



2013-2014

ANNUAL REPORT

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Cover Photo

NCKRI worked with Bat Conservation International and a team of exceptional volunteers this year to conduct the world’s first geophysical survey of bat guano inside the world’s largest bat colony, Bracken Cave, Texas. Photo courtesy of Allan Cobb.

Back Cover Photo

NCKRI celebrates its MOU with China’s International Research Center on Karst through this photo of one of the country’s spectacular tower karst regions. This one shows a river that disappears into a cave, directly below where the photo was taken, at the Xiangqiao Cave National GeoPark, Guangxi Province, China. The natural bridge shows that the valley is a collapsed part of the cave system. NCKRI 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 July 1, 2013 to June 30, 2014. 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

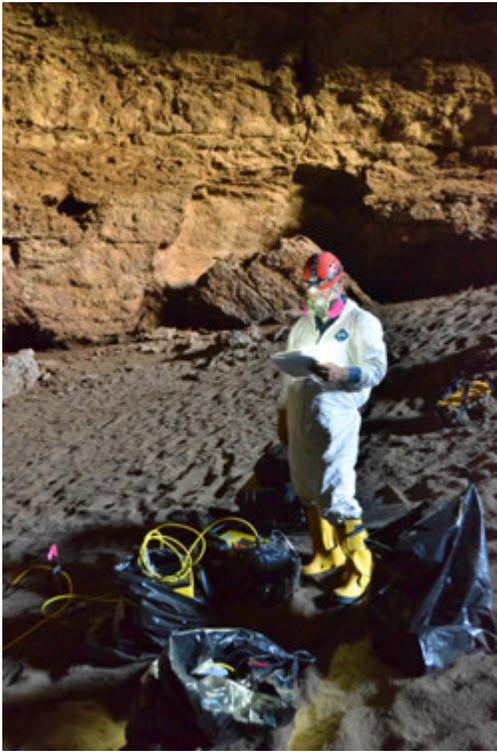


Photo courtesy of Allan Cobb
Dr. George Veni conducting electrical resistivity surveys in Bracken Cave, Texas.

What I love most about caves and karst is the variety. From cover-to-cover, this issue of NCKRI's annual report reveals only a small part of that diversity. During this year we have worn "spacesuits" to study the geophysical nature of bat guano, examined sinkholes for repair and prevention, waded through underground streams in search of animals that may help us better understand karst aquifers, and probed for microbes that reveal the mysteries of life on this and possibly other planets. We have delved into data to help map the karst areas of the world, advised the National Park Service on its cave and karst needs, and continued expanding the knowledge and resources stored in the Karst Information Portal, including the addition of six new publications of our own.

Our Education Program has trained interpretative staff for the National Park Service, volunteer docents for two state park systems, and World Heritage and water resources managers, plus many students, in two foreign countries on the special needs and circumstances of karst. We've supported students who worked in ice caves at the bottom of the globe, studied what soot and plant particles in caves can tell us about past climates and surface conditions, used robots to enhance exploration and research, and even looked at the effects of gravity on microorganisms.

With so much happening, I find it impossible to not be excited every day about NCKRI's work. Much of it has been broadcast through television, radio, magazines, podcasts, and webinars, as well as traditional scientific outlets like journals and conference proceedings. The diversity of activities extends to friendships and partnerships. We organized and hosted a combined six national conferences and meetings, an international student intern, signed an agreement with our sister institute in China, and saw our list of supporters grow.

The range of things that happened this year was dizzying but gratifying. They are all adding to NCKRI's growth, and more exciting events for the coming year. On behalf of everyone at NCKRI, we invite you to be a part of our adventures ahead!

George Veni, Ph.D.

NCKRI RESEARCH

Geophysical Studies: Probing the Unseen

This year NCKRI conducted its most diverse range of geophysical projects to date. The story below describes what may be the oddest electrical resistivity survey ever. It is followed by a report on less strange but equally important research sites.

The World's First Geophysical Survey of Bat Guano!

Bracken Cave is home to the world's largest colony of bats. An estimated 20 million pregnant Mexican free-tailed bats fly north and into the cave each spring following their winter holiday in Mexico. After giving birth to an average one pup each,

the population swells by summer to an astounding 40 million.

First-time visitors to the cave are thrilled by the bats' spectacular evening flights out to feed. As the awe subsides, the trip leader will usually discuss how many tons of insects those bats will eat each night and how the cave's immense mounds of guano were once mined for fertilizer and (during the Civil War) saltpeter to make gunpowder. It is usually then, as a pungent odor drifts up from the cave, that people ask, "How deep is it?"

In January 2014, NCKRI teamed with Bat Conservation International (BCI), the cave's owner, to conduct an electrical resistivity survey in the cave to answer that question. To the best of our knowledge, this was the world's first geophysical survey of bat guano. The timing was planned for most bats to be in Mexico during the work and thus relatively few would be disturbed; the cave is never completely empty of bats.

We set four electrical resistivity arrays: two of them 56 m long, one along the cave's west wall and the other down the middle. A third stretched 80 m along the east wall. The fourth formed a 14- by 12-m grid at the back of the cave. The lateral and middle surveys would produce two-dimensional profiles, while the grid was designed for a three-dimensional image.

This was far from a typical geophysical survey. Everyone was dressed in coveralls and respirators, and the electronic gear was bagged for great protection. Unlike many

bat caves, the guano in Bracken is dusty and floats through the air, invading noses, lungs, clothes and electrical connections. Despite the adversity, BCI had two teams of volunteers eager to help haul, place, and collect the heavy cables and other equipment: members of the Bexar Grotto, the National Speleological Society's chapter from nearby San Antonio, Texas, and a video crew from ResearchWild.com, who also recorded the action.

Extra effort was needed to precisely survey the 248 electrode locations and to decontaminate our equipment. BCI tests in the cave have found no evidence of the fungus that causes White-nose Syndrome, but to ensure safety, we cleaned all 666 m of cable, plus the electrodes, resistivity meter and all other equipment that entered the cave.

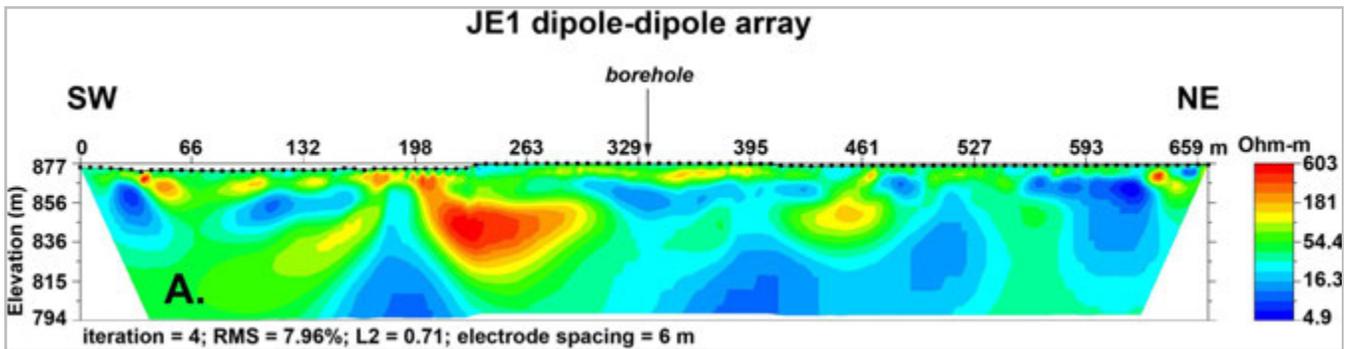
So how deep is the guano? At least 18 m. Electrical resistivity surveying requires a trade-off between depth and detail. We focused on detail, in order to find rocks that are buried in the guano and could cause problems for the next phase of work.

More resistivity studies are planned for the next winter. One goal will be to locate the bottom of the guano deposits as well as the buried bedrock of the cave floor. Another is to use the results to guide coring of the guano. Radiocarbon dating of the cores would establish the age of the guano layers. Studies of bones, DNA, and the guano itself could identify bat species that might have lived in the cave before today's Mexican free-tailed bats, and determine what they were eating.

The coring is planned with a multidisciplinary partnership that will include BCI, the Mammoth Cave International Center for Science and Learning in Kentucky, Southwest Research Institute in San Antonio, and the University of South Florida in Tampa. Stay tuned.



NCKRI photo by George Veni
Dr. Evelyn Mitchell of St. Mary's University and the Bexar Grotto surveys electrode locations in Bracken Cave.



Electrical resistivity profile from a survey line that crossed a proposed borehole location by BHP-Billiton in Loving County, Texas. The high resistivity feature highlighted in yellow and orange is probably a water-filled cave beneath the southwest corner of the well pad.

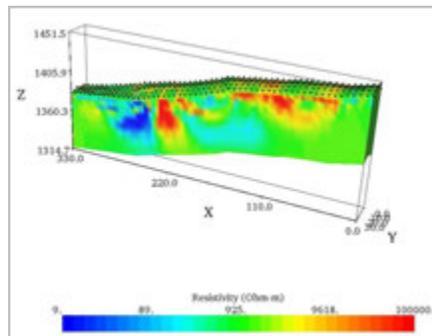
Geophysics for Finding Caves, Sinkholes, and Hazards

NCKRI continued its geophysical studies of karst in New Mexico with a variety of projects led by Dr. Lewis Land who extended them into Texas. He organized both microgravity and electrical resistivity surveys near Fort Stanton Cave in the Sacramento Mountains, over Parks Ranch Cave in the Chosa Draw area, and over Manhole Cave in the Guadalupe Mountains.

The Fort Stanton work was a continuation of research NCKRI has conducted there for several years. Our newest results appear to show a cave, but at a much higher elevation than the known sections of Fort Stanton Cave. The research at Parks Ranch Cave was designed to refine NCKRI's skill and methods with the equipment.

At Manhole Cave, Dr. Land completed a three-dimensional interpretation of six two-dimensional resistivity surveys and presented the results at

the Geological Society of America convention in October 2013. The microgravity survey of Manhole Cave is in progress, with thanks to the Hoff-



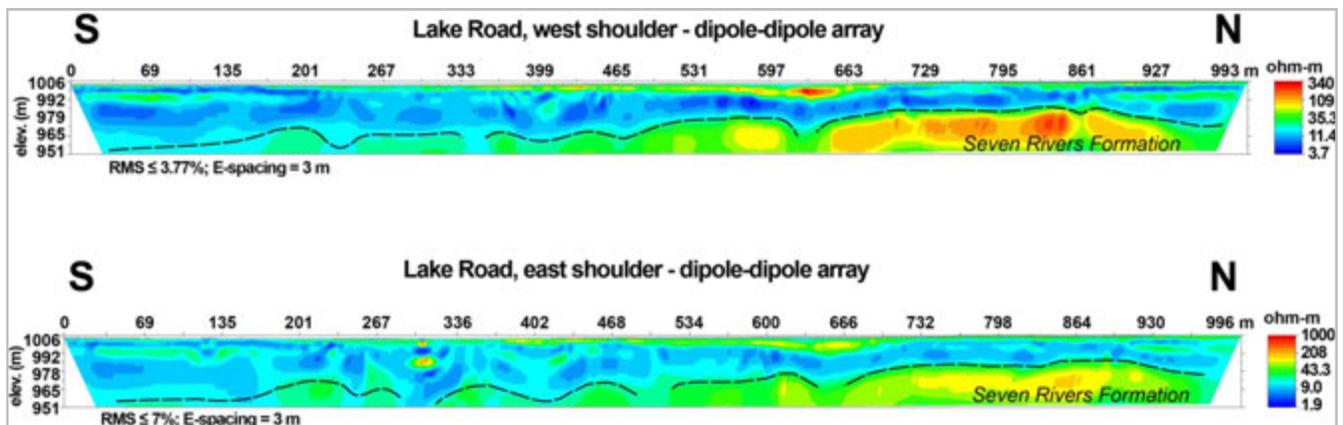
Three-dimensional model of electrical resistivity surveys conducted at Manhole Cave.

man Environmental Research Institute of Western Kentucky University for loaning NCKRI their microgravity meters. Dr. Land was assisted with Parks Ranch Cave and the following two studies by NCKRI graduate stu-

dent intern Lasha Asanidze.

In early 2014, NCKRI was contracted by BHP-Billiton, a Texas-based oil company involved in an extensive drilling program to develop unconventional oil reserves in the Wolfcamp and other shale reservoirs in the gypsum plains of west Texas. Some of their wells have intersected subsurface cavities formed in gypsum bedrock, resulting in significant drilling problems. In one instance, explosive conditions were found that destroyed a drilling rig and threatened the lives of drilling personnel.

