



2014-2015
ANNUAL REPORT

www.nckri.org

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Cover Photo

Popovo Polje, in Bosnia-Herzegovina, is the world’s largest sinkhole at 55 km long by an average 2-3 km wide. Unlike destructive collapse sinkholes, poljes (which means “fields”) are stable, flat-floored sinkholes that flood annually. They are agriculturally productive and thus economically vital to some karst-rich but rocky countries. NCKRI photo by George Veni.

Back Cover Photo

Benjamin von Cramon (holding the camera pole) conducts a 3D photogrammetric survey of a gypsum chandelier in Cottonwood Cave, Lincoln National Forest, New Mexico. He is assisted by NCKRI staff (L-R): Dr. George Veni, Dr. Lewis Land, and Dianne Joop. Photo courtesy of Peter Jones.



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, 2014 to June 30, 2015. 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 Karen Veni
Dr. George Veni visiting a cave in the Fox Glacier, South Island, New Zealand. Study of pseudokarstic glacier caves is crucial to understanding how glaciers are responding to our globally warming climate.

My interest in karst began in 1975 exploring caves in Texas. When I started to study them scientifically, respected university professors, and scientists and managers with state and federal agencies told me that Texas' Edwards Aquifer was not a karst aquifer. Yes, it had caves and sinkholes but I would have to go to Kentucky to find karst.

"Karst" was an unknown word to most scientists and managers throughout much of the 20th Century. It still is. But in the 1980s things began to change. Many communities around the country began significantly expanding within or onto karst areas, discovering unprecedented and complex problems. Staggeringly severe groundwater pollution was one. The 100-m diameter Winter Park Sinkhole in Florida was another, and made national headlines by swallowing Porsches and buildings in 1981. Several conferences then arose which drew in traditional karst scientists, plus those working in karst but from non-karst backgrounds, resulting in a major step up in our understanding of these underground systems. In 1988 the US Congress established the Federal Cave Resources Protection Act and in 1998 created NCKRI, proving that caves and karst were finally recognized for their national importance and challenges to society.

This year saw two important strides in our growing national karst literacy. First, in August 2014, the US Geological Survey completed the first highly detailed map of the nation's karst areas. The project was led by NCKRI Board Director David Weary who found that 25.1% of the country is potentially karst or related pseudokarstic terrain. Karst is so widespread that it can no longer be ignored. As if in response to this finding, two months later the Geological Society of America created a Karst Division as a networking forum for its members interested in caves and karst. NCKRI's Dr. Penny Boston is one of the founding officers.

Recognition is good, but action is vital. During this past year the NCKRI team has been pursuing additional partnerships and projects, most of which are too preliminary to report in these pages, to increase basic understanding of caves and karst among the public, their importance and vulnerability by decision-makers, and how they function through expanded research by and training of scientists. Our Board Chairman, Dr. Bob Brinkmann makes a call for action on page 4. I hope you'll answer his call and join us.

As for the Edwards Aquifer, I'm delighted to report that it is now recognized, and increasingly studied and managed as one of the great karst aquifers of the US.

George Veni, Ph.D.

NCKRI CONSTRUCTION

The City of Carlsbad Completes NCKRI's Laboratory and Library

The City of Carlsbad is one of NCKRI's three permanent partners and again proved its commitment, this time by providing funding to complete NCKRI's cave and karst library and laboratory. Construction is nearly complete as this report goes to press. Current fundraising efforts now focus on purchasing shelving, equipment, supplies, and hiring staff for these rooms. The library and its resources will be available for researchers and anyone interested in learning more about caves and karst. The laboratory will give NCKRI researchers the convenience of conducting many analyses in-house and open up opportunities for partnering with other research organizations. All of the photos on these pages were taken by NCKRI's Office Manager, Debbie Herr.



Walls starting to go up for the laboratory's storage room.

NCKRI's Laboratory



Concrete block going up for our specially-designed dye storage room.



Unfinished wall in laboratory.



Lewis Land standing by finished lab wall with new cabinetry.

NCKRI's Library



Steel studs start forming the walls in the NCKRI Library.



Skylights before installation of the ceiling.



Skylights after the ceiling is finished. Look at all of the energy-saving natural light!



More cabinetry in the library.



Dianne Joop at the new reception desk in NCKRI's library.

A Call for a National Cave and Karst Research Agenda

Robert Brinkmann, Chairman of the Board of Directors

The news was all over the Tampa papers when I visited in August. The sinkhole that killed in February 2014 reopened and was even bigger than the original. Thankfully, there was no loss of life or injury this time, but the event reminds us that karst landscapes can be hazardous places that may change very rapidly.

In today's world, we don't hear just about the naturally occurring sinkholes. We also hear about frequent collapses of urban infrastructure. In the summer of 2015, a large "sinkhole" opened in Brooklyn, New York along a busy corridor. While not a karstic sinkhole, the large hole in the ground brought comparisons to the deadly sinkhole in Florida in the local media. The public does not use our delicate scientific classification systems to differentiate between a karstic sinkhole and collapsed infrastructure. They know a hole when they see one.

In Winnipeg, Canada, sinkholes along a roadway led to widespread discontent among the public when they were not fixed. It created a bit of a political firestorm and encouraged the development of at least two parody Twitter accounts called the Winnipeg Sinkhole.

The home of our institute, Carls-

bad, New Mexico, is where you will find the famous sign that states: "US 285 South Subject to Sinkhole 1000 Feet Ahead." It is one of the world's few sinkhole warning signs. This one warns drivers of a potential sinkhole over a void created by a brine well operation. Abandoned mines throughout the US also are at risk of collapsing.

Each year in the US, millions of dollars in property damage occurs from sinkhole formation. Yet we have never had a true national sinkhole research agenda—much less a karst

issue worthy of a national research agenda. Our karst waters are also in peril. In Florida, for example, the water quality of springs has deteriorated significantly. Earlier this year in Texas, vast urban karst areas were damaged by severe floods. We may never know exactly how urban contaminants and waste were transported in that event. Twenty-five percent of the US sits over karst landscapes and aquifers. But karst gets scant attention by funding agencies.

Of course our caves are also important for research. Over the last several years, we have been concerned with White-nose Syndrome. Never before has research on cave biology and microclimate been so important. Caves also reveal tremendous information about climate change and human history. There is so much more to learn.

The National Cave and Karst Research Institute needs all of its stakeholders to help us keep karst issues at the forefront at

national, state, and local levels. We must all be good stewards of our national cave and karst resources. Please write and talk about karst wherever you can. Help us make a case for a national karst research agenda. Help us by donating to support our education and research initiatives.



NCKRI photo by George Veni

When the Dishman Lane Sinkhole suddenly opened in Bowling Green, Kentucky, in 2002, several cars were caught in the collapse. Luckily no one was driving fast, no one was seriously injured, and the yellow natural gas pipeline in the upper left did not rupture!

one. Sinkholes are seen as distinctly local phenomena that do not have a national impact. We spend millions nationally on hurricane and weather related research but spend pennies on sinkhole and other karst related research. This needs to change.

Sinkholes are not the only critical

Capitan Reef Aquifer

During the fourth quarter of 2014 Dr. Lewis Land began participating with US Bureau of Land Management (BLM) personnel in collecting water level records from a network of seven monitoring wells completed in the Capitan Reef aquifer in Eddy and Lea counties, southeastern New Mexico. The Capitan Reef is the host rock for Carlsbad Cavern in the Guadalupe Mountains. Northeast of Carlsbad Caverns National Park, the reef dips into the subsurface and passes beneath the city of Carlsbad, where it is a karstic aquifer and the principal source of fresh water for that community.

The Capitan Reef extends east and south into Lea County, then south into west Texas for several hundred kilometers. However, fresh water is present in the aquifer only in the immediate vicinity of its recharge area in the Guadalupe Mountains. East of the Pecos River, the Capitan Reef is a brackish water reservoir, with chloride concentrations approaching 10,000 mg/L near the Eddy-Lea County line (the US Environmental Protection Agency recommends maximum chloride concentrations of 250 mg/L for water intended for human consumption).

