size and shape of the objects in great detail and pre-



Photo courtesy of Peter Jones

LiDAR unit ready to scan in Carlsbad Cavern.

cision. This tool has potentially fantastic application to caves, which are highly complex structures and difficult to map using standard techniques.

Working with Real Earth Models (REM), Inc., of Dallas, Texas, and with the generous cooperation of Carlsbad Caverns National Park, NCKRI conducted a LiDAR survey of a short section of the cavern's Left Hand Tunnel. Peter Jones of Shot in the Dark Cave Photography in Camden, Maine, joined the team. His photos will be digitally draped over the LiDAR points to create a three-dimensional real looking image of the passage. The data are being processed and the results will help the team evaluate the feasibility of other LiDAR projects NCKRI is considering. Jason Walz of the U.S. Forest Service was also instrumental in training the REM team in safe caving practices for future LiDAR research.

Granite Caves in Spain and Portugal

Work continues on the geomicrobiology and mineralogy of granite caves in northern Spain and northern Portugal in collaboration with Dr. Juan-Ramon Vidal Romani at the University of Coruna, Spain. We are conducting a series of long-term benchtop laboratory experiments to investigate the affects of microorganism growth on the solubility of silicates in the granite.

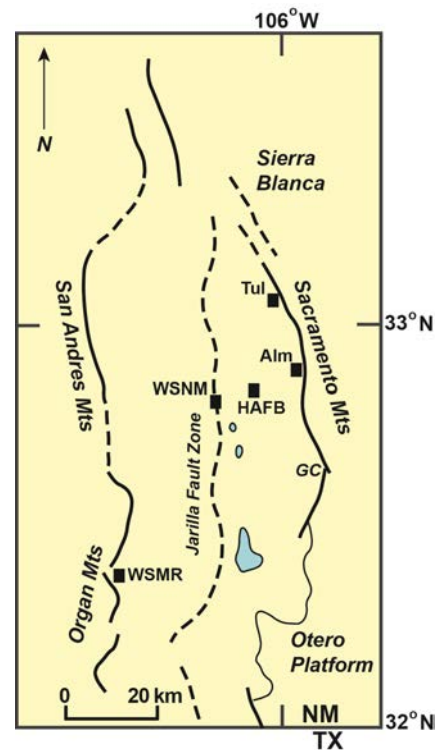
Geophysical Investigations

NCKRI continues use of electrical resistivity (ER) surveys to investigate a variety of karst-related phenomena. This work makes use of the Institute's AGI SuperSting R8/IP resistivity equipment and Topcon GR3 global positioning system. Resistivity profiles collected with the SuperSting equipment package illustrate vertical and lateral variations in subsurface resistivity, which are strongly affected by the presence of air or water-filled conduits. The resistivity method is thus well-suited for investigations of karst phenomena. Depth and precision of investigation is directly related to the length and spacing of the array of

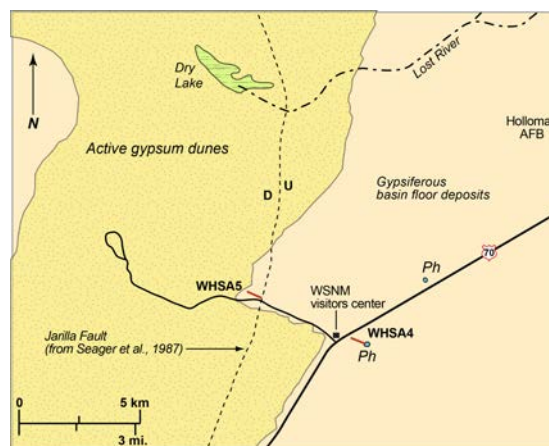
electrodes. NCKRI's equipment package, which uses 112 electrodes, has a maximum possible depth of investigation of approximately 230 meters. During the 2012-2013 fiscal year NCKRI staff will begin conducting microgravity surveys in conjunction with resistivity profiles, using microgravity equipment generously provided on extended loan from the Hoffman Environmental Research Institute at Western Kentucky University.

White Sands National Monument

In December 2011, Dr. Land conducted additional electrical resistivity surveys at White Sands National Monument (WSNM) in central New Mexico's Tularosa Basin. He was assisted by New Mexico Bureau of Geology and Mineral Resources (NMBGMR) colleagues and National Park Service personnel. The purpose of these surveys was to more precisely locate the Jarilla Fault, a large fault with no surface expression that apparently trends north-south beneath White Sands National Monument and the White Sands Missile Range. The Jarilla Fault may play an important role in controlling deep groundwater flow paths in the Paleozoic carbonate aquifers that underlie several hundred meters of Tertiary age fill in the Tularosa Basin. The position of the fault is poorly constrained, and based mostly



NCKRI map
Simplified geologic map of the Tularosa Basin, flanking mountains, and approximate position of the Jarilla Fault. Basin-bounding surface faults = thick solid lines; subsurface faults = dashed lines; blue = Paleozoic bedrock outcrop; WSNM = White Sands National Monument headquarters; HAFB = Holloman Air Force Base; WSMR = White Sands Missile Range headquarters; Tul = Tularosa; Alm = Alamogordo (modified from McLean, 1975).



Detailed map of White Sands National Monument study area. Position of the Jarilla Fault is based on the geologic map by Seager et al. (1987) and gravity data from Healy et al. (1978). Ph = Permian Hueco Limestone outcrop. Short red lines show locations of ER surveys.

on airborne gravity surveys several decades old.

Preliminary results indicate that the Jarilla fault probably occurs several kilometers farther east than indicated on existing surface geologic maps. Additional resistivity surveys at White Sands are planned for the third quarter of 2012. This work is funded by the National Park Service, and is part of a larger NMBGMR effort to characterize the groundwater hydrologic system within WSNM, and determine the relationship between groundwater and surface water systems in that part of the Tularosa Basin.

NCKRI/Karst Information Portal Collaboration

In 2012, following a comprehensive review of available technologies, we migrated the Karst Information Portal (KIP) to a third platform, the Drupal 7 open source Content Management System (CMS). Drupal offers a variety of very powerful content management tools including a robust taxonomy and controlled vocabulary infrastructure which will allow us to provide better access to the content. The system is designed to seamlessly integrate modules that increase performance and capability without the need for a full migration. This system is used by *The Economist* magazine, the White House, MTV, and many other information-rich organizations.

Some of the improvements include browsing by classification, cave name, creator, publisher, and subject term. A “Monthly Archive” feature allows visitors to access changes, including new content, on a month-by-month basis. The search utility has been simultaneously greatly simplified and made more precise by implementing a robust indexing service that scans the collection every 30 minutes to find and taxonomically organize the content. Administrative reports that focus on user behavior have improved our ability to customize KIP to serve user needs.

The University of South Florida Geoportal that was launched in March 2011 will be used to implement a mapping service that will be integrated into the Drupal version of KIP, making it possible to search for information resources using a Google style map. Online mapping services and access to an

initial core of karst relevant geospatial data will be available in early 2013. We hired a full-time Geospatial Analyst to make these and other services available to the KIP community.

The content collection now includes metadata records for 6,655 information resources, 43 percent of which are digitally hosted in KIP. This is an increase over the 37 percent reported in 2011. We continue to digitize George Veni's private library of technical reports and will make them accessible via KIP. *Texas Caver* from 1955 to present (with two missing years) has been digitized and is now loaded into the system with the

metadata under development. Approximately 761 issues of the *NSS News*, 24 NSS Convention guidebooks, and 17 issues of the *SpeleoDigest* are now accessible through KIP. This expansion of content was the result of a strong effort by Alex Sproul of the National Speleological Society who worked with our team to supply issues that filled many gaps in the KIP's holdings. Finally, University of South Florida Professor Bogdan Onac secured permission to digitize and host the full run of the journal *Theoretical & Applied Karstology*. Work on this title will begin in the fall.

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KARST

INFORMATION PORTAL

The Karst Information Portal is a digital library linking scientists, managers, and explorers with quality information resources concerning karst environments.

UPCOMING EVENTS

21st International Conference on Subterranean Biology, Kosice, Slovakia, 2-7 September 2012

5th International Workshop on Ice Caves IMC-V, Barzio (LC), Valsassina, Grigna, Italy, 16-23 September 2012

International Conference on Cave-Roosting Bats, Miskolc-Bükk Mountains, Hungary, 20-23 September 2012

Ghost-Rock Karst Symposium, Han-sur-Lesse, Belgium, 7-11 October 2012

16th International Congress of Speleology, Brno, Czech Republic, 2013

GSA Sessions on Caves & Karst

About the Karst Information Portal

The Karst Information Portal is an open-access digital library linking scientists, managers, and explorers to quality information resources in order to inform research, to enhance collaboration, and to address policy decisions concerning karst environments. The Founding partners in this project include: National Cave & Karst Research Institute, University of South Florida Libraries, University Libraries, University of New Mexico, Union Internationale de Spéléologie (UIS), UIS Introduction to KIP.

[Read more](#)

What is Karst?

Globally, more than a billion people depend on karst terrains for their water supplies. These environments host great biodiversity that is poorly understood and contains rare and endangered species. The spectacular geology of karst, as well as significant archaeological and paleontological resources, contributes to the overall scientific, aesthetic, cultural, and economic value of karst landscapes.



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[Read more](#)

RECENTLY ADDED CONTENT

The Texas Caver vol 44, issue 06, 1999	Contents:
The Texas Caver vol 44, issue 05, 1999	Contents:
The Texas Caver vol 44, issue 04, 1999	Contents:
The Texas Caver vol 44, issue 03, 1999	Contents:
The Texas Caver vol 44, issue 02, 1999	Contents:

EDUCATION PROGRAM



Students examine the remains of a house that disappeared into a sinkhole, Mina Gerais, Brazil.

