Cave and Karst Programs

National Park Service
U.S. Department of the Interior

Inside Earth

Lily pad speleothems in the Hall of the Flying Monkeys, one of the recent discoveries in the Oz area of Lechuguilla Cave, Carlsbad Caverns National Park. NPS Photo by James Hunter.

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Calendar

March 2014
15-22nd 16th International Symposium on Vulcanospeleology, Puerto Ayora, Galápagos Islands, Ecuador, http://www.vulcanospeleology.org/symposia.html

June 2014
5-15th Karst Without Boundaries hydrology conference and field seminar, Croatia http://diktas.iwlearn.org/

July 2014
14-18th National Speleological Society (NSS) Convention at the new NSS Headquarters, Huntsville, Alabama http://nss2014.caves.org/

October 2014
19-22nd Geological Society of America Annual Meeting, Vancouver, British Columbia, Canada www.geosociety.org/meetings/2014/

March/April 2015
29-2nd George Wright Society Conference, Oakland, California http://www.georgewright.org/

July 2015
13-17th NSS Convention, Waynesville, Missouri https://www.facebook.com/NSSConvention2015

November 2015
1-4th Geological Society of America Annual Meeting , Baltimore, Maryland http://www.geosociety.org/meetings/2015/

July 2016
17-23rd NSS 75th Anniversary Convention in Ely, Nevadahttps://www.facebook.com/nss75th

Submit Entries for the Calendar to andrea_croskrey@nps.gov

A Word from WASO

Submitted By Dale Pate

Significant progress has been made on several fronts since the Spring 2013 *Inside Earth* was published. Travel for Technical Assistance Requests from NPS park units and a National Natural Landmark kept me busy beginning in April. I have summarized these requests below. Additionally, summaries for 30 cave and karst park units were completed by Limaris Soto during this time as well. To learn more about this project, please review her article in this issue of *Inside Earth*. As we learn more about cave and karst resources found within NPS units, we hope to identify critical needs, develop project proposals with park input, and seek funding to better understand and protect our sensitive cave and karst resources.

Dale Pate, NPS National Cave and Karst Program Coordinator

Grand Canyon-Parashant National Monument

Created in 2000, this new monument is rugged and remote. Administratively, the monument is operated by both the National Park Service and Bureau of Land Management. I was invited to accompany a trip to a monument cave led by Eathan McIntyre and several research paleontologists to recon several sites within the cave. Recommendations included completing a Cave and Karst Management Plan and some minor changes to protocols when entering monument caves.

Wupatki National Monument

Known for its pre-historic structures and ties to native cultures, Wupatki NM also contains significant earth cracks and sinks. These features are found in the 250 million year old Permian Kaibab limestone which outcrops over a large portion of the monument. Air movement in and around these features directly connect to stories found in the Hopi Culture concerning the source of all winds and the Wind God, Yaponcha. Past practices before the monument was created placed large rocks, boulders, and other debris over and into many of the openings to prevent livestock from falling into the earth cracks. Written recommendations for monument actions concerning the return to more natural conditions for these features will be forwarded in the near future.

Golden Gate National Recreational Area

Famous for Alcatraz and spectacular views of the Golden Gate Bridge and San Francisco, Golden Gate NRA also contains numerous sea caves. I was invited to visit to get a sense of the cave resources, the overall natural setting, and the very complex management issues. I also was asked to provide guidance on information needs and to be a liaison with local cavers that already know and have information on cave areas within Golden Gate NRA. My visit generated considerable interest from local cavers, staff at Golden Gate NRA, and from resource staff at nearby Point Reyes National Seashore.

Mitchell Caverns Natural Preserve (National Natural Landmark)

Two lower entrances to Mitchell Caverns. The tour route goes through the opening on the right. NPS Photo by Dale Pate.

Part of the California State Parks system located within Providence Mountains State Recreation Area (PMSRA), Mitchell Caverns was closed in the spring of 2011 due to state budgets cuts. Located within Mojave National Preserve, the preserve and cave are fairly remote and initially had no one living on the premises. This led to surface buildings being heavily vandalized along with the removal of thousands of feet of electrical cable in February 2012. The cave itself lost some electrical cable but did not appear to have been vandalized beyond the theft of cable. After the vandalism, the State of California hired a caretaker and began the repair of facilities with the goal of reopening PMSRA and Mitchell Caverns. With the cave being closed for more than two years, the entrance area and a 15-foot blasted tunnel in the middle of the cave had debris that had fallen onto the trail. Through the NPS Pacific West Region National Natural Landmark Program Coordinator, the facility manager for Mitchell Caverns requested assistance in assessing the areas for potential rockfall problems before reopening the cave to the public. The entrance area showed that various animals had been active over the last two years and knocked small rocks and other debris onto the trail. The blasted portion within the cave showed that the tunneling had actually cut through an area of clay interbedded with thin layers of flowstone. The blasting had shattered much of the exposed clay and flowstone. It appears the tunnel was blasted through an existing tunnel that had been naturally filled with the interbedded clay and flowstone. With a solid limestone roof and a well-made concrete floor, only pieces of dried cracked pieces of clay and flowstone were tumbling out of the filled passage onto the trail. There was no evidence to indicate a problem from collapse, but rather the debris found on the floor had slowly built up over two years as pieces of dried clay or broken flowstone fell out of the walls. Evidently, the guides and caretakers before the closure had been routinely picking up debris as it fell onto the floors.

In the Upcoming Year

Looking forward, my plan is to begin a more intensive look at park units with karst-related needs. In particular, I would like to look at, but not limited to:

- recharge basins and flow paths
- potential contaminant sources
- endemic ecosystem species and dynamics

Many times, NPS park units do not contain the entire karst system. Park managers not only need to know the resources within their boundaries but what factors and resources outside the park unit boundaries may affect the resources they manage. I welcome ideas and thoughts on potential projects that we should consider. If so inclined, please email me at dale_pate@nps.gov.

Preliminary NPS Cave and Karst Summaries

Submitted by Limaris Soto

Over the last eight months, I have been working for the NPS Cave and Karst Program to develop preliminary cave and karst summaries for all NPS park units containing these types of resources. These synopses are important in an effort to identify and understand cave and karst resources within NPS units and include discussions on geology, archeology/cultural resources, biology, hydrology, paleontology, hazards, threats, potential studies, the significance of resources, and current monitoring activities. The information collected will be used to:

- identify any gaps or information needs for the long-term protection and conservation of these fragile and sensitive resources
- justify funding needs
- keep management informed

In addition, the summaries will be also used to provide better and more accurate information for upcoming Foundation and State of the Parks documents. The NPS National Leadership Council (NLC) is committed to completing foundation documents for all NPS units by 2016 as part of the Park Planning and Facilities and Lands Directorate park planning portfolios. For more information on foundation documents and park planning, go to the InsideNPS summary posted at "New Direction Set for Park Planning Program", visit the NPS intranet SharePoint site at http://share.nps.gov/PP-GMP, or contact Patrick Gregerson at 202-354-6972. The State of the Parks is part of the Inventory & Monitoring Division and intends to show the status and condition of park resources. For more about the State of the Park Reports visit their website at http://www.nps.gov/stateoftheparks/. The Geologic Resources Division is helping parks provide geologic pertinent information for these national level reports, including cave and karst resource management and concerns.

