Cave and Karst Programs

National Park Service
U.S. Department of the Interior

Inside Earth

Dave Hays, Natural Resources Branch Chief at El Malpais National Monument, in Skylight Cave. NPS Photo by Dale Pate

Spring 2013 Issue

Calendar

May 2013

6-10th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst in Carlsbad, NM https://sites.google.com/site/sinkholeconference2013/

15-19th & 20-24th Western Bat Survey and Acoustic Inventory Techniques in Portal, AZ http://www.batmanagement.com/Programs/programcentral.html

June 2013

2-22nd Karst Field Studies Class through WKU. Karst Geology (2-8th), Cave Photography (10-14th), Karst Hydrology (17-21st), Karst Geophysics (9-15th), Cave Biology & Ecosystems (17-22nd) http://karstfieldstudies.com/

July 2013

6-13th National Cave Rescue Operations and Management Seminar in Schoharie, NY http://www.caves.org/commission/ncrc/national/2013Seminar/seminar2013.htm

21-28th International Congress of Speleology in Brno, Czech Republic http://www.speleo2013.com/

August 2013

5-9th NSS Convention in Shippensburg, PA http://nss2013.caves.org/

22-26th Rescue Technician: Cave Rescue I/II in Huntsville, AL http://www.hcru.org/rescueclass

September 2013

8-12th & 14-18th Eastern Bat Survey and Acoustic Inventory Techniques in Park City, KY http://www.batmanagement.com/Programs/programcentral.html

October 2013

27-30h GSA 125th Anniversary Convention in Denver, CO http://communty.geosociety.org/2013AnnualMeeting/Home/

November 2013

4-8h National Cave and Karst Management Symposium (NCKMS) in Carlsbad, NM http://www.nckms.org/2013/

June 2014

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

Submit Entries for the Calendar to: andrea_croskrey@nps.gov

A Word from WASO

Submitted By Dale Pate

Making Progress

Over the last nine months the Cave and Karst Program has been making good progress. One aspect of the program is trying to learn more about the park units and the cave and karst resources they contain. The most recent count of park units with caves and/or karst has risen to 136, with 96 of these parks containing a total of 4,935 caves and with 40 units containing karst with no known caves. These numbers will continue to change as the program develops. On another note, we recently updated the National Park Service Cave and Karst Program website. A brief description for that is highlighted below along with other activities that have occurred in recent months, including the addition of a new volunteer.

Dale Pate, NPS National Cave and Karst Program Coordinator

Welcome Limaris Soto

In February, Ms. Limaris Soto became a volunteer for the NPS Cave and Karst Program and works at the Geologic Resources Division (GRD) office in Lakewood, Colorado. Limaris received a Master of Science in Geology from the University of South Florida in 2005, completing the first karst paleoclimate study in Florida. Her initial work for the program will be to develop cave and karst summaries for NPS units with known cave and karst resources. These summaries will help us have a better understanding of the cave and karst geology and resources found within park units and help us provide more accurate information to various programs such as the 'State of the Parks' and 'Foundation Statement' documents.

NPS Cave and Karst Website

An updated website for the NPS Cave and Karst Program is now available at: http://nature.nps.gov/geology/caves/index.cfm

It was no small task to update the content, links, and photos and get all the information into the new(ish) NPS website template. Thank you to everyone that helped, including Jim Wood and Andrea Croskrey. None of us would have had the time to take this on alone but by working together we got the first phase done.

The next step for this updated website is to build upon this initial effort, particularly within cave and karst management-related activities and information. We welcome thoughts and ideas on new content, more links, and other information that can help advance the conservation, management, education, study, and enjoyment of the cave and karst resources found within the National Park Service park units.

El Malpais TAR

I traveled to El Malpais National Monument the week of December 4-8, 2012 for a Technical Assistance Request (TAR) to discuss issues and ideas for the completion of two planning documents for the monument. The first document is to be an Environmental Assessment (EA) that will potentially open several caves to recreational activities. This follows the 2010 closure of all caves on the monument to recreational caving due to concerns of the spread of White-Nose Syndrome (WNS) in bats and the need for a planning document. Before the 2010 closure,

recreational caving was one of the most popular activities at the Monument. The second document is also to be an EA and will be a more comprehensive review of the cave program through the development of a cave management plan.

Foundation Statements & State of the Parks Programs

These two key national level programs will be in progress for NPS units over the next few years. The development of Foundation Statements for each park will focus on a park unit's purpose, significance, fundamental and important resources, and interpretive themes. For more information on this program, visit: http://www.nps.gov/applications/digest/headline.cfm?type=Announcements&id=12245

The State of the Parks program will look at status and trends for natural features and processes and cultural features as determined through analysis of available information. This program is basically establishing a snapshot of how resources are faring within park units.
It is important for the Geologic Resources Division to be a part of these programs by working with each park unit and providing input into the development of documents that contains significant geologic features and processes. For the Cave and Karst Program there are two separate projects that are in place to help us know and understand the cave and karst resources found within park units and that will help make our analysis and professional opinions on the status and trends of these resources more accurate.