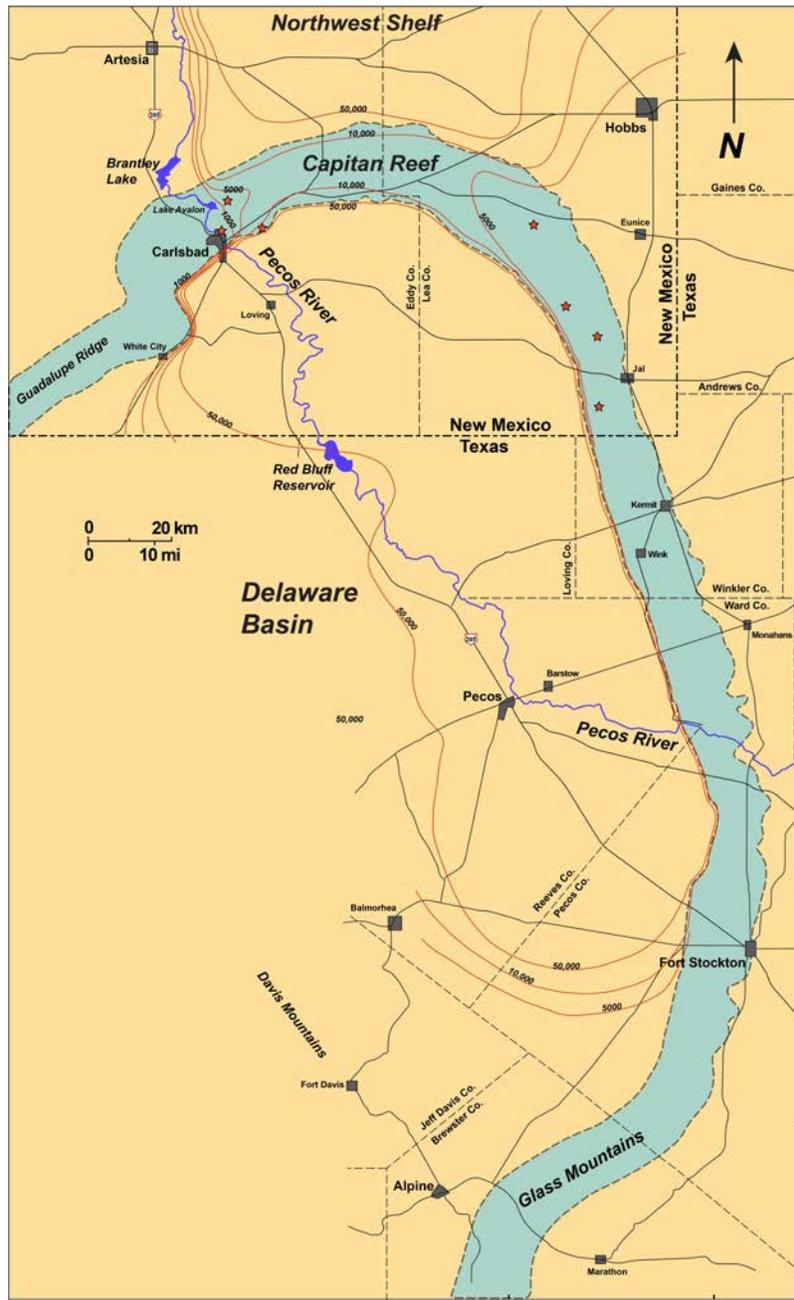
The aquifer's

brackish water is a valuable resource for industrial applications in southeastern New Mexico. Both the petroleum and potash mining industries

have recently expressed interest in exploiting brackish water in the reef aquifer for flooding mature oil fields and the processing of potash ore.

The impact of brackish water withdrawals on fresh water resources near Carlsbad and baseflow into the Pecos River is thought to be minimal. A partial hydraulic barrier is believed to exist near the Eddy-Lea county line that inhibits communication between the eastern and western segments of the reef. Evidence for this barrier is based primarily on hydrograph response to meteorological events, as measured in a series of monitoring wells installed in the reef aquifer by the US Geological Survey in the 1970s. Although its existence is frequently cited, the nature of this barrier is not well understood and is based on doctoral research conducted over 40 years ago. The current research will attempt to better define the barrier.

Water in the western segment of the Capitan Reef is presumably very young because of its proximity to recharge areas in the northern Guadalupe Mountains. The east-



Surface and subsurface extent of Capitan reef in southeastern New Mexico and west Texas. Red stars show locations of Capitan Reef aquifer monitoring wells. Chloride ion concentrations (mg/L) are indicated by red contour lines. The City of Carlsbad, because of its proximity to recharge areas in the Guadalupe Mountains to the southwest, is the only community in the region able to use the fresh water resources of the reef aquifer.



NCKRI photo by Lewis Land
Capitan Reef exposed in outcrop at El Capitan promontory, southern prong of Guadalupe Mountains, west Texas.

ern segment of the reef is thought to be recharged from the Glass Mountains southwest of Fort Stockton, Texas, although flow patterns in this portion of the aquifer are not as well constrained. If brine in the eastern segment of the aquifer is hydrologically isolated it may be very old, possibly representing recharge that occurred during the Pleistocene. More detailed knowledge of the age distribution of groundwater within the reef aquifer, using isotopic and environmental tracers, would provide valuable insight into groundwater flow paths and flow rates, and the impact of current and proposed brackish water withdrawals on fresh water resources within the reef.

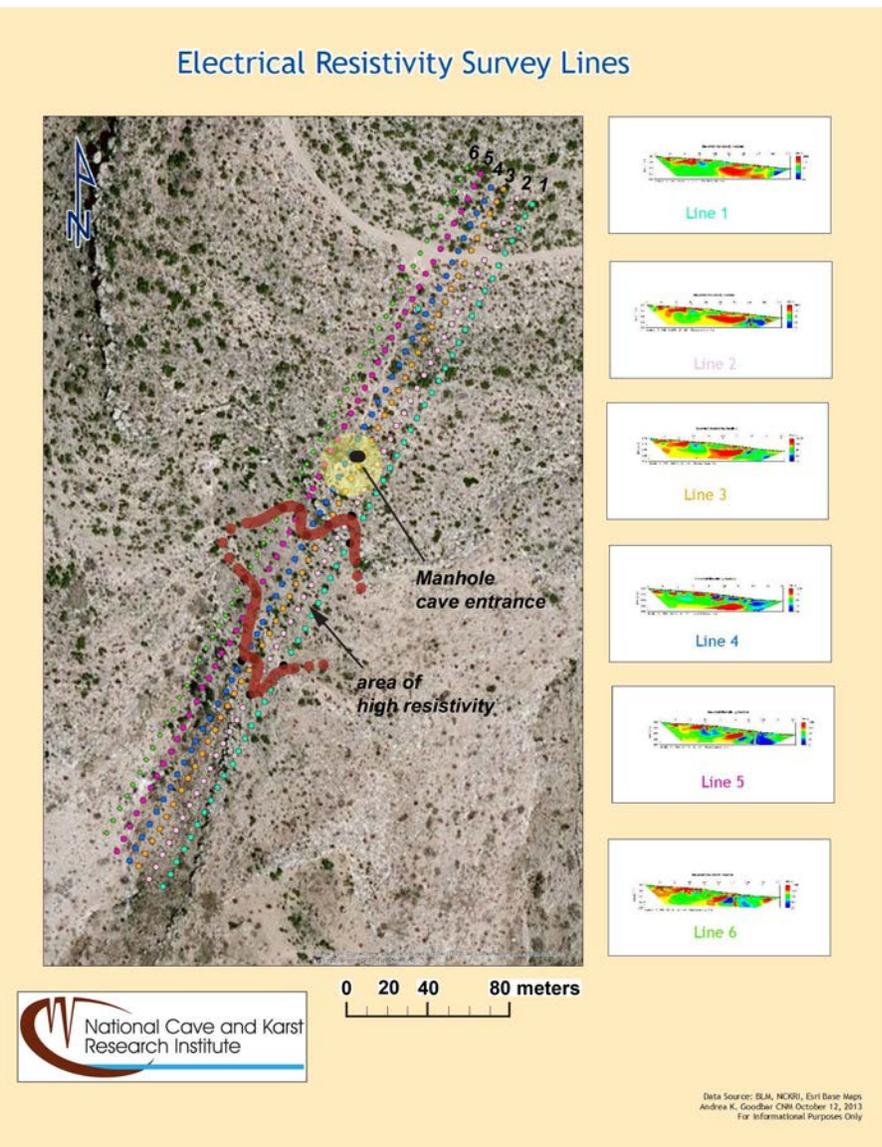
Water levels in the eastern segment of the reef aquifer are several tens to hundreds of meters below ground level, making a conventional sampling program logistically challenging and prohibitively expensive. Grab sampling methods might be suitable for sampling these deeper wells at ~1% of the cost of a conventional sampling program. NCKRI staff have proposed using this method to sample the seven wells in the Capitan Reef monitoring well network. Samples would be analyzed for major ions, trace metals, contaminants, stable isotopes of carbon, oxygen and deuterium; tritium, and carbon-14. BLM personnel have proposed incorporating this sampling program into a larger investigation of water resources in the lower Pecos region that is being initiated by Sandia National Lab, under contract with the Bureau of Land Management.

Geophysical Investigations

NCKRI personnel completed data collection for a microgravity survey over Manhole Cave, a relatively shallow (~25 m deep) pit cave in the Seven Rivers Embayment of the Guadalupe Mountains in New Mexico. Many cavers believe the cave is a likely second entrance to Lechuguilla Cave, the world's sixth longest with a current length of 222.6 km. Digging in Man-

hole has continued off and on for nearly three decades, following air-flow through cemented breakdown.

Preliminary analysis of the microgravity data indicates the presence of a negative gravity anomaly over the known portion of the cave that extends to the south. These results are consistent with results from the electrical resistivity surveys NCKRI conducted in 2012 and 2013, which suggest a sizable open cave is present beyond the collapsed area (see figure below). Final analysis of both data sets will be completed and published next year.



Graphic courtesy of Andrea Goodbar
Electrical resistivity survey lines in the vicinity of Manhole Cave. Microgravity surveys were conducted over and south of the cave entrance.