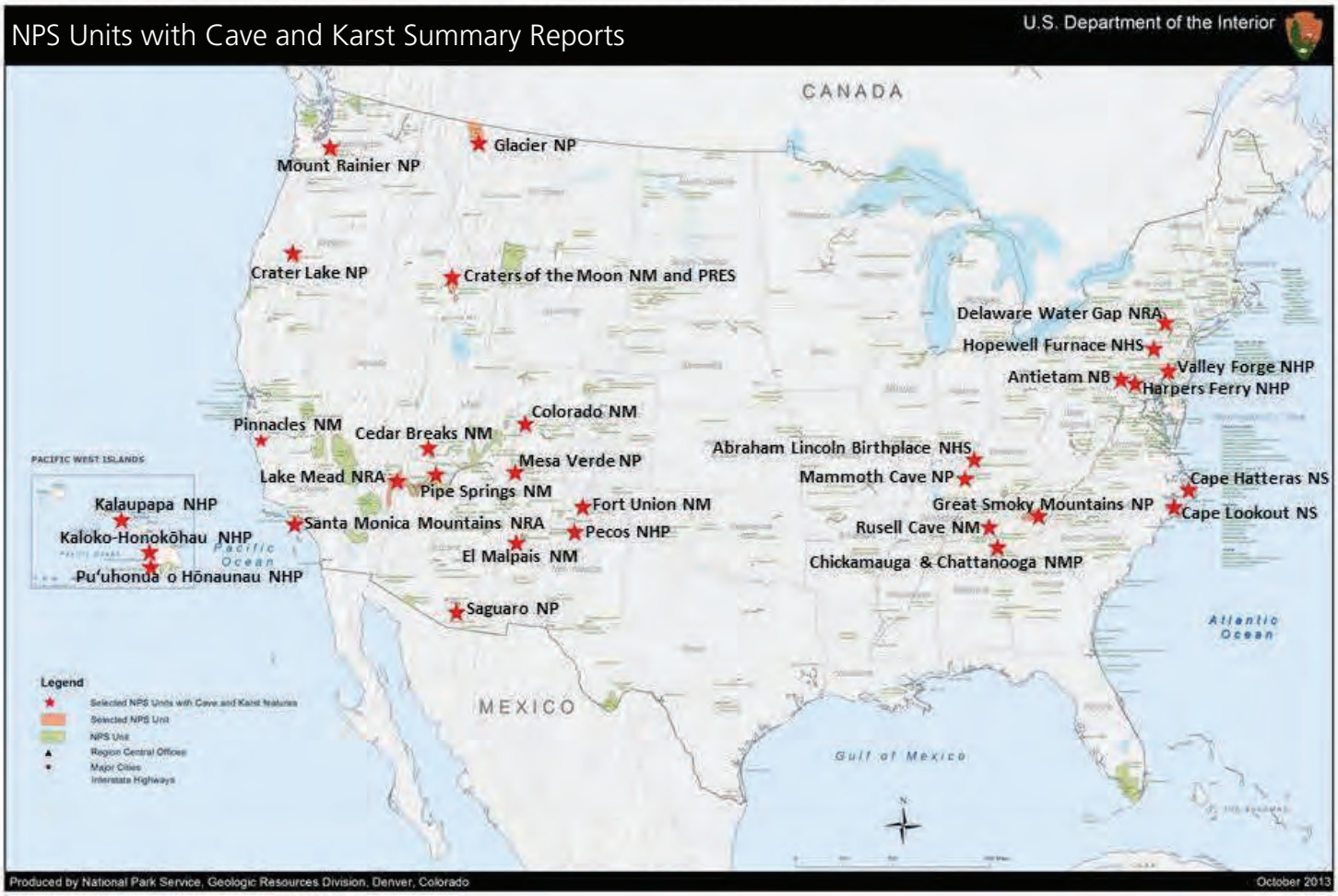
The order in which cave and karst summary reports are created follows the queue in which Foundation and State of the Parks reports have been and will be created. To this point, 30 summary reports have been completed and include the following parks:

Abraham Lincoln Birthplace NHS
Antietam NB
Cape Hatteras NS
Cape Lookout NS
Cedar Breaks NM
Chickamauga & Chattanooga NMP
Colorado NM
Crater Lake NP
Craters of the Moon NM and PRES
Delaware Water Gap NRA
El Malpais NM
Fort Union NM
Glacier NP
Great Smoky Mountains NP
Harpers Ferry NHP
Hopewell Furnace NHS
Kalaupapa NHP
Kaloko-Honokōhau NHP
Lake Mead NRA
Mammoth Cave NP
Mesa Verde NP
Mount Rainier NP
Pecos NHP
Pinnacles NM
Pipe Springs NM
Pu'uhonua O Hōnaunau NHP
Russell Cave NM
Saguaro NP
Santa Monica Mountains NRA
Valley Forge NHP

These summaries are mostly derived from web engine searches and information that is generally available online. In a few instances information has been obtained by doing interlibrary loans or contacting the parks. It is an eventual goal to have these summaries available on the NPS Cave and Karst website, http://www.nature.nps.gov/geology/caves/.

An important part of the summaries that assist in the completion of the State of the Parks reports is the identification of threats and opportunities for each unit in regards to cave/karst resources. Results show that some of the threats affecting the units include: vandalism, decline in water quantity/quality, disturbance of archeological materials, rockfall hazards, and potential for sinkhole activity, among others. Based on the collected data thus far, we found that 60% (18 of 30 park units) show signs of surface/groundwater contamination, 43% (13 of 30 park units) appear to be in need, or would benefit from a cave inventory, and 20% (6 of 30 park units) contain caves/karst species officially listed on the Endangered Species List, with MACA having 3 listed species.

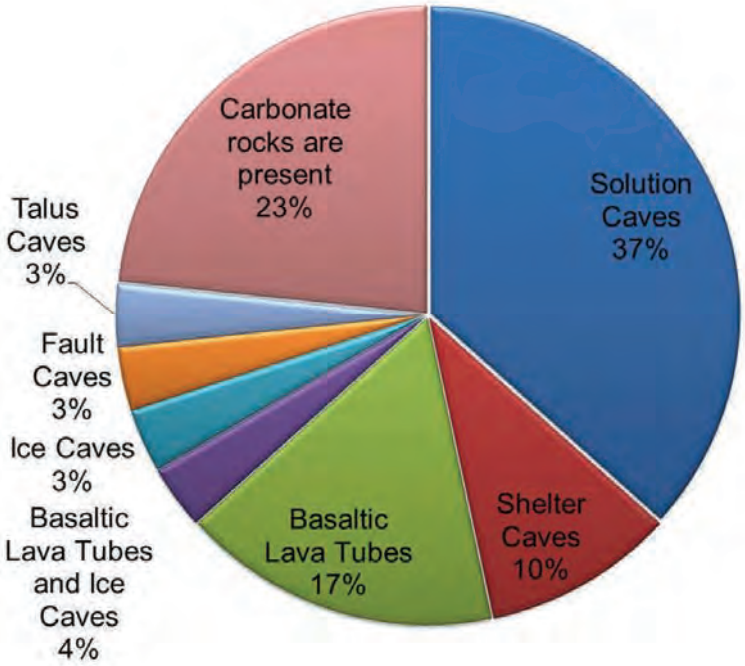
So far I have reviewed 50 parks and of those 30 were found to have caves or karst and had a summary written. The NPS National Cave and Karst Program has a goal to review all units and complete summaries for those that are found to contain cave or karst features in the preliminary information search. These summaries will provide a better understanding of park resources and provide a reference and record of the information for the national program. Then the intention will be to use the completed summaries to identify critical cave and karst related needs for parks from a national perspective. This will aid the NPS National Cave and Karst Program in categorizing projects and funding needs. Additionally, we would like to explore the concept of 'Karst Significance'. At this time, 'Karst Significance' isn't defined and doesn't have specified metrics, but one of our long-term goals is to be able to identify and assign priorities to karst areas based on these metrics. The process of calculating the karst significance could be enabled by using GIS to better quantify the number of karst features in parks through mapping and spatial analysis. We recognize that these are forwarding thinking goals but we believe these preliminary summaries will provide a base for planning upcoming cave and karst projects.