Photo by George Veni

International Workshops

NCKRI's Executive Director Dr. George Veni travelled to Brazil and Mexico to teach the workshop, *Environmental Impacts and Management of Karst Systems*. The Instituto do Carste hosted the first workshop in Belo Horizonte, Brazil. It included three days of lectures and two days of field trips. The 50 participants were geologists, biologists, and environmental scientists who work for the Brazilian government to manage its natural resources, as well as consultants, university professors, and students.

The workshop was taught in three parts:

- environmental problems unique to karst or unique in their severity in karst;
- research tools to evaluate those problems; and
- management strategies to solve them.

The field trip was co-led by Dr. Augusto Auler, Executive Director of the Instituto do Carste. Sites were visited where landfills, sinkhole collapses, sinkhole flooding, land management for water quality, agriculture, archeology, paleontology, quarries, and show

cave management could be seen and discussed.

Dr. Luis Mejia arranged for the Cozumel branch of the University of Quintana Roo to sponsor an abbreviated version of the course. It was taught for the International Speleological Congress on Maya Caves and Cenotes in Playa del Carmen,

Mexico. One day was devoted to lecture and one to a field trip into a recently discovered cave.

National Workshops WALL Workshop

*"Bottles, bottles, everywhere...
we need clean water to drink.
Bottles, bottles, everywhere...
Polluting our karst waters; trash
dumps in the sink!"*

Life on our planet is dependent on the quality and quantity of water resources. As water quality issues continue to escalate, so does the demand for greater public awareness and education for healthy and sustainable water resource management. Millions of people worldwide depend on karst groundwater for their health and

well-being, yet have never heard the word "karst" and do not understand how karst works.

The Edwards Aquifer is a karst groundwater resource that supplies two million residents of San Antonio, Texas and the surrounding area with their drinking water. For the past eight years, Region 20 of the Texas Education Agency has partnered with water interest groups to conduct a summer water conference, Water A Living Lesson (WALL), for educators to explore practical strategies to teach water concepts and issues and to connect educators to the physical resources within the region.

Who better to teach the teachers about karst water resources than karst specialists? Geary Schindel, the Edwards Aquifer Authority's (EAA) Chief Technical Officer, initiated a collaboration with NCKRI and other cave and karst research organizations to develop a two day session giving San Antonio educators unique insights and experiences in regards to their water supply.

Day One: Karst Geology Field Trip and Classroom Applications.

The EAA kicked off the morning with a field trip following typical flow of water in a karst system, from recharge to discharge. The field trip started in northern San Antonio to view the recharge zone containing both Bear and Cub caves to demonstrate how



Photo by Dianne Joop

Geary Schindel explaining groundwater flow in a karst aquifer.

the aquifer receives water from rainfall and its runoff into conduits. The teachers were intrigued to learn that these conduits may be a fracture only a few millimeters wide or a cave large enough to walk through. After brief stops identifying other recharge areas and dye trace study locations, the trip concluded at San Pedro Springs, the karst springs which made the establishment of San Antonio possible in 1691. Viewing these springs from a different perspective helped the teachers to identify with the environmental issues inherent with karst groundwater.

After the field trip, NCKRI presented its first Project CAVER workshop, *Everything is Connected*, in partnership with the American Cave Conservation Association (ACCA).

NCKRI's Education Director, Dianne Joop, developed this workshop for teachers to gain the skills and tools necessary to apply the experiences gained on the field trips to classroom teaching. Using inquiry-based and hands-on teaching methods and the ACCA's *Exploring Caves and Karst* curriculum, teachers gained background knowledge and practice with the lessons for classroom integration. The ACCA provided each teacher with a copy of *Exploring Caves and Karst* for their classroom.

Day Two: Exploring a Wild Cave. Teachers experienced learning in a new way as they ventured into Robber Baron Cave! This all-day, in-cave field trip led by EAA, NCKRI, and members from the Bexar Grotto of the National Speleological Society, truly gave educators new perspectives on "active learning."

Owned by the Texas Cave Management Association, Robber Baron is the longest cave in the San Antonio area. A show cave in the 1920s and 1930s, the cave is now managed to protect its endangered species of karst invertebrates. As the participants squeezed and climbed through the crisscrossing network of passages in the cave, they gained new perspective on the geology, history, and biology of this environment below a highly urbanized area.

Education Program Projects *nckri.org*

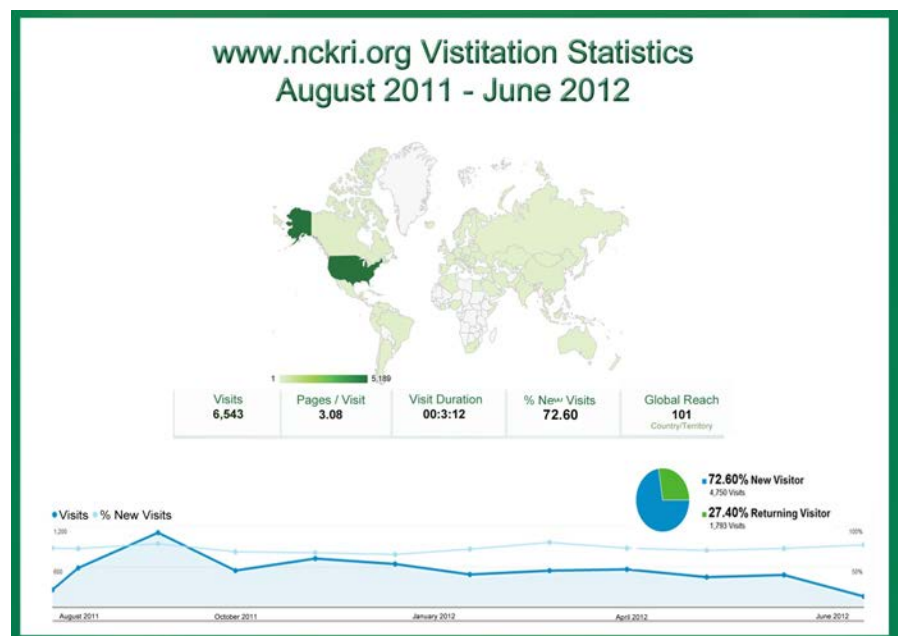
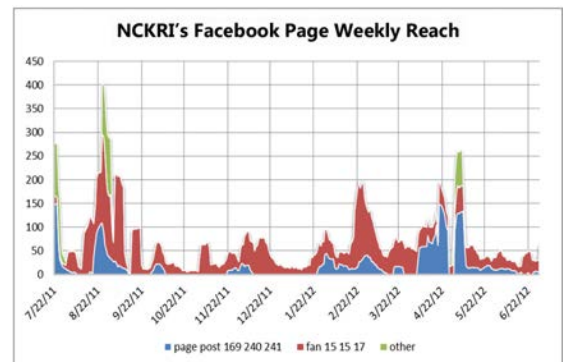
NCKRI's redesigned website was launched on September 21, 2011 and was well received. But how well? We are using Google Analytics to track user statistics and site ranking. In the first nine days we had 356 visitors (26 from outside the US) to our site. On average, they looked at 3.08 pages per visit and spent 4 minutes and 19 seconds on the site. During the last quarter of the year, visitation increased with more than half being new visitors to the website. The most visited pages, with the longest times on a page, are the two pages with content focusing on sinkholes.

Data from September 2011 through June 2012 indicate that new visitors to the site, both domestic and foreign, are increasing while returning visitor numbers are leveling off. New visitation is expected to significantly increase next year as people register for conferences NCKRI is hosting (see page 15). Since the redesign was launched, NCKRI.org has had over 20,000 page-views from 101 countries/territories. These and other data from Google Analytics are being used by NCKRI staff to guide further site and program development.

Facebook

NCKRI joined Facebook in February 2011. Since its launch, the page has expanded to 266 "Likes" with over 800,000 views of our postings.

The growth of digital content has established learning as a hybrid of formal education and self-directed discovery enhanced by virtual tools and communities. NCKRI is developing digital cave and karst education tools to reach a global audience through new equipment and free software like Facebook to create engaging and high quality educational and Internet material, internally and for potential clients. NCKRI is expanding iCAVERN (International Cave and Karst Awareness Via Education and Research Network) by developing educational and interpretive modules for app-based distribution, expanding social networking, and beginning phase II of *nckri.org*.



Hidden Voyages!

After the music stopped, the cake was cut and the doors to the Institute swung wide open, then what? May 2011, NCKRI celebrated the opening of its headquarters. While this accomplishment denotes a milestone for the Institute, it also symbolizes a stepping stone toward developing our Education Program's major project, designing the National Cave and Karst Museum's inaugural exhibition.

The Education Program's most important initiative this year has been the development of *Hidden Voyages: Exploring the Amazing World of Caves and Karst*. This combination of traditional exhibits, experiential learning opportunities, and hands-on teaching space will provide an immersive introduction to cave and karst science that is easy to absorb, and inspire further topic exploration. Small museums can have exhibits as attractive and sophisticated as those of larger institutions, it just takes design and discipline to focus on the storyline. This philosophy led NCKRI's selection of a design firm. With 20 years in the field and many successful projects involving realistic rockwork, geoscience topics, and related industries, Storyline Studio, LLC was the obvious choice.

Storyline Studio is devoting itself to this project to create engaging, one-of-a-kind visitor experiences about caves and karst that will resonate with NCKRI's broad audiences. Working closely with NCKRI staff, they began with three fundamental steps:

- 1) designing a gallery plan that guides visitors on a voyage of discovery about caves and karst;
- 2) create an identity of the total space and each exhibit gallery; and
- 3) melding graphics and multi-media displays with the flexibility to update and change content, while maintaining a consistent identity.

Storyline
STUDIO



Illustration courtesy of Storyline Studio

Gallery A will welcome visitors to NCKRI. "Rock" walls lead them to the voyages inside (the exhibit name was changed to "Voyages" after this graphic was created).