In an attempt to avoid future drilling hazards, Dr. Land conducted electrical resistivity surveys for subsurface cavities at a proposed well site in Loving County, Texas. These surveys show a well-defined resistivity anomaly near the proposed borehole that probably represents a water-filled cave. Because the cavities encountered during drilling operations are isolated from the surface, this geophysical study will



Electrical resistivity profiles collected east of the village of Lakewood, New Mexico. Depressions and breaks in the top of the Seven Rivers Formation are probably paleosinkholes.

have direct application to future geophysical investigations NCKRI will conduct over isolated caves that have no surface access. The full results of this study are in NCKRI Report of Investigation 5, *Electrical Resistivity Surveys, Johnson Estate Drill Site, Loving County, Texas* (see page 28).

In the Spring of 2014, NCKRI conducted over 3.5 km of electrical resistivity surveys near the village of Lakewood, New Mexico. Many small sinkholes developed in the area in the aftermath of flooding in September 2013. Several formed along two roads, causing significant damage.

The goals of the surveys were to map the underground extent of the sinkholes and see if other sinkholes may be forming that had not yet breached the surface. This work was funded by Eddy County and the Federal Emergency Management Agency, through a sub-contract with Pettigrew and Associates, with the purpose of making road repairs as effective as possible. It also added to NCKRI's geophysical database of sinkholes for future analysis.

The Lakewood surveys succeeded in imaging the subsurface stratigraphy to a depth of about 60 m. An irregular bedrock surface was found below alluvium deposited by the Pecos River. These irregularities probably represent paleokarst features and paleosinkholes formed on the top of the Permian age Seven Rivers Formation.

The modern sinkhole collapses appear formed by relatively narrow vertical downward movement of floodplain sediments, possibly related to the paleosinkholes. The full results of this study are documented in NCKRI Report of Investigation 6, *Geophysical Investigation of Flood-Induced Sinkhole Collapses, Lakewood Region, Eddy County, New Mexico*, which is available on NCKRI's website (see page 28).

Who's Home Underground? Looking for Cave Life on Earth and Beyond

Life underground is often small and not noticed, yet amazingly diverse, as were NCKRI's biological research projects this past year as seen in the following reports.

Life in the Aquifers of Southeastern New Mexico

It wasn't long after NCKRI was established in Carlsbad that we began to ask, "Is anything living in the groundwater?" Many karst aquifers are home to a rich fauna that tell us a



Photo courtesy of Jim Goodbar
NCKRI graduate intern Lasha Asanidze sets a trap for groundwater fauna in the Moss Cave Complex.

great deal about the history of life above and below ground in those regions. Stygobites, aquatic animals that live in aquifers, also often reveal important details about the aquifers that aren't always available from traditional research techniques.

No stygobites were known in the area until NCKRI suggested a biologi-

cal survey of some caves east of Carlsbad as part of an environmental impact study. In late 2011, three were discovered: a new species of amphipod, copepod, and another that is under study. Encouraged by these results, NCKRI began a preliminary but broader survey for stygobites throughout the region, led by NCKRI graduate student intern Lasha Asanidze.

With the cooperation and assistance of the Bureau of Land Management, City of Carlsbad, and US Forest Service, Lasha set traps in nine springs, three caves, and two wells located in both limestone and gypsum

karst aquifers in Eddy County, New Mexico. The specimens are currently being identified by James Reddell at the Texas Natural Science Center. A report will likely be prepared next year with the results.

Fort Stanton Cave Snowy River Passage; Bureau of Land Management Cave Assistance Agreement

The Fort Stanton Cave Snowy River Passage project continues under various restrictions imposed by White – nose Syndrome concerns. Microbial samples obtained during previous years are still under long-term analyses in Dr. Boston's laboratory. In addition, NCKRI Scholar Daisy Morgan-Edel focused on materials from this cave in her study of cave phytoliths as a biological signal preserved in caves from previous climate eras.

Zia Pueblo, Penasco Springs, New Mexico

A pilot study of karstic springs on the Zia Pueblo lands was organized by Dave Decker,

University of New Mexico, and participated in by a variety of scientists and cavers from a number of institutions and geographical regions during June 2014. Dr. Boston is analyzing samples from several springs with intentions of comparing the microbial inhabitants to other cave springs from around the world.

Cueva de Villa Luz Expedition

A team of 14 investigators from a variety of NASA centers and universities was recruited by Dr. Boston to work on a suite of scientific questions about the sulfuric acid cave, Cueva de Villa Luz, in Tabasco, Mexico. Dr. Boston and others have been investigating this fascinating cave since the late 1990's. Chemistry, geology, microbiology, and other topics were addressed. Formal reports of results are anticipated in the coming year.

Galápagos Islands, Ecuador, Lava Tube Microorganisms

A small pilot effort was undertaken to investigate some properties of microorganisms from wall rock samples of Galapagos Islands lava tubes visited by Dr. Penny Boston during the 16th International Symposium on Vulcanospeleology, held in mid-March 2014. It appears that no previous study of these microorganisms has been undertaken.

NASA Minority Engagement Project

This project continues in collaboration with Dr. Nancy Chanover at New Mexico State University, Las Cruces, New Mexico, and Scott Halliday at Navajo Technical College, Crownpoint, New Mexico. Dr. Penelope Boston and colleagues are analyzing field samples from various caves using a field-portable version of the acousto-optical spectrometer developed with previous NASA funding. A major effort in mid-July 2013 involving the entire team, was followed up by smaller efforts through the following year. The results are used to investigate microbiological, mineralogical, and micrometeorological properties of cave walls at small scales.

JPL Moon and Mars Analog Mission Activities Project

Dr. Boston is co-investigator on a newly funded NASA project to test innovative robotic devices in cave environments. Dr. Aaron Parness of the NASA Jet Propulsion Laboratory (JPL) is the Principal Investigator, assisted by Dr. Karl Mitchell also of

JPL who is a planetary scientist. Both collaborators plus several additional JPL personnel conducted a site visit under Dr. Boston's direction in early March 2014 at the El Malpais National Monument near Grants, New Mexico. In addition, study sites at the Pissgah lava field in California were also visited by the team and will be used during the study.

Data Projects for Better Research, Education, and Management

One of NCKRI's mandates is to "centralize and standardize speleological information." That is happening on some major fronts and producing important results as seen below.

Caves, Karst, and US National Parks

About 20 to 25% of the United States is karst, a terrain widely recognized for diverse natural and cultural resources and exceptional environmental vulnerability. But how much karst occurs in the US National Parks? The US National Park Service (NPS) asked NCKRI to answer this question and more by:

- providing an updated list of all NPS units with karstic and/or pseudokarstic caves and terrains;
- developing a comprehensive database with basic cave and karst information about the parks and their related resources;
- evaluating the database for general trends in cave and karst research, management, and education/interpretation;
- identifying the most critical needs in cave and karst research, management, and education/interpretation and providing recommendations on general park-wide levels and for specific parks;
- providing the database in a format

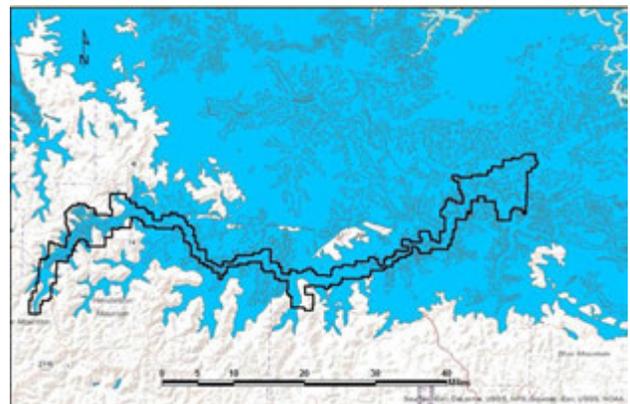
where it can be queried and filtered by the NPS to create custom "menus" of needs by topic, region, or park.

In late 2013, NCKRI staff analyzed the results of a survey sent to the parks for this NPS-funded study. Parks that received the questionnaire were identified as having the potential for cave and karst features from a variety of sources, but in large part from the US Geological Survey's *Karst in the United States of America: A digital map and database*, an in-press Open-File Report by NCKRI board member Dave Weary and Dr. Dan Doctor. The detailed results of this project are in NCKRI Report of Investigation 4, *Evaluation of Cave and Karst Programs and Issues at US National Parks* (see page 28).

Two general but major observations are:

- more than half of the park units that responded have no staff dedicated to management or research of cave or karst resources;
- there is a lack of basic knowledge or understanding of the cave and karst resources at many park units.

NCKRI offered several recommendations to the NPS for overcoming these challenges and commended the NPS and its personnel on their efforts to improve their understanding, management, and interpretation of their cave and karst resources. The NPS plans to continue updating and analyzing the database NCKRI created to more effectively identify current and future needs.



Example of GIS analysis in the area of Buffalo National River, Arkansas, to identify National Park Service properties in karst (blue). Base map from the US Geological Survey.

Karst Information Portal

The Karst Information Portal (KIP) is a vital project NCKRI is conducting in partnership with the University of South Florida Libraries (USF), the University of New Mexico, and the International Union of Speleology. NCKRI's role is to promote KIP, provide it a steady stream of materials for its archives, and seek out new projects. USF focuses on the operational aspects of KIP, and is preparing it for an important transformation, long in coming.

When KIP was launched in 2006, we relied upon an extensive database of bibliographic citations of karst publications donated by Dr. Diana Northup to populate the catalog. These entries were the equivalent of a standard library catalog record—metadata referencing the existence of physical, printed, objects. We had only 52 of the 3,750 records linked directly to digital objects stored within the KIP system. Our goal was to provide a proof of concept, then grow the digital collection to where the number of digital objects exceeded the number of metadata-only records.

We met that goal early this year. Currently, KIP includes 8,423 metadata records, over 4,700 of which link to digital objects stored within the KIP repository. We then began to delete the metadata-only records for commonly discoverable items such as commercially published monographs, websites, and subscription based journal articles. We kept metadata records for hard-to-discover items such as conference proceedings, privately-held materials, maps, personal correspondence, etc. We now emphasize KIP's "digital library" aspect, with links to many gray resources including grotto newsletters and reports.

The National Speleological Society (NSS) has been a major contributor and we deeply appreciate the NSS Board's support. As we continue to grow the collection, we are contacted by people wishing to contribute to KIP—often with a deep concern for long-term preservation and broader access to their materials. The largest donation to date was two large pallets

of newsletters, technical reports, organization documents, etc. from NSS' Windy City Grotto. We are digitizing that material, which will sharply increase the KIP collection and its value to the cave and karst community.

During this year, the NCKRI-USF -KIP partnership deepened as USF, through its KIP-related resources, began providing infrastructure for groups hosting conferences. The service includes a website for conference information, facilities for online registration, and tools to manage paper submissions, review, and publication. To date KIP has supported the 13th and 14th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst, the International Workshop on Ice Caves, and with plans underway to support the DeepKarst 2016 conference.

Preparations are also underway for KIP's next "face-lift," which will be a fully geospatial presentation. During the 2013-2014 academic year, USF employed a graduate student from the School of Geosciences to manually enter geospatial coordinates and place names for thousands of caves and karst features referenced in the KIP's digital collections (precise cave locations will not be released).

This painstaking effort is the critical first step to making the digital content discoverable through a geospatial interface. When this process is far enough along, the new KIP site will take the form of a searchable world map that will link researchers to content based on geospatial coordinates. This will likely be the final major version of KIP; it was the goal from the beginning of the project. No other on-line or off-line resource will be as comprehensive or offer the level of discoverability that KIP will provide once this work reaches its conclusion.