If you are interested in obtaining more information or have any questions or comments about cave and karst summaries for parks, please contact me at limaris_r_soto@partner.nps.gov or Dale Pate at dale_pate@nps.gov.

Based on the information collected so far, we have concluded that a total of 1,082 caves are known from the 30 studied units. Mammoth Cave NP (MACA) and Craters of the Moon NM and PRES (CRMO) have the largest number of known caves so far at 400 solution caves and 344 basaltic lava tubes, respectively. In addition, 37% (11 of the 30 park units) have solution caves. Furthermore, 23% (7 of the 30 park units) have areas of limestone or other carbonates but no known caves. These 7 parks units are: Antietam NB, Cape Hatteras NS, Cape Lookout NS, Delaware Water Gap NRA, Fort Union NM, Hopewell Furnace NHS, Mesa Verde NP, Pipe Springs NM, Saguaro NP, and Santa Monica Mountains NRA.

Pie chart displaying Cave and Karst Classification of 30 Parks with Completed Reports



Reports From the Field

Return to Oz

Submitted by Shawn Thomas, Cave Technician, Carlsbad Caverns National Park

The 2012 discovery of the "Oz" section of Lechuguilla Cave, a significant upper level extension to the cave, was accomplished via a 400+ foot technical dome climb known as the Kansas Twister. This dome was first seen in 2007 when John Lyles pioneered a survey route beyond a tight squeeze that opened into Emerald City, named for the green minerals found within the thick, white gypsum deposits that coat this area. Beyond Emerald City lay a steep talus slope containing a massive amount of material being sourced from the tall Kansas Twister dome. James Hunter led climbs in 2007 and 2008, making progress above the talus slope but ultimately being stopped by featureless, overhanging walls. From this point, in 2009 John used a homemade apparatus consisting of a slingshot coupled with a reel of monofilament in the hopes of draping a rope over a natural bridge 90' above the top of the talus slope. This attempt failed, and another year passed before a team of Art Fortini, Bonny Armstrong, and Daniel Chailloux succeeded with a similar method and used pull cords to anchor an 11 mm static climbing rope from the bridge. Using this rope, Art, along with Simeon Warner, ascended to the top of the bridge, hoping to continue the climb. Finding rotten rock walls leading up from the bridge, Art and Simeon abandoned the dome.

In 2012, on an expedition led by Derek Bristol, Derek and James Hunter teamed to attempt the dome, trading climbing leads and being assisted by other team members rotating belay and survey duties. The climbers began at the bridge, immediately having to deal with the rotten rock where Art and Simeon left off. Using traditional free and aid climbing methods, Derek and James made slow but steady progress up the dome throughout the week. Dealing with poor quality rock, the climbers often relied on hooks for protection or found pockets that would accept gear after removing clay and rotten rock with hammers and nut tools. Despite the challenges of the dome, the commitment to the climb and inventive climbing techniques ultimately proved successful. On the fifth day of climbing, at the very end of the day, Derek and James topped out and, along with surveyors Brian Kendrick and Roger Harris, crawled along the edge of another talus slope to reach a large black void that swallowed their lights and echoed their voices – the explorers were looking up into Munchkinland, the 2nd largest known room in the cave.

Highly decorated pool in the Hall of the Flying Monkeys, Lechuguilla Cave, New Mexico. NPS Photo by John Lyles.

The following day, the last survey day of the trip, two teams ascended the Kansas Twister to officially begin the survey of Oz. One team (Derek, James, John Lyles, and Adam Weaver) surveyed over 2700' in Munchkinland and the borehole beyond, while another team (Shawn Thomas, Brian Kendrick, Abby Tobin) surveryed over 800' in large side passages that led to additional domes and pits. This marked the single biggest day of survey footage in Lech since the discovery of the Far East branch in 1989. After midnight, with both teams out of food, out of water, and even running out of survey paper, but nowhere near out of cave to survey, the hard but necessary decision was made to return to camp, which marked the conclusion of survey for the 2012 expedition. The team enjoyed an impromptu celebration in camp at 4 a.m., recounting the discoveries.

It was tough to wait an entire year for the return to Oz. The much anticipated follow-up expedition took place over the last week of May, 2013. A team of 12 cavers spent eight days in the Deep Seas Camp to explore leads in Oz and pursue additional cartographic goals in the Far West. The 2013 team roster included several returning members from the 2012 expedition – Derek Bristol (expedition leader), James Hunter, John Lyles, Shawn Thomas, Abby Tobin, and Adam Weaver – as well as Stan Allison, Andy Armstrong, Dan Austin, Jason Ballensky, Pete Johnson, and Rene Ohms. Five of the team members happened to be NPS cave resource employees from Carlsbad Caverns National Park (Allison and Thomas), Jewel Cave National Monument (Austin and Ohms), and Timpanogos Cave National Monument (Armstrong). Since the focus of the 2013 expedition was to explore leads in the Oz section of the cave, two teams traveled to Oz during each of the six survey days. The third team was sent to other areas of the Far West branch each day to continue work on Keel Hall and Zanzibar quadrangle goals.

Among the most notable passages surveyed in Oz during the expedition was the Hall of the Flying Monkeys, named for the abundant broken formations that have fallen and been cemented into un-

derlying flowstone. Given the Oz theme, the explorers pictured the Wicked Witch's flying monkeys circling about in this passage, careening into stalactites and sending them crashing to the ground. This area is among the most decorated and fragile in the cave, with numerous pools and pool deposits (see the cover photo for this issue of *Inside Earth*) among the extensive flowstone and countless colorful formations, somewhat reminiscent of the Nirvana area of the Near East. One of the amazing aspects of Lechuguilla Cave is the juxtaposition of such clean, pristine sections with areas that are among the slimiest and grittiest of any cave passage in the Guadalupe Mountains. A lead in the Hall of Flying Monkeys, for example, connected into an upper fissure passage coated in some of the thickest corrosion residue deposits (or ferro-manganese deposits, FMDs) known in the cave. Surveying these passages in dirty mode, explorers were slimed with FMDs, requiring them to spend extra time cleaning before changing into clean clothes in order to travel back through the decorated section without causing impact.

In a different area of Oz, explorers dropped a virgin pit named the Wizard's Elevator. This lead turned out to be a series of pits in a fissure complex that reminded the team of a steeper version of the Great White Way, which is located on the travel route to the Deep Seas Camp in the Western Branch. Over three survey days, the teams that explored the Wizard's Elevator rigged several drops and surveyed down multiple pitches, extending the pit to almost 500' in depth. The deeper areas of the pit contain gypsum crusts and rillenkarren along the walls, as well as calcite rafts and mammilaries in places. Surprisingly though, the pit eventually ended abruptly and did not connect to any lower levels of cave passage, despite the pit extending down to nearly the same elevation as the cave development at the base of the Kansas Twister.

James Hunter in the newly discovered Wizard's Elevator pit in Lechuguilla Cave, Carlsbad Caverns National Park. NPS Photo by Derek Bristol.