Discovery Phase

Developing exhibits to achieve the highest level of visitor engagement, learning, and satisfaction required first identifying NCKRI's story and communication goals. Developing an experiential exhibition on caves and karst is exciting and challenging. Since most people have no knowledge of karst or cave environments, or base their impressions on Hollywood's interpretation, we need

to present our subject matter from a different perspective. Our goal is to convey the excitement and intrigue of cave and karst exploration based on accurate and cutting-edge science. How better to start identifying our visitor activities and exhibit content themes, than by taking our designers underground?! Storyline's team visited not only our headquarters, but various caves during our initial design meetings.

Hidden Voyage: Karst Science Table

In the center of one gallery, a cave and karst investigations table will allow visitors a much more interactive and appealing experience with collections on display. Giving visitors the opportunity to handle objects, it will change the dynamic of the exhibit. When an item leaves its glass case, it will become a "living" object, teaching in ways beyond words. The table will hold microscopes and other tools that allow for close examination of objects. A smart pad will allow for deeper exploration into cave and karst topics. The table will serve as a classroom, a place for students, and the public to examine artifacts, and to undertake some of the same experiments and exercises conducted by cave and karst scientists.

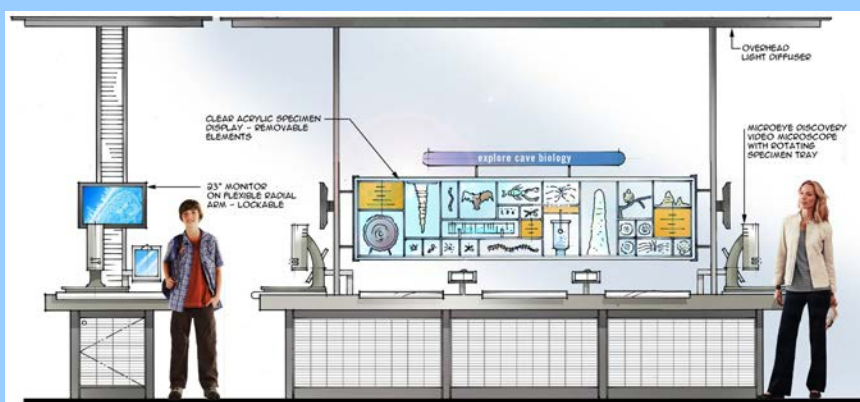


Illustration courtesy of Storyline Studio

Hidden Voyages: An invitation by Dianne Joop, NCKRI's Education Director

"We want to facilitate visitors' engagement with our exhibit, inviting curiosity by offering a framework within which to start asking questions. Learning works best when it engages us through multiple mental pathways and sensory inputs. With immersive thematic settings, we can add multiple layers of experience and learning. For example, in my time spent with cave exploration, my own understanding of cave and karst concepts has been augmented by crawling through the rock, conducting inventories, and documenting caves through mapping and photography. Our cave crawl exhibit will promote discourse on the ways NCKRI mediates our relationship with the cave environment, and fosters the idea that caves are a natural laboratory and a place to learn through scientific discovery."

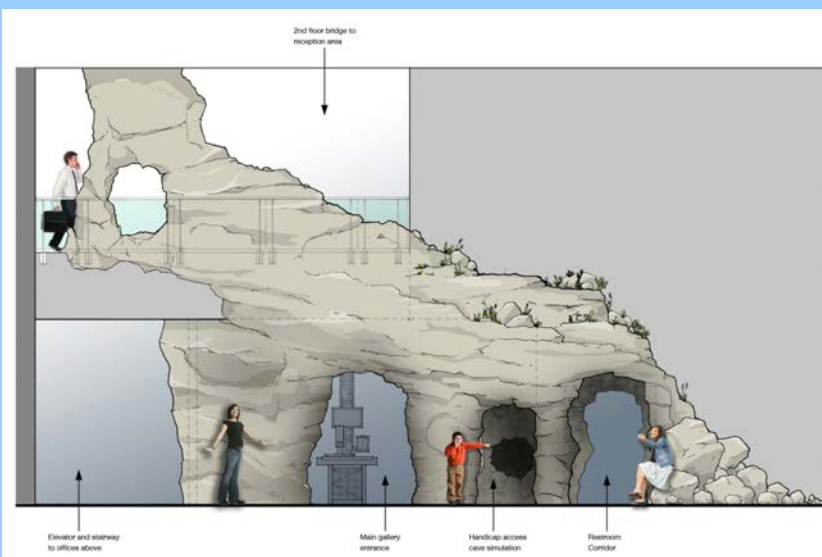


Illustration Courtesy of Storyline Studio

Design Development

The brainstorming sessions during our initial meeting generated many more questions than answers, which in the design world is a good thing. The design team used the questions as a guide to develop our schematic, exhibition title, and exhibit designs.

Currently we are near the end of the design development phase, transitioning toward the final design. This end phase hones in on specific ideas for the detailed drawings and con-

struction specifications. Even more exciting for the Education Program, this phase is developing the operational descriptions, storyboards for multimedia components, and coordinating educational curricula!

Most of this annual report's description of NCKRI's exhibit plans has been deliberately conceptual since the details are not yet final. Next year, our exhibit designs will be unveiled as part of our capital campaign, which will fund construction and installation of NCKRI's *Hidden Voyages*!

Project Learning Tree

NCKRI hosted a one-day Project Learning Tree (PLT) workshop in December 2011, given to 25 local educators. PLT has been growing environmental stewardship for 35 years through its award-winning curriculum resources that helps educators teach complex environmental issues.

National Environmental Education Week

NCKRI hosted the Lincoln National Forest's Guadalupe Mountains District's 15th annual National Environmental Education Week. Almost 800 people came to NCKRI Headquarters where 44 presenters taught on the theme of Green STEM (science, technology, engineering, and math) to about 700 5th grade students, and 66 teachers and chaperones.

Volunteers

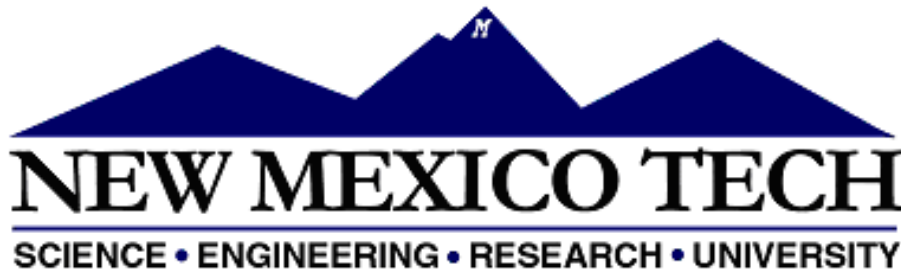
We deeply appreciate NCKRI's volunteers, especially in strengthening cave and karst education. During this year, Education Program volunteers gave close to 800 hours of their time. Estimated monetary value: \$16,800. Value to NCKRI, priceless!



Students learning about water quality with the US Geological Survey during National Environmental Education Week.

Photo by Dianne Joop

STUDENT ACTIVITIES



Student Projects

Sulfuric Acid Caves and Sulfur Springs of Tabasco, Mexico

Laura Rosales-Lagarde defended her PhD dissertation on the geochemistry of the Cueva de Villa Luz system in Tabasco, Mexico, in January of 2012. She is now working as a post-doctoral fellow on climate data from caves in Mexico under the direction of Dr. Michael Lachniet at the University of Nevada, Las Vegas.

Ice Caves in Antarctica

Aaron Curtis, geology PhD student, continues to analyze ice samples from Antarctica obtained during the previous three field seasons as part of his work on the physical and biological dynamics of fumarolic ice caves and towers on Erebus Volcano. Aaron will be returning to Antarctica for a

fourth field season in November 2012.

Fort Stanton Cave

Kristina Daisy Morgan, hydrology MS student, continues to develop cutting edge procedures to search for biological materials and climatically significant geochemical signals from surface sources during previous flooding events in the Snowy River passage of Fort Stanton Cave, New Mexico. This cave is managed by the Bureau of Land Management (see page 4).

Surface Drainage in the Jemez Caldera

Yaika Echeverria-Roman, geochemistry MS student, is on track to defend her thesis in late summer or early fall 2012. She has investigated the hydrological properties of surface drainages in the Jemez Caldera area of northern New Mexico.

Guadalupe Mountains Caves

Sam Rochelle, physics major/Earth science minor BS student, began a research project in Black Cave, Hidden Cave, and Cottonwood Cave in the Guadalupe Mountains of New Mexico in Fall 2011. This project is aimed at characterizing distinctive dark coatings and banding in speleothems and on surfaces in these caves. He will attempt to explain how such coloration came to be

present and what role it may have played in the history of these caves. These caves are managed by the US Forest Service.

Cave Microorganisms

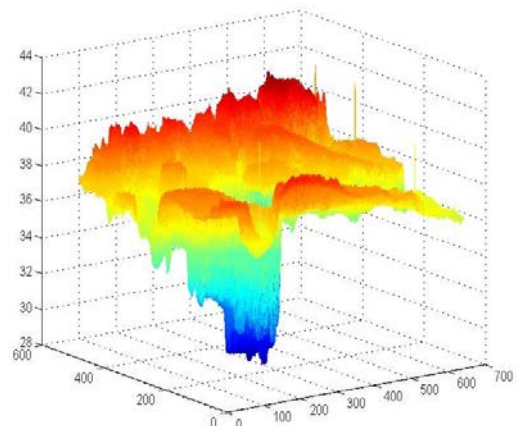
Raquel Daza Brunet, visiting PhD student from the Museo Nacional de Ciencias Naturales, Madrid, Spain, is spending 3 months with Dr. Boston's research team learning how to work with cave microorganisms, geochemical techniques, and field techniques. Her PhD work concerns the unique opal A biospeleothems in lava tubes in the Azores Islands.

Student Support at Other Universities

NCKRI's broader educational outreach efforts extend to universities outside of New Mexico Tech. General support through information is provided to many students. Formal support this year was provided by Dr. George Veni, who served on the doctoral committee of Keith Muhlestein at The University of Texas at San Antonio. Mr. Muhlestein successfully completed and defended his dissertation, *Detecting Thermal Infrared Radiation from Cave Openings Using Thermography*.