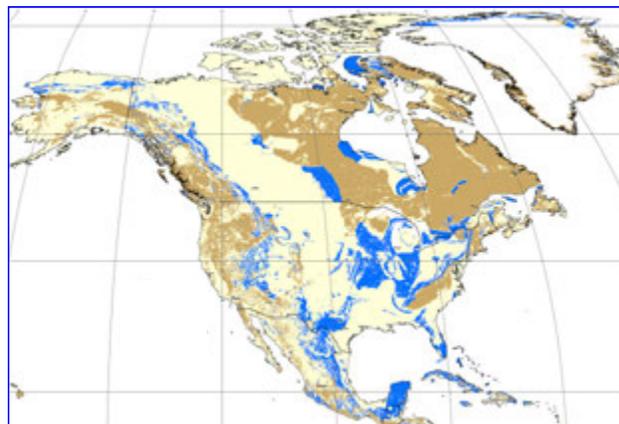
The World Karst Aquifer Mapping Project

For the past two years, NCKRI has worked as part of an international team, led by the Karlsruhe Institute of Technology in Germany, to develop a new, highly detailed, GIS-based World Karst Aquifer Map (WOKAM). The International Association of Hydrogeologists is funding the project. The team which produced the Global Lithological Map in 2012 has provided their data as the invaluable backbone of the project, which will set this map far apart from previous global karst mapping efforts.

During the past year, the second WOKAM draft was developed and closely reviewed. Refinements are continuing in the mapping and data collection methods, and the accuracy of some sections of the map is being confirmed through the literature and international experts. (Is too much karst shown? Too little? Are the boundaries correct?)

NCKRI is leading the effort on North America and the Caribbean, with help from the US Geological Survey and many other collaborators in the US and several other countries. The WOKAM team is also collecting information on major caves, karst springs, and wells.

The project has a 2016 targeted completion date, when a paper map will be produced. The map will also be available digitally for broad international distribution.



The North American section of the World Karst Map, still in revision. Blue areas=karst; brown=non-karst sedimentary rocks; tan=crystalline rocks.

EDUCATION PROGRAM

NCKRI's Education Program is directed by Dianne Joop. This year her program focused on sustaining and further developing projects that maintain NCKRI's online presence through various websites and social media, and advancing NCKRI's museum design. One new area of focus for the Education Program has been mass media.

NCKRI has participated in and assisted with various media projects this year, working with major networks like CNN and Discovery Channel Canada. One very exciting project



NCKRI Photo by Dianne Joop
Discovery Channel Canada conducting an on-camera interview with karst hydrogeologist Dr. Lewis Land by a giant sinkhole in Eddy County, New Mexico.

was serving as Cave and Karst Educational Consultants for Nippon Hoso Kyokai's (Japan Broadcasting Corporation) *Great Nature* program featuring the Chihuahuan Desert and Carlsbad Cavern.

NCKRI's Education Program is enthusiastic about expanding this venue of cave and karst interpretation/educational media and is currently developing scripts and storyboards for two documentary shorts for release in 2015.

Partnerships

NCKRI's Education Program Director, Dianne Joop, was invited to assist with the National Association for Interpretation's educational curriculum revision.

NCKRI and Flowstone Films are currently co-producing a short documentary film focusing on naturally occurring and man-made, or anthropogenic sinkholes. The tentative release date is sometime in 2015.

Local Workshops

This year Dianne Joop conducted a series of mini-workshops for interpretation professionals in the Carlsbad area. The first in the series was an introduction and overview of karst, conducted for the management staff of Carlsbad Caverns National Park.

For the second workshop, she worked with Carlsbad Caverns National Park's Chief of Interpretation, Marie Marek, to develop a one-day field experience for the 2013 National Cave and Karst Management Symposium.

The third installment of this series was co-developed with Carlsbad Caverns National Park staff for the docents of New Mexico's Living Desert State Park. These workshops were given to interpretive staff on the local geology and its karst features.



NCKRI Photo by Dianne Joop
NPS Interpretive Ranger Mark Joop identifies a potential interpretive station by showing NCKMS attendees the fossils and carbonate cement of the Permian age Capitan Reef.

National Workshops

NCKRI taught two workshops in Texas in 2013. The first was in September for the Texas Master Naturalist's Tierra Grande Chapter. The Texas Master Naturalists have the admirable mission "to develop a corps of well-informed volunteers to provide education, outreach, and service, dedicated to the beneficial management of natural resources and natural areas within their communities." The Tierra Grande Chapter covers much of west Texas. The workshop was on the karst hydrogeology of the Balmorhea area and held at Balmorhea State Park. It included a field trip to nearby springs and a cave.



NCKRI Photo by Dianne Joop
Living Desert State Park docents identify an overlook to view and discuss the local geologic setting of the park.



NCKRI photo by George Veni
Master Naturalists look into the entrance of Kingston Cave No. 1 as part of a NCKRI workshop on the karst hydrogeology of the Balmorhea, Texas, area.

The second workshop was the *Karst Environmental Assessment Field Course* for the Texas Commission on Environmental Quality's (TCEQ) Edwards Aquifer Program. Evaluating karst features is a critical part of TCEQ's program to protect the Ed-



NCKRI photo by George Veni
Geologists from the Texas Commission on Environmental Quality evaluate a small karst feature as part of their NCKRI karst assessment field course.

wards Aquifer from urbanization. TCEQ requested that NCKRI teach this workshop to sharpen their karst hydrogeological knowledge and skills. This intensive workshop was taught in October 2013 in San Antonio. It included detailed lectures in the morning, field evaluations in the afternoons, and cave evaluations in the evenings

International Workshops

In late 2013, NCKRI went to China as a guest of the International Research Center on Karst (IRCK), a branch of China's Karst Geology Institute, to teach two seminars. The first was for IRCK's annual international student program. The 2013 class included graduate to professional-level students from 14 countries.

and springs, and environmental impact assessments in karst.

It seems those lectures went well because they were followed by a plane ticket to return to China in June 2014 and teach a seminar on the *Guiding Principles in the Management of Karst World Heritage Sites*. This was taught as part of the UNESCO World Heritage Forum Series: *Tourism Development and Rural Socio-Economic Prosperity at World Heritage Sites*. UNESCO and China are recognizing that many of the world's most amazing, yet vulnerable areas are in karst and require special care and management. This year's Forum was held at the Shilin Stone Forest near the city of Kunming.



NCKRI photo by George Veni
Underground landscapes are often the focus of study in karst, but the Shilin Stone Forest of China is a spectacular example of surface karst.

The seminar focused on hydrological investigations and monitoring in karst. The overall program included field trips into the spectacular tower karst in and around the city of Guilin.

NCKRI taught the second seminar at Southwest University, located in the bustling city of Chongqing. These lectures were attended by undergraduate and graduate geology students who learned about karst dye tracing techniques, hydrological and geochemical monitoring of karst wells

The Stone Forest is a fascinating maze of sharp limestone pinnacles that rise more than 20 m from the ground.

In addition to the seminar, the Forum offered NCKRI the chance to promote a cultural and tourism exchange between China and the US, through the striking contrast between the above-ground karst World Heritage Stone Forest with the below-ground karst World Heritage Carlsbad Cavern.

Cave and Karst Studies Program at NMT

Cave and Karst Studies at New Mexico Tech (NMT) is NCKRI's Academic Program and taught through NMT's Earth and Environmental Sciences Department. A variety of regular courses and special topics are taught by Dr. Penelope Boston on a rotating 2-year frequency, several in collaboration with other faculty.

Dr. Boston is providing leadership at our academic partner, New Mexico Tech, serving for another year as Associate Chair of the Department of Earth and Environmental Sciences. She will be taking over the Chair position in July 2014. Dr. Boston is currently serving on the major campus-wide effort to develop a new multi-year plan as a member of NMT's Strategic Planning Committee. She is tasked specifically on the Subcommittee on Interdisciplinary Programs because of her long and broad experience crossing wide divides between different scientific and engineering disciplines.

Researchers and students of the Cave and Karst Studies program are engaged in excellent and exciting research with new and continuing projects, setting a very high academic and research standard at NMT.

Student Projects

Ice Caves in Antarctica

Aaron Curtis, PhD Student, Geology, continues to analyze ice samples from Antarctica obtained during the previous four field seasons as part of his work on the physical and biological dynamics of fumarolic ice caves and towers on Erebus Volcano. He hopes to defend his dissertation work in the fall of 2014 or spring of 2015.

Snowy River, Fort Stanton Cave

Kristina Daisy Morgan-Edel, MS Student, Hydrology, successfully defended her thesis entitled "Plant-Derived Mineral Bodies (Phytoliths)

as Geobiological and Climatic Indicators in Arid Environments" in May 2014, under the advisement of Dr. Penny Boston.

Imagine walking along the banks of the Rio Bonito in Lincoln County, New Mexico, and encountering erect green plants growing alongside the river. These are known as horsetails or scouring rush (*Equisetum hyemale*) and have been used by ancient peoples as both a medicine and a cleaning aide, due to the rough texture. In New Mexico, these plants only grow in riparian areas and are capable of taking up elements from the soil and groundwater, including silica and calcium. The plant lines its cells with these substances and produces both amorphous structures and minerals, which provide many different functions in the plant. These are what give it the rough texture sought out for

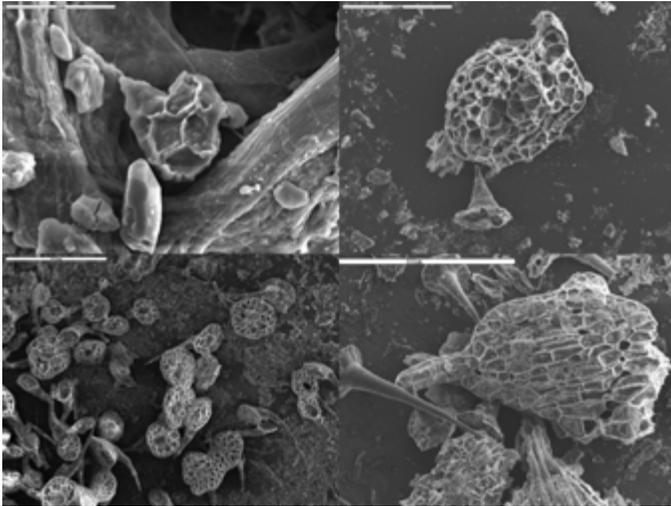
cleaning.

When the plant dies, it can be deposited in the soil or washed into the river. As the organic matter decays, the microscopic plant minerals called "phytoliths" are left behind and can be unique identifiers to specific plant species or families. Eventually, some phytoliths make their way into caves



Photo courtesy of Stas Edel
NCKRI Scholar Daisy Morgan-Edel collecting sediment at Government Spring, the surface resurgence of water leaving Snowy River Passage, Fort Stanton Cave, Lincoln County, New Mexico.





Electron microscope images comparing a phytolith fragment from Snowy River sediment (upper left) to phytoliths extracted from live modern plants. Lower left is *Helianthus maximilliani*, Maximillian's perennial sunflower. Upper right is *Helianthus annuus*, common sunflower. Lower right is a species of squash.

and can be found and analyzed for clues about the climate in the area at the time they were transported underground.

Kristina chose to study Fort Stanton Cave and whether any phytoliths were deposited there during past floods that transported sediment into the cave. If correctly identified within a datable sediment layer, the phytoliths can be a signature of plant ecosystems at the time of deposition. This has not been well applied to cave deposits in general and is a new, exciting avenue to understanding how caves can act as repositories for surface climate signals.

This work was the first of its kind at NMT and NCKRI. A manuscript detailing some of the potential biomineral fragments from Fort Stanton Cave has been sent to the journal, *New Mexico Geology*, and is awaiting review for publication. Additional experiments were conducted on the phytoliths to simulate mechanical weathering. The results are currently being written into a manuscript for publication.

Phytolith mineralogy was carried out with the assistance of Michael Spilde, University of New Mexico, Albuquerque, and several specific and unusual biominerals have been identified in arid land plants. NCKRI's

support helped Kristina compile a phytolith reference library for some modern plants in New Mexico in key ecosystems around caves, and will hopefully be published for reference use.

El Malpais National Monument

Hilary Kelly, MS/PhD Student, Geology, completed her work on the NASA Minority

Engagement project to map and test lava tube wall textures for physical and microbiological properties. Caves in the El Malpais National Monument, Grants, New Mexico, were the study sites for this effort. She will be presenting this work as her Master's thesis.

Hilary has now gone on to her PhD work funded by a NASA Harriet G. Jenkins Fellowship working on the simultaneous development of scientific instrumentation for use on robotic platforms for access to extreme Earth caves and extraterrestrial caves on Mars, Titan, and other bodies. She will spend her first summer internship at the Jet Propulsion Laboratory during the summer of 2014. The fellowship calls for a 10-week residency at the Jet Propulsion Lab each year of the three years of fellowship support.

Black Cave, New Mexico

Sam Rochelle, BS student, Physics Major, Earth Science Minor, graduated in May 2014 and is headed to graduate work at Arizona State University in Fall 2014. He completed an excellent cave research project in Black Cave, New Mexico, for his senior thesis. The paper resulting from this work will be submitted for publication.