NCKRI photo by Lewis Land
CG-5 microgravity meter taking measurements near Manhole Cave.

NCKRI thanks its partners at Western Kentucky University for the use of the microgravity equipment which made this phase of research possible.

Ft. 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 finished her work on materi-

als from this cave in her study of cave phytoliths as a biological signal preserved in caves from previous climatic periods. The first paper of four planned is published and listed in the Publications section of this report. Others will deal with the mineralogical analysis of 22 species of plants and their phytoliths, weathering rates of phytoliths of 12 species, and an atlas of southwest US plant phytoliths to aid in identification of such particles in cave muds and speleothems in southwestern caves.

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. 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 field trial of the new portable version of this instrument is planned for early fall 2015 in collaboration with our Jet Propulsion Lab (JPL) colleagues. The results of these studies are being used to investigate microbiological, miner-

ological, and micrometeorological properties of cave walls at small scale and identify and characterize significant biosignatures of life in cave environments.

JPL PSTAR Project

Dr. Boston is co-investigator on a newly funded NASA project to test innovative robotic devices in cave environments building on our Moon and Mars Analog Mission Activities project of last year. Dr. Aaron Parness of the NASA JPL is the Principal Investigator, assisted by planetary scientist Dr. Karl Mitchell, also of JPL. Both collaborators plus several additional JPL personnel conducted two recon visits under Dr. Boston's direction in June 2015 at the El Malpais National Monument near Grants, New Mexico. In addition, lava tube study sites at the Pisgah Lava Field in California and lava tubes in Hawaii have been added to this expanded project. New Mexico Tech's portion of the work is funded at the \$202,000 level and will support our new graduate student, Sarah Lott, coming to us from her undergraduate work at Northern Kentucky University.

Karst Information Portal

The Karst Information Portal (KIP) is a virtual on-line cave and karst library that is free and widely used internationally via www.karstportal.org. NCKRI conducts this project in partnership with the University of South Florida Libraries (USF), the University of New Mexico (UNM), and the International Union of Speleology (UIS). 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 involving the hardware, software, and integration of digital materials. UNM serves as the "think tank" for new uses and projects, and the UIS promotes KIP's use worldwide.

During the past year, over 1,200 items were added to KIP's digital library, bringing the total number of



NCKRI photo by George Veni
Golden droplets of moisture on lava stalactites are colored by microbes inhabiting this Idaho cave that was visited during 6th International Workshop on Ice Caves.

reports, articles, theses, journal papers, newsletters, etc. to almost 10,000. Notable additions include:

- Jim Werker and Val Hildreth-Werker's 2006 edition of *Cave Conservation & Restoration*
- *Cave Research Foundation Newsletter*
- *Cave Talk* (newsletter of the National Caves Association)
- *Passages, TCMA Activities Newsletter*, and *TCMA Conservationist* (newsletters of the Texas Cave Management Association)
- *Peschery* (Russian language newsletter; "Peschery" = "Caves") and Russian monographs on caves
- *Speleo Spiel* and *Southern Caver* (newsletters from Australia's Southern Tasmanian Cavers).

KIP had one unfortunate set-back this year. The National Speleological Society (NSS) has been a major contributor and we deeply appreciate the NSS Board's support. One NSS grotto generously donated a large amount of material to KIP and gave KIP permission to digitize and post the publications. KIP will not post anything unless it has permission. In this case, while the grotto meant well, it was not authorized to give permission to post some of the materials it submitted, primarily newsletters from other NSS grottos as well as NSS materials. As soon as this mis-

take was discovered, the USF KIP team immediately removed from KIP the 7,345 items it had digitized and posted. We greatly regret the error and have implemented additional verification measures to prevent a similar mistake from happening again. Currently, the NSS is reviewing its policies on digitally posting publications, especially where sensitive information like cave locations may be disclosed. The KIP team looks forward to resuming work with the NSS in whatever capacity it decides to digitally post items on KIP.

While KIP is generally described as a digital library, it is in fact an online tool kit to support cave and karst research, education, management, and exploration. The virtual library is presently the biggest and best known tool in the kit. Other tools are in development.

The NCKRI-USF-KIP partnership has continued through USF's KIP-related resources by 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. During this past year the proceedings of the International Workshop on Ice Caves were published through this collaboration, and upcoming NCKRI conference proceedings are in development.

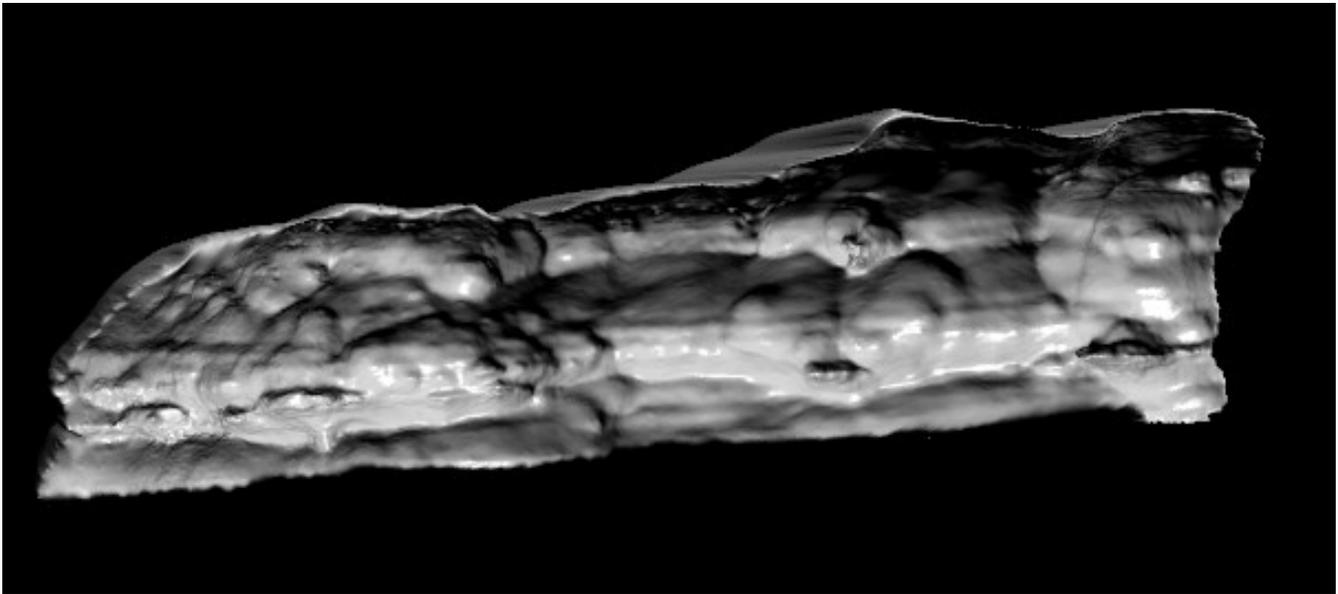
3D Cave Visualization Projects

NCKRI worked on two projects this year using photogrammetry to create 3D images of caves. Photogrammetry uses overlapping photos that computer software processes into three-dimension figures. The first project is described on page 10 (Exhibit Research).

The second project was in partnership with Aaron Ellis of Texas' San Antonio College. Aaron had developed a 3D image of a stalactite in Cave Without A Name. He contacted Dr. Veni, whose dissertation research included that cave, for ideas on how such imagery can be used for research.

They tested it on a wall of the cave that Dr. Veni thought had large but hard to discern scallops—scooped out features created by flowing water. Dr. Veni thought they were scallops that indicated flow to the north, but he was never certain because their size and elevated location made them difficult to measure. Aaron's work objectively proved they are scallops and that they subtly point northward.

NCKRI and San Antonio College are now looking at developing a computer program to analyze such 3D images to measure scallop flow direction, dimensions, and from that, the velocity of the groundwater flow which made them.



3D image of 10-m long section of a wall in Cave Without A Name, Texas, that shows the undulations in the wall are scallops formed by water flowing from right to left.

NCKRI PARTNERS AND FRIENDS

NCKRI Partners

NCKRI recognizes four levels of partnership 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
- 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

Meeting and Conference Rental Space

NCKRI's conference space and classrooms are ready for hosting your workshops, trainings, meetings, and conferences. Our facilities can easily accommodate up to 150 people. They are rented by a wide variety of organizations and businesses looking for a versatile and professional meeting setting, as well by individuals for private parties in one of Carlsbad's most scenic locations, the Cascades at Carlsbad along the beautiful Pecos River. Caterers are welcome! 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.

Membership

NCKRI's Annual Membership program is offered to all interested persons wanting to support NCKRI activities. You can join online at www.nckri.org or call us at 575-887-5518. When you become a member, you will receive reduced rates on publications, special presentations, classes, lectures, and facility rentals, and in the future, discounts in the Museum Store.



roles and responsibilities.