Photo courtesy of Laura Rosales-Lagarde
NMT students Stas Edel and Daisy Morgan
studying Cactus Cave, New Mexico.



Courtesy of Keith Muhlestein
Thermal image of a cave entrance.

ADVANCEMENT

National Cave and Karst Research Institute Establishes Endowment Fund

The National Cave and Karst Research Institute's Board of Directors approved the establishment of NCKRI's Endowment Fund in partnership with the New Mexico Institute of Mining and Technology (NMT). This fund will be managed and invested by the NMT Foundation. The creation of the endowment is an important step for NCKRI and NMT. Donors share our mission and help us fulfill the vision through education, research and community outreach. This endowment will help to build a strong philanthropic effort to provide a progressive future of excellent programs through additional funds from private and corporate giving.

Many endowed gifts are scholarships given in someone's memory. You can begin a scholarship with any amount; however, a scholarship is not considered to be "endowed" until it reaches \$15,000, at which point it is able to sustain itself in perpetuity.

Donors can choose to give any gift amount to the project of their choice. They can also specify where and how they want their gifts used. Common gifts include research scholarships, funding for travel, graduate students, and research equipment.

We are currently working on funding educational museum exhibits for our new headquarters. Donors can

Continuous Line in Space

by
Michael Orgel

The City of Carlsbad, through the 1% Arts in Public Places program, implemented by the New Mexico Arts Division, procured two exquisite artworks for NCKRI Headquarters. This piece reflects the curves of caves formed by flowing water. It is sculpted from Salem (aka Indiana) Limestone, famous for adorning many buildings and containing some of the longest caves in the USA.



endow these exhibits to fund their construction and maintenance. These generous gifts will help NCKRI grow and at the same time allow donors to support their special interests.

For more information about how to donate to NCKRI's endowment fund, please contact, Dr. George Veni, Executive Director, at 575-887-5518 or by email at gveni@nckri.org.

Partnering for the Future

Founding Partners

NCKRI's Founding Partners continue to play a crucial role in NCKRI's growth and development. Each Founding Partner maintains one permanent position on NCKRI's Board of Directors:

City of Carlsbad
New Mexico Institute of Mining and Technology
US National Park Service

Education Partners

Bat Conservation International
Carlsbad Municipal Schools
Geological Society of America
Hoffman Environmental Research Institute
National Speleological Society
NASA
University of New Mexico
University of South Florida
US Bureau of Land Management
US Fish and Wildlife Service
US Forest Service
US Geological Survey
US National Park Service

International Partners

Emil Racovita Institute of Speleology
Instituto do Carste
International Union of Speleology
Karst Research Institute
Ukrainian Institute of Speleology and Karstology

Research Partners

Bat Conservation International
Edwards Aquifer Authority
Fort Stanton Cave Study Project
Hoffman Environmental Research Institute/Western Kentucky University
New Mexico Bureau of Geology and Mineral Resources
University of New Mexico
US Bureau of Land Management
US Geological Survey
US National Park Service



Passing Storm

by
Dean Pulver

This second artwork is a creatively designed wooden table that now rests in NCKRI's reception area. It serves as a lovely and functional setting for promotional and education information. NCKRI thanks the City of Carlsbad for its support in acquiring these art pieces.

Stewardship Partners

Bat Conservation International
Edwards Aquifer Authority
Hoffman Environmental Research
Institute
National Speleological Society
US Bureau of Land Management
US Fish and Wildlife Service
US Forest Service
US Geological Survey
US National Park Service

Giving Recognition

Annual Donors

NCKRI's Annual Giving Program recognizes the following individuals and corporations who made gifts or pledges this year:

Dr. E. Calvin Alexander, Jr.
Paula Bauer and Dale Pate
Anna Beason
Canon®
David Decker
Ann and Terry Dowdy
Harvey DuChene
Paula Dye
Edwards Aquifer Authority
Alan Fryar
Annette Fuerhoff
Mel Gascoyne
GoodSearch.com
Jim Grantner
Dr. William Halliday
Larry Henderson
Dr. John (Jack) Hess
Dianne and Mark Joop
Ronald Kerbo
Ellen Krumm
Lowe's®
Hazel Medville
Doug Omundson
Pinsonnault Creative®
Ginger Price
Paula Provencio
Jesse Richardson
Patricia Seiser
Linda Starr
Mary Ellen Trout
US Bureau of Land Management
Karen and George Veni

Gifts are not limited to funds. Mary Ellen Trout entrusted NCKRI with the cave photography collection of her late husband Bob. One of those photos graces the cover of this report, demonstrating the great historical and scientific value of such gifts.

Giving to the Future of NCKRI

Private gifts support the mission of the National Cave and Karst Research Institute. Your contributions enhance programs provide for excellence in staff, and support research programs. Thank you for your generosity and making NCKRI a priority in your charitable giving choices.

Many Ways to Give

At the National Cave and Karst Research Institute, every gift makes a big difference. Through **Annual Giving**, donors and friends support the areas of greatest need. The annual fund is the cornerstone of our fundraising program, and is used to support scholarships, equipment, facilities, research, and exhibit development. By making gifts, our supporters demonstrate their regard for the National Cave and Karst Research Institute and its mission.

Give Online: The simplest way to give. Visit www.nckri.org to make your gift.

Give by telephone with a credit card: Call our Advancement Office at 575-628-2702 and we will assist you in making your gift.

Give through the mail: Use the contribution envelope included in your printed Annual Report to make your gift, or send it to us at, National Cave and Karst Research Institute, 400-1 Cascades Avenue, Carlsbad, NM 88220-6215

Scholarship Funds

Scholarship support is one of the most important ways to impact the lives of students. There are several ways to support student scholarships at the National Cave and Karst Research Institute:

- Through NCKRI's Annual Giving program
 - By making a gift to an existing scholarship fund
 - By creating a new scholarship fund
- You can designate your program of choice and name the scholarship fund in memory or honor of someone. We would love to talk with you about your ideas.

Legacy Covers

NCKRI's **Legacy Covers** is a group of donors that have chosen to make a planned or deferred gift through their estate planning that will have an everlasting impact on the organization. Planned or deferred gifts include: bequest through a will, charitable gift annuity, charitable remainder trust, charitable lead trust, and gift of life insurance, real estate or other assets. Legacy Covers can also make gifts through the NCKRI Endowment Fund, now established at the New Mexico Institute of Mining and Technology.

Gifts such as this not only help NCKRI, but also help provide the donor with additional income, convert low income assets to higher income assets, help care for your surviving family members, avoid long-term capital gains tax, reduce your estate taxes, and generate income tax deductions.

The NCKRI Advancement staff will work with you to arrange appropriate forms of recognition that reflect your personal gift's purpose and your preferences. Your gift may also be given anonymously. For tax purposes, the National Cave and Karst Research Institute is a 501(c)(3) with a tax exempt ID: #42-1741207. For more information on leaving a legacy, please call 575-628-2702.

NCKRI Membership

We hope you will join us today! There is no better way to support NCKRI than by becoming a member.

JOIN BY PHONE OR MAIL:

You can join by phone at 575-628-2702. Or, you can download our Membership Brochure and Application and mail it with your Payment to:

NCKRI Membership
400-1 Cascades Avenue
Carlsbad, NM 88220-6215.



CONFERENCES AND MEETINGS AT NCKRI

Workshops, symposia, meetings, congresses, and conferences all serve as focused events that are vital to fulfilling NCKRI's diverse mission. Since opening its headquarters in 2011, NCKRI has received many requests to host such events; seven are currently planned. Below are descriptions of conferences held during the year of this report and those planned for the next two years. For more information and to register for the upcoming meetings, visit www.nckri.org.

BCI-USFS Bat Inventory and Monitoring Workshop

This event was the first workshop held at NCKRI Headquarters. It was organized by Bat Conservation International and the US Forest Service and ran August 10-13, 2011. Bat biologists Sybil Amelon and Janet Tyburec taught a group of about 30 biologists, land managers, and bat research volunteers about bat habits, needs, management, and identification. The workshop included field trips to net and identify bats visually and with acoustical equip-



Photo by George Veni

Sybil Amelon (left) of the US Forest Service helps students set up a mist net for bat research.

ment. The three-day workshop was followed by an abbreviated one-day

version for those unable to attend the full event.



Photo by Dianne Joop

Dr. Penny Boston (wearing the green helmet) discusses how the study of terrestrial caves, like Carlsbad Cavern, can be used to predict characteristics of extraterrestrial caves.

First International Interplanetary Caves Workshop: Implications for Astrobiology, Climate, Detection and Exploration

This international meeting was organized by the Lunar and Planetary Institute, co-chaired by NCKRI's Dr. Penny Boston, and held at NCKRI headquarters on October 25-28, 2011. It was the first in a continuing series of meetings that promote the exchange of knowledge between planetary and terrestrial scientists interested in cave exploration and research across the solar system. The workshop was interdisciplinary and covered theoretical, experimental, and field experiences. Scientists from six countries presented 28 papers discussing caves on five different planetary bodies.



Carbon and Boundaries in Karst

There is growing interest in the storage, transport, and production of inorganic and organic carbon between the surface and subsurface in karst systems. Scheduled for January 7-11, 2013 at NCKRI headquarters, this latest Karst Waters Institute (KWI) conference is being co-organized by NCKRI. *Carbon and Boundaries in Karst* is especially timely because of rapid scientific advances and the importance of carbon sequestration in global climate change. As is the tradition with KWI meetings, this one will be aggressively interdisciplinary, international, and focused on cutting-edge science in a new area of karst research through meetings, sessions, a day-long field trip, and other activities.

13th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst

Generally called "The Sinkhole Conference," since 1984 this conference series has been among the most significant in creating a better understanding of karst processes that result in environmental issues. It has also highlighted effective methods to identify karst impacts before they occur, prevent them from occurring, and remediate them when they do occur. In 2011 NCKRI was given management of this conference series, and the next one will be held in Carlsbad on May 6-10, 2013.