Distinctive dark coatings and

banding in speleothems and on surfaces in this cave appear to be from two separate sources: 1) soot blown in during forest fires, and 2) particulate soot transported through the fracture system in the cave. Careful mapping of the dark features, with collaboration from Phil Miller of the New Mexico Bureau of Geology and Mineral Resources, allowed determination of these two separate mechanisms of soot transport. Laboratory simulations of soot transmission through microfractures also contributed to his understanding of this cave. Black Cave is managed by the US Forest Service and we thank Jason Walz for assistance with this project.

Hypergravity Effects

Paige Hansen, BS student, Physics Major, Earth Sciences Minor, is working on the issue of hypergravity effects on microorganisms and is applying this to organisms from both cave environments and selected surface environments. Paige is a junior and will be working on this project through the 2014-2015 academic year.

Maria Troyer, high school student, Spring Semester, 2014, worked with Dr. Boston and senior thesis student Paige Hansen to develop a hypergravity simulator constructed from robotics kits and a bicycle tire to use slow speed centrifugation to provide additional artificial gravities. The gravitational values were chosen to match specific classes of identified exoplanets. Microorganisms were tested in the device to look at the effects of different gravities on cellular processes.

Frontiers in Cave and Karst Science

Lindsey Curnutt, NMT alumnus, and Hydrology Certificate Student, Special Cave and Karst Class, is a Bureau of Land Management (BLM) employee. Lindsey received her undergraduate degree from NMT and is now seeking a certificate in hydrology. Dr. Boston developed a special online version of the Frontiers in Cave and Karst Science class offered

at NMT every 2 years, giving Ms. Curnutt the flexibility to meet the needs of her work at the BLM plus the information she needs on karst terrains and associated caves. Lindsey is completing her work over the 2014 summer semester.

Student Advisor

Dr. Lewis Land served as an external advisor for a group of graduate students with the Bren School of Environmental Science and Management at the University of California, Santa Barbara. The students worked with

the New Mexico Interstate Stream Commission to develop a groundwater management model for the Black River Basin south of Carlsbad, New Mexico. The Black River is fed by a group of springs along the boundary of limestone and gypsum karst.

NCKRI Spotlight: Lasha Asanidze

NCKRI was delighted to host its first student intern this year. Lasha Asanidze is a PhD hydrogeology student at the Ivane Javakishvili Tbilisi State University in the country of Georgia. He received a scholarship from the Shota Rustaveli National Science Foundation to travel to the United States and increase his technical knowledge, experience, skills, and contacts with the international professional community by working with NCKRI from early February through early June 2014.

Mr. Asanidze proved an eager, hard-working, student. Following are of some his activities and experiences. He:

- Conducted a geo-biological study, setting traps at wells, springs, and caves in southeastern New Mexico (see page 4) where he later collected, sorted, and preserved the specimens for study by biologists. He will be included as co-author on the report of this study.
- Assisted with the morphological study of caves, sinkholes, and other karst and paleokarst features exposed in highway road cuts in central Texas.
- Worked on multiple geophysical projects in two US states, gaining experience with electrical resistivity and microgravity techniques, in different configurations, and in diverse geological settings that include limestone, gypsum, and alluvium. He is a co-author of NCKRI Report of Investigation 6.
- Participated in the survey and banding of cave swallows at Carlsbad Caverns National Park to support his geo-ecological interests.
- Received several hours of personal training in cave and karst geomorphology, hydrology, geochemistry, and management.
- Participated in the *Karst Interest Group Workshop* of the US Geological Survey (see page 17) and assisted with the conference's karst hydrogeology field trips.
- Monitored for evidence of bat activity in the bat roost which is part of NCKRI Headquarters.
- Participated in the mapping surveys of three caves, plus field trips that searched for new caves and karst features.
- Assisted with geological mapping of Caverns of Sonora, Texas, and with three geological tours of that cave.



Photo courtesy of Jim Goodbar
Lasha Asanidze, at the entrance of Gyp Pit Cave, enjoyed visiting his first gypsum caves during his NCKRI internship.

To improve his English skills and communicating information to the general public, he gave an invited lecture, hosted by NCKRI, on caves in Georgia, and an interview to the local newspaper on his experiences.

To further diversify Lasha's experience, he also spent two weeks working at the Edwards Aquifer Authority in San Antonio, Texas, with NCKRI board member Geary Schindel where he:

- Attended a nationally acclaimed distinguished lecture;
- Gauged stream and spring flows;
- Collected water from karst wells and springs for water quality analysis;
- Monitored and serviced data loggers in karst springs;
- Monitored and serviced weather stations;
- Visited caves and sinkholes in different hydrogeologic settings.

We wish Mr. Asanidze the best of success and look forward to building our friendship in the years ahead.

ADVANCEMENT

NCKRI's Advancement Office was established in 2010 to position, support, and advance NCKRI's mission through membership, fundraising, news and communication, marketing, community relations, and special events. The Advancement Office coordinates with New Mexico Tech's Advancement Office and is active in the Carlsbad Chamber of Commerce, Carlsbad Department of Development, Carlsbad Bat Brigade, New Mexico Association of Museums, and the American Alliance of Museums. Suzanna Langowski directs the Advancement Program and welcomes calls from anyone who would like to help NCKRI grow through gifts and volunteer efforts.

Give Grande New Mexico 2014

NCKRI participated in New Mexico's first annual day of giving, part of a national campaign called Give Local America where over \$50 million dollars were raised nationally. Thanks to our generous supporters, we will be able to apply funding toward a variety of projects.



NCKRI photo by George Veni
Dr. Lewis Land enjoys a respite on a honeycombed karsted boulder—the newest addition to NCKRI's landscape thanks to a team of kind donors and volunteers.

Example of Karst Donated for NCKRI's Landscape

Often it requires the efforts of many people to get something really great to happen. NCKRI received a unique gift from Standard Pacific Homes—a large and fascinating example of honeycombed karst from property that is being developed over the Edwards Aquifer area in Austin, Texas. Though the boulder itself was given to us by Standard Pacific Homes, it took the coordinated effort of many people to make this happen.

We thank Brian Smith and Brian Hunt of Barton Springs/Edwards Aquifer Conservation District for finding the rock and arranging for its donation; Kevin Forader with Standard Pacific Homes, Dustin Einhaus with Blake Magee Company, and Tommy Harper with Cash Construction for loading the boulder on the trailer; and the Bureau of Land Management for assisting with unloading and placing the boulder attractively into NCKRI's landscape in Carlsbad. Last but not least, none of this would have happened without a wonderful Carlsbad resident, Jerri McTaggart, having

allowed NCKRI to take her flatbed trailer to Austin to pick up the boulder. This was no small effort, so our thanks go out to all the individuals and companies who assisted along the way.

NCKRI plans to exhibit different examples of karst through educational yet decorative boulders in the landscape of our headquarters. If you have an outstanding example of karst you would like to donate, please let us know!

NCKRI Receives Funding from the City of Carlsbad for Completion of its Library and Laboratory

The City of Carlsbad is one of NCKRI's three permanent partners and it has again proven its commitment by generously providing funding to finish construction of NCKRI's cave and karst library and laboratory. The work is anticipated to be complete by the end of 2014.

The end of construction will signal the start of fundraising efforts for equipment and supplies for the library and laboratory to increase NCKRI's research capacity, flexibility, and speed.

Over the past few years, several caring donors have given NCKRI numerous unique and scientifically valuable publications, maps, and photos dealing with caves and karst areas throughout the world. Once completed, the library and its resources will be available for researchers and anyone interested in learning more about caves and karst.

Membership

Please consider joining NCKRI's Annual Membership program! Our Membership Program is offered to all interested persons wanting to support NCKRI activities. You can join online at www.nckri.org or call the Advancement Office at 575-628-2702. As a member, you will receive a quarterly digital newsletter, reduced rates on special presentations, classes, lectures, and facility rentals, as well as discounts in the Museum Store. We look forward to having you as a NCKRI Member.

Facebook

To find out what we have been doing and to get the latest buzz on all things cave and karst, follow us on Facebook at <https://www.facebook.com/NCKRI?ref=hl>

Meeting and Conference Rental Space

NCKRI's conference space and classrooms are ready for hosting your workshops, trainings, meetings, and other activities. Our facilities have been rented by a wide variety of organizations and businesses looking for a versatile and professional meeting setting in one of Carlsbad's most scenic locations, the Cascades at Carlsbad (see pages 16-17 for examples and a photo of a fraction of our meeting space).

NCKRI also rents space for parties, reunions, weddings, and other events. All funds from the rentals go to support and build NCKRI and its programs. For more information, contact us at info@nckri.org or by calling 575-887-5518.

Adopt-A-Bat

NCKRI's Adopt-A-Bat program helps raise funds for the maintenance and equipment needed for our bat roost. NCKRI Headquarters is the first building in the world designed to include a custom home for bats. Although we do not have visitors or residents yet, when it is occupied, it will be possible to watch the bats on our website and in one of our future museum exhibits! Bat experts tell us that the existing habitat is ideal for occupation and it is only a matter of time before the roost is "discovered."

Each adoption is only \$25 and includes a Certificate of Adoption, educational information about bats and our bat roost, and a "Barty the Bat" stuffed bat. You will not receive a live bat with your adoption. For more information and to adopt a bat, go to www.nckri.org or call us at 575-628-2702.



Partnering for a Strong Institute

NCKRI recognizes four levels of partnerships and uses their descriptions below in defining its relationships with NCKRI partners:

Founding Partners

NCKRI's Founding Partners played a crucial role in the creation of the Institute and continue to serve as major supporting partners. Each founding partner maintains one permanent position on NCKRI's Board of Directors.

- City of Carlsbad
- New Mexico Institute of Mining and Technology (NMT)
- US National Park Service

Institutional Partners

Organizations with formally defined, mutually supportive relationships with NCKRI through Memoranda of Agreement, Memoranda of Understanding, contracts, or other written and signed agreements that are in effect for periods of at least one year and which define each party's specific roles and responsibilities.

- American Geosciences Institute
- Emil Racovita Institute of Speleology (Romania)
- Geological Society of America
- Hoffman Environmental Research Institute/Western Kentucky University
- Instituto do Carste (Brazil)
- International Academy of Karst Sciences (Slovenia)
- International Research Center on Karst (China)
- International Union of Speleology (Slovenia)
- Karst Research Institute (Slovenia)
- Ukrainian Institute of Speleology and Karstology
- US Forest Service
- University of New Mexico
- University of South Florida

NCKRI Affiliates

Organizations that have demonstrated meaningful support for NCKRI and its goals, or their intent to

do so, but without a formal defining agreement. NCKRI Affiliates are approved by the NCKRI Board of Directors. NCKRI and its Affiliates exchange news and information as available, and they seek to coordinate and/or cooperate with each other in projects and activities. Each organization may also extend other benefits according to their internal rules and abilities.

- ADM Exploration Foundation
- Bat Conservation International
- Carlsbad Municipal Schools
- Edwards Aquifer Authority
- Fort Stanton Cave Study Project
- Karst Waters Institute
- National Speleological Society
- National Aeronautics and Space Administration
- New Mexico Bureau of Geology and Mineral Resources
- US Bureau of Land Management
- US Fish and Wildlife Service
- US Geological Survey

NCKRI Members

Individuals and organizations that have paid annual dues to NCKRI and receive the rights and benefits described in Section III of the most current version of NCKRI's Bylaws and as explained in the most current version of associated membership documents found at www.nckri.org.



NCKRI Volunteer Program

Thanks in large part of our many loyal volunteers, NCKRI was able to complete a variety of programs and projects, some of which required long days working outdoors under rather challenging conditions. We would like to thank the following individuals for supporting NCKRI through their volunteer efforts:

- Carol Belski
- Dave Belski
- Dave Culp
- Dustin Einhaus (Blake Magee Co.)
- Andrea Goodbar
- Andrew Goodbar
- Jim Goodbar
- Tommy Harper (Cash Construction)
- Larry Henderson
- Michael Hernandez
- Brian Hunt
- Mark Joop
- Chase Kicker
- Desiree Kicker
- Dwayne Kicker
- Manija Muhamadieva
- Larry Pardue
- Brian Smith
- Jack Swickard
- Karen Veni
- Rich Wolfert

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. Thanks to our loyal donors for your generosity and making NCKRI a priority in your charitable giving choices!

Many Ways to Give

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.