- American Geosciences Institute
- Emil Racovita Institute of Speleology (Romania)
- Geological Society of America
- Institute of Karst Geology (China)
- Instituto do Carste (Brazil)
- International Academy of Karst Sciences
- International Union of Speleology
- Karst Research Institute
- New Mexico Bureau of Geology and Mineral Resources
- Ukrainian Institute of Speleology and Karstology
- US Forest Service
- University of New Mexico
- University of South Florida
- Western Kentucky University

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
- NASA
- US Bureau of Land Management
- US Fish and Wildlife Service
- US Geological Survey

NCKRI Volunteer Program

Many of our programs and projects rely on the help of our volunteers. We would like to thank the following individuals for supporting NCKRI through their volunteer efforts:

- Carol Belski
- Lisa Chappa
- Sandra Cosand
- Mike Flannigan
- Charles Goldsmith
- Larry Henderson
- Michael Hernandez
- Mike Huber
- Peter Jones
- Mark Joop
- Amanda Melvin
- Larry Pardue
- Jack Swickard
- Tish Tackett
- Benjamin von Cramon
- Wm. Wade Smith Productions
- Rich Wolfert

EDUCATION PROGRAM

Education Program

NCKRI's Education Program focused this year on further developing its Museum Project.

Exhibit and Film Premiere

NCKRI launched its first temporary museum exhibition: *The Story and Legacy of Floyd Collins*. A series of panels and a recreated camping scene tell the tragic and somewhat bizarre story of the entrapment of renowned cave explorer Floyd Collins. Ninety years ago in central Kentucky, Collins explored boldly in search of a cave to rival the world's longest, nearby Mammoth Cave. His last exploration proved fatal. As a complimentary piece to the opening of this exhibition, NCKRI launched its Documentary Series by premiering *The Death of Floyd Collins*, which documents Collins' attempted rescue and what became the biggest media event of 1925. A generous donation from Intrepid Potash gave NCKRI the opportunity to launch its Documentary Series and host the film's production team for our Premiere Party at NCKRI Headquarters.

Vertical Voyages!

NCKRI has also been working with the City of Carlsbad to leverage funds to support the design and construction of our Outdoor Vertical Classroom and Exhibits. This project will convert our courtyard into a training site and practice area for people who use ropes and do vertical work as a part of their job. This space will also be used to launch our Vertical Voyages program, which will provide the general public with authentic vertical experiences. Exhibit design will begin in Fall 2015.

Exhibit Research

Through our Museum Project we have also been engaged in exhibit development. NCKRI brought a team of visual storytellers together for a 3D mapping project conducted in New Mexico's Cottonwood Cave (see back cover photo). The idea behind this research is to use the data gathered to develop a 3D model that would replicate gypsum chandeliers for a permanent exhibit in our gallery.

Indoors, highlighting the challenges in photographing and shooting video in cave environments. von Cramon's program also presented his work in cutting-edge 3D modeling techniques using photogrammetry—a digital overlapping of photographs for 3D rendering.

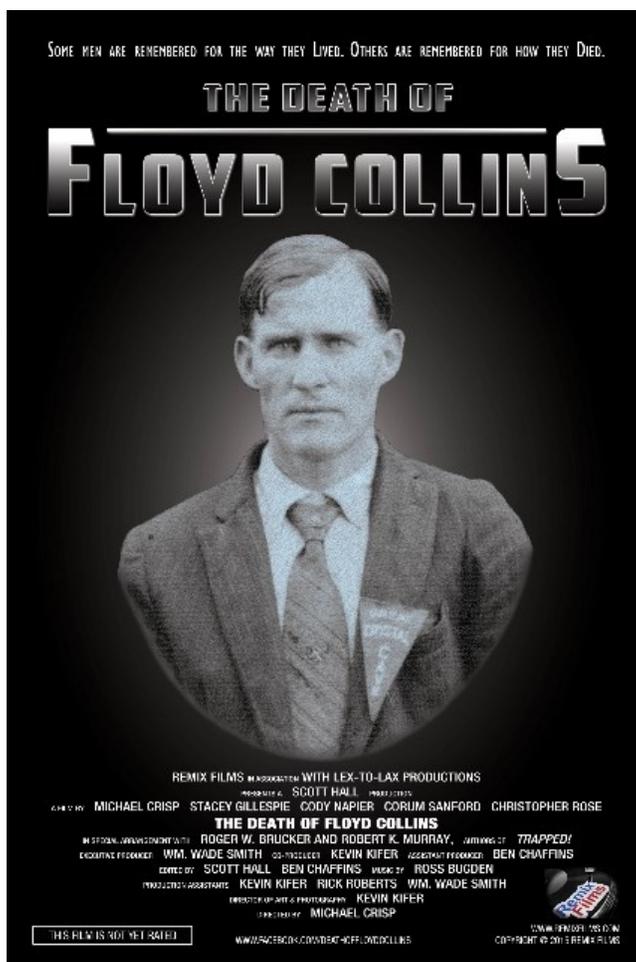
Offsite, NCKRI's own Dr. George Veni gave an invited presentation for the Explorers Club's prestigious Public Lecture Series in New York City, New York, entitled *Karst: Exploring the Hidden Quarter of Planet Earth*. A video of this detailed 1-hour overview of the benefits and challenges of karst environments is available through the Explorers Club website: <https://explorers.org/>.

National Environmental Education Week

NCKRI hosted the US Forest Service's Guadalupe District of the Lincoln National Forest 10th Annual National Environmental Education Week. This series of lectures and hands-on training classes is offered annually to the 5th grade students of Eddy County, New Mexico, inspiring environmental learning and stewardship. Local agencies, nonprofits, and federal partners established learning stations around this year's theme, *Surrounded by Science*. NCKRI's learning station featured a lesson where students learned about the effects of urbanization on cave life by modeling adaptation in a competitive

race.

Over 800 students attended the event at NCKRI Headquarters. When combined with local and regional media outlets, we reached between 7,000 to 74,000 people in southeast New Mexico.



Distinguished Lectures

NCKRI's Museum Project also hosted two Distinguished Lectures. Onsite at NCKRI's Headquarters, renown cave explorer and documentary artist, Benjamin von Cramon presented *Photographing the Great*

National Workshops

NCKRI partnered with the US Forest Service's Project EduBat to develop new education curricula and trunks with materials focused on bats and White-nose Syndrome. This campaign extended from the US throughout North America. NCKRI's Education Director Dianne Joop, presented the Project EduBat Educational Trunk at the 2014 National Association for Interpretation's National Workshop. To learn more about Project EduBat, please visit www.batslive.pwnet.org/edubat.

NCKRI taught two workshops this year. The first was in September 2014, as part of the first Texas Hydro-Geo Workshop, organized by the Bexar Grotto of the National Speleological Society and the Edwards Aquifer Authority. Nineteen modules were taught by karst experts from around the country, including NCKRI Board members and staff: Dr. Calvin Alexander (*Tracer Testing in Karst*), Dr. Ron Green (*Surface Geophysics*), and Dr. George Veni (*Cave Geology and Karst Feature Evaluation Using the TCEQ Forms*). The event was orchestrated at Cave Without A Name by former NCKRI Board Vice President, Geary Schindel. NCKRI Board Chairman Dr. Robert Brinkmann gave an engaging keynote lecture on sustainability and karst.

Dr. Veni taught NCKRI's second national workshop this year in February 2015 in the offices of the Coconino National Forest in Flagstaff, Arizona. *Karst Aquifers, Landscapes, and Caves: The Basics, Cave Ecology and Threatened and Endangered Species, and Cave, Karst, and People Management Strategies* were attended by Coconino staff and staff from eight other US Forest Service offices via video-conferencing.

Interpretation Workshops

This year NCKRI's Education Director, Dianne Joop, conducted a series of mini-workshops for interpretation professionals at New Mexico's Living Desert State Park. Through this series, participants learned about local geologic history, cave and karst geology, and bats.

Partnerships

NCKRI's Education Program Director, Dianne Joop was invited to participate in the development of wayside exhibits at Carlsbad Caverns National Park. The scope of this wayside project is currently the largest in the National Park Service system.

NCKRI is enthusiastic about expanding its program of cave and karst interpretation and educational media into film production. We have begun working with Guano Loco Productions to develop a full scale documentary to tell the story of Carlsbad Cavern's legendary cave explorer, James Larkin White.

Everyone at NCKRI sends a huge "Thank you!" to all of the organizations and individuals that supported our Education Program. Your donations and time are directly valued at \$215,000. Your kindness and expertise are priceless.

If you would like to learn more about how you can support NCKRI's Education Program please visit: www.nckri.org/education.