Another vertical lead in Oz was Yellowstone Falls, a dome-pit with a yellow flowstone cascade that was discovered on the previous year's expedition. The discovery team had felt cool, dry air descending from the dome. This airflow was unlike any they had experienced elsewhere in Lechuguilla and caused them to speculate on the possibility of an unknown surface connection above Yellowstone Falls. This year, a climbing team successfully accessed the passage above this dome, and over a couple of return trips, the area was surveyed to completion, with the exception of two leads that are too delicate to enter. The

A lead climb in the Oz area of Lechuguilla Cave led to a beautifully decorated chamber found and named Tatooine. Andy Armstrong is the caver on rope. NPS Photo by Derek Bristol.

survey designation chosen for the climb was OB, and after setting station OB1, explorers couldn't resist breaking from the Wizard of Oz theme and naming the area Kenobi. A second lead climb later in the week accessed a highly decorated chamber that was named Tatooine. While no new entrances were found above Yellowstone Falls, the survey data shows this area to be among the highest in the cave – the high point of Oz is only 19 feet below the elevation of Lechuguilla's entrance and 44 feet below the high point of the cave. The location of Oz relatively close to the surface suggests that a surface connection is still plausible.

Over the course of the week, over two miles of cave passage was surveyed and documented, including over 10,000' of virgin cave, the majority of which was discovered in Oz. This marks the most productive weeklong expedition in Lechuguilla in decades. The new discoveries were bittersweet, though, as most leads in Oz were surveyed to completion, and no major new breakouts occurred. Some leads still remain though (mostly high leads), and teams will continue working in this area in 2014.

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Allison, Stan. 2012. Park Updates: Carlsbad Caverns National Park. Inside Earth: NPS Cave and Karst Programs Newsletter, Volume 15 Number 2.

Bristol, Derek. 2013. Lechuguilla Cave Far West Expedition Report: May 25 – June 1, 2013. Unpublished report, Carlsbad Caverns National Park, Carlsbad, NM.

Bristol, Derek and John Lyles. 2013. Lechuguilla Cave: The Discovery of Oz. NSS News, May 2013.

Lyles, John and Derek Bristol. 2012. The Discovery of Oz. Rocky Mountain Caving, Spring 2012.

Carbidimites in Wind Cave

Submitted By Marc Ohms, Physical Science Technician, Wind Cave National Park

Carbide lamps were (and some still do) used by cavers for many years as a primary light source. The operation of the lamp is quite simple. Carbide mixed with water produces acetylene gas, which is then burned for light. This involves putting the calcium carbide in the lower chamber of the lamp and water into the upper reservoir. A valve is used to control the rate at which the water is allowed to drip into the chamber containing the calcium carbide. By controlling the rate of water flow, the production of acetylene gas is controlled. This in turn, controls the flow rate of the gas and the size of the flame at the burner, (and thus the amount of light it produces).

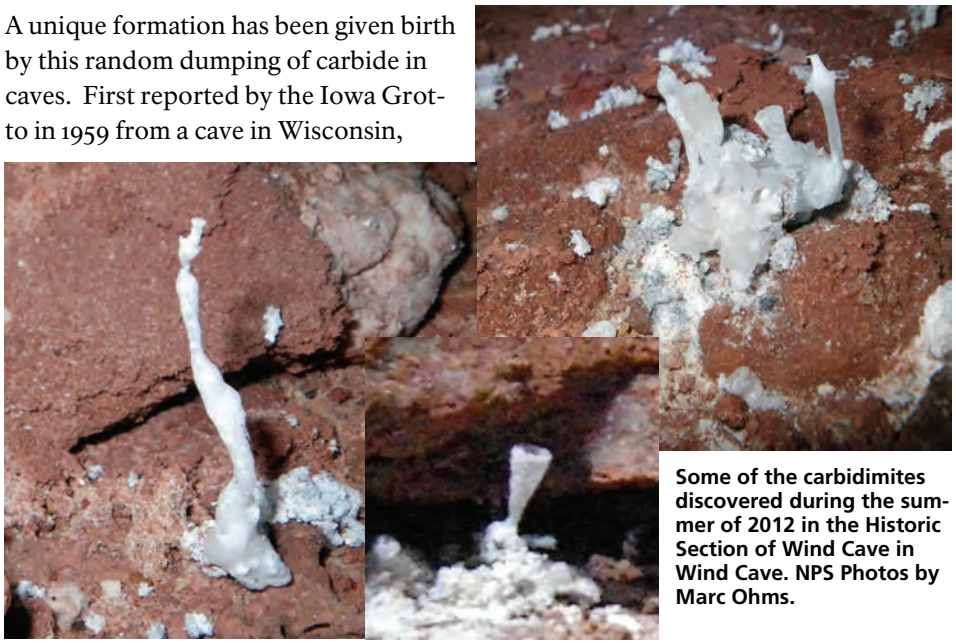
Once the carbide is used it turns into a white/grey powdery ash. It was commonplace "back in the day" for cavers to simply dump this spent ash in the cave. It was also common for them to concentrate this dumping at given locations, perhaps at common rest stops or the like. These dumps are known simply as carbide dumps and can still be seen today in many caves.

A unique formation has been given birth by this random dumping of carbide in caves. First reported by the Iowa Grotto in 1959 from a cave in Wisconsin, they were named Carbidimites. Since then they have been reported in a handful of caves around the world, but still remain a very rare occurrence. Carbide is calcium carbide and upon reacting with water forms calcium hydroxide. When carbon dioxide in the air reacts with the calcium hydroxide, calcite is precipitated. The calcium hydroxide gas bubbles continually form after the dumping, and move to the top of the dump, where calcite is then precipitated. This continues as long as gas is being produced. (Hill and Forti 1997)

During the summer of 2012 MaryBeth Wells and the author discovered a small carbide dump containing over a dozen carbidimites within the Historic Section of Wind Cave. This is the first report of this formation in South Dakota and only the seventh in the US.

References

Hill, Carol, and Paolo Forti. 1997. Cave Minerals of the World, second edition.



Some of the carbidimites discovered during the summer of 2012 in the Historic Section of Wind Cave in Wind Cave. NPS Photos by Marc Ohms.

Park Updates

Buffalo National River

Submitted by Kayla Sapkota and Scott House

Volunteers that helped with the resurvey of Fitton Cave in Buffalo National River. Standing from left to right: Jenn Ellis, Ethan Brown, Bryant Galloway, Jeffrey Bridgman, Kayla Sapkota; Seated: Mike Screiber. Photo by CRF.

The year 2013 was an eventful time for cave monitoring and survey. Crews from the Cave Research Foundation focused their efforts in four main areas---Big Creek, Broadwater Hollow, Big Hollow, and Upper Buffalo River float objectives.

The future of the natural resources in the Big Creek area have been a hot topic of conversation in Arkansas and the surrounding states due to the introduction of a Concentrated Animal Feeding Operation on the creek. Efforts to document and survey caves in this area have been a large focus this summer. Teams completed biological monitoring and survey of Jawbone Cave (565.1 ft) and have begun the survey of Tom Barnes Cave (currently at 1,024.9 ft).

In the Broadwater Hollow area, a vertical team visited a reported lead known as Blood Root Pit, surveying the 58.7 ft cave to a total vertical extent of 40.5 ft. Additionally, efforts have continued concerning the resurvey of Fitton Cave in both the Bat Passage and the Tennouri areas. Data checking yielded significant improvements in loop closure in the Bat Passage, and continued resurvey yielded 1,846.1 ft in Tennouri this year.

Monitoring and survey has been ongoing in Big Hollow for a little over a year now. To date, the following caves have been located, monitored, and mapped: Big Hollow Cave (34.9 ft), Big Hollow Pit (in progress), Big Mouth Cave (80.8 ft), Broken Stone Cave (159.6 ft), Chimney Cave, Leatherwood Sink (62.1 ft), Pretty Well (in progress), and Winding Staircase Cave #1 (in progress).

Carlsbad Caverns National Park

Submitted by Stan Allison and Shawn Thomas

Cave Exploration, Survey & Cartography

Lechuguilla Cave

Since the last *Inside Earth* update, there have been three Lechuguilla Cave exploration expeditions. Lechuguilla Cave is now 138.2 miles in length.