The first project is to develop general summaries of the cave and karst resources found in individual park units from GRD Geologic Resource Inventory reports and other information available to the general public. Limaris Soto is doing an excellent job developing these summaries. The second project is a contract with the National Cave and Karst Research Institute (NCKRI) to provide a report to the NPS containing an expanded view of cave and karst resources within park units and will include information on educational programs given at each park unit also. This information will mostly come from an evaluation survey that park units with cave and karst resources will be asked to complete. This project will help identify information gaps and critical issues that may need further discussions and studies. I encourage each park to fill this survey out as completely as possible. If your park has cave and/or karst resources, but has not been contacted by NCKRI by mid-April, please let me know. We will make sure you get access to the online survey.

Program Partners

A Memorandum of Understanding has been renewed with the Cave Research Foundation (CRF). This 5-year document has the objective to "cooperatively engage the CRF in scientific research, cartography, and interpretive activities on lands administered by the NPS." This document can be found on the new website at the following location: http://nature.nps.gov/geology/caves/publications.cfm

We are also in the process of renewing a similar agreement with the National Speleological Society. Once completed, this new agreement will be posted in this same location.

Summary

While we have made inroads, we still have a long ways to go. The potential for this national level program is tremendous. I encourage employees at all cave and karst parks to consider how this program can help conserve and protect these types of resources in your park while encouraging education and outreach to an interested and engaged public. Don't work at a national park? That's okay. I still need your thoughts and ideas on these same topics. Please give me your ideas at: dale_pate@nps.gov

Braided Cave is a well-known cave in the lava flow at El Malpais National Monument, New Mexico. The caves in the monument have been closed to recreational caving since 2010 due to concerns about the spread of White-Nose Syndrome (WNS) in bats of the United States. NPS Photo by Dale Pate

White Nose Syndrome, 2013 Update

Submitted By Kevin Castle

WNS Overview, A National Perspective

White-nose syndrome (WNS) is a disease of cave-hibernating insectivorous bats caused by a fungus, *Geomyces destructans*. The disease was first observed in four caves near Albany, New York, in the winter of 2006 –2007. Since 2007, white-nose syndrome has spread into 21 additional states and 5 Canadian Provinces, and has devastated populations of bats in its path. Overall declines of hibernating colonies at the most closely monitored New York sites reached 75% within two to three years of initial detection, and declines have approached 100% in some areas. As of April 2013, WNS has been detected in 7 species of hibernating bats, and *G. destructans* has been found on 2 additional species without apparently causing disease.

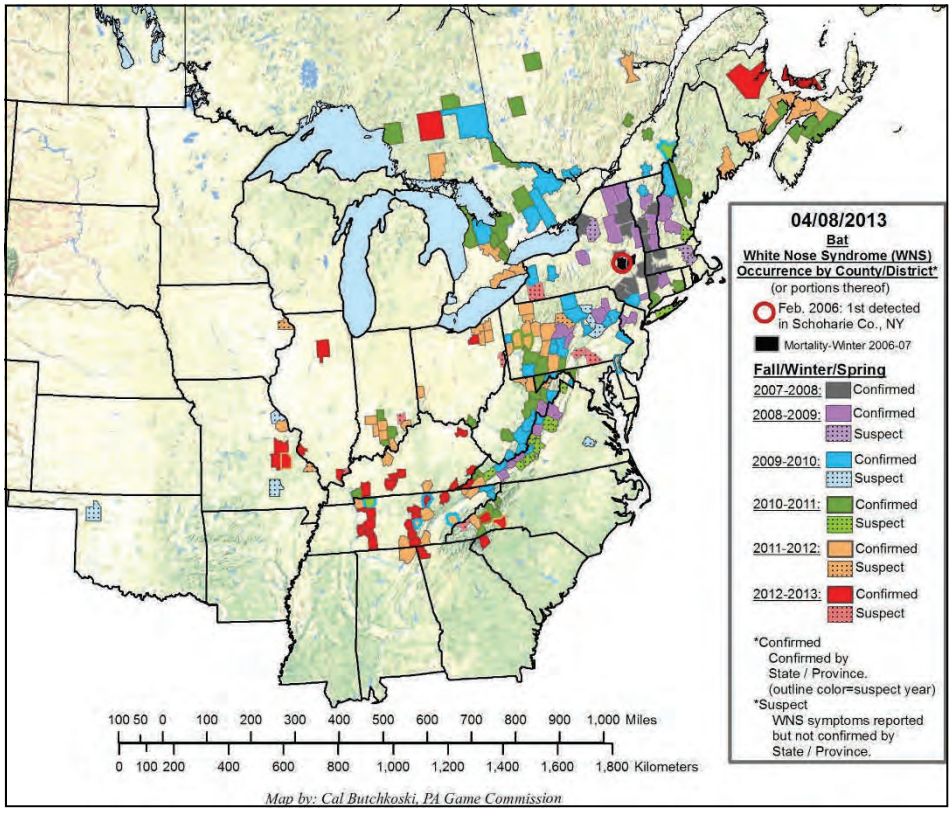
In 2011, *G. destructans* was identified as the causal agent of WNS. This fungus thrives in low temperatures (5-14°C; 40-55°F) and high levels of humidity (>90%), conditions that are characteristic of the bodies of hibernating bats and the caves and mines in which they hibernate. Chronic disturbance of hibernating bats can cause high rates of mortality through loss of fat and possibly water, and effects associated with skin infection by *G. destructans* may also cause bats to consume critical fat and water reserves during winter.