NCKRI's Museum Project Exhibit Development Lechuguilla Chandelier Ballroom

Donors:

- Michael and Suzanna Hernandez
- Mike Huber
- Mark and Dianne Joop
- Real Earth Models
- Shot in the Dark Cave Photography
- George and Karen Veni

Volunteers:

- Mike Huber
- Mark Joop

Outdoor Classroom and Exhibit Partners:

- American Cave Conservation Association
- City of Carlsbad

Donors:

- Adventure Solutions

The Story and Legacy of Floyd Collins

Donors:

- American Cave Conservation Association

- Circle S Feed Store
- Keeping Up With the Joneses
- Mark and Dianne Joop
- Michael and Suzanna Hernandez
- McCoy's Building Supply
- Pecos River Antique Mall
- ZH Services

Volunteers:

- Michael Hernandez
- Mike Huber
- Mark Joop

NCKRI's Distinguished Lecture Series

Donors:

- Albertson's Market
- Michael and Suzanna Hernandez
- Mark and Dianne Joop

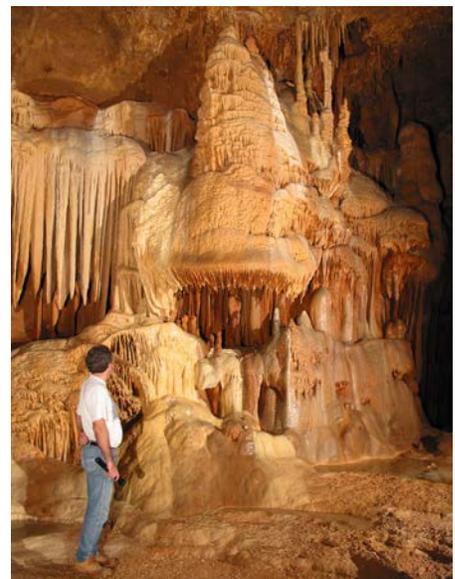
NCKRI's Documentary Series, Sponsored by Intrepid Potash, Film Premier Party

Donors:

- Michael and Suzanna Hernandez
- Mark and Dianne Joop
- Lowes Home Improvement
- Wm. Wade Smith Productions

Volunteers:

- Lisa Choppa
- Sandra Cosand
- Michael Hernandez
- Debbie Herr
- Amanda Melvin



NCKRI photo by George Veni
Cave Without A Name, a lovely show cave near San Antonio, was the site of the first Texas Hydro-Geo Workshop.

STUDENT ACTIVITIES

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.

NMT is NCKRI's academic partner, and Dr. Boston is providing ongoing leadership, serving as Chair of the Department of Earth and Environmental Sciences. Researchers and students of the Cave and Karst Studies program are engaged in excellent and exciting research and continue setting high academic and research standards at NMT.

Student Research Projects

Aaron Curtis (PhD Student, Geology) – Mr. Curtis continues to analyze ice samples from Antarctica obtained during the previous five field seasons as part of his work on the physical and biological dynamics of fumarolic ice caves and towers on Erebus Volcano. He will defend his dissertation in early fall 2015.

Hilary Kelly (MS/PhD Student, Geology) – Having completed the masters portion of her studies, she is conducting 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 is spending her second summer internship at the Jet Propulsion Laboratory (JPL) in summer of 2015. The fellowship calls for a 10-week residence at JPL each year of the three years of fellowship support. She is preparing for major trials of the integrated science package aboard several JPL robotic platforms to be field tested in September 2015.



from gold dust to star dust!

Giving to the Future Giving to NCKRI

Private gifts support the mission of the National Cave and Karst Research Institute. Your contributions enhance our programs and provide for excellence in staff, facilities, and services.

The global economic crisis of the past several years has reduced NCKRI's ability to support our students at New Mexico Tech. You can help restore this program and make a major difference in the lives of some incredible and gifted young scientists, as well as other excellent NCKRI programs.

There are many ways to help NCKRI. Choose whatever works best for you:

- On-line, mail in, and call in donations.
- Join our Adopt-A-Bat program to support study of our bat roost (we would love to add an acoustic bat detector!).
- Legacy gifts through wills, charitable annuities and trusts, life insurance, real estate, and other assets.
- Scholarships to support students, grants, or current or new programs.
- Endowments for programs or staff positions.
- Equipment and supplies (we really need a new field vehicle!).

NCKRI is a 501(c) (3) non-profit corporation. All gifts to NCKRI are tax deductible. NCKRI does not use professional solicitors so it receives 100% of each contribution. For more information, visit www.nckri.org and select "Giving" in the upper right of the page for details, or call us at 575-887-5518 and we will assist you in making your gift.

Annual Giving

Our Annual Giving Program recognizes those individuals and corporations who made gifts or pledges during FY 2014-2015 in support of NCKRI programs:

- Albertson's Market
- Calvin and Sheri Alexander
- Beverly Allen
- Kelton Barr
- Anna Beason
- Carol Belski
- Brian Bower
- Connie Campbell Brashear
- Robert Brinkmann
- Jessica Buckles
- Richard Cervantes
- Circle S Feed Store
- City of Carlsbad
- Lisa Chappa
- Mara Cloutier
- James and Shirley Cogburn
- John and Dorothy Corcoran
- Paul and Sandra Cosand
- Mike Currier
- Eddie David
- Dawson Geophysical Company
- Tom Edwards
- Edwards Aquifer Authority
- Explorers Club
- Bill and Peri Frantz
- Julia Germany
- Give Grande New Mexico
- GoodSearch.com
- Ronald Green
- Larry and Signe Henderson
- Michael and Suzanna Hernandez
- Debbie Herr
- Jack Hess
- Melissa Horn
- Intrepid Potash
- Illinois State Geologic Survey
- Peter Jones
- Mark and Dianne Joop
- Keepin' Up With the Jones' Antique Shop
- Douglas Kirkland
- Johanna Kovarik
- Joseph Krawczyk
- Thomas Lera
- David Lester
- Lowe's Home Improvement
- Amanda Rose McClain
- McCoy's Building Supply
- Hazel Medville
- Amanda Melvin
- Woody Miraglia
- Mykhaelsoft/iCaverns
- National Center for Suburban Studies, Hofstra University
- Dale Pate
- Pecos River Antique Mall
- Jesse Richardson
- Ira Sasowsky
- John Scheltens
- Geary Schindel
- Susan Schmerling
- Larry Shore
- Dave Steensen
- Susan Lee Stevens
- Brad Stevenson
- Jack Swickard
- Bern Szukalski
- Drew Thomas
- Ronald Thomas
- Mary-Ellen Trout
- Heather Tuček
- James Van Gundy
- Benjamin von Cramon
- George Veni
- Karen Veni/Night Cat Books
- Wm. Wade Smith Productions
- David Weary
- Ellen Weinacht
- ZH Services, Inc.



NCKRI photo by George Veni

Cave scientists, managers, and explorers, like those at the 6th International Workshop on Ice Caves, frequently give of their time, talent, and resources to study and properly manage caves.

CONFERENCES AND MEETINGS AT NCKRI

Sixth International Workshop on Ice Caves (IWIC VI)

The 6th International Workshop on Ice Caves (IWIC-VI) occurred on August 17-22, 2014 in Idaho Falls, Idaho, USA. IWIC is the only conference focused on the state-of-the-art in ice cave research and is a function of the Glacier, Firm, and Ice Caves Commission of the International Union of Speleology.

IWIC-VI was the first IWIC held outside of Europe and was hosted by NCKRI. It was attended by people from 11 countries who presented 20 papers and abstracts that cover ice caves and glacier caves in eight countries, three continents, and some extraterrestrial bodies. The 97-page proceedings were digitally published, edited by Dr. Lewis Land, and are now posted on the NCKRI website for free international sharing. The major topics of the papers include modeling, measuring, and monitoring of ice and glacier cave processes, microclimates, and cave ice, as well as the effects of climate change.

While the papers are important, visiting underground ice is the main attraction of any IWIC. An added attraction was that this was the first IWIC to visit lava tubes. One major topic of discussion was how ice formation differs in lava tubes versus limestone and gypsum caves.

Eleven caves were visited during the field trips, most in Craters of the Moon National Monument. However, ice was found in only five caves. Another major conference topic was the need to develop an international cave ice sampling program before more of the ice melts due to climate change. NCKRI is looking for funds and partners to conduct such a program.

Special thanks go to Craters of the Moon National Monument for hosting the field trips, Timpanogos Caves National Monument for publishing our program, and to April and Scott Earl for working with members of the National Speleological Society's Silver Sage Grotto to superbly organize the field trips and many other details.



NCKRI photo by George Veni
IWIC participants wade carefully through frigid water covering a partially melted ice floor in the upper part of Crystal Falls Ice Cave, Idaho. The effects of climate change on cave ice was a hot topic!



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

14th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of 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 at the Mayo Civic Center 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. To learn more, visit www.sinkholeconference.com.



DeepKarst Conference 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. <http://deepkarst.org/>

Professional Partnerships

The International Union of Speleology (UIS) is an organization of 57 member nations dedicated to the exploration, study, and proper management of caves. Dr. George Veni has served on the UIS Bureau (governing board) since 2002 and is currently its Vice President of Administration. UIS and NCKRI have worked jointly on several projects, and at the UIS Bureau meeting in October 2014, NCKRI was invited to be UIS' first Affiliated Organization to further extend our cooperative relationship.

The UIS celebrated its 50th Anniversary in June 2015 at its headquarters in Postojna, Slovenia. Over 200 people from 40 countries attended. Dr. Veni gave an invited lecture looking ahead to the next 100 years of cave exploration and science.

Professional Meetings

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

- National Speleological Society Convention; Huntsville, Alabama.
- Sixth International Workshop on Ice Caves in Idaho Falls, Idaho.
- Eddy County Mayors' Energy Summit; Carlsbad, New Mexico.
- New Mexico Geological Society's annual Fall Field Conference, which focused on geology and hydrology of the karstic Sacramento Mountains.
- Geological Society of America Convention in Vancouver, British Columbia, Canada.
- Celebration of the 50th Anniversary of the Wilderness Act, Santa Fe, New Mexico.
- Explorers Club Annual Dinner, New York, New York.
- South-central section meeting of the Geological Society of America in Stillwater, Oklahoma.
- Working group meeting in Socorro, New Mexico, focused on brackish water resources, sponsored by

Los Alamos National Lab.