More Ways to Support NCKRI

Please help raise funds and support for NCKRI by searching the Internet and shopping online through www.goodsearch.com and www.goodshop.com.

Legacy Covers

NCKRI's Legacy Covers are donors who 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
- Gift of life insurance
- Real estate or other assets.

Gifts such as these 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 in arranging proper forms or recognition that reflects 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) non-profit organization with a tax-exempt ID: 42-1741207. The National Cave and Karst Research Institute has not retained any professional solicitor and 100% of each contribution is received directly by NCKRI. For more information on leaving a legacy, please call our Advancement Office at 575-628-2702.

Scholarships Change Lives

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
- By donating to NCKRI's Endowment Fund that is managed and invested by the New Mexico Institute of Mining and Technology's NMT Foundation

You can designate your program of choice and name the scholarship fund in memory or honor of someone. We would be happy to talk with you about your ideas, so please call our Advancement Office at 575-628-2702.



Giving Recognition Annual Giving

Our Annual Giving Program recognizes those individuals and corporations who made gifts or pledges during FY 2013-2014 in support of NCKRI programs:

- Albertson's Market
- Calvin and Sheri Alexander
- Kelton Barr
- Barton Springs/Edwards Aquifer Conservation District
- Anna Beason
- Carol and Dave Belski
- Brian Bower
- Jessica Buckles
- Robert Burnett
- Robert Brinkmann
- Richard Cervantes
- Cave Conservancy Foundation
- Cave Research Foundation
- City of Carlsbad
- Dorothy and John Corcoran
- Sandra Cosand
- Mike Currier
- Edwards Aquifer Authority
- Environmental Systems Research Institute Inc. (Esri)
- Kevin Forader (Standard Pacific Homes)
- Bob and Barbara Forrest
- Jim Goodbar (BLM)
- GoodSearch.com
- Ronald Green
- Jack Hess
- Illinois State Geological Survey
- Larry and Signe Henderson
- Melissa Horn
- Intrepid Potash
- Dianne Joop
- Douglas Kirkland
- Johanna Kovarik
- Suzanna Langowski
- Thomas Lera
- David Lester
- Lincoln National Forest
- Jerri McTaggart
- Hazel and Doug Medville
- Phillip Miller
- Mykhaelsoft/iCaverns
- National Speleological Society
- Dale Pate and Paula Bauer
- Jesse Richardson
- Ira Sasowsky
- Grant Scarsdale
- Geary Schindel
- Susan Schmerling
- Larry Shore
- Ted Smith (Earth and Water Resources)
- Dave Steensen
- Susan Lee Stevens
- Brad Stephenson
- Jack Swickard
- Texas Cave Management Association
- Mary-Ellen Trout
- Heather Tuček
- George and Karen Veni
- Ellen Weinacht
- Walmart
- David Weary

Gifts of Knowledge

This year's contributions to NCKRI's library are a wonderful addition to our reference collection. James Van Gundy's donated collection of 1950s – 1970s *NSS News* editions will interest and intrigue many of our library's visitors. Please contact our Advancement Office at 575-628-2702 if you would like to make a literary donation to our growing library.

NCKRI Spotlight: Solution to Prevent Sinkholes

The staff of NCKRI was impressed by Carlsbad High School student Chase Kicker. To encourage his growth as a young scientist, we invited him to present his work at NCKRI-sponsored events, including the 13th Sinkhole Conference in 2013 and at the US Geological Survey's Karst Interest Group in 2014.

In 2012, Chase began developing a solution to stabilize the underground cavity at the I&W Brine Well site in Carlsbad to prevent a sinkhole. Chase created a cost-effective flowable fill material (fill dirt, fly ash, and cement, mixed with saturated salt water) for cavity stabilization. His research has shown that maintaining a pressure balance while pumping the flowable fill material into a brine-filled cavity and discharging the brine at the surface, is a feasible method to stabilize the cavity. The flowable fill would replace the existing brine and solidify in place to permanently prevent sinkhole occurrence. This research also potentially has application for stabilizing underground mines to prevent collapse and reduce subsidence. The flowable fill might also be used to stabilize foundations in areas of naturally occurring dissolution cavities that cause sinkholes.

Chase has won numerous awards for his research, including Grand Champion at the 2014 Southeastern New Mexico Regional Science and Engineering Fair and a 4th Place Award at the 2014 Intel® International Science and Engineering Fair® in Los Angeles.

Chase is now a freshman at New Mexico Tech majoring in Chemical Engineering.



Photo courtesy of Desiree Kicker
Chase with a sample of his flowable fill material.

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. NCKRI organized and hosted several meetings during the past year and has at least one a year planned through 2019. Below are descriptions of conferences held during the year of this report and those planned through 2016. For more information and to register for these upcoming events, visit www.nckri.org.

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 returned for its 20th meeting on November 4-8, 2013 in Carlsbad. NCKRI hosted this NCKMS in close partnership with the Bureau of Land Management, National Park Service, and the US Forest Service.

"NCKMS: A Changing Climate" reflected 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 cave and karst management.



NCKRI photo by Dianne Joop
NCKMS attendees examine karst features during a field trip.

Dr. Land served as co-editor of the conference proceedings, which are freely available via NCKRI's website and the Karst Information Portal (www.karst-portal.org) and were downloaded more than 1,300 times within the first seven months following the meeting.

This NCKMS offered participants the greatest number and diversity of activities in the Symposium series' history. Field trip choices included show cave management in Carlsbad Cavern, backcountry cave management in Slaughter Canyon Cave, karst land management in the Chosa Draw area, and an interpretive program extending through several locations in Carlsbad Caverns National Park. Short courses provided training on GIS resources, cave photography, and bat cave conservation and management.

NASA Cassini Meeting

The Cassini Mission Radar Imaging Team at NASA's Jet Propulsion Laboratory (JPL) in California have become interested in the issue of karst-like features on other planetary bodies including Mars, Titan (largest moon of Saturn), and other icy moons of gas giant planets. To help the team formulate their ideas about what to look for in radar imaging data from planetary missions, a working group meeting was held at NCKRI Headquarters in November 2013.



NCKRI photo by Lewis Land
Mirror Lake, one of the gypsum cenotes at Bottomless Lakes State Park, New Mexico.

Three days of informal presentations, discussions, brainstorming, and trips to caves in New Mexico were attended by fifteen attendees from the JPL, NCKRI, and the University of New Mexico. The interest was originally sparked by the attendance of two JPL scientists at the NCKRI co-sponsored *First International Planetary Cave Research Workshop* held at NCKRI Headquarters in October of 2011.

National and Regional Cave Board Meetings

NCKRI believes in partnerships and was happy to host two national board meetings in late 2013. The Cave Research Foundation Board met immediately before the National Cave and Karst Management Symposium. The National Speleological Society's Board of Governors met immediately afterward. Both meetings were well attended.

In December 2013, NCKRI also hosted the Winter Technical Meeting of the National Speleological Society's Southwestern Region. Cave explorers braved icy roads around New Mexico and west Texas to attend. Many excellent presentations were made and the region conducted its business meeting.

Dr. Land gave a presentation on



NCKRI photo by George Veni

The Board of Governors of the National Speleological Society held their fall 2013 meeting at NCKRI Headquarters.

results of his electrical resistivity surveys at Manhole Cave in the Guadalupe Mountains of southeastern New Mexico, and Dr. Veni gave a demonstration of the WallsMap cave database software.

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. NCKRI hosted the 6th KIG Meeting at its furthest west location at NCKRI Headquarters on April 28 - May 2, 2014. The meeting was attended by personnel from the USGS and other Department of Interior agencies, as well as by scientists from several universities and research institutes.

The meeting included two NCKRI-led field trips, one focused on the karst hydrology of the Pecos River region of southeastern New Mexico, including the gypsum cenotes at Bottomless Lakes State Park, and a geologic tour of Carlsbad Cavern. The roadlog for the hydrology trip is published in the KIG proceedings volume, which is available through the USGS website and the Karst Information Portal (www.karstportal.org).

Upcoming NCKRI Conferences



International Workshop on Ice Caves VI

The International Workshop on Ice Caves (IWIC) is a series of workshops devoted entirely to ice cave research. IWIC is the only conference focused on state-of-the-art ice cave research, where international experts discuss ongoing research efforts and promote global cooperation in ice cave science and management. IWIC is a conference of the Glacier, Firn, and Ice Caves Commission of the International Union of Speleology. IWIC-VI is being hosted by NCKRI on August 17-22, 2014, in Idaho Falls, Idaho. This will be the first IWIC held outside of Europe.

14th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts on Karst

Since 1984, "The Sinkhole Conference" series has been among the most significant in creating a better understanding of karst processes that result in environmental problems. Under NCKRI's management since 2011, the next Sinkhole Conference will be held on October 5-9, 2015 in Rochester, Minnesota.

This will also be the first jointly-held Sinkhole Conference, conducted in partnership with the Minnesota Ground Water Association, and is expected to have record participation and a broad array of papers on many aspects of karst geology, hydrology, engineering, and environmental issues. For more information, visit www.sinkholeconference.com.

DeepKarst 2016

Hypogenic karst is formed by deep, rising waters, creating distinct types of caves and related features. Much remains to be learned about this new and exciting field, which has direct application to geologists, engineers, hydrologists, land managers and planners, and oil and gas professionals. NCKRI will organize this conference on April 11-14, 2016 in Carlsbad, New Mexico to further understand this newly emerging field of karst research. This meeting will be held in partnership with the International Union of Speleology's Commission on Karst Hydrogeology. Visit <http://deepkarst.org> for more information.



OUTREACH

Professional Partnerships

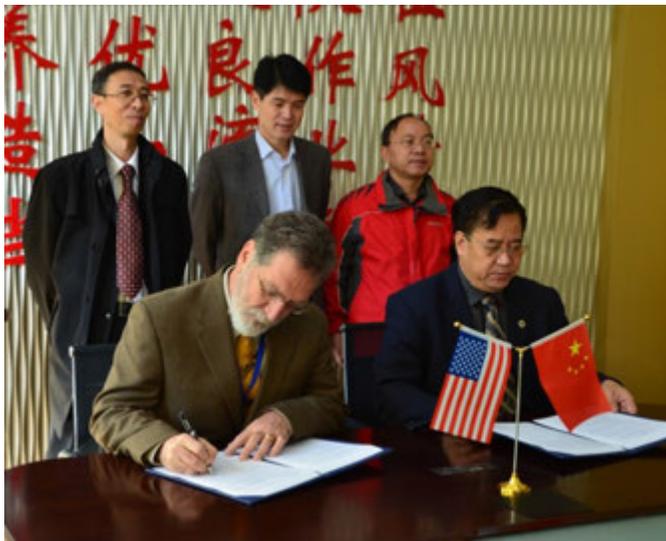
NCKRI established a Memorandum of Understanding (MOU) with the International Research Center on Karst (IRCK) in Guilin, China. IRCK is the first category II center on geosciences under the auspices of the United Nations Educational, Scientific, and Cultural Organization (UNESCO). It was established in 2008 under China's Ministry of Land and Resources, the China Geological Survey, and the Chinese Academy of Geological Sciences.

The MOU between NCKRI and IRCK formally establishes a collaborative and mutually beneficial relationship to better meet the goals of both institutes. As part of that collaboration, Dr. Veni served as a member of the UNESCO Evaluation Committee of IRCK's first six years of progress, and now serves on IRCK's Academic (advisory) Committee.

Professional Meetings

NCKRI staff attended, sponsored, or gave presentations at the following venues:

- 16th International Congress of Speleology; Brno, Czech Republic.



- 20th National Cave and Karst Management Symposium; Carlsbad, New Mexico, USA.
- CONTACT meeting; Menlo Park, California, USA.
- Geological Society of America Convention; Denver, Colorado, USA.
- Human to Mars Summit; sponsored by Explore Mars and George Washington University; Washington, DC, USA.
- Karst Interest Group Workshop; Carlsbad, New Mexico, USA.
- Mayor's Oil and Gas Summit; Carlsbad, New Mexico, USA.
- National Speleological Society Convention; Shippensburg, Pennsylvania, USA.
- XVIth Vulcanospeleological Congress; Galapagos Islands, Ecuador.

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

Dr. Boston:

- With NCKRI personnel Suzanna Langowski and Dianne Joop, co-organized a meeting of the NASA Jet Propulsion Laboratory Cassini Mission Radar Imaging Team to discuss the issues of cave and karst-like features on Titan (the giant moon of Saturn) and other solar system bodies and how such features could be.