• Hazel Barton led a six-person expedition to the Southwest Branch May 6-12, 2013. Hazel's expedition succeeded in surveying 1.07 miles of passage, including 0.46 miles of new survey. Most work was done in the Voids area in support of Hazel's cartography project.

• Derek Bristol led a twelve-person expedition to the Western Branch May 25-June 1, 2013. An exceptional total of 2.06 miles of cave was surveyed including 1.93 miles of new survey. This is the most cave surveyed in Lechuguilla Cave on a single expedition in recent decades. Most of the survey work was accomplished in the Oz area that had been discovered in 2012. See Shawn Thomas' in-depth article on the Oz discoveries elsewhere in this issue of *Inside Earth*.

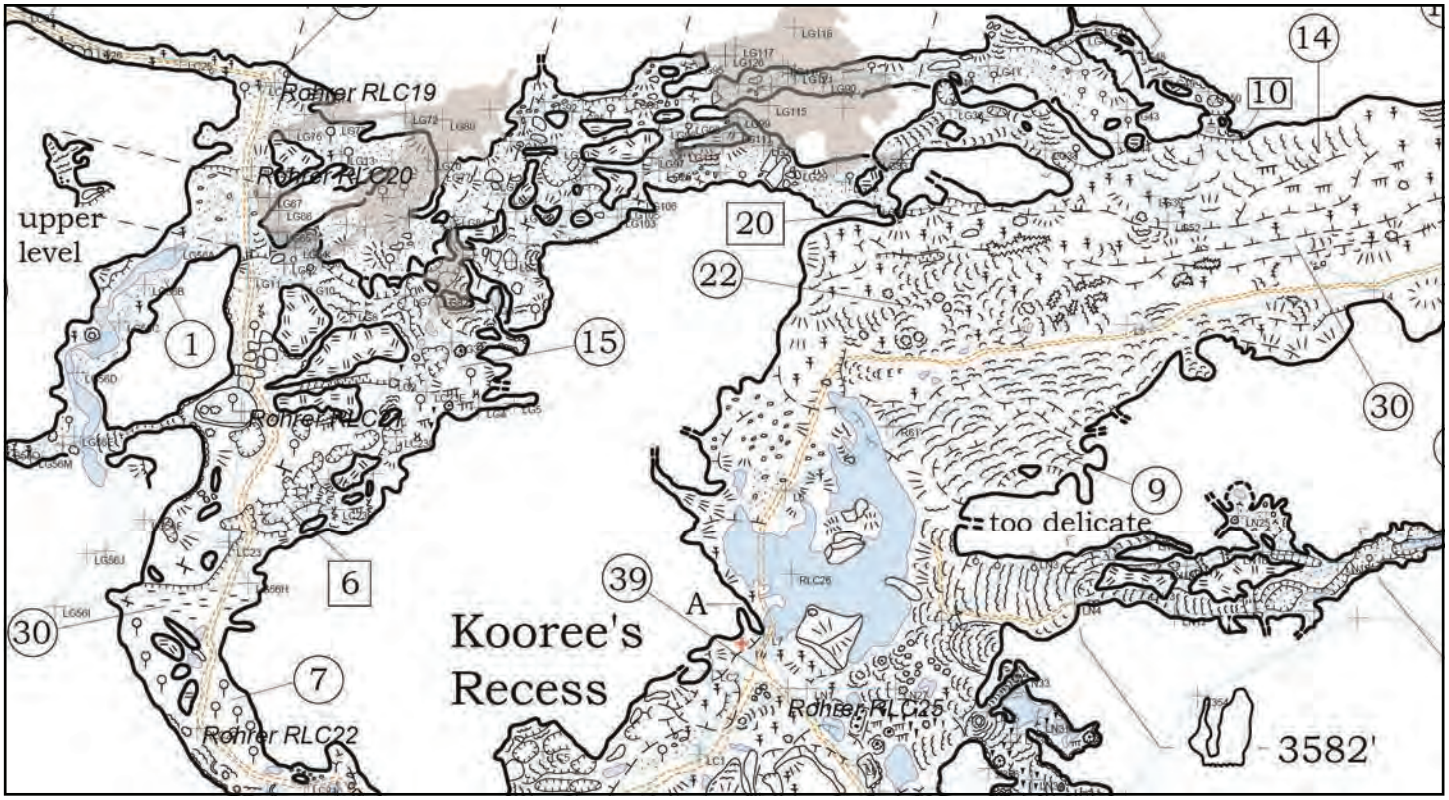
• Cathy Borer & Art Fortini co-led a six-person Western Branch expedition June 13-20, 2013. Their expedition accomplished 0.70 miles of survey, including 0.40 miles of new survey. The high point (literally) of the trip was working on The Other Bear climb in the Neverland area. This climb was initiated with a slingshot to get a pilot line and then a rope over a stalagmite. Spicy aid climbing got the team higher in the dome, but they ran out of time before they were able to complete the climb.

Carlsbad Cavern

• In June, 2013, Ed Klausner spent a week in the park to lead resurvey efforts in Carlsbad Cavern. Ed spent several days surveying and proofing areas of the Big Room for his quad map and also did some work in the Lower Cave section of Carlsbad Cavern.

• Derek Bristol continued work on his Guadalupe Room Complex map over the Fourth of July. The highlight was discovering and climbing the 120 foot tall Spooky Chimney in the Grand Ballroom area. The Spooky Chimney was an exposed climb that led to large walking passage that was left continuing into unexplored leads at the end of the trip.

• Ed Klausner, Scott House and Derek Bristol of the Cave Research Foundation (CRF) led multiple survey teams in late October. Ed Klausner continued work on his Carlsbad Cavern, Big Room and Lower Cave maps. Scott House continued work on his Main Corridor map. Derek Bristol continued working in the Guadalupe Room Complex including additional survey in the Spooky Chimney area which almost connected to Hall of the White Giant but was blocked by sediment and breakdown fill. Leads still con-



An example of Ed Klausner's detailed work on the Big Room quadrangle of the new and in progress map for Carlsbad Cavern.

tinue in this area. The highlight of the trip took place on Halloween night when Shawn Thomas belayed Derek Bristol up a short 15 foot climb in the Sacred Ground area of the Spirit World high above the Big Room. The unassuming lead soon led to a large room approximately 100 feet in diameter and 20 feet tall, which was named Halloween Hall. Two leads appear to continue out of the room including a flowstone slope leading to a dome lead. The flowstone slope is covered with bat skeletons. Exploration and survey was stopped due to lack of time and will continue in February 2014.

Slaughter Canyon Cave

In late October, 2013, Dave West of CRF was in the park with Ed, Derek and Scott, but instead of working in Carlsbad Cavern, Dave led resurvey efforts in Slaughter Canyon Cave, a backcountry cave that is also used for primitive, helmet and headlamp visitor tours. Dave spent four days resurveying, resketching, and fixing bad loops, both on and off the flagged tour route. Dave is also working on the cartography for this cave.

Spider Cave

In September, 2013, Paul Burger returned to the park to continue working on leads left in the new section of Spider Cave called Gilead that Chris Amidon discovered in 2012. Paul, Stan Allison, and Shawn Thomas comprised the survey teams for three days of survey. The team attempted to push the edge of the known Gilead footprint but did not make any breakouts. While most of the external leads are now rather grim, much internal survey remains. The highlight of the trip was finding some 2.6 foot long gypsum needles. The teams surveyed a total of 0.22 miles of passage during the week, bringing the cave to a new length of 5.28 miles.