More than half of the species of insectivorous bats that occur in the U.S. rely on hibernation as their primary strategy for surviving the winter, when insect prey is not available. Four endangered species and subspecies of bats in the U.S. rely on undisturbed caves or mines for successful hibernation, and all four of these species (Indiana, Gray, Virginia big-eared and Ozark big-eared bats) hibernate/reside within the WNS affected area. Although the potential for the cold-adapted fungus to continue spreading is currently unknown, the implications of it undermining the survival strategy of so many bat species are enormous. We are just beginning to appreciate the roles bats play in North American ecosystems, and the impact of WNS on bat populations. We need to further understand its potential to influence ecosystem function, for example through cascading effects on bat prey abundance.

Little brown bat; close-up of nose with fungus, New York, Oct. 2008. Photo by Ryan von Linden/New York Department of Environmental Conservation

Species of bats with WNS:
- Big brown bat (*Eptesicus fuscus*)
- Eastern small-footed bat (*Myotis leibii*)
- Gray bat (*Myotis grisescens*, **endangered**)
- Indiana bat (*Myotis sodalist*, **endangered**)
- Little brown bat (*Myotis lucifugus*)
- Northern long-eared bat (*Myotis septentrionalis*)
- Tricolored bat (*Perimyotis subflavus*)

Species of bats with *G. destructans* only:
- Cave bat (*Myotis velifer*)
- Southeastern bat (*Myotis austroriparius*)



WNS and the National Park Service

WNS or *G. destructans* have been found in 10 national parks:

- Acadia National Park (WNS)
- Chesapeake and Ohio Canal National Historic Park (WNS)
- Chickamauga and Chattanooga National Military Park (WNS)
- Cumberland Gap National Historical Park (WNS)
- Delaware Water Gap National Recreation Area (WNS)
- Great Smoky Mountains National Park (WNS)
- Mammoth Cave National Park (WNS)
- New River Gorge National River (WNS)
- Ozark National Scenic Riverway (*Gd*)
- Russell Cave National Monument (WNS)

Since spring 2009, the NPS Wildlife Health Branch (WHB) has led an NPS WNS working group made up of cave and bat ecologists, regional biologists, and park superintendents. The primary objectives of the working group are to disseminate information among parks and regions and to coordinate NPS WNS response and management activities nationwide. A number of NPS biologists have helped with WNS national planning efforts through their input to various National Plan working groups. In addition, the NRSS Associate Director is a member of the WNS National Plan Executive Committee, and NPS Wildlife Veterinarians are members of the WNS National Plan Steering and Coordination Committees.

A September 2010 Deputy Director's guidance memorandum recommended that parks across the country work to minimize the risk of WNS impacting NPS resources. The NPS WNS Working Group is currently working to provide an update to the 2010 guidance memo. The primary recommendations of the memo were that field-based staffs continue to make WNS management decisions based on the best science available and in accordance with the NPS mission, policies, and park enabling legislation, and that efforts be made to limit the human-assisted spread of WNS into or out of NPS units. In response to the memorandum, parks have written or updated Cave Management Plans or have used the Superintendent's Compendium or other means to take a number of actions to help manage WNS:

- In parks where cave visitation is allowed, access to caves requires a permit or tour ticket. In parks where visitors can be screened prior to cave entry and gear can be decontaminated or disallowed as necessary, such as NPS tour caves, NPS caves remain open. Where those precautions cannot be implemented, caves have been closed.

- Many NPS units have focused efforts on educating visitors, partners, and neighbors about cave ecosystems, bats, and the potentially devastating impacts of WNS. For example, Mammoth Cave National Park has developed a WNS information booth, educational posters, and a video that provide information to over 450,000 cave visitors per year, and Great Smoky Mountains National Park, which does not offer cave tours, has produced a WNS podcast that is available online.

- Parks across the country have been supporting WNS research by monitoring bat populations, conducting disease surveillance, sharing existing data, and providing research sites and research assistance.

In 2013, the NPS produced a series of podcasts regarding WNS, which are available to parks, the public, partners, and media outlets:

http://nature.nps.gov/multimedia/wns01/index.cfm

According to the NPS Office of Public Health, WNS does not appear to pose a threat to human health since *G. destructans* only grows at temperatures well below human body temperature. However, WNS can cause sick bats to exhibit unusual behavior, such as flying outdoors or at hibernaculum entrances at all times of day and in all types of weather, so bats may be encountered in unusual settings. NPS visitors and employees are being reminded to not handle any wildlife they encounter, including bats, and to notify park employees if they see bats behaving abnormally, or if they come in contact with bats.

For additional information about WNS, please visit:

NPS WNS Website
http://www.nature.nps.gov/biology/wns/index.cfm
Deputy Director's WNS Guidance Memo 2010 (166KB)
http://www1.nrintra.nps.gov/BRMD/WNS/assets/docs/DDWNSGuidanceMemo2010.pdf
National WNS Website
http://www.whitenosesyndrome.org/
USGS WNS Website
http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/index.jsp
WNS Fact Sheet (858 KB)
http://www1.nrintra.nps.gov/BRMD/WNS/assets/docs/WNSFactSheet.pdf

Kevin Castle is a Veterinary Medical Officer in the Biological Resources Management Division in Ft. Collins, CO. He is currently the WNS lead for the NPS. Photo by ©Ralph Arwood

Park Updates

Carlsbad Caverns National Park

Submitted by Stan Allison and Shawn Thomas

Cave Exploration, Survey and Cartography:

Lechuguilla Cave

Since the last Inside Earth update, there have been two Lechuguilla Cave exploration expeditions. Lechuguilla Cave is now 135.88 miles in length.