- New Mexico Association of Museums' Southeast Region's Museum Mingling, Roswell.
- National Association of Interpretation's National Workshop in Denver, Colorado.
- University of California, Berkeley's Science for Parks, Parks for Science Summit.
- Nash Draw Hydrogeology Workshop, Carlsbad, New Mexico.
- International Conference on Groundwater in Karst; Birmingham, England, United Kingdom.

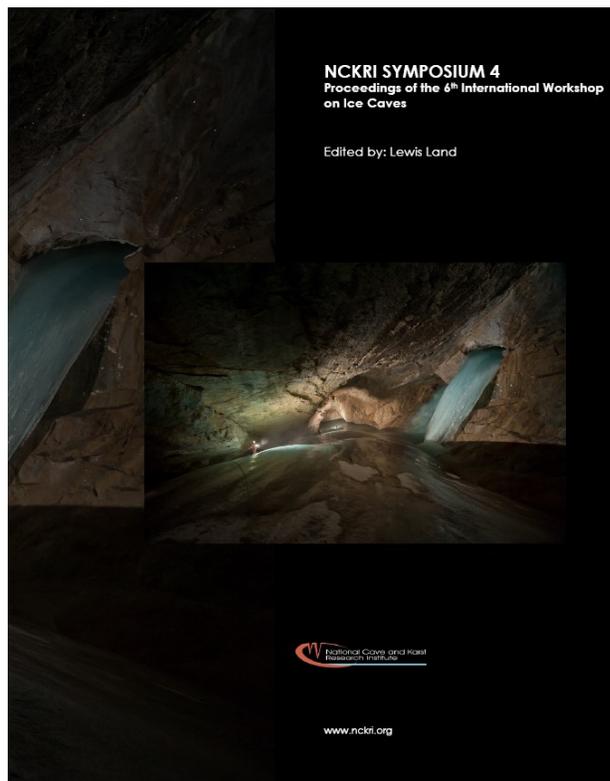
NCKRI staff also assisted with the organization of the following events:

- Hypogea2015: International Congress of Speleology in Artificial Caves, Rome, Italy.
- New Mexico Association of Museum's conference to be held in Carlsbad, New Mexico.

National Involvement

Dr. Veni:

- Completed his three-year appointment, by the Secretary of the US Department of the Interior, 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



NCKRI Symposium 4, the proceedings of the 6th IWIC, can be downloaded for free like all NCKRI publications from www.nckri.org.

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.
- Completed his service as a member of the Joint Technical Program Committee for the Geological Society of America (GSA), stepping down to serve as an advisor to GSA's newly created Karst Division.
- Continued as a member of Appalachian Land Conservation Cooperative's Cave and Karst Technical Oversight Team.

Community Involvement

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 staff:

- Gave a presentation on the karst hydrogeology of southeastern New Mexico as part of the Bottomless Lakes State Park Enchanted Evenings summer lecture series.
- Gave a presentation about the I&W brine well's potential sinkhole collapse hazard in Carlsbad, New Mexico, for KUNM public radio in Albuquerque, New Mexico.
- Gave a presentation to the Roswell Rotary Club on the impact of karst processes on the geomorphology and water resources in the Pecos valley region of southeastern New Mexico.
- Participated in the Bat Brigade delegation to Santa Fe to meet with state legislators and state government officials during the spring, 2015 legislative session; while there Dianne Joop and Suzanna Hernandez set up a NCKRI information booth and Dr. Land spoke to the Secretary of the Energy, Minerals and Natural Resources Department about the I&W brine well in Carlsbad and its potential for a sinkhole collapse.
- Gave a presentation to the Desk and Derrick Club in Roswell, New Mexico, on sinkhole hazards in the Pecos valley region.
- Co-led a field trip focused on salinity variations in the Pecos River, attended by personnel from the New Mexico Interstate Stream Commission, New Mexico Office of the State Engineer, Texas Commission on Environmental Quality, US Army Corp of Engineers, US Bureau of Reclamation, and US Geological Survey.
- Led a karst hydrogeology field trip to Bottomless Lakes State Park for Dr. Bogdan Onac's students from the University of South Florida.



Photo courtesy of Robert Brinkmann
The NCKRI Board held its May 2015 meeting in the historic headquarters of the Explorers Club in New York City.

- Addressed a Girl Scout troop from Austin, Texas, about the geology of Carlsbad Cavern and the greater Delaware Basin region.
- Regularly attended board meetings of the Carlsbad Chamber of Commerce, and its Government Affairs and Tourism Committees, Carlsbad Department of Development, and participated in related activities supporting new businesses and community leaders
- Served as an instructor for Leadership Carlsbad.
- Participated in the Pecos River Water Users Organization meetings.
- Attended the New Mexico Drought Task Force meeting.
- Regularly attend the meetings of the New Mexico Association of Museums Southeast Region.

Guest Lectures by NCKRI

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

- *Caves as Sacred Spaces*. The National Speleological Society Con-

vention, Huntsville, AL. broadcast at 50th Anniversary of the Wilderness Act Session, July 14, 2014.

- *Caves from Earth to Mars and Beyond*. TechTalks for New Mexico Tech 49'ers event in Socorro, New Mexico.
- *Caves in the Solar System*. The National Speleological Society's webinar series.
- *Caves of the Solar System Overview*. Extraterrestrial Karst meeting for the new CAVER working group at the NASA Jet Propulsion Lab, Pasadena, California.
- *Explore Mars "Humans 2 Mars."* Panel on Life on Mars representing the subsurface potential for microbial life at Georgetown University, Washington, DC.
- *Impact of Evaporite Karst on the Lower Pecos Region, Southeastern New Mexico: A Blessing or a Curse?* Sandia National Lab offices, Carlsbad, New Mexico.
- *Planetary Protection*. NASA Astrobiology Science Conference Chicago, Illinois.
- *Regional Investigations of Ground-*

water Residence Time Using Multiple Tracers: Southern Sacramento Mountains and Roswell Artesian Basin, New Mexico. Arizona Geological Society.

- *Results of Electrical Resistivity Surveys: I&W Brine Well, Carlsbad, New Mexico.* Arizona Geological Society
- *The Geobiology and Biosignatures of Caves and Mines.* The European Space Agency, Sardinia, Italy.
- *What's a Nice Girl Like You Doing in a Place Like This?* Sigma Xi University of New Mexico *Science & Society.*
- *Writing the Field Guide to Unknown Organisms: Caves on Earth and Mars.* Mars Trekker Global Teen Summit, at Space Center, Houston, Texas.
- *Geology and Origin of Carlsbad Cavern.* Field trip for the Sul Ross University Geology Club.
- *Hidden Caves, Hidden Sinkholes: High Tech Tools for Finding Underground Wonders and Hazards.* Heights Lions Club, Carlsbad, New Mexico.
- *Oil, Gas, and Karst: Production, Protection, and Possibilities.* Eddy County Mayors' Energy Summit, Carlsbad, New Mexico.
- *Government Canyon State Natural Area: an Emerging Model for Karst Management.* Bexar Grotto, San Antonio, Texas.
- *World's First Geophysical Survey of Bat Guano: Phase 1.* Bexar Grotto, San Antonio, Texas; Texas Hydro-Geo Workshop, Cave Without A Name, Texas.
- *An Introduction to the National Cave and Karst Research Institute.* Roswell Rotary Club, New Mexico.
- *To Boldly Go Where No One's Gone Before: Exploring the Guano of the World's Largest Bat Cave.* Southwest Chapter of The Explorers Club, Flagstaff, Arizona; Met Grotto, New York, New York.
- *Karst—Exploring the Hidden Quarter of Planet Earth.* The Explorers Club Public Lecture Series, New York, New York.
- *The Future of Cave Exploration and*

its Contributions to Cave Science. 23rd International Karstological School, Postojna, Slovenia.

Co-Sponsored Speakers

NCKRI co-sponsors the Edwards Aquifer Authority's Distinguished Lecture Series in San Antonio, Texas. In September 2014, we were especially honored when our Board Chairman Dr. Robert Brinkmann gave the distinguished lecture on *Sustainability, Water, and Karst.* He was followed in April 2015 by Dr. Abe Springer, of Northern Arizona University, speaking on the human and ecological importance of springs.