Cave Research Activities

• Dr. Art Palmer and Peg Palmer continued their research in the Left Hand Tunnel and Lake of the Clouds region of Carlsbad Cavern in April 2013. They surveyed in the elevation and location of raft cones and folia in relation to other geologic features. This work was part of their study to interpret cave origin and subsequent deposits and weathering characteristics. Their focus is on weathering of the cave bedrock and the chemical evolution of the weathered material in order to evaluate the nature of water flow and air chemistry after the major phase of cave development. Their study has been successful in identifying several late-stage events following the main phase of cave development including influxes of anoxic water, hydrogen sulfide and possibly high concentrations of carbonic acid. While the immediate goal of this study is not paleoclimatology they plan to collaborate with other researchers who can use the information for that purpose.

• Pat Cicero led three Lechuguilla Cave day trips in May to assist Dr. Diana Northup with removal of her long-term human impact study slides. Pat led trips to all three branches of the cave including

Deep Seas, Hudson Bay, Rusticles and Big Sky. Pat's long term commitment to assisting Dr. Northup with her human impact study slide project is much appreciated.

• Dr. Diana Northup led a survey trip to Spider Cave in July 2013 to assist her students with their studies. Tammi Duncan's research was intended to determine if cave microbes produced iron-chelating compounds. She was studying siderophores produced in the cave and analyzed samples for iron, manganese, carbon, nitrogen and phosphorus CAS assays by leaving inoculated agar samples in the cave. Secondary minerals were obtained that appeared to be purely mineral, but actually contained many microbial communities for study utilizing SEM and genomic sequencing. Cave soil and air temperatures were recorded during sample collection. Mathew Medina worked on his project to identify microbial interactions with cave minerals in order to study microbes that masquerade as minerals.

• In May, Dave Decker, a PhD candidate in the Department of Earth & Planetary Sciences at University of New Mexico, collected spar (dogtooth calcite) samples from the southwest branch of Lechuguilla Cave on a day trip. Dave is using isotope and fluid inclusion analysis to date the spar and link it to landform processes that were occurring at the time of the spar formation. Shawn Thomas accompanied this research trip.

Cavern Lighting Project

This extremely significant project is intended to replace the aging 30+ year old Carlsbad Cavern lighting system with new transformers, cables and eventually LED lights. This is the largest project currently taking place in the entire Intermountain Region of the NPS. The first stage of the project starts in November 2013 and will involve replacing all of the old main wires and transformers. The new wires and transformers will then be transitioned into powering the old light fixtures. This first stage of the project is scheduled to take one year and will involve working in very delicate off-trail cave areas in addition to scheduling work around cave biota such as the Cave Swallows, Brazilian Free-tailed bats and the summer maternity colonies of Cave Myotis and Fringed Myotis that inhabit the Left Hand Tunnel and Lake of the Clouds area. The Cave Resource Office will be heavily involved in the project including presenting training to all of the contractor's employees on how to safely travel and minimally impact the off-trail areas of Carlsbad Cavern through a presentation and an off-trail trip in the cave. The second stage of the project which will involve replacement of the current light fixtures with new mainly LED fixtures and control boxes is not yet funded.

Stan Allison admiring 2.6 foot long gypsum needle in Spider Cave. NPS photo by Shawn Thomas.

Cave Resources Office Staffing Changes

Stan Allison resigned as Acting Cave Specialist in September 2013 to resume his Cave Technician duties after serving as Acting Cave Specialist since June 2012 when former Cave Specialist Dale Pate moved to the National Cave & Karst Coordinator Position. Tom Bemis' return from retirement ended in late July. Currently Shawn Thomas and Stan Allison are the only Cave Resource positions in the park. The reduction of the Cave Resources staff from 4 full time positions to 2 full time positions has resulted in significantly less cave and karst related work being accomplished at Carlsbad Caverns National Park. The park is hoping to fill the Cave Specialist position in 2014.

Coronado National Memorial

Submitted by Jason Mateljak and Matt Stoffolano

Coronado National Memorial contains several caves, the largest of which is known as Coronado Cave. This is the only cave in the Memorial open to the public, and one of the most frequently

Park Ranger Carolyn Hunt shows park visitors a preserved pseudoscorpion during a Lehman Cave tour. Photo credit: NPS photo by Gretchen Baker

visited public caves in southern Arizona. The cave came under NPS management in 1978 with an expansion of the Memorial. Until the 1930's, it was common practice for visitors to collect formations as souvenirs. Many hundreds of formations were broken and removed by early cave explorers who did not consider the loss to future generations. Vandalism to the cave continues today, primarily in the form of spray paint, etched graffiti, smoke damage from fires, and litter.

New technology is aiding in identifying and prosecuting vandals. Two visitors vandalized the entrance of Coronado Cave with etched graffiti in February 2013. A well-camouflaged remote wildlife camera captured their images while in the act of vandalizing the cave. Rangers working the case prepared a press release (http://www.kvoa.com/news/vandals-sought-by-coronado-park-officials/#_), seeking assistance in identifying the pair. The press release was picked up and distributed by local newspapers and television stations and within a day, the two vandals called the Memorial to confess. Rangers then worked with the Investigative Service Branch, US Attorney's Office and the guilty parties to finalize a restitution settlement.

This vandalism monitoring and restoration effort to cover the graffiti worked extremely well, and is a model for future efforts at mitigating the effects of vandalism at Coronado Cave. The use of monitoring technology, and enlisting the help of the public through news organizations and social media enabled the quick resolution of the case and restoration of the graffiti site.

Comparison photographs of the graffiti before and after mitigation can be seen in the InsideNPS incident report.

Grand Canyon National Park

Submitted by Deanna Greco

Steve Rice has moved on to a position with the USGS in New Mexico but is looking to stay engaged in cave management at Grand Canyon NP through research. Research permits continue to be issued for cave related exploration and mapping. The park hopes have a GSA Guest Scientist position to help with cave resources as they relate to our ongoing landscape assessment and lay the groundwork for a Cave Management Plan. It will be a six month position which posted on the Geological Society of America's GeoCorp jobs page http://www.geosociety.org/g_corps/2013/allJobDescriptions.asp. For GRCA cave related issues contact Deanna Greco at deanna_greco@nps.gov.

Great Basin National Park

Submitted by Gretchen Baker

Great Basin National Park's new park film, "Under a Desert Sky: Life in the Great Basin", was released this summer and includes information about cave life, showing cave biologist Jean Krejca looking for organisms and speaking about the fragility of caves. The Great Basin pseudoscorpion (*Microcreagris grandis*) is featured.

Visitors to Lehman Cave also have the opportunity to view a real pseudoscorpion (*Microcreagris grandis*; endemic to the park) during their cave tour. A dead pseudoscorpion has been placed in a vial that interpreters can pass around to their groups. The park is investigating ways of making a longer-lasting model of the pseudoscorpion, as many visitors have made remarks about how much they enjoy seeing cave life close up.

One new cave, Lone Bat Cave, was found in the park by Ben Roberts. It was surveyed to a total length of 32 feet. Although it didn't have much of interest geologically, it contained an interesting cave fauna, including a Townsend's bat, pseudoscorpions (a different species than those in Lehman Cave), springtails, spiders, and larvae.

A survey of cave entrance biota using wildlife cameras has been completed, and

results will be presented at the National Cave and Karst Management Symposium in Carlsbad in November.

Park staff took Dr. Larsen, the park's medical advisor, for a biomonitoring trip in Lehman Cave to familiarize him with the cave environment and to provide him with a better idea of what medical concerns might arise in park caves.