John Lyles led a seven-person expedition to the Far East Branch November 10-17, 2012. John's expedition succeeded in surveying 1.1 miles of passage, including 0.88 miles of new survey. A significant resurvey effort was completed in Happy Hunting Grounds, an area beyond the Lake of the Lost Marbles in Firefall Hall. Accessing this area required using waders to cross the lake, an activity that was approved by the Cave Resources Office.

The following week, November 19-26, Max Wisshak led a seven-person expedition to the Far West Branch. Max's expedition succeeded in surveying 0.77 miles of passage, including 0.45 miles of new survey. Resurvey and mop up was completed in Southern Climes, South Winds, Romper Room, and Southern Cross, aiding in updating the respective quads for cartographers Max and Hazel Barton. Scientific samples were also collected during the expedition for research being conducted by investigators Max (spar biocorrosion) and Hazel (microbial communities).

Carlsbad Cavern

In February, 2013, Derek Bristol and 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 primarily worked on the New Section, which contains the Guadalupe Room, the second largest room in the cave, discovered in the 1960s. Because this area has been known for almost 50 years, referring to it as the New Section is a bit outdated and is being discontinued; this area is now named the Guadalupe Room Complex. Derek also completed the resurvey of the Spirit World, a passage that connects to a dome over 200' above the Big Room. The Spirit World was first accessed in the 1980s when Ron Kerbo, Jim Goodbar, and Mike Queen used helium balloons to lift a pull cord and hook it over a stalagmite at the edge of the passage.

Slaughter Canyon Cave

In February, 2013, Dave West was in the park with Derek and Ed, but instead of working in Carlsbad Cavern, Dave led resurvey efforts in Slaughter Canyon Cave, a backcountry cave that is also used for primitive, flashlight visitor tours. Dave spent six 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.

Stan Allison admires a large helictite found in the newly discovered Gilead section of Spider Cave. Photo by Paul Burger

Spider Cave

In March, 2013, Chris Amidon and Paul Burger returned to the park to continue working on leads left in the new section of Spider Cave that Chris discovered a year earlier. Chris, Paul, Stan Allison, and Shawn Thomas comprised 3-person teams for five consecutive days of survey. The new section is a maze of passages, collectively known as Gilead, dominated by parallel rift-like passages interconnected by small, gritty crawls. There are also some large (by Spider standards) rooms and heavily decorated areas, including dense concentrations of gypsum flowers and needles. The teams surveyed a total of 0.71 miles of passage during the week, bringing the cave to a new length of 5.06 miles, which surpasses Wind-Hicks Cave (BLM, Eddy County) to make Spider Cave the 5th longest cave in New Mexico. The footprint of Spider Cave has been significantly extended to the north and west, and dozens of leads remain in the new section.

Cave Research Activities:

Dr. Andreas Pflitsch of Ruhr University in Germany visited the park in February, 2013, to download temperature loggers that are part of his ongoing cave airflow and climatology study.

In March, Dave Decker, a PhD candidate in the Department of Earth & Planetary Sciences at University of New Mexico, collected spar (dogtooth calcite) samples from two sites in Carlsbad Cavern. 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.

Park staff recently collected soil samples from multiple backcountry caves for Dr. Diana Northup of the University of New Mexico, who is testing the samples for presence of Geomyces destructans, the fungus that causes white-nose syndrome. Replicate samples are being collected from each site; one sample is combined with lysine buffer (to aid in DNA preservation) and sent to Dr. Northup for analysis, and a second sample is collected dry

Foz Trautner and Andrew Ritzdorf package brave instructor Shawn Thomas in a SKED during the Orientation to Cave Rescue Training class in Park's Ranch Cave. Photo taken by Jason Walz

(no buffer added) and sent to Dr. Kevin Castle, Wildlife Veterinarian with the NPS Biological Resources Management Division, for long-term storage in a deep freezer.

In early April, Dr. Hazel Barton and graduate student Michael Johnston of the University of Akron spent three days in the Southwest Branch of Lechuguilla Cave collecting samples for geochemistry, cell counting, and DNA extraction. These samples are being used to confirm their previous observations that Archaea dominate over Bacteria with increasing depth into the cave.

Cave Rescue Training:

Two cave rescue weekend training sessions were recently organized by the park and held in Carlsbad. Tom Bemis coordinated and served as lead instructor for both trainings, with Stan Allison and Shawn Thomas assisting. In February, an NCRC Orientation to Cave Rescue (OCR) was attended by 18 students, including federal agency staff, state SAR personnel, local fire fighters, and local cavers. The classroom session was held at the National Cave & Karst Research Institute (NCKRI) facilities, and the mock rescue was conducted in Parks Ranch Cave (BLM), an extensive gypsum cave in the Delaware Basin adjacent to the Guadalupe Mountains. During the mock, students worked in hasty, search, comm, and evac teams. The patient was located, patched, packaged, and transported out of the cave intact, including a complete nose (barely), making for a successful mock. In March, a "Small Party Rescue" was attended by eight students, who were able to take advantage of the high ceilings of Carlsbad's Riverwalk Recreation Center, which is housed in a converted power plant. Four rope stations were rigged to the rafter beams over the ball court for practicing pick-offs, counterbalances, and traveling hauls (while dodging the occasional stray basketball or volleyball). A three-story rebelay course was also rigged, and it proved to be a hit at the end of the day. In-cave small party exercises were conducted at Lost Cave (BLM), where students tried out a variety of haul systems constructed with minimal gear to haul patients out of the vertical entrance pit. The small party rescue course was quite inspiring, as the students who took

A cluster of *Myotis sp.* bats found in Arco Tunnel on Craters of the Moon National Monument during the 2013 winter surveys . Photo by Devin Stucki.

the training will now be carrying a pulley and a prusik or two when vertical caving.