This Carlsbad meeting will be the most westward location of the conference. It will be the first to include evaporite karst and oil and gas production in karst as major topics in both the field trips and sessions. Other field trips will visit the deep salt disposal site for transuranic materials at the Waste Isolation Pilot Plant. The conference will also offer four short courses on grouting, hydrophysical logging of wells, site characterization, and use of electrical resistivity in karst.



20th National Cave and Karst Management Symposium

The National Cave and Karst Management Symposium (NCKMS) is the world's longest-running conference series on cave and karst management issues. It began in New Mexico in 1975 and will return to that state for its 20th meeting on November 4-8, 2013 in Carlsbad.

"NCKMS: A Changing Climate" reflects this symposium's theme, not just on how climate change is or might impact caves and karst systems, but the changing attitudes, laws, funding sources, and other factors which are crucial to the proper management of show caves, "wild" caves, and karst terrains and aquifers. This 20th NCKMS is hosted by NCKRI in close partnership with the Bureau of Land Management, National Park Service, and the US Forest Service.

2014 Karst Interest Group Meeting

The Karst Interest Group (KIG) meets roughly every three years to encourage and support interdisciplinary collaboration and technology transfer among US Geological Survey (USGS) scientists working in karst areas. The KIG also encourages cooperative studies between the USGS and other Department of Interior agencies, and with university researchers and research institutes. NCKRI is co-organizing this 6th KIG Meeting and Carlsbad will be its furthest westward location.



Sinkhole collapse under an engineered pond in Austin, Texas.

Photo courtesy of Russell Lewis

OUTREACH

Professional Partnerships

NCKRI signed a memorandum of understanding with Brazil's Instituto do Carste. The Instituto was founded in 2007 to conduct and support karst research and sustainable usage of karst resources. Its projects include groundwater and biological research, management and restoration of karst environments, programs for young cave scientists, annual invited distinguished scholar-led workshops, and public education presentations. The memorandum formally establishes a collaborative and mutually beneficial relationship to better meet the goals of both the Instituto do Carste and NCKRI.

Professional Meetings

NCKRI attended, sponsored and/or had a booth at many conferences during the past year:

- 2011 National Speleological Society Convention; Glenwood Springs, Colorado.
- 2012 National Speleological Society Convention; Lewisburg, West Virginia.
- Geological Society of America Convention; Minneapolis, Minnesota.
- International Speleological Congress on Maya Caves and Cenotes; Playa del Carmen, Mexico.
- National Association for Interpretation, 2012 International Conference; Kailua-Kona, Hawaii.
- National Cave and Karst Management Symposium; Midway, Utah.

NCKRI staff also organized or co-organized the following events:

Dr. Penny Boston:

- First International Conference on Planetary Caves, Carlsbad, New Mexico.
- Making New Worlds: Atmospheric, Thermal, and Astrobiological Interpretation of Exoplanets. Sevilletta National Wildlife Refuge Field



Photo by George Veni

Instituto do Carste Executive Director Dr. Augusto Auler advises a homeowner on remediation of a sinkhole collapse that destroyed much of her home.

Station, New Mexico.

Ms. Dianne Joop:

- Co-sponsored the Cave Conservation and Management Special Session for Agencies and Cavers with US Forest Service National Cave and Karst Coordinator, Cynthia Sandeno, and National Speleological Society (NSS) Conservation Division Co-Chairs Jim Werker and Val Hildreth-Werker at the 2011 NSS Convention, Glenwood Springs, Colorado.

Dr. George Veni:

- Co-convened the Karst Soils Session of the EuroSoils 2012 conference, Bari, Italy.
- Served as a Scientific Committee member of the International Workshop on Ice in Caves V, Barzio and Milan, Italy, scheduled for September 2012.

Guest Lectures by NCKRI

Drs. Boston, Land, and Veni were invited to give the following

presentations and lectures:

- *Amazing ice caves of Austria* for the National Speleological Society's Pecos Valley Grotto, Carlsbad, New Mexico, Bexar Grotto, San Antonio, Texas, and the University of Texas Grotto, Austin, Texas.
- *An introduction to environmental impacts and management of karst systems*, University of Quintana Roo, Cozumel, Mexico.
- *An introduction to NCKRI and NCKRI Headquarters* for the Kiwanis Club, Carlsbad, New Mexico.
- *Artesian water resources of the Pecos Valley region*, at the Enchanted Evenings educational event at Bottomless Lakes State Park, New Mexico.
- *Astrobiology in the age of exoplanets: Defining homes for life across the galaxy*. Keynote address, Solstice Celebration, The Albuquerque Astronomical Society, Albuquerque, New Mexico.

- *Astrobiology of the Subsurface* for Microbiology class at University of New Mexico, Albuquerque, New Mexico.
- *Biomining: Linking life and the geosphere* for Environmental Microbiology class, New Mexico Tech, Socorro, New Mexico.
- *Caves as extreme environments.* American Museum of Natural History. New York, New York.
- *Caves as landforms, and habitats* for Surface Processes class at New Mexico Tech, Socorro, New Mexico.
- *Caves: Exploring Life Underground from Earth to Mars and Beyond* presented to the CalTech Summer Science Program, which is jointly held each summer at NMT and Westmont College, Santa Barbara, California.
- *Crunchy on the outside, tender on the inside: Persistence of microorganisms in geological materials.* Second International Symposium on Mine Caves, Iglesias, Sardinia, Italy, and New Mexico Mineral Symposium, New Mexico Tech, Socorro, New Mexico.
- *Electrical resistivity study of the I&W Brine Well, Carlsbad, New Mexico, U.S.A.* at the Carlsbad Heights Lion's Club, Carlsbad, New Mexico.
- *Extreme cave life: From New Mexico to Mars to Alpha Centauri.* Rotary Club, Socorro, New Mexico.
- *Living with karst: the benefits and*

challenges of living in a cavernous environment at the Hubbard Museum of the American West, Ruidoso, New Mexico.

- *Long-term persistence of microorganisms in geological materials: Lazarus, Rip van Winkle, and the Walking Dead.* Conference on Life Detection in Extraterrestrial Samples, Scripps Institute. San Diego, California.
- *Long-term persistence of microorganisms in geological materials.* AbSciCon, Georgia Tech, Atlanta, Georgia.
- *Microbial Influence on Geological Processes: Biomineralization, Biopatterning, and the Long Term Geological Persistence of Microbes.* Earth and Planetary Science Department, University of New Mexico, Albuquerque, New Mexico.
- *Microcosmos to the Cosmos.* Celebrating a Life in Science: In Memory of Lynn Margulis; University of Massachusetts, Amherst, Massachusetts.
- *Preview of the 2013 National Cave and Karst Management Symposium* at the 2011 National Cave and Karst Management Symposium, Midway, Utah.
- *Rapid recharge events in a karstic aquifer: An example from Lake of the White Roses, Lechuguilla Cave, New Mexico.* Carlsbad Museum's Underground of Enchantment exhibit, Carlsbad, New Mexico.

ated with karstic limestone aquifers in southeastern New Mexico at the Carlsbad Lions Club, Carlsbad, New Mexico.

- *Women in Mars Exploration.* George Washington University, Washington, DC.

National Involvement

Dr. Penny Boston:

- Attended a Mars Science Lab launch and a NASA Planetary Protection Subcommittee meeting at the Kennedy Space Center, Cape Canaveral, Florida.
- Participated on a Planetary Protection Proposal Review Panel at NASA Headquarters in Washington, DC.
- Participated in the NASA Precursor Strategy Analysis Group.
- Attended a NASA Innovative Advanced Concepts External Council meeting in Pasadena, California.

Dr. George Veni:

- Was appointed by the Secretary of the U.S. Department of the Interior to serve a three-year appointment on the Resource Advisory Council for the Bureau of Land Management's Pecos District. The council meets 2-4 times a year to collect and analyze information, make field observations, hear public comments and develop recommendations for the Bureau.
- Continues his service on the Aquifer Science Advisory Panel of the Edwards Aquifer Authority (EAA). The panel meets about twice a year in San Antonio, Texas, to review active and proposed EAA research and management programs.

Community Involvement

NCKRI Staff:

- Served on the City of Carlsbad's Long Range Planning Committee, which is charged to develop recommendations for the city's growth based on public surveys.
- Arranged a demonstration of LiDAR surveying and photo-draping technology at NCKRI Headquarters by Dr. Xueming Xu of Real Earth Models, Inc. (see pages 4-5 for details on this high tech equipment).



Photo by George Veni
Cave managers from Korea ready for a NCKRI-led tour of Carlsbad Cavern.

- *Show cave management at Carlsbad Caverns National Park,* a field lecture and cave tour for show cave managers from the Republic of Korea.

- *The Claim of Arsenic Life* for Global Change Hydrology class, New Mexico Tech, Socorro, New Mexico.
- *The persistence of microbial life in geological materials.* CONTACT Conference, Sunnyvale, California.

- *Water resources associ-*

- Participated in the Carlsbad Chamber of Commerce's annual *Bat Brigade*. This delegation of community leaders visits New Mexico government leaders at the state capitol to raise awareness and support for issues in the City of Carlsbad and Eddy County.
- Presented an introductory lesson on karst for Eddy County's National Environmental Education Week attendees.
- Celebrated their sixth year of partnership with the Bureau of Land Management, National Park Service, and National Forest Service in *Relay for Life*, a nationwide campaign to raise awareness and funds to fight cancer.
- Raised \$1,235 for the Carlsbad Battered Family Shelter by serving as celebrity bartender at the Trinity Hotel and Restaurant.
- Regularly attended meetings of the Carlsbad Chamber of Commerce, Carlsbad Department of Development, and Carlsbad Rotary Club, and participated in related activities supporting new businesses and community leaders. NCKRI also hosted a Carlsbad Rotary meeting at NCKRI Headquarters.
- Hosted the New Mexico Museum Association's 2011 summer meeting.
- Participated in the annual Carlsbad Chamber of Commerce Business Fair.
- NCKRI hosts the monthly meetings of the Pecos Valley Grotto of the National Speleological Society on the third Thursday of each month at 7 p.m. Anyone interested in caves, cave exploration, and cave research is welcome to attend.
- Served on New Mexico Tech's English as a Second Language (ESL) committee.
- Participated in a panel discussion on water resources in the lower Pecos region of southeastern New Mexico, sponsored by New Mexico State University-Carlsbad. The panel included representatives from the New Mexico Interstate Stream Commission, US Bureau of Land Management, and Carlsbad Irrigation District.