Media

Dr. Boston:

- The Weather Channel, *Strangest Weather on Earth Series III*, segment on caves, and other topics, filmed for broadcast in late 2015.
- BBC Interview on Naica Cave.
- The Fringe Radio Show; a two hour interview on caves, planets, and astrobiology. Station KTKK in Salt Lake City, Utah.
- Ebola Outbreak May Hold Lessons for Handling Samples from Mars. Interview by Leonard David. *Space.com* Oct 30, 2014. <http://www.space.com/27599-ebola-outbreak-mars-sample-lessons.html>
- *Cosmos Magazine (Australian science publication)* – Interview on life on other planets, relationship to cave life on Earth, etc. Oct 8, 2014, publ. in Jan, 2015. <https://cosmosmagazine.com/physical-sciences/looking-microbes-mars>
- Wired UK, The Mystery of Mexico's Crystal Caves, Interview appeared Sept. 3, 2014. <http://www.wired.co.uk/magazine/archive/2014/09/start/crystal-mystery>
- National Geographic Soc. and NASA sponsored event, Is There Life Beyond Earth? Signed letters by 2 Congressmen and a copy of the July 2014 National Geographic Magazine with article on our work, sent to every member of Congress to promote space and exploration science funding. <http://>

video.nationalgeographic.com/video/ng-live/boston-beyond-earth-lecture-nglive

Dr. Veni:

- *How that Giant Hole in Siberia [sic] Could Have Formed.* Interview by Sarah Zhang, Gizmodo, July 18, 2014, <http://gizmodo.com/how-that-giant-hole-in-sibera-could-have-formed-1607248914?rev=1405963932459>
- *The Rapture of the Deep: Descending into Germany's Harrowing Underground Realm.* Interview by Eric Elder, Atlas Obscura, July 11, 2014, <http://www.atlasobscura.com/articles/the-rapture-of-the-deep-descending-into-germanys-harrowing-underground-realm>
- *Eishöhlen-Forschung Bedrohtes Klimaarchiv vor der Haustür.* Interview by Deutschlandradio, Deutschlandfunk, August 27, 2014, http://www.deutschlandfunk.de/eishoehlen-forschung-bedrohtes-klimaarchiv-vor-der-haustuer.676.de.html?dram:article_id=295791.
- *inTV Presents: Exploring Karst with Dr. George Veni.* Interview by San Antonio College, September 18, 2014, San Antonio, Texas, <https://vimeo.com/108581120>.
- *When Evidence Melts Away: Climate Scientists Race to Sample Cave Ice Before it is Too Late.* Interview by Lucas Laursen, Scientific American, November 2014.
- *Inside Bracken Cave with NCKRI and BCI.* Robert Garner Photography, Fort Worth, Texas, <http://www.robertgarnerimages.com/p806616890/h340851b6#h340851b6>, February 2015.
- Was interviewed and featured for stories in the Carlsbad Current-Argus, Focus on Carlsbad, and the Roswell Daily Record.

Social Media

With a new focus on mass media, NCKRI's online audience has doubled in size; reaching 99,000 people. Like us and visit us on Facebook, LinkedIn, and Twitter.

BOARD OF DIRECTORS

Message From the Chairman of the Board



Never before in the history of our country have issues of caves and karst landscapes been more significant. From sinkholes to flooding, the complex features of karst landscapes are on the minds of many Americans. No longer do we see karst landscapes as just curious tourist attractions or the playground of spelunkers. More and more people see the complex interrelationships between geology, climate, water, and soil in the development of karst landscapes and their management.

This spring, flooding in the karst Hill Country of Texas caused millions of dollars of damage and the loss of life. Sinkholes have plagued several parts of the country and policy makers are struggling with how to best design land use and insurance policy to confront the problem. White-nose Syndrome continues to devastate bat populations in many areas causing significant ecosystem concern. Plus, environmentalists are worried about the impacts of hydraulic fracturing and oil and gas extraction in highly porous karstic rocks.

The challenge we face as karst

scientists is that it is a relatively new and small field in the United States. While more Americans are aware of the issue of karst, most do not understand the complexity of karst systems around them. This is, in part, due to the lack of solid scientific information available in the scientific literature and the absence of karst topics in most state and local educational curricula. The National Cave and Karst Research Institute is working to change this.

Through our scientific conferences, research, and educational programs, NCKRI is striving to provide a clearer picture about karst and its significance to the environmental sustainability of our nation. As you review this report, please consider how you can help us achieve our scientific and educational mission. By attending conferences, providing financial support, or supporting research or educational projects, you can help us to create a world that is more aware of the beautiful, yet complicated, karst resources of our nation.

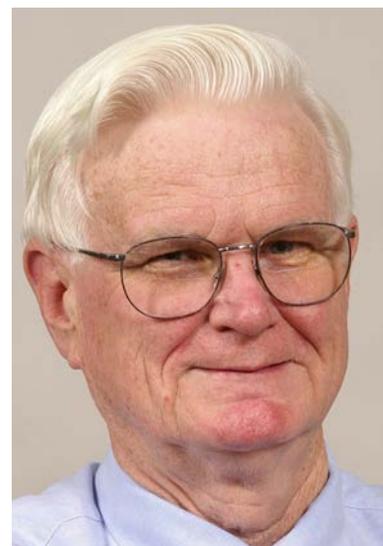
We held our last Board of Directors meeting in New York City at the venerable Explorers Club—home to many important events in the history of world exploration. As we met around the table where President Theodore Roosevelt planned the Panama Canal, I was struck by the importance of NCKRI in promoting a national conversation on the wise use of karst landscapes. We have an important directive from the US Congress to “promote and develop sound and sustainable resource management practices.” In many ways, NCKRI is an outgrowth of President Roosevelt’s conservation ethic and it was fitting that we met at the headquarters of an organization he helped found.

Within this annual review of activities, you will find that NCKRI was active over the last year in creating new knowledge, in organizing conferences, in developing educational ini-

atives, and in seeking grant and donor support. We could not do this without terrific staff and leadership and the support of many partners and stakeholders. Thank you.

Dr. Robert Brinkmann, Chairman

Member since May 2010; Bachelor’s and Master’s degrees in Geology, PhD in Geography. Formerly from the University of South Florida, he is now 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.



Dr. E. Calvin Alexander, Jr. Vice-Chairman

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, particu-

larly agriculture, on karst systems and vice versa, the limits that karst systems place on sustainable agriculture and other human activities.



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 Nation-



al 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.



Dave Lester
Member at Large

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 NCKRI's founding and early years. Dave is a Fellow of the National Speleological Society (NSS) and has served on its Board of Governors. He co-chaired the NSS' 1996 convention and chaired its 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 a commercial pilot license.



Eddie David

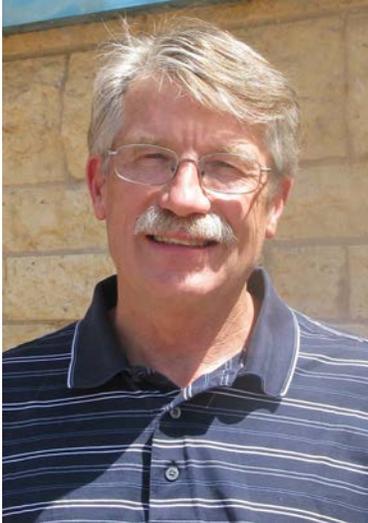
Member since May 2014. Bachelor's Degree in Petroleum Geology. Eddie is the President of David Petroleum Corporation, an oil and gas exploration company.



Tom Edwards

Member since May 2014. Bachelor's and Master's Degrees in Mechanical Engineering, and an MBA. Tom is an

Associate Professor and Director of the Engineering Management Program at Temple University. Tom has worked in the fields of design engineering, aerospace, and writing.



Dr. Ronald T. Green
Member since 2007; Bachelor's Degrees in Industrial Engineering and Geology, Master's Degree in Geophysics; and PhD in Hydrology. Ron is a hydrogeologist with the Southwest Research Institute, San Antonio, Texas, where much of his work focuses on karst aquifers.



Dale Pate
Member from 2000-2002; 2006 to present. Bachelor's Degree in Geography. Dale 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.



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



John Scheltens
Member since May 2014. Bachelor's Degree in Civil Engineering. John has 35 years of experience in professional

civil engineering, principally in public works and national drinking water policy. John served as a member of the Environmental Protection Agency's (EPA) National Drinking Water Advisory Council (NDWAC) from 1996-2002. The NDWAC advises the Administrator of the EPA on matters relating to the nation's drinking water policy. He has served on many state and national water policy organizations, boards, and commissions to include Vice President of the Water Utility Council for the American Water Works Association in Washington, DC. John is an Honorary Life member of the National Speleological Society (NSS), where he served as national president from 1988-1992. As President, John led efforts to develop and pass the Federal Cave Resource Act of 1988 as well as developing national MOU's between the NSS, the National Park Service, the National Forest Service, and the Bureau of Land Management. John is currently a Sr. Principal Engineer for Applied Engineering Management Corporation, where he is engaged in international projects for drinking water training at US Embassies abroad.



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.



Bernard Szukalski

Member since May 2014. Bachelor's Degrees in Biology and Chemistry from Delaware Valley University. With a background in both environmental consulting and biomedical research, Bern joined leading GIS software developer Esri in 1986. During his 29-year career at Esri, he has held a variety of positions and responsibilities that have covered a broad spectrum of geospatial projects and software development activities. Currently he is a chief technology advocate and product strategist, focusing on ways to broaden access to geographic information via cloud-based GIS.

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 cooper-

ation with NCKRI and the National Speleological Society.



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 210 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*.



**Suzanna Hernandez,
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 experi-

enced 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-Centiment 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

STAFF EDUCATION AND PUBLICATIONS

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.