Park Filming:

In 2012, Aperture Films was awarded a contract to shoot and produce a short film to be shown in the park Visitor Center. The park has never had a film made specifically for and about Carlsbad Caverns. The production crew spent seven full days in February, 2013 filming scenes throughout Carlsbad Cavern, on the surface (including aerial videography using a helicopter), and in Slaughter Canyon Cave. The film will include a diversity of footage, ranging from visitors walking through the Big Room to cavers using vertical gear to descend to Lake of the Clouds, the deep point of the cave. Stan Allison, Shawn Thomas, and Tom Bemis worked with the crews each day to serve as behind the scenes resource advisors and lighting assistants, while many other park staff members had the chance to participate in front of the camera, acting as uniformed rangers and civilians. The film should be completed and available to view in the Visitor Center by early 2014.

Cavern Lighting Project:

This project is intended to replace the aging 30+ year old Carlsbad Cavern lighting system with new transformers, cables and LED lights. There have been many delays in this project due to test cables having mold, test light enclosures corroding and contractor bids being over budget. This project is planned to start late in 2013.

Cave Resources Office Staffing Changes:

Stan Allison continues in the role of Acting Cave Specialist, while Tom Bemis continues to assist the Cave Resources Office 2 days per week. Shawn Thomas has been hired as a permanent Cave Technician and started work in early 2013. Shawn has extensive NPS cave management experience and is highly qualified for the position. Shawn is very familiar with the cave resources of Carlsbad Caverns National Park, having worked and volunteered for the Cave Resource Offices on many different projects. The Cave Specialist position is being affected by sequestration and the hiring of this position is delayed indefinitely. The reduction of the Cave Resources staff from 4 full time positions to 2 full time and 1 part time positions has resulted in significantly less cave and karst related work being accomplished at Carlsbad Caverns National Park.

Craters of the Moon NM & Preserve

Submitted by Todd Stefanic

In 2007, bats were chosen as one of Craters of the Moon National Monument's "Vital Signs". A Vital Sign is a species that has been chosen for long-term monitoring because of its importance, uncertain conservation status, emerging threats, and/or its value as an indicator of ecosys-

Large passage being checked for breakdown leads during late 2012 survey trip. James Hunter in background for scale. NPS photo by Steve Rice

tem health and environmental change. This vital sign designation, combined with the looming threat of White-Nose Syndrome, highlighted the need to develop a baseline of bat populations, seasonal distribution and habitat use. Developing that baseline, specifically where bats hibernate, has been the focus of resource management staff for much of this winter.

Very little is known about where or how many bats hibernate in caves on Craters of the Moon NM & P (CRMO). In fact, while CRMO has hundreds (if not thousands) of caves scattered over the vast lava flows (roughly the size of Rhode Island), only one hibernaculum is verified and surveyed on a regular basis. In 2012, the wildlife biologist at CRMO piloted a handful of winter cave searches to test methods and White-Nose Syndrome decontamination procedures. That work got going in earnest this winter as park staff visited nearly 40 caves in search of hibernating bats. As a result, 3 new hibernacula were documented. Accessing caves on Craters of the Moon NM & P is a challenging endeavor. Sometimes trips involve snowshoeing several miles across sagebrush and lava fields to reach cave entrances, of which very little may be known. Quite often these efforts were in vain as caves turned out to be unsuitable for hibernating bats, but these efforts have expanded the knowledge of winter bat use in CRMO caves and will allow biologists to better focus efforts in the future.

El Malpais National Monument

Submitted by Dave Hays

El Maplais National Monument is in the final stages of completing a Cave Access & Permitting Strategy / EA to implement a recreational caving permit system, and restore visitor access to a limited number of caves within the monument. The EA will be available for review sometime in April.

Grand Canyon National Park

Submitted by Steve Rice

Exploration

Leandras Cave Extension

Found in 2006, Leandras Cave was surveyed from 2006-2009 for a total length of 8.01 miles. In late 2012, a group re-entered the cave to check two small climbing leads. While these did not pan out, it was noted that a section of the map that was drafted as a wall was actually a borehole passage leading off the main footprint of the map! The team divided into two survey teams, and in two days we mapped an additional 1.1 miles of mainly huge passage, with more still remaining. The cave is now 9.11 miles and continues to expand its lead on the title of longest Arizona cave. The volume of the cave is staggering for its length at 61

million cubic feet. By comparison, the new Dallas Cowboys stadium, the largest domed structure on Earth, is 104 million cubic feet.

A few additional trips occurred to new cave locations as well as continuation of survey on a couple known caves since the last *Inside Earth* update. Approximately 2,500 feet of survey has been added to park caves during these efforts. Cave exploration has been slow recently with winter weather and no access to the North Rim, but picks up in April for hopefully another productive season.