Dr. Veni:

- Served as a Scientific Committee member for the International Symposium of Karst Water under Global Change Pressure, Guilin, China, 2013.

- Led a two-day field trip for The Explorers Club, *Inner Space to Outer Space: Exploration and Science in Southeast New Mexico*.
- Was a symposium co-convenor of *125 Years Underground: a Retrospective and Prospective of Cave and Karst Research*, Geological Society of America Convention, Denver, Colorado, USA, 2013.
- Co-organized the symposium *125 Years of Exploration and Geoscience with GSA and the National Geographic Society: Celebrating the Rich History of Geoscientist Explorers who have Broadened our Horizons and Knowledge of our World*, Geological Society of America Convention, Denver, Colorado, USA, 2013.
- Serves as a member of the Scientific Committee for the upcoming *Hypogea2015: International Congress of Speleology in Artificial Caves*, Rome, Italy.

Guest Lectures by NCKRI

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

- *Caves as Integrated Systems: Life and Times in the Near Subsurface*. The University of South Florida Best of Karst celebration.
- *Collaboration During Times of Limited Resources*. Panel discussion, US Geological Survey Karst Interest Group Proceedings, Carlsbad, New Mexico.
- *Extremophiles and Their Habitats*. New Mexico Tech class on environmental microbiology.
- *Geochemistry and Microbial Interactions in Caves*. New Mexico Tech class in aqueous chemistry.
- *Giant Crystals, Blue Copper Speleothems, and Miles of Sparkling Calcite*. Florida grotto meeting and the University of South Florida students and faculty.
- *Karst Hydrology of the Lower Pe-*

Photo courtesy of Erin Lynch
NCKRI and IRCK Executive Directors Drs. George Veni and Jiang Yuchi sign an MOU of cooperation and collaboration.

cos Region. Geology students, Carlsbad High School, New Mexico.

- *Life in Our Solar System and on Exoplanets*. New Mexico Tech class on exploration of the universe.
- *Living with Karst: the Benefits and Challenges of Living in a Cavernous Environment*. Distinguished lectures for University of Wyoming, Laramie, Wyoming, and Sul Ross State University, Alpine, Texas.
- *Local Issues at World Heritage Sites*. Panel discussion, UNESCO World Heritage Forum Series: Tourism Development and Rural Socio-Economic Prosperity at World Heritage Sites, Shilin, China.
- *Microbes in Caves*. Freshman Learning Community Class at the University of New Mexico.
- *Microbially Mediated Metal and Mineral Transformations in Natural Cavities and Fractures*. New Mexico Tech class on rock/water interactions as applied to mining and other subsurface environments.
- *Natural History Tour of Caverns of Sonora, Texas*. Tierra Grande Master Naturalists, Sonora, Texas.
- *One Joke is Worth 10,000 Words: Using Humor in Presentations*. Honors and Graduate Science Communication class at the University of New Mexico.
- *The Critical Nature of Communication in Science and Engineering*. New Mexico Tech graduate class on communicating science.
- *The Galactic Real Estate Market, Exoplanets Become Geological Destinations Not Just Dots in the Sky; and The Planet Within, What Are the Worlds Underneath Our Feet?* The Perimeter Institute for Theoretical Physics in Waterloo, Ontario, Canada. The public lecture was attended by over 700 participants.
- *The National Cave and Karst Research Institute: from Inner Space to Outer Space*. Southeast New Mexico Historical Society, Carlsbad, New Mexico.



Photo courtesy of Larry Pardue
American cave explorer Chris Nicola presenting the amazing true story about holocaust survivors in *Priests' Grotto in Ukraine* as part of NCKRI's Distinguished Lecture Series.

- *Towering Karst and Deepening Guano*. Bexar Grotto, San Antonio, Texas; Pecos Valley Grotto, Carlsbad, New Mexico.
- *Water Resources in the Northern Chihuahuan Desert: Karstic Aquifers of the Lower Pecos Country, Southeastern New Mexico*. Enchanted Evenings summer lecture series, Bottomless Lakes State Park, New Mexico.
- Dr. Penny Boston served as a Phi Beta Kappa Distinguished Visiting Lecturer during the 2013-2014 academic year visiting nine different institutions ranging from small liberal arts colleges to major state universities, and both private and state supported institutions. These three-day visits enabled several formal talks at each venue, and extensive informal interaction with students, faculty, and the public. Dr. Boston also taught a number of guest classes at the various institutions. Titles of the talks included:
 - * *The Planet Within: Caves from Earth to Mars and Beyond*
 - * *The Planet Within: Life in the Subsurface of Earth and Mars*
 - * *Acid Metal Rock, Crunchy On the Outside, Tender on the Inside: The Geology and Microbiology of Naica*
 - * *The Microbial Existential Crisis*
 - * *Geomicrobiology: Linking Life & Geology Through Chemistry*

- * *My Day Job*
- * *Rock Habitats*
- * *Future Karst and Beyond!*
- * *Caves As Critical Zones*
- * *Biological Aspects of Caves*
- * *Human Habitation of Extraterrestrial Caves*

Co-Sponsored Speakers

NCKRI co-sponsors the Edwards Aquifer Authority's Distinguished Lecture Series in San Antonio, Texas. In November 2013, Dr. Andrej Mihavec, of the Karst Research Institute in Slovenia, spoke on *Karst Geomorphology with Special Focus on the Dinaric Karst*. He was followed in May 2014 by Dr. Ira Sasowsky, of the University of Akron, speaking on *Drawing Stories from Limestone Landscapes*.

Distinguished Lecture Series

Chris Nicola presented *The Secret of Priest's Grotto: A Holocaust Survival Story*. While exploring a gypsum cave in western Ukraine, Nicola came upon many humble objects such as shoes, combs, buttons, and lamps. Years of research on their origin revealed a remarkable true story, where 38 members of five Ukrainian Jewish families hid from the Nazis in a cave for nearly two years during World War II. Nicola published the story in his book, *The Secret of Priest's Grotto*, which led to the making of the international award-winning documentary, *No Place on Earth*.



Photo courtesy of Larry Pardue
Book signing by Chris Nicola, a NCKRI Distinguished Lecturer and co-author of *"The Secret of Priest's Grotto."*

National Involvement

Dr. Boston:

- Served on the NASA Astrobiology Roadmapping team from June of 2013 until the final reports were produced and finalized in May 2014. She was a team member of SR2-SAG, a body constituted by the NASA Headquarters chartered Mars Exploration Program Analysis Group to reassess the Special Regions on Mars issue in light of new advances in our understanding of that planet.
- Was a team member of the NASA/NRC Meeting of Experts on Organic Contamination of Spacecraft at the University of California - Irvine with a follow-on meeting to occur in September 2014 at Woods Hole National Research Council facilities.
- Serves on the NIAC (NASA Innovative Advanced Concepts) External Council with recent meetings in Washington, DC, and Stanford University, California. Dr. Boston is a long time member of the Planetary Protection Subcommittee of the NASA Advisory Council and attended two meetings this past year. Was appointed to the Space Studies Board of the National Academy of Sciences.
- Takes all opportunities to advance STEM (Science, Technology, Engineering, Math) education espe-

cially for women and minority populations at all ages, participating for the 4th year in STEM Women's Day, and on an outreach panel to 8th grade girls (STEM Sisters) at New Mexico Tech.

- Gave a lecture on the world of caves and the life they contain for the Summer Science Program at NM Tech that is part of a joint effort with Cal Tech each year at which she has spoken every year since 2003.
- Spoke to students at a private elementary school in the DC area (Nativity School, Burke, Virginia) as part of the Nifty Fifty Program, which provides well known speakers to K-12 institutions nationally on a volunteer basis.
- Has participated in outreach to a number of other organizations during the past year to help raise awareness of science opportunities in the subsurface, most notably meeting with key personnel from Sandia National Laboratories. Dr. Boston also reaches out beyond the science and engineering communities to help the broader public gain a greater understanding of cave and karst issues. For example, she presented a banquet speech at the International Center in Albuquerque in to an audience composed of historians, political scientists, and the general public.

Dr. Veni:

- Continued his three-year appointment by the Secretary of the US Department of the Interior to serve 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.
- Continues to represent NCKRI as a member of the US Fish and Wildlife Service's White-nose Syndrome Stakeholder Committee.
- Continues to serve on the Environmental Geoscience Advisory Committee for the American Geosciences Institute.
- Began service as a member of the Joint Technical Program Committee for the Geological Society of America.
- Became a member of the Appalachian Land Conservation Cooperative's Cave and Karst Technical Oversight Team.

Regional Involvement

- Dr. Boston briefed Senator Martin Heinrich (NM) at the Bureau of Land Management's Fort Stanton Bunkhouse (Lincoln County, New Mexico) as part of an outreach to inform our legislative leaders about cave and karst issues. She also met with Bureau of Land Management officials and stakeholders in February of 2014 to help advance the research being conducted in Fort Stanton Cave in the era of White-nose Syndrome cave access restrictions.

Community Involvement

NCKRI staff:

- Participated in the Carlsbad Chamber of Commerce's annual *Bat*



Photo courtesy of Kenneth Ingham

Cave ice has been a focus of NCKRI's efforts this year in preparation for hosting the 6th International Workshop on Ice Caves in August 2014.

Brigade. This delegation of community leaders visits leaders of New Mexico government at the state capitol to raise their awareness and support for issues in the City of Carlsbad and Eddy County.

- Celebrated their 8th year of partnership with the Bureau of Land Management, National Park Service, and US Forest Service in *Relay for Life*, a nationwide campaign to raise awareness and funds to fight cancer.
- Regularly attended board meetings of the Carlsbad Chamber of Commerce, and its Government Affairs and Tourism Committees, Carlsbad Department of Development and its Cascades Committee, and participated in related activities supporting new businesses and community leaders.
- 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.



NCKRI photo by George Veni
Cavers of the National Speleological Society's Pecos Valley Grotto and Southwestern Region regularly use NCKRI Headquarters for their meetings.

Media

Dr. Boston:

- Major coverage of our National Geographic Society sponsored expedition to Cueva de Villa Luz in Tabasco, Mexico included the cover article of the July 2014 issue of *National Geographic Magazine* entitled "Is Anybody Out There? Life Beyond Earth." Boston participated in a public outreach event at National Geographic Society headquarters in Washington, DC at the end of June 2014, attended by ~400 participants. In association with this event, co-sponsored by NASA, a copy of the July 2014 issue was sent to each member of Congress with a letter signed by Representatives Culberson (TX) and Schiff (CA) expressing their

support for science and space exploration. Additionally, Boston has given a number of other interviews to print journalists over the past year, notably to Kathryn Nave of *Wired Magazine* in April (2014), and Zoe Cormier of *Science Uncovered*, a UK publication.

- Was one of three special guests on the BBC's high concept hour radio program, *Forum*, on an episode devoted to *Crystals* which was broadcast at the end of August 2013. She spoke of the giant crystals in the Naica, Mexico cave system and other examples to be found in the underground. In March 2014, she presented a Na-

tional Speleological Society Webinar *Giant Crystals and Tiny Microbes of Naica*.

- Provided an hour long Internet streaming webcast on the Ken McKeighon radio show (Fine Art of Paleontology Series on the *Under The Sea Radio Show*) on the topics of caves, space exploration, and life in the universe in September 2013. In January 2014 gave another 2 hour interview on similar topics to *Mars Pirate Radio*, a podcast series by science fiction author Doug Turnbull.
- Led two NASA Astrobiology webinars (*How does Earth's earliest rock record inform us about the origin of life on Earth?* and *Were*

primitive icy bodies a free lunch for early life?) in January 2014.

Dr. Land:

- Was interviewed by Discovery Canada, a Canadian television program focused on science issues, on the subject of sinkhole hazards in Carlsbad and Eddy County, New Mexico. As part of the film shoot Dr. Land, assisted by other NCKRI staff and volunteers, conducted a resistivity survey near the JWS sinkhole in northern Eddy County.
- Was interviewed on the subject of sinkhole formation by Shraddha Chakradhar, a reporter for the Beacon Reader, an online journal.

Dr. Veni:

- Gave a featured interview on the Hofstra University podcast, *Thriving in the Anthropocene*, in August 2013.
- Was interviewed about the National Cave and Karst Management Symposium by Radio Station KCCC, Carlsbad, New Mexico, November 2013.
- Wrote an article for and was interviewed multiple times by the Carlsbad Current-Argus newspaper in 2013 and 2014.
- Was interviewed about

caves and karst on Marfa Public Radio, Marfa, Texas, in March 2014.