- Participated in a field trip with personnel from the New Mexico Office of the State Engineer, to consider land management implications of karst in the lower Pecos valley.

Media

Dr. Penny Boston:

- Gave a *60 Minutes Australia* interview on the Naica Caves and extremophile underground environments.
- Was interviewed by the Brazilian *Globo TV* on her experience in Mexico's Naica Cave.

Dr. George Veni:

- Gave an Associated Press interview on the impact of the 2011 drought on bats.
- Described the results of NCKRI's geophysical research on the I&W Brine Well Cavity to the Associated Press.
- Was interviewed by *Science* on carbon release and storage from karst regions.
- Was featured in two press conferences on the value of caves and karst and to promote the International Speleological Congress on Maya Caves and Cenotes, Cancun and Playa del Carmen, Mexico.

Distinguished Lecture Series

Have you ever wondered how photographs, especially spectacular and artistic photographs, can be made in dark and difficult cave environments? Internationally known cave photographer Peter Jones shared his secrets to the techniques and artistry of his work as part

of NCKRI's Distinguished Lecture Series. He showed a filled room some of his stunning photographs and demonstrated the equipment and methods used to create them.

Co-Sponsored Speakers

NCKRI co-sponsors the Edwards Aquifer Authority's Distinguished Lecture Series in San Antonio, Texas. This year Drs. Petar Milanovic and Nevin Kresic spoke on *Developing Water Resources in Karst—Engineering and Modeling Challenges* in July 2011. They were followed in March 2012 by Dr. John Van Brahana who presented the seminar, *Understanding Karst Challenges*. These lectures are attended by water research and management specialists throughout Texas and always completely fill the 100-person room.



Photo courtesy of Joe Ranzau
Dr. George Veni begins his invited lecture for the International Congress on Maya Caves and Cenotes, in Playa del Carmen, Mexico.

BOARD ACTIVITIES

The NCKRI Board met in Minneapolis, Minnesota in October 2011, by telephone in January 2012, and in Carlsbad, New Mexico in May 2012. In addition, the Executive Committee held monthly conference calls.

Dr. Harry Burgess, Board representative from the City of Carlsbad, took a new job as the Administrator of Los Alamos County, New Mexico, and needed to resign as a director. We appreciate his years of valuable support. The city appointed Ms. Anna Beason in October 2011 as its new representative. She worked closely with NCKRI in the construction of NCKRI Headquarters and has been a good friend to the Institute in many ways.

Todd Chavez, from the University of South Florida, retired from the Board in May 2012. He continues his partnership with NCKRI through his leadership on the Karst Information Portal. We thank him for his excellent service.

During the May 2012 Board meeting, David Lester, an entrepreneur from Littleton, Colorado was elected to a three-year term as a director. Also, Dr. Jack Hess stepped down as the Member-at-Large, but remained on the Board, and was replaced by Jesse Richardson. These changes and Mr. Lester's biography will be included in next year's annual report.

Actions of the Board

- Approved an Advancement Plan, Integrated Marketing Communications Plan, and Capital Campaign Plan for the completion of NCKRI's lab and library and the fabrication of its museum exhibits.
- Approved MOU with the Instituto do Carste in Brazil.
- Appointed a standing committee for Strategic Planning.
- Accepted the Strategic Plan with revised values, vision, and mission statements for NCKRI.

Hazel Medville, Chairman

Member since 2005, Chairman since 2006, Bachelor's Degree in Statistics and Computer Science. Hazel is a retired Computer Engineer/Manager who now spends much of her time surveying caves in Hawaii and Colorado. She was the President Pro-Tem and Government Liaison for the National Speleological Society, the Technical Program Chairman for the 15th International Congress of Speleology, and is currently the Director of the West Virginia and Hawaii Speleological Surveys. In 2003, Hazel was honored to receive the William J. Stephenson Outstanding Service Award from the National Speleological Society in recognition of her long term contributions to the society.

Dr. Robert Brinkmann, Vice-Chairman

Member since May 2010; Bachelor's and Master's degrees in Geology, Ph.D. in Geography. He recently left the University of South Florida to become Professor and Director of Sustainability Studies at Hofstra University and the Director of Sustainability Research at the National Center for Suburban Studies. Bob works on many karst issues, particular karst policy, urban karst, environmental sustainability, and geomorphology.

Richard Cervantes, Secretary/Treasurer

Member since 2005; permanent position representing New Mexico Tech (NMT); Master's Degree in Accounting and Information Systems, and is also a CPA. Richard is NMT's Associate Vice President of Research and Economic Development. He is responsible for administrative affairs including budget preparation, fiscal and project management, proposal development and contract negotiation, and provides oversight for those activities at NCKRI.

BOARD OF DIRECTORS

Dr. Harry Burgess

Member from 2005 to October 2011; permanent position appointed by the Mayor of Carlsbad, New Mexico; Bachelor's Degree in Industrial Relations, Master's Degree in Fire and Emergency Management Administration; Master's of Business Administration; Ph.D. in Economic Development. Harry represented the City of Carlsbad's participation with NCKRI. He was the City Administrator and has an extensive caving background, having worked previously with the National Park Service at Carlsbad Caverns and served on the Board of the National Cave Rescue Commission. He also taught caving for the National Outdoor Leadership School.

Anna Beason

Member since October 2011; permanent position appointed by the Mayor of Carlsbad, New Mexico; Bachelor's Degree in Business Administration. Anna has over 25 years of experience in fiscal management, 23 of those with the City of Carlsbad. As the City's Project Administrator, Anna oversees capital improvements, grant administration, project management, and fiscal administration. Anna was instrumental in the construction and funding of NCKRI and continues to support NCKRI.

Dave Steensen

Member since January 2009; permanent position representing the National Park Service (NPS); Bachelor's Degree in Geology, Master's Degree in Environmental Systems/Applied Geology. Dave is the NPS Geologic Resources Division Chief. One of his responsibilities is oversight and support of the Service-wide cave and karst resource management program.

Dr. John (Jack) Hess, Member at Large

Member since 2005; Member at Large of the Executive Committee;

Ph.D. in Geology. He is the Executive Director of the Geological Society of America (GSA). Prior to joining GSA in 2001, he was Executive Director of the Division of Hydrologic Sciences and Vice President for Academic Affairs at the Desert Research Institute in Nevada. He serves on the boards of the Karst Waters Institute and Longs Peak Council of the Boy Scouts of America, as well as NCKRI. He is a Fellow of GSA, the National Speleological Society, and the Cave Research Foundation.

Dr. E. Calvin Alexander, Jr.

Member since October 2011; Bachelor's Degree and Ph.D. in Chemistry. Calvin is a Professor in the Earth Sciences Department at the University of Minnesota, Minneapolis. He serves on the Board of the Deep Portage Learning Center. He is a Fellow of the National Speleological Society. Calvin works on many aspects of karst hydrogeology and the impacts of human activities, particularly agriculture, on karst systems and vice versa, the limits that karst systems place on sustainable agriculture and other human activities.

Todd Chavez

Member from 2009 to May 2012; Master's Degree in Library and Information Science. Director of Academic Resources at the University of South Florida Tampa Library, Todd's research focuses on understanding scholarship in the sciences including the tools and processes underlying its creation, organization, discovery,

communication, and preservation. Activities include building non-traditional library collections to support scientific research and publication, and applying bibliometric research methods to document and visualize scientific scholarship. He is the Karst Information Portal's Operations Manager and a founding partner.

Paula Dye, AICP

Member since October 2011; Bachelor's and Master's degrees in Geography. Paula is the Strategic Planning Manager for Tampa Bay Water. She has been with the agency since 1997, and manages the agency's long-term water supply planning program, serves as liaison with local and regional government planning officials, and directs the its outside funding and legislative program. She is a member of the American Planning Association and the American Water Works Association. Paula obtained her membership in the American Institute of Certified Planners (AICP) in 1998.

Jim Goodbar

Charter board member; Bachelor's Degree in Park and Recreation Management; graduate studies in cave and karst resources, geology, and geomorphology. Jim works in Carlsbad for the US Bureau of Land Management (BLM) as the Senior Cave and Karst Resources Specialist with the Washington Office. He serves as BLM New Mexico State Cave Coordinator and Senior Cave and Karst Specialist for the BLM Pecos District and the Carlsbad Office. His primary responsibilities: establish policy and provide guidance on cave/karst resource management to all BLM offices, serve as the international point of contact for all cave/karst related issues and requests for assistance, develop and conduct training for cave/karst resources, and develop best management practices for land use in karst.

Dr. Ronald T. Green

Member since 2007; Bachelor's in Industrial Engineering;

Bachelor's in Geology; Master's in Geophysics; Ph.D. in Hydrology. Ron is a hydrogeologist with the Southwest Research Institute, San Antonio, Texas, where much of his work focuses on karst aquifers.

Dale Pate

Member from 2000-2002; 2006 to present. Bachelor's Degree in Geography. Dale has been the National Park Service's Acting Cave and Karst Program Coordinator since May 2007, and the Supervisory Physical Scientist (Cave Specialist) at Carlsbad Cavern National Park since July 1991.