Management

Grand Canyon National Park (GRCA) is currently updating its Backcountry Management Plan (BMP). As part of this process, analyses will be done on proposed new backcountry use zones, as well as looking at cave location proximity to known trails, routes, and newly published canyoneering routes. Locations with potentially affected cave resources will be ranked by resource vulnerability, helping to focus needs for additional inventory and monitoring efforts in the future. Cave management itself will not be addressed in the BMP, but will reference the need for the development of a park Cave Management Plan. Once the BMP process is complete, the Cave Management Plan NEPA process will likely begin soon afterwards.

In other resource management news, GRCA is also currently producing a Landscape Assessment (Greater Grand Canyon Landscape Assessment – GGCLA). This analysis is looking at the entire watershed surrounding the park (almost 5 million acres) to identify significant resources, and how these resources may be affected by such things as development, land use changes, climate change, etc. Caves and their associated resources (biological, paleontological, archaeological, geological) were identified in initial scoping as an important resource that may be quite sensitive to these types of changes. Initial workshops to identify resources, impacts, indicators and threshold limits will be convened in early April.

Upcoming

Survey trips

Several trips are planned this spring and summer to accomplish a number of tasks ranging from cave survey, ridge walking/exploration, water sampling, and installation of visitation monitors.

Graduate research

Graham Schindel worked as a Cave Technician last summer and fall, and is now working on his Master's thesis project investigating the karst hydrogeology of the Kaibab Plateau (North Rim), and the role of the large cave spring systems that drain the plateau. As part of this project, survey, instrumentation and sampling of several of the plateau's large cave systems will be conducted, with the field portion of the project likely wrapping up fall 2013.

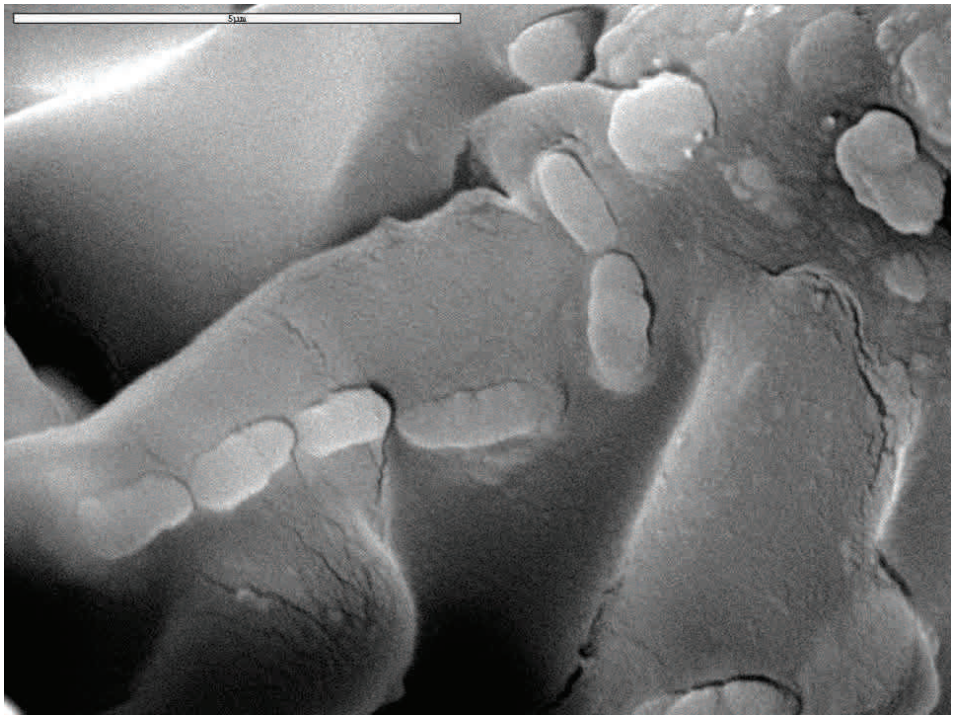
River Trip

The Cave Management program received a grant from the Grand Canyon Association to fund an 8-day trip on the Colorado River to document and inventory many caves along the river through Marble Canyon. In this area, the Redwall Limestone is at or near river-level, making many of these sites susceptible to damage from the tens of thousands of commercial and private river-runners that float by each year. These sites have not yet been comprehensively inventoried and documented for resources, although many are known to contain substantial paleontological and archaeological material. A small group of cave specialists and cultural resources staff will complete the trip late June.

Grand Canyon-Parashant NM

Submitted by Eathan McIntyre

This year marks the start of a three year cave microbiology project partnering with Dr. Diana Northup of University of New Mexico, Albuquerque. Cave adapted microbes, including an overwhelming variety of fungi, bacteria, protists and archaea, create colorful crusts and mats on cave surfaces at Parashant



A scanning electron microscope image of PARA2204 Cave sample (GWC121115-2) of putative ferromanganese deposit (red crystalline). The smooth areas that are cracking under the electron beam are putative biofilm. The rod shapes suggest microbial cells partially covered by biofilm. The scale bar in the upper left corner represents 5µm. Image by Dr. Diana Northup

NM. Microbial organisms known to occur in the monument's caves exhibit properties similar to the group of bacteria known as extremophiles. The initial year of this project explores the biodiversity of microbes, both known and unknown on the monument, providing direction for further research locally and at an international level, and bringing this unusual and rare group to the attention of the public. Understanding these microbes, the microclimate in which they thrive, and their interactions with their environment yields profound implications for other areas of research such as detecting life on Mars as well as subtle shifts in the subterranean- surface nitrogen cycle due to climate change. Much more to come as the first round of sampling completes this Spring.