- Gave interviews to two radio stations to promote the Carlsbad Museum and Art Center's Masters of the Night exhibit in May 2014.

Staff:

- The Carlsbad Current-Argus reporters Brandon Bowers and Zack Ponce conducted an online chat with the two cavers responsible for the recent discover of *Halloween Hall* in Carlsbad Cavern. Dianne Joop and Suzanna Langowski jointed the chat to talk about the use of technology in assisting with cave exploration.

BOARD OF DIRECTORS

Message From the Chairman of the Board

This last year has been a busy one for those of us interested in karst issues in the United States. It seems that a day does not go by without hearing about karst related issues in the news. We've seen killer sinkholes in Florida, major droughts and floods in karst areas of Texas, and continued problems with White-nose Syndrome in caves in many parts of the eastern US.

For decades, karst science did not receive great attention by US scientists. Many institutes formed in Europe and other parts of the globe while we focused on other geologic and geomorphic topics like alpine geology, fluvial geomorphology, or coastal systems. However, today, interest in karst science has never been higher in the US.

Just take a look at a few issues that the National Cave and Karst Research Institute is working on:

- **Sinkholes.** As many of you know, I have a strong interest in sinkholes. Their distribution and formation provide clues to late Cenozoic landscape formation. But to the general public, they are vexing landforms that cause tremendous property damage and pose a great risk to many people living in sinkhole prone areas. The scientific and applied science issues are addressed at the Sinkhole Conference that NCKRI manages in partnership with others. These conferences set the standard for sinkhole research and provide opportunities for researchers to share information.
- **Climate Change.** Many scientists around the world are focused on trying to understand how and why our climate is changing. As we know through the work of many individuals associated with NCKRI, caves hold clues about past climates that help us under-

stand how and why climates change in different parts of the world. Climate change will be a major point of discussion at the upcoming *International Workshop on Ice Caves* that is organized by NCKRI.

- **Exploration.** Whether it is discovering caves on other planets, or understanding the formation of well-known caves on Earth, NCKRI is leading the way.

The budget for all of this work is partially derived from state, federal, and local sources. However, we also receive grants, contracts, and donations to help us achieve our goals. The funding we receive from all of these sources help us maintain our day to day operations. Yet, we want to do more.

In the coming years, we wish to build a science center at our headquarters in Carlsbad, New Mexico. We also seek to expand our educational and research programs.

We need your help to make this happen. Please consider a tax-deductible gift to the organization to help us advance our karst agenda. You can make a donation on our website (www.nckri.org) or you can contact me directly at Robert.brinkmann@hofstra.edu to discuss.

When I first got involved with NCKRI several years ago, we were a new organization without a building and almost no staff. Today, we have a beautiful headquarters, an excellent Executive Director, and fantastic staff. In the coming years, I have no doubt that the organization will continue to grow and expand its reputation as one of the most important voices on karst issues in the world.

All of us involved with NCKRI have a commitment to elevating karst science and education in the United States. I want to thank all of our stakeholders for the support and ser-

vice they give to the organization and to our research and education goals.



Photo submitted by Robert Brinkmann
Chairman of the Board

Dr. Robert Brinkmann, Chairman

Member since May 2010; Bachelor's and Master's degrees in Geology, PhD 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.

Geary Schindel, Vice-Chairman

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.

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.

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 Chief of the Geologic Resources Division of the National Park Services (NPS), located in Denver, Colorado. One of his responsibilities as Chief is oversight and support of the NPS cave and karst resource management program.

***Jesse Richardson,
Member at Large***

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.

Dr. E. Calvin Alexander, Jr.

Member since October 2011; Bachelor's Degree and PhD in Chemistry. Calvin is an Emeritus 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.

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; PhD in Hydrology. Ron is a hydrogeologist with the Southwest Research Institute, San Antonio, Texas, where much of his work focuses on karst aquifers.

Dr. John (Jack) Hess

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

Dave Lester

Member since May 2012; Master's Degree in Business Administration. Dave has spent over three decades founding, building, and operating successful entrepreneurial companies and guiding non-profit organizations. As a principal and chief officer, he has managed two public offerings and served as president, executive VP, board member, secretary, treasurer and chief financial officer of NASDAQ traded public companies. He was an advisor during the founding and early years of NCKRI. Dave is a Fellow of the National Speleological Society (NSS) and has served on its Board of Governors. He co-chaired the 1996 convention and chaired the NSS's 2011 convention. He has been actively involved in cave and karst research and exploration in the US and internationally, including National Geographic and NSS sponsored projects. He holds issued and pending United States and international patents and holds a commercial pilot license.

Hazel Medville

Member since 2005, Chairman from 2006 to 2013, 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.



Photo courtesy of Dale Pate
Braided Cave, El Malpais National Monument, New Mexico.

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 200 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*.



Dale Pate

Member from 2000-2002; 2006 to present. Bachelor's Degree in Geography. Dale is the National Cave and Karst Program Coordinator for the National Park Service. He served in an Acting capacity for this job from May 2007, and filled the full-time position in July 2012. Involved in cave and karst management since 1970, Dale served as the Cave Specialist (Supervisory Physical Scientist) for Carlsbad Caverns National Park from July 1991 to June 2012.

Jack Swickard

Member since May 2013, writer. Former editor and general manager of the Roswell Daily Record and Farmington Daily Times in New Mexico; President of The Triton Group, a Roswell, New Mexico-based public relations consulting company specializing in government affairs and international law enforcement.

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.

**Suzanna Langowski,
Advancement Director**

Ms. Langowski joined NCKRI in August 2012. Ms. Langowski began her professional career as an archaeologist studying human adaptations during the Pleistocene period in Europe. Her PhD research took her to Ukraine, where she spent two years on excavation projects in Crimean caves with the National Academy of Sciences of Ukraine. Prior to joining NCKRI, Ms. Langowski served as a principal investigator at the US Army Corps of Engineers Construction Engineering Research Laboratory as a Cultural Resources Program Manager at Fort Campbell, Kentucky. Her successful record of obtaining funding for research, preservation, and collections management activities in an environment of increasing competition for limited funds is testimony to her dedication to ensuring that precious natural and cultural resources are protected, understood, and enjoyed. Ms. Langowski has held chair and board positions for several organizations, including the Military Family Member Scholarship Fund and the Community Assistance Program of the Fort Leavenworth Spouses' Club. She is also a member of national level organizations such as the Association of Fundraising Professionals /New Mexico Chapter and the National Speleological Society.



**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 Science. He is a Past-President of the New Mexico Geological Society (NMGS), and served for five years on the NMGS Executive Committee.



STAFF EDUCATION AND PUBLICATIONS

Debbie Herr, Office Manager

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 over 11 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.

Since joining NCKRI, Debbie has set up and organized NCKRI's filing system, set up NCKRI's corporate accounting system, and completes the corresponding monthly reports. She has been the treasurer for several conferences and workshops held at NCKRI and has submitted appropriate reports to their committees. Debbie has worked on NCKRI's annual reports yearly and other reports as necessary. Debbie is also the recording secretary for Board of Director's meetings as well as the Executive Committee meetings. Debbie maintains the day-to-day operations in the office to ensure smooth administrative operations.



Continuing Education

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

- *Delivering Great Customer Service—How to Deliver on a Promise and Keep Customers Happy.* Carlsbad Chamber of Commerce.
- *Drawing Stories from Limestone Landscapes.* Dr. Ira Sasowsky, Distinguished Lecture Series, Edwards Aquifer Authority, April 2014, San Antonio, Texas.
- *National Park Service Fundamentals V.* US National Park Service.
- *New Business Workshop.* New Mexico Taxation and Revenue Department.
- *QuickBooks Basic Parts I & II.* New Mexico State University - Carlsbad.
- Advancement participated in a variety of training webinars including: *Developing Major Gifts, Non-profit 911: Revive Your Middle Donors, How to Approach Foundations, and How to Capture New, Repeat and Loyal Donors.* Additional Advancement training included two board development workshops, a nonprofit training workshop on financial management and legal responsibilities through the Center for Nonprofit Excellence, the Dale Carnegie Course, as well as participation at



NCKRI photo by Dianne Joop
Robert Stanton, first African American National Park Service Director addresses the Fundamental V graduating class.

the Texas-New Mexico Association of Museums Annual Conference.

Refereed Papers

Journal Papers

- Burleigh, T.D., Gierke, C.G., Fredj, N., and Boston, P.J. 2014. Copper tube pitting in Santa Fe municipal water caused by microbial induced corrosion. In: *Materials* 7(1): DOI:10.3390/ma70x000x
- Kminek, G., Conley, C., Allen, C.C., Bartlett, D.H., Beaty, D.W., Benning, L.G., Bhartia, R., Boston, P.J. and 19 other authors. 2014. Report of the Workshop for Life Detection in Samples from Mars. In: *Life Sciences in Space Research* 2:1–5. DOI: 10.1016/j.lssr.2014.05.001.
- Land L. 2013. Caves in New Mexico and the southwest. In: *Lite Geology* 33: pp 2-4.
- Rosales-Lagarde, L., Boston, P.J., Campbell, A.R., Hose, L.D., Axen, G., and Stafford, K.W. 2014. Hydrogeology of northern Sierra de Chiapas, Mexico: A conceptual model based on a geochemical characterization of sulfide-rich karst brackish springs. In: *Hydrogeology Journal*, DOI:10.1007/s10040-014-1135-z
- Spilde, M.N., Melim, L.A., Northup, D.E., and Boston, P.J. 2013. Anthropogenic lead as a tracer of rock varnish growth: Implications for rates of formation. In: *Geology* 41(2):263-266.
- Timmons S., Land L., Newton B.T., Frey B. 2013. Aquifer mapping program technical document: Water sampling procedures, analysis, and systematics. In: *New Mexico Bureau of Geology and Mineral Resources Open-File Report 558*: <http://geoinfo.nmt.edu/publications/openfile/downloads/OFR500-599/551-575/558/OFR-558.pdf>

- Veni G. 2013. A framework for assessing the role of karst conduit morphology, hydrology, and evolution in the transport and storage of carbon and associated sediments. In: *Acta Carsologica*, 42(2-3), pp. 203-211.

Books and Book Chapters (not published by NCKRI*)

- Fong D.W., Culver D.C., Veni G., Engel S.A., editors. 2013. Carbon and boundaries in karst. Karst Waters Institute, Special Publication 17, 46 pp.

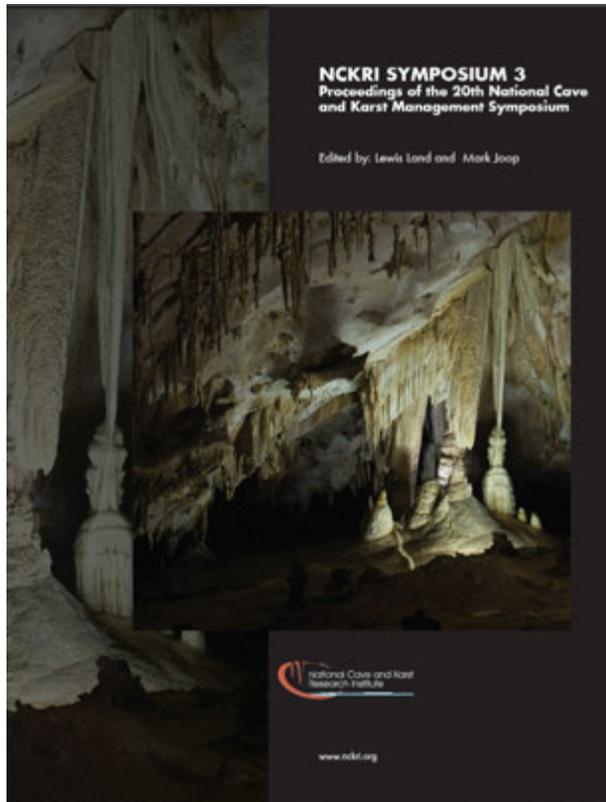
* See page 28 for NCKRI publications

Conference Papers

- Boston, P.J. 2014. Speleotrek: The cutting edges of karst into the 21st Century. In: Kuniatsky, E.L., and Spangler, L.E., editors. U.S. Geological Survey Karst Interest Group Proceedings, Carlsbad, New Mexico, US Geological Survey Scientific Investigations Report 2014-5035, 155 pp.
- Golubovic Deligianni M., Veni G., and Theodorakopoulou K. 2013. The relationship of karst landforms and land use, Ksiromero Region, western Greece. In: Filippi M., Bosák P., editors. 16th International Congress of Speleology Proceedings, Brno, Czech Republic, pp. 291-295.
- Joop D., Joop M., Hernandez M. 2013. iCaverns: Interpretation, there's an app for that! In: Land L., Joop M, editors. NCKRI Symposium 3: Proceedings of the 20th National Cave and Karst Management Symposium. p. 101-104.
- Land L.A. 2013. Crossing boundaries on public lands: Geophysical surveys of a potentially extensive cave underlying BLM and National Park Service Units. In: GSA annual meeting, Denver, CO, Abstracts with Programs.
- Land L., Veni G. 2013. Solving

karst flooding in Las Cruces, Petén, Guatemala. In: Filippi M., Bosák P., editors. 16th International Congress of Speleology Proceedings, Brno, Czech Republic, pp. 252-255.