Jesse Richardson

Member since May 2010; Bachelor's and Master's Degrees in Agricultural and Applied Economics from Virginia Tech; Juris Doctor from the University of Virginia School of Law; Jesse is an Associate Professor in Urban Affairs and Planning at Virginia Tech and a practicing attorney.

Geary Schindel

Member since 2004; Bachelor's Degree in Geology and a Master's Degree in Geography. Geary is the Chief Technical Officer of the Edwards Aquifer Authority in San Antonio, Texas, and directs the Aquifer Science Research Program. The Edwards Aquifer is a major karst aquifer that provides water to more than 1.7 million people in south-central Texas.

David Weary

Member since June 2009, Bachelor's Degree in Geology from George Mason University, Master's in Geology from Virginia Tech. He has worked for the US Geological Survey (USGS) in Reston, Virginia, since 1988; represents USGS on the NCKRI Board. A research geologist, he is Chief of the USGS KARST Project, which includes hydrogeologic studies and geologic mapping in the Missouri Ozarks and Shenandoah Valley of the Virginias, and work on the new national karst map in cooperation with NCKRI and the National Speleological Society.



Illustration Courtesy of Storyline Studio
Cut-away of part of NCKRI's planned exhibit gallery.

NCKRI STAFF

Dr. George Veni, Executive Director

Dr. Veni is an internationally recognized cave and karst hydrogeologist. Prior to NCKRI, he owned and served as principal investigator of George Veni and Associates for over 20 years. He has conducted karst research throughout the United States and in several other countries. His administrative work includes serving as the Executive Secretary of the National Speleological Society's Section of Cave Geology and Geography for 11 years, President of the Texas Speleological Survey for 13 years, Adjunct Secretary of the International Union of Speleology (UIS) from 2002-2009, and UIS Vice President of Administration since 2009. He has served as a committee member of geological, geographical, and biological dissertations at The University of Texas and Harokopio University (Greece), and taught karst geosciences courses for Western Kentucky University for 12 years. He has published and presented over 180 papers and five books, on hydrogeology, biology, and environmental management in karst.



Dr. Penelope Boston, Academic Director

Dr. Boston teaches classes in cave and karst science, geomicrobiology, astrobiology, and global systems, and supervises graduate students studying those topics at New Mexico Tech. She received a National Research Council Postdoctoral Fellowship at NASA-Langley Research Center, has held positions at the National Center for Atmospheric Research, University of Colorado, University of New Mexico, founded her own non-profit research institute (Complex Systems Research Inc.) and operated it for 14 years before joining NCKRI in 2002.

Dr. Boston is a Fellow of the NASA Institute for Advanced Concepts, Past President of the Association of Mars Explorers, and Senior Editor of the journal *Astrobiology*. She is a member of NASA's Advisory Council Committee on Planetary Protection, a member of the National Academy of Sciences COMPLEX committee, and past advisory board member for the *Journal of Cave & Karst Studies*.



Ann Dowdy, Advancement Director

Ms. Dowdy joined NCKRI in October 2010 and worked with us through April 2012. She brought an impressive background in fundraising with a Bachelor of Arts in Organizational Communication, Certification in Non-profit Leadership and Management from the Texas Association of Non-profit Organizations, and a 29-year career in the fundraising and marketing profession. She had worked at an art museum, science museum, crisis center, private school, private foundation, and a national nonprofit before coming to NCKRI. Ms. Dowdy is a member of several national level organizations such as the American Association of Museums (AAM), where she serves as a peer reviewer, the International Association of Fundraising Professionals, the Texas Association of Non-profits, the Tourism Association of New Mexico, Carlsbad Chamber of Commerce, and the Carlsbad Rotary Club. Her contributions to NCKRI were many and appreciated.



**Dianne Joop,
Education Director**

Ms. Joop began working for NCKRI in June 2009 and brought a wealth of teaching experience, both formal and informal. While most of this experience was gained in Kentucky and Tennessee classrooms teaching at many levels, she also worked with cave and karst education programs with the National Park Service, American Cave Conservation Association, and Western Kentucky University. Ms. Joop holds a Master's Degree in Education, with a focus on science and history. Since 2009, she has served as the Education Division Chief of the National Speleological Society. She is an active and experienced cave explorer and surveyor on multiple and diverse projects.

Ms. Joop brings a broad and creative set of talents to NCKRI, with a Bachelor's Degree in Theatre, and through a decade of theatrical and television production experiences with Kentucky Educational Television, the state of Florida, Discovery Channel, and more. Since joining NCKRI, she now serves on education and cave and karst management committees for Carlsbad Municipal Schools and the US Forest Service, and conducts cave and karst education programs nationally. In addition to her education projects at NCKRI, she also serves as NCKRI's webmaster.



**Dr. Lewis A. Land,
Karst Hydrologist**

Dr. Land is a karst hydrogeologist with the New Mexico Bureau of Geology & Mineral Resources (NMBGMR). He serves as the Bureau's liaison with NCKRI and as NCKRI's lead geophysical investigator. Prior to his career as a hydrogeologist, Dr. Land spent eight years in the petroleum industry exploring for new oil reserves in the Mid-Continent and Rocky Mountain regions of the U.S., and offshore West Africa. He received his Ph.D. from the University of North Carolina-Chapel Hill, where his doctoral research included submersible investigations of submarine sinkholes in the Straits of Florida. Before coming to work for NCKRI and NMBGMR in 2002, Dr. Land spent two years with the North Carolina Division of Water Resources conducting geophysical surveys of aquifers beneath the coastal plain of North Carolina.

Dr. Land's current research mostly focuses on regional investigations of karstic aquifers and associated phenomena in southern New Mexico, but have extended as far as Guatemala on NCKRI projects. He has served on several graduate student committees at New Mexico Tech (NMT), and is an adjunct faculty member in the NMT Department of Earth and Environmental Sciences. He is a Past-President of the New Mexico Geological Society (NMGS), and served for five years on the NMGS Executive Committee.



**Debbie Herr,
Administrative Coordinator**

Debbie joined NCKRI in January 2008 to organize and lead its administrative activities after working as a secretary in the Truth or Consequences Municipal School District for 11½ years. She received an Associate's Degree in Secretarial Administration from New Mexico State University at Carlsbad, and has over 25 years experience as a secretary and administrative assistant. Debbie works as interim publisher for NCKRI, producing the annual report series and other materials. She is also a piano accompanist, having worked with many high school students, several churches, and community chorus.



Continuing Staff Education

NCKRI staff polish and expand their skills whenever possible. Formal training attended by one or more staff members in the past year includes:

- *Bat Inventory and Monitoring Workshop*, Bat Conservation International and US Forest Service, NCKRI Headquarters, Carlsbad, New Mexico (see page 14).
- *Understanding Karst Challenges* taught by Dr. John Van Brahana, Distinguished Lecture Series, Edwards Aquifer Authority, San Antonio, Texas.
- *National Park Service Fundamentals III*, Grand Canyon National Park, Arizona.

STAFF PUBLICATIONS

Refereed Papers *Conference Papers*

- Veni G. 2011. The role of the National Cave and Karst Research Institute in cave and karst management. In: Stratford V, editor. Proceedings of the National Cave and Karst Management Symposium; 2011 Oct. 3-7; Midway, Utah. National Cave and Karst Management Symposium. p. 79-83.

Books and Book Chapters

- Boston P. 2012. Invited essay. 'Jokin' in the Girl's Room. In: Lynn Margulis: The Life and Legacy of a Scientific Rebel. D. Sagan. Editor. Chelsea Green Press.
- Land L, Rawling G, Timmons S. 2012. Regional water table map of the southern Sacramento Mountains. In: New Mexico Bureau of Geology and Mineral Resources Open-File Report 542, 1:100,000: <http://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=542>
- Land L, Veni G. 2011. Electrical resistivity survey: I&W brine well, Eddy Co., New Mexico. NCKRI Report of Investigations 2, 18 p.
- Newton BT, Rawling GC, Timmons SS, Land L, Johnson PS, Kludt TJ, Timmons JM. 2012. Sacramento Mountains hydrogeology study. In: New Mexico Bureau of Geology and Mineral Resources Open-File Report no. 543, <http://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=543>
- Partey FK, Land L, Frey B, Premo E, Crossey L. 2011. Final report on the geochemistry of Bitter Lake National Wildlife Refuge, Roswell, New Mexico. In: New Mexico Bureau of Geology and Mineral Resources Open-File Report no. 526, <http://geoinfo.nmt.edu/publications/openfile/details.cfm?Volume=526>
- Veni G. 2011. National Karst Research Institutes: their roles in cave

and karst management. In: Karst Management, Philip E. van Beynen, Editor. Springer Science+Business Media, New York, pp. 321-347.

Journal Papers

- Dohm JM, Miyamoto H, Ori GG, Fairén AG, Davila AF, Komatsu G, Mahaney WC, Williams J-P, Joye SB, Di Achille G, Oehler DZ, Marzo GA, Schulze-Makuch D, Acocella V, Glamoclija M, Pondrelli M, Boston P, Hart KM, Anderson RC, Baker VR, Fink W, Kelleher BP, Furfaro R, Gross C, Hare TM, Frazer AR, Ip F, Allen CCR, Kim KJ, Maruyama S, McGuire PC, Netoff D, Parnell J, Wendt L, Wheelock SJ, Steele A, Hancock RGV, Havics RA, Costa P, Krinsley D. 2011. An inventory of potentially habitable environments on Mars: Geological and biological perspectives. In: Garry WB, and Bleacher JE, editors. Analogs for Planetary Exploration. Geological Society of America Special Paper 483, p. 317-347, doi:10.1130/2011.2483(21).
- McLennan SM, Sephton MA, Allen C, Allwood AC, Barbieri R, Beatty DW, Boston PJ, Carr M, Grady M, Grant J, Heber VS, Herd CDK,

Hofmann B, King P, Mangold N, Ori GG, Rossi AP, Raulin F, Ruff SW, Sherwood-Lollar B, Symes S, Wilson MG 2012. Planning for Mars returned sample science: final report of the MSR end-to-end International Science Analysis Group. In: Astrobiology 12(3) pp. 175-230.