Ongoing Cave Projects include:

- Paleontology Outings at PARA3507 Cave and PARA3504 Cave, Spring 2013
- Cave Inventory on 400 cave leads, 14 weeks field outing, Winter- Spring 2013
- Cave Microbiology sampling, Summer-Fall 2013

A volunteer brushes lint, and other debris carried in by humans, off of formations on the ceiling of Lehman Cave in Great Basin National Park. Photo by Gretchen Baker.

A close-up of a brush full of debris. Volunteers removed 36.5 pounds of such material from Lehman Caves over the Thanksgiving holiday last year. Photo by Gretchen Baker.

Great Basin National Park

Submitted by Gretchen Baker and Gorden Bell

Lint Clean-up

What happens when over 30,000 people visit Lehman Caves *each* year? It gets dirty. The dirt, hair, lint, and other debris that accidentally gets left behind in the cave can cover cave formations, detracting from the beauty of the cave. The dirt can alter the growth of cave formations, changing how calcite-laden water flows. It can also provide an unnatural food source for cave biota.

Fortunately, part of the cave was cleaned recently. Several members of the Southern Nevada Grotto spent their Thanksgiving vacation at Great Basin National Park, volunteering over 120 hours in the cave. In addition to continuing their survey project, they also cleaned part of the cave, using paintbrushes to dust the lint and other debris off the formations, stairs, and trail. A shop vac was used to suck up the fine material that escaped going into the bags held under the paintbrushes. They removed 36.5 pounds of dirt, lint, hair, and debris from the entrance and exit tunnels and from the Music Room to the Lodge Room.

The results were noticeable immediately. The staircases now gleam, and strands of hair no longer dangle under every step. Formations appear brighter. In fact, park management decided that it would be beneficial to clean even more of the cave.

Over two days in early February, twenty-eight participants came from Utah, Nevada, and California and volunteered over 200 hours to clean additional parts of the cave. This lint camp did much more than remove lint clinging to delicate formations. Participants also removed buckets of sand. Some of the sand dated to over 80 years ago, when it had been brought in to make trails in the cave. Other sand had been brought in as sand bags to help protect delicate areas of the cave when some passages were enlarged. When volunteers removed the sand, they found natural cave features underneath, including some beautiful rimstone dams in the Lodge Room. Participants also removed components of the old lighting system, old rusty nails, and a couple of pennies as part of the 1,900+ pounds of lint, hair, sand, and old trail debris removed from Lehman Cave.

"We plan on having an annual lint camp for the next few years," said Ben Roberts, Chief of Natural Resources. With the NPS centennial in 2016 and the National Speleological Society Convention in Ely, Nevada in 2016, with an estimated 1,000 cavers coming for the event, this is a prime time to get the cave cleaned and looking its best.

Roberts added, "We are really grateful to all the volunteers who made this happen." In addition to knowing that they have helped restore the cave to a more natural ecosystem, volunteers were also rewarded by close-up views of cave biota, including a pseudoscorpion that is only found in the Park, and a behind-the-scenes tour of the Talus Room for participants.

These events generated some positive publicity for Great Basin National Park, with articles in the Las Vegas Review Journal and The Ely Times.

Pleistocene Cave Fauna

Great Basin National Park's resource management staff recently discovered significant Pleistocene vertebrate fauna in Snake Creek Cave. The discovery marks the first time that definitive pre-Holocene fossil vertebrates have been identified in any of the park's 47 known caves. Trips to the cave in September and December 2012 produced discoveries of thin, bone-bearing sediment deposits in at least six different locations as well as one area of deeper stratified fossiliferous deposits. During these two visits the team found a number of what appeared to be fossilized bones and teeth exposed on and immediately below the surface of the sediments. A few samples were removed to better assess the character of these deposits. The samples were subsequently dried and washed, and the resulting concentrate searched under a dissecting microscope.

Four pika dentaries from Snake Creek Cave, associated with specimens of *Aztlanolagus agilis*, an extinct rabbit. Bar scale is 1 cm in length. Photo by Gorden Bell.

The recovered fauna consists mostly of small- to medium-sized mammals. A few hoof bones and teeth provide very limited indications of larger mammals and, with no apparent breakdowns or other sinkhole indications, it seems that large mammals would not likely have made it into the cave to become fossilized. Nevertheless, the utility of the smaller mammals cannot be understated as they provide a deep-time window into changing environmental conditions in the Snake Range and the mountains of the interior Great Basin and may very well give more clues about faunal responses to climate change.

The fauna identified so far is dominated by rodents and rabbits, and some of the more exciting of those include pikas, pygmy rabbits, and the extinct rabbit *Aztlanolagus agilis*. Some of the more common teeth are from marmots, suggesting that the Snake Range supported a much larger population in the Pleistocene than today. Present also are remains of several types of lizards, including horned lizards, as well as snakes and birds. Fish and amphibians are rare, represented to this point only by a single frog element and one fish vertebra. It is expected that additional work in the cave will produce a more robust picture of the faunal assemblage and hopefully a greater variety of extinct animals.