- Veni G. 2013. A historical review and forward view of cave and karst research in Texas. In: Abstracts with Program, Geological Society of America Convention, Denver, Colorado (on CD).



- Veni G. 2013. Impact of climate change on human and ecological use of karst groundwater resources: a case study from the southwestern USA. In: Land L, Joop M, editors. NCKRI Symposium 3: Proceedings of the 20th National Cave and Karst Management Symposium, National Cave and Karst Research Institute, Carlsbad, New Mexico, pp. 51-59.
- Veni G. 2014. Groundwater tracing in arid karst aquifers: concepts and considerations. In: Kuniatsky E.L., and Spangler L.E., editors. Scientific Investigations Report 2014-5035, U.S Geological Survey Karst

Interest Group Proceedings, Carlsbad, New Mexico, pp. 39-43.

Unrefereed Papers

- Hanson J., Veni G. 2014. Southwest Chapter. In: *The Explorers Log*, 46 (1), pp. 16-17.
- Veni G. 2013. Coming to an agreement: US Forest Service and the National Cave and Karst Research Institute. In: *Beneath the Forest*, 6 (2), pp. 10-11.
- Veni G. 2013. WallsMap: a GIS-based cave database. In: Southwest Region of the National Speleological Society's Winter Technical Meeting, Carlsbad, New Mexico, Southwestern Cavers, 51(6), pp. 67.
- Veni G. 2014. 11 orders of magnitude: the range and implications of karst recharge rates. Minnesota Ground Water Association Spring Conference, St. Paul, Minnesota.

Peer Review

Dr. Lewis Land was the lead editor of the *NCKRI Symposium 3: Proceedings of the 20th National Cave and Karst Management Symposium* and is the sole editor of the upcoming *NCKRI Symposium 4: Proceedings of the 6th International Workshop on Ice Caves*. In addition, he has peer reviewed the following papers:

- *Associations between surface water salinity and unplugged oil/gas well density in the Pecos River basin, Texas and New Mexico*, submitted to the *Journal of the American Water Resources Association*.
- *Hydrogeology of eastern Union County, northeast New Mexico*, submitted to *New Mexico Geology*.
- *Radiocarbon and fossil vertebrate ages of late Pleistocene and Holocene sediments imply rapid rates of evaporite deposition in the northern Tularosa Basin, south central New Mexico*, submitted to the *New Mexico Geological Society 2014 Fall Field Conference Guidebook*.

NCKRI PUBLICATIONS

NCKRI has been especially prolific with publications this year. All are posted on our website and can be downloaded for free.

The publication we are especially excited to introduce is:

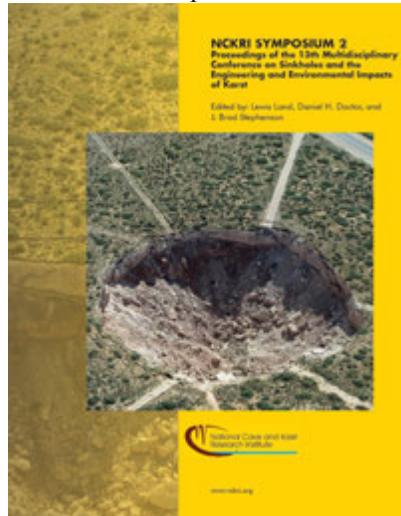
NCKRI Special Paper 2: *Role of Hydrogen Sulfide in the Formation of Cave and Karst Phenomena in the Guadalupe Mountains and Western Delaware Basin, New Mexico and Texas*, by Douglas Kirkland.



The Guadalupe Mountains serve internationally as the classic study area for hypogenic cave development. Despite the years of study, uncertainty and controversy remain about how these caves formed. Douglas Kirkland has worked for decades in the area and pulled together and analyzed a tremendous amount of information to answer some of the more important questions and offer new insights to the region's cave and karst development. Some of his results will likely serve as models for understanding hypogenic caves elsewhere in the world.

NCKRI hosted two conferences last year from which it published two proceedings volumes. They have been downloaded well over a thousand times each:

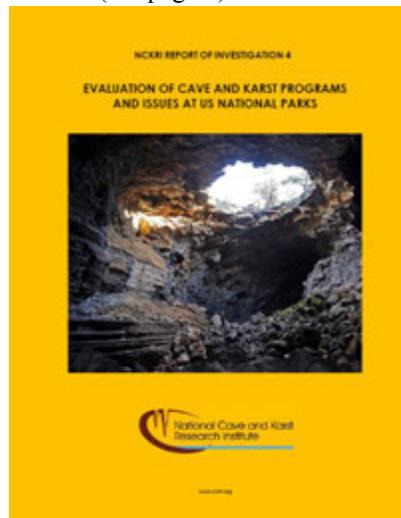
NCKRI Symposium 2: *Proceedings of the Thirteenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst*, edited by Dr. Lewis Land, Dr. Daniel H. Doctor, and J. Brad Stephenson.



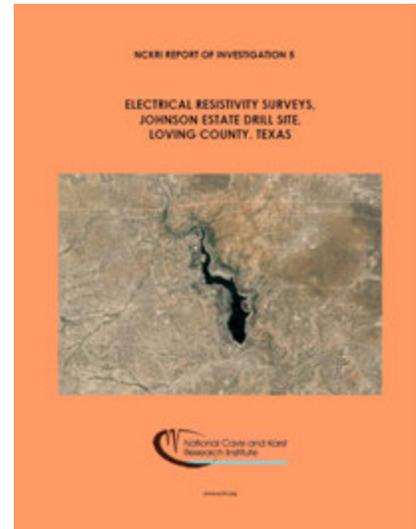
and
NCKRI Symposium 3: *Proceedings of the 20th National Cave and Karst Management Symposium*, edited by Dr. Lewis Land and Mark W. Joop.

The Report of Investigation series highlights research projects conducted by NCKRI. New reports are:

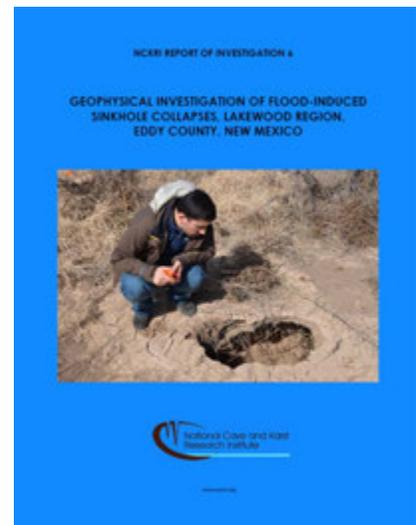
Evaluation of Cave and Karst Programs and Issues at US National Parks (see page 5)



Electrical Resistivity Surveys, Johnson Estate Drill Site, Loving County, Texas (see page 3)



and
Geophysical Investigation of Flood-Induced Sinkhole Collapses, Lakewood Region, Eddy County, New Mexico (see page 4)



This brings NCKRI's Report of Investigation series to a total of six, with more in the works. Though some are not in themselves nationally significant projects, they are carefully selected as first steps toward developing broad data sets to better evaluate karst and its research methods.

2013-2014 STATE AND FEDERAL BUDGET

FUNDS REPORT

Administered by New Mexico Tech

| | National Park Service | | | COMBINED | | | | | |
|--|-----------------------|----------------|----------------|----------------|----------------|----------------|------------------|----------------|----------------|
| | FY 11-12 | FY 12-13 | FY 13-14 | FY 11-12 | FY 12-13 | FY 13-14 | FY 11-12 | FY 12-13 | FY 13-14 |
| <i>Beginning Fund Balance</i> | | | | 508,392 | 277,681 | 237,618 | 508,392 | 277,681 | 237,618 |
| Revenues | | | | | | | | | |
| State Appropriation | 0 | 0 | 0 | 377,704 | 377,700 | 383,000 | 377,704 | 377,700 | 383,000 |
| Federal Appropriation | 322,976 | 309,201 | 291,857 | 0 | 0 | 0 | 322,976 | 309,201 | 291,857 |
| Federal Grant Revenue | 2,808 | 2,664 | 38,915 | | | | | | |
| TOTAL REVENUES & FUND BALANCES | 325,784 | 311,865 | 330,772 | 886,096 | 655,381 | 620,618 | 1,209,072 | 964,582 | 912,475 |
| Expenses | | | | | | | | | |
| Personnel | | | | | | | | | |
| Staff Salaries & Student Wages | 179,528 | 172,621 | 179,245 | 236,507 | 212,632 | 203,918 | 416,035 | 385,253 | 383,163 |
| Fringe Benefits | 60,686 | 58,673 | 66,795 | 62,719 | 62,334 | 66,346 | 123,405 | 121,007 | 133,141 |
| Total Personnel | 240,214 | 231,294 | 246,040 | 299,226 | 274,966 | 270,264 | 539,440 | 506,260 | 516,304 |
| Operating | | | | | | | | | |
| Rent, Utilities, Telephone | | 0 | 18,269 | 73,926 | 50,185 | 51,766 | 73,926 | 50,185 | 70,035 |
| Supplies & Other | 19,016 | 27,949 | 3,541 | 40,215 | 16,858 | 16,012 | 59,231 | 44,807 | 19,553 |
| Exhibit Design | 0 | 0 | 0 | 153,268 | 32,250 | | 153,268 | 32,250 | 0 |
| Travel | 13,073 | 7,572 | 6,598 | 14,338 | 9,017 | 10,101 | 27,411 | 16,589 | 16,699 |
| Contractor Services | 4,133 | 3,388 | 7,965 | 7,442 | 14,487 | 11,894 | 11,575 | 17,875 | 19,859 |
| Property & Equipment | 7,069 | | 5,338 | | | 2,572 | 7,069 | 0 | 7,910 |
| NMT Administrative Support | 0 | 0 | 0 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 |
| NMT "Indirect" from NPS Budg- | 22,279 | 21,662 | 23,021 | 0 | 0 | 0 | 22,279 | 21,662 | 23,021 |
| NPS "Indirect" to GRD at 6% on NPS appropriation | 20,000 | 20,000 | 20,000 | 0 | 0 | 0 | 20,000 | 20,000 | 20,000 |
| Total Operating | 85,570 | 80,571 | 84,732 | 309,189 | 142,797 | 112,345 | 394,759 | 223,368 | 197,077 |
| TOTAL FUNDS EXPENDED | 325,784 | 311,865 | 330,772 | 608,415 | 417,763 | 382,609 | 934,199 | 729,628 | 713,381 |
| <i>Ending Fund Balance</i> | 0 | 0 | 0 | 277,681 | 237,618 | 238,009 | 274,873 | 234,954 | 199,094 |

2012-2013 CORPORATE BUDGET

NCKRI Inc. Annual Audited

Statement of Activities and Changes in Net Assets

For the Year Ended June 30, 2013

Administered by NCKRI

| UNRESTRICTED NET ASSETS: | | | |
|---|----------------|-------------------------------|-----------------|
| Public support and services: | | Functional expenses | |
| Contributions | \$135,570 | Program Services | 169,252 |
| Program | 111,858 | Administrative Services | 23,820 |
| Rent and Other Income | 6,251 | Fundraising | 2,492 |
| TOTAL PUBLIC SUPPORT AND REVENUE | 253,679 | TOTAL PROGRAM SERVICES | 195,564 |
| CHANGE IN NET ASSETS | | | 58,115 |
| NET ASSETS - Beginning of year | | | 10,248 |
| NET ASSETS - End of year | | | \$68,363 |



National Cave and Karst Research Institute

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Carlsbad, New Mexico 88220, USA