Unrefereed Papers

- Boston PJ. 2011. A physics and chemistry based framework for speleogenesis in the Solar System. First International Conference on Planetary Caves, Carlsbad, New Mexico.
- Boston PJ. 2011. Extraterrestrial caves: a solar system-wide prospectus. First International Conference on Planetary Caves, Carlsbad, New Mexico.
- Chanover NJ, Glenar DA, Voelz DG, Xiao X, Tawalbeh R, Uckert K, Boston P, Brinckerhoff W, Getty S, Mahaffy P. 2011. Rapid assessment of high value samples: a miniature AOTF-LDTOF spectrometer suite for cave environments. In: First International Conference on Planetary Caves, Carlsbad, New Mexico.
- Gillespie [Joop] D., Sandeno CM, Hildreth-Werker V. 2011. Sustained



Illustration Courtesy of Storyline Studio
Stalactites, stalagmites, flowstone, rimstone dams, and rock walls serve as the backdrop for one section of NCKRI's Hidden Voyages exhibit design.



Photo by George Veni

NCKRI attended a conference this year on karst groundwater and cenotes, water-filled sinkholes that were the main sources of water for the ancient Maya civilization of Yucatan, Mexico.

ble cave resource management in a post-WNS world: a practical workshop for land managers. In: Geological Society of America Convention; 2011 Oct. 9-12; Minneapolis, Minnesota.

- Golubović Deligianni M, Pavlopoulos K, Stournaras G, Vouvalidis K, Veni G. 2011. The contribution of geomorphological mapping in the Ksiromero karstic region: land use and water quality protection. In: Program of the 9th International Hydrogeological Congress; 2011 Oct. 5-8 Kalavrita, Greece.
- Johnson S, Schindel G, Veni G, Hauwert NM, Hunt BB, Smith BA, Gary MO. 2011. Defining the springsheds of two major springs in Texas: San Marcos and Barton Springs. In: Geological Society of America Convention; 2011 Oct. 9-12; Minneapolis, Minnesota. p. 166.
- Land LA, Timmons SS. 2012. Regional investigation of groundwater resident time using multiple tracers: southern Sacramento Mountains, New Mexico. In: Geological Society of America Rocky Mountain Section Meeting, Albuquerque, New Mexico.
- Land L, Veni G. 2011. Electrical resistivity surveys of anthropogenic

logical Society Convention Program; 2012 June 25-29; Lewisburg, West Virginia. National Speleological Society, Huntsville, Alabama. p. 80.

- Land LA, Rawling G, Timmons SS. 2012. Regional water table map of the southern Sacramento Mountains watershed. In: Geological Society of America Rocky Mountain Section Meeting, Albuquerque, New Mexico.
- Northup DE, Spilde MN, Hathaway JJM, Garcia MG, Moya M, Stone FD, Boston PJ, Dapkevicius MLNE, Riquelme C. 2011. Lava cave microbial mat and secondary mineral deposit communities: implications for life detection on other planets. First International Conference on Planetary Caves, Carlsbad, New Mexico.
- Parness A, Frost M, Boston P, Cutkosky M. 2012. A rock climbing robot for exploration and sample acquisition at lava tubes, steep slopes, and cliff walls. In: NASA RFI, May, 2012.
- Schubert KE, Gomez E, Curnutt J, Boston PJ. 2011. Patterned extremophiles. In: First International Conference on Planetary Caves, Carlsbad, New Mexico.

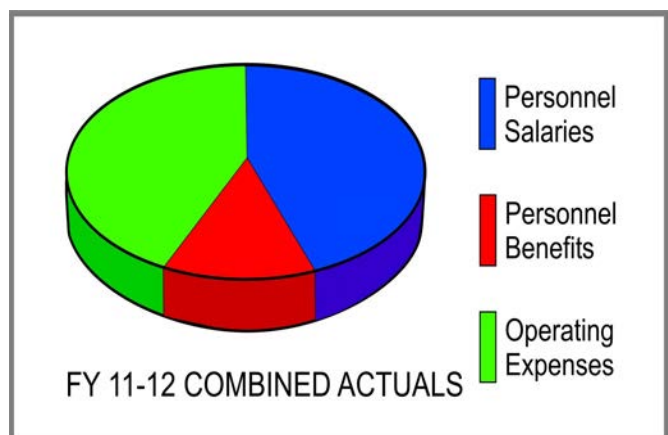
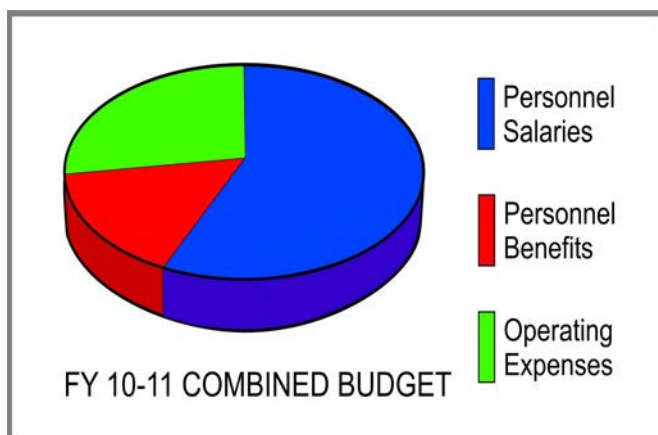
karst phenomena associated with brine well operations: southeastern New Mexico, USA. In: Geological Society of America Convention; 2011 Oct. 9-12; Minneapolis, Minnesota. p. 167.

- Land L, Veni G. 2012. Karst without borders: solving karst flooding problems in rural Guatemala. In: Bowen J, Hoke B, editors. Maya-Con 2012, National Speleo-

- Spilde MN, Boston PJ, Melim LA, Northup DE. 2011. In: Extraterrestrial caves as archives of life. First International Conference on Planetary Caves, Carlsbad, New Mexico.
- Timmons SS, Johnson PS, Newton BT, Rawling G, Land LA, Timmons JM, Kludt T. 2012. The aquifer mapping program approach in the southern Sacramento Mountains, New Mexico. In: Geological Society of America Rocky Mountain Section Meeting, Albuquerque, New Mexico.
- Veni G. 2011. Environmental impacts in karst areas. In: First Karst Symposium of Minas Gerais; 2011 Nov. 21-22; Belo Horizonte, Brazil.
- Veni G. 2011. Tectonic Development and Mineralogy of a Rhyolite Cave in Big Bend National Park, Texas, USA. In: Geological Society of America Convention; 2011 October 9-12; Minneapolis, Minnesota. p. 138.
- Veni G. 2012. Photography for cave and karst science. In: Bowen J, Hoke B, editors. MayaCon 2012, National Speleological Society Convention Program; 2012 June 25-29; Lewisburg, West Virginia. National Speleological Society, Huntsville, Alabama. p. 69.
- Veni G. 2012. Zuhuy ha: the role of water, caves, and karst in Maya culture. In: Program of the International Speleological Congress on Maya Caves and Cenotes; 2012 May 25-27; Playa del Carmen, Mexico.
- Veni G, Land L. 2011. Electrical resistivity prospecting for karstic cavities in resistivity-adverse conditions. In: Program, 2011 National Speleological Society Convention; 2011 July 18-22; Glenwood Springs, Colorado. National Speleological Society, Huntsville, Alabama. p. 37.
- Wiens RC, Ollila A, Spilde M, Boston P, Barefield J, Le L, Clegg S, Lasue J, Newsom H, Vaniman D. 2011. In: Consideration of LIBS for exploration of caves. First International Conference on Planetary Caves, Carlsbad, New Mexico.

2011-2012 BUDGET

	<i>National Park Service</i>		<i>State of New Mexico</i>		<i>COMBINED</i>	
	FY 11-12 Budget	FY 11-12 Actuals	FY 11-12 Budget	FY 11-12 Actuals	FY 11-12 Combined Budget	FY 11-12 Combined Actuals
REVENUE						
State General Funds Appropriation	0	0	377,000	377,000	377,000	377,000
Federal Fund Appropriation	323,000	323,000	0	0	323,000	323,000
Fund Balance (Carryforward)	0	0	508,392	508,392	508,392	508,392
TOTAL REVENUE	323,000	323,000	885,392	885,392	1,208,392	1,208,392
EXPENSES						
Staff	188,049	177,570	200,034	201,501	388,083	379,071
Students	0	0	6,650	22,490	6,650	22,490
Project Salaries Sub-total	188,049	177,570	206,684	223,991	394,733	401,561
FRINGE BENEFITS						
Staff	60,176	60,092	64,011	55,927	124,187	116,019
Students	0	0	133	450	133	450
Fringe Benefits Sub-total	60,176	60,092	64,144	56,377	124,320	116,469
TOTAL PERSONNEL EXPENSE	248,225	237,662	270,828	280,368	519,053	518,030
OPERATING EXPENSES						
Rent, Utilities, Telephone	0	0	64,050	75,579	64,050	75,579
Supplies & Expenses	14,325	18,968	15,077	36,372	29,402	55,340
Exhibit Design	0	0	0	153,268	0	153,268
Travel	16,000	13,073	7,045	14,511	23,045	27,584
Contractor Services	500	4,133	0	7,442	500	11,575
Property & Equipment	1,500	7,069			1,500	7,069
NMT Administrative Support	0	0	20,000	20,000	20,000	20,000
NMT "Indirect" from NPS Budget (8%)	22,450	22,071	0	0	22,450	22,071
NPS "Indirect" to GRD at 6% on NPS appropriation	20,000	20,000	0	0	20,000	20,000
TOTAL OPERATING EXPENSE	74,775	85,314	106,172	307,172	180,947	392,486
TOTAL ALL EXPENSES	323,000	322,976	377,000	587,540	700,000	910,516





National CAve and Karst Resarch Institute

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