Jewel Cave National Monument

Submitted by Dan Austin

Cave Exploration

2013 has been a productive year for exploration within Jewel Cave. Volunteer cavers have added 4.8 miles to the length of the cave thus far, with some interesting new discoveries. Jewel Cave is now 168.6 miles long.

Ian McMillan led two four-day camp trips this year to the southeast section of the cave. His objectives were to survey a good lead in the Art Attack area, check leads in the TV survey beyond "The End," and to continue mop up survey within an hour of camp. Hopes were high that the area beyond the Art Attack would yield some new and exciting cave passage. One team had visited the area a few years before, and they left a large lead to be explored for the next team. Due to the difficult nature of this part of the cave, it took an enthusiastic team of cavers and several years before a return trip was planned. Ian's first camp trip found nearly 900 feet of new passage beyond this lead. The cave continued in multiple directions from the end of their survey, but the team had run out of time. On Ian's subsequent trip, a three-person team surveyed 2,577 feet in one day, continuing the lead to the North, West and South. After plotting up the new survey, it was discovered that the new passage comes within 77 feet of the Mind Blower area. A connection here would save cavers approximately 6 hours of round-trip travel time to these leads.

Chris Pelczarski has led several trips into the cave recently to push leads in the Mind Blower to the South. So far, the connection to the Art Attack area remains elusive. Chris has also been surveying in the main part of Jewel, conducting mop up survey, and along the far eastern edge of the Calorie section where several promising leads exist with strong airflow.

Lydia Austin led three trips to a small upper level near Shady Acres in the main part of the cave recently. Prior to Lydia's trip, only one other exploration trip had been to this area in 1967. One lead in particular here surprised everyone by producing nearly 1,000 feet of virgin passage on these trips. The area is well decorated with spectacular frostwork trays and massive rims, nearly 7 feet long in some places. She named the area "Hidden Loft." Lydia's husband, Dan, led a return trip to the area in November. The objective was to continue the survey off the end of Lydia's discovery. The team surveyed in one lead for 9 hours, accumulating 1,168 feet of survey in virgin passage with ceilings up to 60 feet tall in some places. The entire area is now 2,047 feet long with over a dozen leads left to explore, many of them walking-sized. The proximity of these new passages to the elevator entrance (less than 1 hour) has many cavers excited about the possibilities here.

Cave Research

Dr. Andreas Pflitsch continues his work to study cave airflow patterns and climatology. He visited the park recently in November to download data from temperature loggers and a sonic anemometer that has been permanently placed at the historic entrance to the cave.

Mike Wiles has recently consolidated his observations into a study called "Paleohydrology and the Origin of Jewel Cave". He presented a paper and a talk at the National Cave and Karst Management Symposium at Carlsbad, NM in November 2013. Mike's study suggests a geologically recent origin of Jewel Cave, with cave development beginning just prior to the surrounding landscape reaching its modern configuration. New information has been incorporated into a conceptual model that is simple and straightforward, and geomorphically

Dan Austin near a large aragonite tray discovered in September in Hidden Loft. NPS Photo by Jen Foote.

compatible with the main surface and cave features. It precludes the need for direct recharge from rainfall, hydrothermal waters rising from below, or prior development of a Mississippian karst. This conceptual model is a challenge for future researchers to find answers that will adequately incorporate all the observations. It is a good starting point for addressing questions that, until recently, were not even known to exist.

Building on previous work, the model is the next logical step toward predicting the location of undiscovered passages. It bolsters the park's ability to justify external protection actions, such as mineral withdrawals and land exchanges. The early research has already been used to justify mineral withdrawals 1990 and 2008, totaling 2,825 ha (6,983 acres); and a land exchange in 2000, that converted 148 ha (366 acres) from private to Forest Service Land. The NPS is mandated to make science-based management decisions. The better the science, the more meaningful the decisions will be.

Cave Restoration

This September concluded a four-year project to remove lint and wax accumulations from the historic area of the cave. The tour routes here were used to conduct candlelight tours for the past 100 years and wax drippings on the floor had begun to grow mold in some places. A restoration project was begun in 2010 to remove the foreign debris and restore the cave to its original condition. Kelly Mathis was hired as the restoration lead, and under his direction the project succeeded in its goals. During the four years that the project was conducted, 60,396 pounds of lint and wax was removed from the cave. The project also utilized many volunteers who spent 942 hours helping in the effort. It is estimated that 96% of the wax was removed from the cave and lint removed from over 90% of the tour route.

Rene Ohms admires a gypsum beard on the March 2013 camp trip. NPS Photo by Garrett Jorgensen

Currently, the park uses paraffin oil and LED lanterns on the historic tours to help minimize future impact on this part of the cave.

Personnel

Several changes to the park resource management staff have occurred within the last few months. In July, Rene Ohms accepted a position as Chief of Resource Management at Devils Tower National Monument. Kelly Mathis has also departed for a job in New Mexico with the Fish and Wildlife Service. They both will be missed greatly. Currently, Blase LaSala is volunteering to help fill needs within the division, and he will be helping out at the park until February 2014.

Lava Beds National Monument

Submitted by Scott House

Lava Beds National Monument has over 750 documented lava-tube entrances, most of which represent distinctly separate caves. The bulk of the caves are formed in the Basalt of Mammoth Crater, broken down into different flow regimes. Other basalts host lesser numbers of caves but also in a variety of flows.

Pro-bono research is helpful in this era of budget cuts. Operating under an umbrella general agreement, Cave Research Foundation helps resource management through a number of approved research projects at Lava Beds.

A long term photo-monitoring project operates under principal investigators (PI) Peri and Bill Frantz. In FY13 new stations were established, archives were searched, and older photos were color-balanced. Numerous photographs were added to the park's digital files.

A project to complete the resurvey of the popular Cave Loop caves was continued by PI Liz Wolff. Thousands of feet of survey were completed in FY2013 in the Ovis Paradise Alley System and in the very popular Labyrinth Cave system. Surface surveys complete loops which are carefully scrutinized for errors, particularly given the magnetic nature of the rock.

Monitoring of ice cave levels is continued by PI Bill Devereaux. The monitoring protocol uses established points in caves from which to measure ice and/or water levels. Monitoring takes place in spring and is helpful in monitoring trends in the warming climate and its effects on the caves.

PI John Tinsley is heading up a resurvey of Craig Cave with hundreds of feet surveyed in FY13. Craig Cave is one of the caves established as a baseline for the park's Inventory and Monitoring System (I&M). New surveys of caves are producing much more accurate maps; necessary for field and lab use. Another project headed by Ed Klausner and Scott House is creating new maps of several other I&M caves. Last year Valentine Cave and Pearl Caves were finished; this year work

will continue in Post Office and Balcony/ Boulevard Caves.

One project is in a remote area of the park, north of Hardin Butte. This is in a distinctly different unit. The host rock is the late Pleistocene Basalt of the Castles which postdates the Basalt of Mammoth Crater and erupted through it. Two distinctive flow units are represented but this project involves only one, the North Castle Flow. This was a low-gradient flow and the tubes did not develop deep; most of the "tubes" are on the flat side, seemingly having spread out like wet pancake batter poured on a griddle. More than 30 caves have thus far been surveyed and inventoried and a new database created to contain the information. Scott House is the principal investigator.

CRF member Don Dunham stands on top of a typical cave entrance in the North Castle Flow. Photos by Scott House

Ozark National Scenic Riverways

Submitted by Scott House

The spring, summer and fall were moderately busy times for cave management in the Ozark National Scenic Riverways.

The OZAR cave monitoring program continued strong with emphasis during the winter on bat counts and attempting to detect traces or signs of White Nose Syndrome. Over eighty cave monitoring trips were taken during FY2013, down somewhat from previous years because of budget cuts and the need to take precautions to prevent the spread of WNS; where in the past several caves might be visited over a wide area, now it is not unusual to be "one and done" in order to have time to bag and decontaminate all gear and clothing.