**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' ex-

perience 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:

- *Certified Interpretive Trainer certification*. National Association of Interpretation.
- *Creating Stores that Make a Difference*. National Association of Interpretation's Interpretive Writing Workshop presented by Greenfire Creative.
- *How Smart Leaders Create Engaged Employees*. Dale Carnegie and Associates, Inc., Carlsbad, New Mexico.
- *Geoscience and Ethics*. Texas Board of Professional Geologists training webinar.
- *Wither Wellspring*. Dr. Abe Springer, Distinguished Lecture Series, Edwards Aquifer Authority, San Antonio, Texas.
- *World Class Customer Service*. Dale Carnegie and Associates, Inc., Carlsbad, New Mexico.
- *Sustainability, Water, and Karst*. Dr. Robert Brinkmann, Distinguished Lecture Series, Edwards

Aquifer Authority, San Antonio, Texas.

- *Classical Karst School*, Karst Research Institute, Postojna, Slovenia.

Refereed Papers

- Uckert, K., Chanover, N.J., Voelz, D.G., Xiao, Xifeng, Boston, P.J., & Glenar, D.A. 2015. Demonstration of a portable AOTF IR spectrometer for in situ exploration of planetary surfaces. Proc. Aerospace Conference IEEE 2015:1-9.
- Uckert, K., Chanover, N., Getty, S., Brinkerhoff, X. L., Floyd, M., Voelz, D., Xiao, X., Tawalbeh, R., Boston, P., McMillan, N., Chavez, A., Glenar, D.A., Ecelberger, S., and Cornish, T. 2014. A comparative study of *in situ* biosignature detection: Spectroscopy techniques on planetary surfaces. In *Aerospace Conference, 2014 IEEE*, IEEE. Big Sky, MT: IEEE, pp. 1-12.

Journal Papers

- Melim, L.A., Northup, D.E., Spilde, M.N., and Boston, P.J. 2015. Update: Living Reticulated Filaments from Herbstlabyrinth-Adventhöhle Cave System, Germany. *J Cave Karst Studies*, DOI: 10.4311/2015MB0112.
- Morgan-Edel, D.K., Boston, P.J., Spilde, M.N., & Reynolds, R.E. 2015. Plant-derived mineral bodies (phytoliths) as geobiological and climatic indicators in arid environments. *New Mexico Geology*, 37 (1):3-20.
- Rummel, J.D., Beaty, D.W., Jones, M.A., Bakermans, C., Barlow, N.G., Boston, P.J., Chevrier, V.F., Clark, B.C., de Vera, J.-P.P., Gough, R.V., Hallsworth, J.E., Head, J.W., Hipkin, V.J., Kieft, T.L., McEwen, A.S., Mellon, M.T., Mikucki, J.A., Nicholson, W.L., Omelon, C.R., Peterson, R., Roden, E.E., Sherwood Lollar, B., Tanaka,

K.L., Viola, D., and Wray, J.J. (2014) A new analysis of Mars "Special Regions": Findings of the Second MEPAG Special Regions Science Analysis Group (SR-SAG2). *Astrobiology* 14(11), p. 887-968, doi:10.1089/ast.2014.1227.

Conference Papers

- Land L. 2015. Rollalong resistivity surveys reveal karstic paleotopography developed on near-surface gypsum bedrock: Lakewood, New Mexico. New Mexico Geological Society spring meeting, Socorro, NM, Abstracts with Programs.
- Land L. 2015. Impact of evaporite karst on the lower Pecos region, southeastern New Mexico: A blessing or a curse? GSA south-central section meeting, Stillwater, OK, Abstracts with Programs.
- Land L, Asanidze L. 2014. Geophysical investigation of flood-induced sinkhole collapses in southeastern New Mexico. Geological Society of America annual meeting, Vancouver, BC, Abstracts with Programs.
- Veni, G., Goldscheider, N. and Chen, Z. 2014. The World Karst Aquifer Mapping Project (WOKAM): a tool for regional to global scale karst research. Geological Society of America annual meeting, Vancouver, BC, Abstracts with Programs.
- Veni, G., Land, L. and Joop, D.. 2014. Evaluation of cave and karst programs and issues at US national parks. Geological Society of America annual meeting, Vancouver, BC, Abstracts with Programs.
- Veni G, Land L, Persoiu A. 2014. Time, money and melting ice: Proposal for a cooperative study of the world's cave ice in a race against climate change. In: Land L, Kern Z, Maggi V, Turri S, editors. Proceedings of the sixth international workshop on ice caves, August 17-22, Idaho Falls, Idaho, USA: NCKRI Symposium 4. Carlsbad (NM): National Cave and Karst Research Institute. p. 65-67.

Unrefereed Papers

- Land L. 2015. Sinkholes and humans in the Delaware Basin, southeastern New Mexico and west Texas. In: Outcrop: Newsletter of the Rocky Mountain Association of Geologists. 64 (1): 10-18.
- Veni, G. 2014. Karst wilderness: a global perspective of current exploration, science, and management. National Speleological Society Convention Program, Huntsville, Alabama.
- Veni, G. 2015. Rock and art: reflections on geoarcheological research with Andrea Stone. The Power of Art in the Mesoamerican

World: A Conference in Honor of Andrea Joyce Stone, Northern Arizona University, Flagstaff.

Peer Reviews by NCKRI

- *A study on the thermal dynamics inside Carlsbad Cavern, New Mexico, USA.* Submitted to the Journal of Cave and Karst Studies.
- *Recharge estimation for the southern Roswell Basin, New Mexico.* Submitted to the Hydrogeology Journal.
- *Fifty years of the UIS: 1965-2015.* By José Ayrton Labegalini, Published by the Karst Research Institute, Postojna, Slovenia.



*Carbonate bedrock
Fractures abound
Recharge dissolves
Crevices resound
Groundwater follows
Flowpath creation
End result
Karstification
- Sam Panno*

2014-2015 STATE AND FEDERAL BUDGET

FUNDS REPORT

Administered by New Mexico Tech

	National Park Service						COMBINED		
	FY 12-13	FY 13-14	FY 14-15	FY 12-13	FY 13-14	FY 14-15	FY 12-13	FY 13-14	FY 14-15
<i>Beginning Fund Balance</i>				277,681	237,618	238,009	277,681	237,618	238,009
Revenues									
State Appropriation	0	0	0	377,700	383,000	387,300	377,700	383,000	387,300
Federal Appropriation	309,201	291,857	315,432	0	0	0	309,201	291,857	315,432
TOTAL REVENUES & FUND BALANCES	309,201	291,857	315,432	655,381	620,618	625,309	964,582	912,475	940,741
Expenses									
Personnel									
Staff Salaries & Student Wages	171,803	156,357	177,993	212,632	203,918	244,310	384,435	360,275	422,303
Fringe Benefits	58,374	58,355	69,424	62,334	66,346	94,349	120,708	124,701	163,773
Total Personnel	230,177	214,712	247,417	274,966	270,264	338,659	505,143	484,976	586,076
Operating									
Rent, Utilities, Telephone	0	18,269	20,283	50,185	51,766	55,084	50,185	70,035	75,367
Supplies & Other	27,447	3,337	1,939	16,858	16,012	16,932	44,305	19,349	18,871
Exhibit Design	0	0	0	32,250			32,250	0	0
Travel	7,572	6,598	5,761	9,017	10,101	11,599	16,589	16,699	17,360
Contractor Services	2,540	3,465		14,487	11,894	22,768	17,027	15,359	22,768
Property & Equipment		5,338			2,572	-1,617	0	7,910	-1,617
NMT Administrative Support	0	0	0	20,000	20,000	20,000	20,000	20,000	20,000
NMT "Indirect" from NPS Budget (8%)	21,465	20,138	22,032	0	0	0	21,465	20,138	22,032
NPS "Indirect" to GRD at 6% on NPS appropriation	20,000	20,000	18,000	0	0	0	20,000	20,000	18,000
Total Operating	79,024	77,145	68,015	142,797	112,345	124,766	221,821	189,490	192,781
TOTAL FUNDS EXPENDED	309,201	291,857	315,432	417,763	382,609	463,425	726,964	674,466	778,857
<i>Ending Fund Balance</i>	0	0	0	237,618	238,009	161,884	237,618	238,009	161,884

2014-2015 Corporate Budget

NCKRI Inc. **Unaudited** Annual Statement of Activities and Changes in Net Assets
For the Year Ended June 30, 2015

Administered by NCKRI

Public support and services:		Functional expenses	
Unrestricted Contributions	\$12,155.70	Conferences	\$11,801.69
Conferences	\$3,770.00	Contract	\$1,878.06
Program	\$890.00	Program	\$7,493.18
Rent and Lease	\$11,374.61	Operations	\$3,312.04
Other	\$840.52	Travel	\$8,548.50
		Other	\$100.00
TOTAL PUBLIC SUPPORT AND REVENUE	\$29,030.83	TOTAL PROGRAM EXPENSES	\$33,133.47
CHANGE IN ASSETS		-\$4,102.64	



National Cave and Karst Research Institute

400-1 Cascades Avenue
Carlsbad, New Mexico 88220 USA