While all caves are closed administratively due to WNS concerns, many of the caves continue to be entered by occasional visitors. The monitoring helps identify which caves are experiencing continued traffic and how disruptive that traffic might be. One continuing concern is with fewer authorized visitors going to caves, unauthorized and intentionally disruptive traffic might be doing great harm – particularly with cave archaeological sites.

With the fall comes the opportunity to visit summer bat roosts and measure guano. One important cave, un-gated but in a remote area, may have a summer bachelor colony of more than 40,000 gray bats (M. grisescens). This number is based on the largest of numerous fresh guano piles located in the rear of the cave and accessed only by a vigorous trip involving much crawling and climbing, made more sporting by the confusing nature of the cave.

Round Spring Cavern, which is developed for visitation, was closed this summer due to budget cuts; only a few environmental education tours were taken. The unfortunate closure did give us the chance to do a count of amphibians along the trail; normally affected by the presence of visitors, the numbers were much higher this year although some of these results might have been affected by a steady rainfall pattern through the spring and early summer.

Monitoring in one large spring cave revealed that invasive crayfish are moving into the dark zones. These crayfish could impact watch species such as the blind Salem cave crayfish (Cambarus hubrichti) or the blind southern cavefish (Typhlichthys subterraneus). Plans are to investigate several nearby caves and try to remove the invasives.

Surveys of larger wet caves continued slowly as resources and conditions permitted. One large shallow karst spring (as opposed to the huge deep-conduit springs) was finally entered and several hundred feet mapped. This is exciting because the spring drains an area of more than six square miles of intense karst upland, almost all of which is outside the park boundaries and highly subject to disturbance.

With the permission of the landowner, a property for sale adjacent to the park was investigated for caves. Two new caves

Dan Lamping watches Tony Schmitt descend into a newly discovered pit near Ozark National Scenic Riverways. NPS Photo by Scott House.

were found including a pit that opened into several hundred feet of large passage. Survey and inventory work is continuing at that site.

Cave maintenance continues in the form of installing signage on certain high-priority (well-visited) caves and maintaining gates and locks. Lastly, several CRF members attended a NCRC cave rescue training to keep them certified for any possible incidents.

Timpanogos Cave National Monument

Submitted by Andy Armstrong

Division Integration

It has been a busy year at Timpanogos Cave National Monument. In order to deal with a lapsed position and sequestration budget cuts, the Interpretation and Resource Management Divisions have been combined under division chief Cami McKinney. In addition to saving money, this change has allowed for better integration and communication between the divisions. In the resource management division, we see providing accurate information and help to the interpreters as one of our greatest responsibilities, and we look forward to continuing to work closely with our cave guides.

Cave Management Plan

The environmental assessment for Timpanogos Cave's first ever cave management plan has been completed. Final comments were reviewed and integrated into the document last spring, and the Finding of No Significant Impact has been sent to the regional office and is currently awaiting the signature of the Regional Director. This plan is innovative in that it prescribes specific guidelines for our tour operations. At Timpanogos Cave, we are fortunate to not have many external threats to the cave system. In addition, there is no active exploration at the current time. The vast majority of impacts to the cave and karst system come from our own operations. This is mostly in the form of tours from May to October, but also includes RM, maintenance, and contractor use of the caves. We felt that in order to effectively manage impacts and prevent impairment, the size, frequency, and allowed behaviors on tours had to be addressed.

Based on measured temperature impacts, and the international occupancy standard on which fire codes are based, the number of visitors on a public tour has been reduced from 20 to 16. This allows for adherence to the international occupancy code in our smallest tour stop, Middle Cave Lake. While the cave is not a building, it has similar issues when it comes to safety and ability to evacuate in case of an emergency. The CMP also prescribes a 15-minute gap between each tour. This provision allows the caves and connecting tunnels to cool slightly between tours, contributing to better overall cave microclimate management.

EPA Contaminant Testing

Timpanogos Cave has been involved for two years in a region-wide effort by the EPA to look for traces of pesticides, personal care products, and waste indicators in selected national park streams, springs, and lakes. Middle Cave Lake was chosen as a sampling site in this study because the tour travels directly above this body of water on a metal bridge. We had identified this lake as our most likely site for human contamination of cave water, and this study has proven it. To date, we have found caffeine, Tri(dichloroisopropyl) phosphate, bendiocarb, estrogen, and other compounds in the water in small quantities. Efforts are being made to determine the source of these contaminants. The caffeine and estrogen are assumed to be from urine. Tri (dichloroisopropyl) phosphate is a flame retardant found in baby products, while bendiocarb is a pesticide that has been banned from sale in the USA for over ten years! Efforts are being made to identify the source of these contaminants, and to

improve the bridge to reduce the likelihood of dropped items.

Restoration Camp

At the end of September, Timpanogos Cave National Monument hosted our second annual Restoration Camp. We had a total of five volunteer over three days. Work included removing lint and mud accumulations, speleothem repair, and a thorough cleaning of the Middle Cave Lake bridge.

Wind Cave National Park

Submitted By Rodney D. Horrocks

Projects

We have started construction on the new airlock structure being built on the Walk-In Entrance of Wind Cave. After nearly 12 years in the planning process, this new structure will replace the deteriorating revolving door that was built in 1991. It will also address several resource management, interpretation, maintenance, and safety issues. During the excavation for the pad, an archaeologist on site conducting the required monitoring work, discovered some 1890's medicine bottle fragments and window pane glass fragments from the trap-door cabin entrance that was built over the current Walk-In Entrance in the late 1800's. The new airlock structure is being designed and built to last for 100 years.

Research

Dr. Art & Peg Palmer and Jim Paces (USGS) recently presented the results of their two-year long research project during a webinar on 10/31/13. Their presentation was titled, "How to Make a Cave in 340 Million years, The Geology, Origin, and Genesis of Wind Cave". Their dating of the wall crusts in the lower part of the cave revealed some fascinating details about the fluctuations of the paleo water table during the glacial and inter-glacial time periods.

Rod Horrocks recently gave a PowerPoint presentation titled, "Development of the NPS Cave Visitor Vital Signs Monitoring Protocol" at the National Cave and Karst Management Symposium in Carlsbad, New Mexico. He is currently adding figures to that protocol and preparing SOP's in preparation for the peer review process of his draft protocol.

Rod recently completed a mineral evaluation of two 40-acre inholding tracts of BLM land that the park would like the BLM to transfer to the NPS. These tracts are both found within the 5,500 acre Casey property the park acquired in 2011. In his evaluation, Rod recommended that the subject tracts be classified for disposal under the R&PP Act and transferred to Wind Cave National Park.

Personnel

Dan Austin will be working as a Physical Science Technician for the Park's Physical Science Branch of the Resource Management Division beginning on 11/7/13. Because Jewel Cave National Monument is sharing him with the park during his scheduled furlough, Dan will only be working for us one day a week through the winter months.

Cave Survey & Inventory

Since the last reported length of the Wind Cave survey in Inside Earth, cavers have increased the surveyed length of the cave by 0.42 miles; establishing the current length of 141.00 miles. Our on-going cave resurvey project recently got a big shot in the arm when our funding proposal to resurvey much of the pre-cave management cave survey found in the Wind Cave survey (primarily from the 1950-1970's) was funded by the NRPP program for three years, beginning in 2017. This project will hire a team of four seasonals for three consecutive years to conduct the resurvey work.

The excavated pad and forms for the footings for the new airlock being built on the Walk-In Entrance of Wind Cave. NPS Photo by Rod Horrocks.

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