It has never been verified if Pleistocene faunal materials were recovered during early excavations in the park's flagship cave, Lehman Cave. Horse teeth and bones found in archeological excavations there in 1963 have yet to be compared to fossil horses and there is no indication that any of the faunal materials were submitted for radiocarbon dating. However, in Snake Creek Cave the presence of *Aztlanolagus* provides definitive evidence that the associated fauna is, at a minimum, Pleistocene in age. According to published literature, where *Aztlanolagus* is associated with radiometric dates, these are all 25,000 years old or greater. Thus, there is some indication that older portions of the fauna may be concordant with or possibly even prior to the last glacial maximum of the Wisconsinan glaciation which occurred between 26,500 and 19,000 years ago. The next step in assessing the age of the fauna is to submit some of the larger bone fragments for radiocarbon dating.

Oregon Caves National Monument

Submitted by Emily Ring

Over the past year resource staff and volunteers have been collecting, observing and documenting arachnids at the Oregon Caves National Monument (ORCA). While some surface soil work was conducted, primary emphasis was within the cave encompassing twilight zones to deeper rooms off common routes. Specimens were chosen, preserved, labeled and catalogued into a survey database. Several contracted experts received shipments of specimens for identification. Dr. Rod Crawford, University of Washington, examined the majority of the collections from the caves.

Over 60 arachnids were identified down to species and four down to genera. Of these, eight species were new to the monument. Impressively, the northern geographic limit for the species *Calymmaria shastae* was extended over a hundred miles north with this study.

A decade earlier, Crawford had found all species of *Calymmaria* identified from the cave to be *C. emertoni*, a species at the southern limit of its range (Crawford). In contrast, collections in 2011-2012 showed that most of the *Calymmaria* were *C. shastoni*, now at its northern limit. Another spider (*Cybaeus septatus*) was also new for ORCA in 2011-2012 and it is also now at its northernmost limit. The implication of shifting species offers interesting geographic and climatic considerations.

All three species are twilight zone trogloxenes rather than the troglobites and troglomorphs found in deeper parts of the cave where temperatures and relative humidity presumably are responding more slowly to climate change. There has been a 2 degree C. average rise in surface temperatures in the Klamath-Siskiyous (the bioregion surrounding the monument) in the last sixty years. Such change may be affecting some animals, although there is not enough distributional data to determine if there is a general trend among near-surface arthropods. Notably, a well inventoried regional flora indicates that twice as many vascular taxa extended their range to the north compared to those taxa that have extended south (Roth). Ranges already at their southernmost limit are also shrinking northward although not as fast as in adjacent regions.

***Calymmaria shastae*, whose northern geographic limit has been extended over a hundred miles with this study.**

Oregon Caves and other caves in the bioregion have a handful of species at or near their geographic limits. But these species cover a wide range of taxa including a new spider family from a nearby cave. Limits unexpectedly extended south and east may be largely due to higher humidity in the caves than the surface. Taxa reaching their north and east limits may reflect winter temperatures that are higher underground compared to the surface. Oregon Caves National Monument continues to exemplify the Klamath-Siskiyou bioregion's many climate refuges (Olson et al.) and now has some new refugees to harbor.

Olson, David, Dominick A. DellaSala, Reed F. Noss, et al. 2012. Climate change refugia for biodiversity in the Klamath-Siskiyou Ecoregion. Natural Areas Jour. 32(1): 65-74.

Crawford, Rodney L. 2009. Calymmaria emertoni (Simon) Arachnida, Araneida, Agelenidae), a cave twilight spider: troglophile status, range extension, and natural history. Speleobiology Notes 1: 6-8.

Roth, John E. 2009. Flying flowers: Vascular plant ranges move and contract northward in last 60 years (abstract). Presentation at 3rd Symposium on the Ecology of the Siskiyou Mountains.

Ozark National Scenic Riverways

Submitted by Scott House

The summer of 2012 was busy with cave monitoring and survey, mostly accomplished by Cave Research Foundation (CRF) personnel. Surveys were extended

in two of the newer finds in the park. Bealert Blowing Spring Cave is now just short of a mile in length. Other caves were monitored with special attention paid to unauthorized entry. Periodic spot checks of gates revealed few problems. In FY12 over 120 monitoring visits were made to caves.

As winter set in, cave monitoring continued, with an emphasis on bat counts. Particularly we are looking for signs of WNS infestation. Monitoring of major Indiana bat hibernacula was done this winter with NPS and CRF personnel in cooperation with the Missouri Department of Conservation. On the face of it, all bats were healthy and numbers were at least as good as in recent years. However, WNS-detecting swabs were taken of a number of bats and substrate and those results will not be available for some time. Round Spring Cavern was monitored by an NPS/CRF crew in late February and bats were reasonably plentiful, with a good variety of species. Most of the hibernators are *Perimyotis subflavus* (so-called tri-colored bats) but there are also several Myotine species as well.

Thus far in FY13 over 50 cave monitoring visits have been made. Cave surveying in conjunction with monitoring continued at a lower level over the winter, with the survey of biologically-rich McCubbin Hollow Cave being finished.

One cave was recently re-gated. Lost Man Cave in Carter County, long a popular recreational cave, was gated in the 1990s. However, the design did not prove to be substantial enough and the gate was breached repeatedly. A new gate was designed by CRF in 2011 but no funds were available to accomplish construction. However, steel had been previously bought in the hopes that funding would be forthcoming. This summer, funds were found to facilitate construction, compliance work had mostly already been done, and the go-ahead was given in late August 2012. Only three weeks later, the gate was finished by CRF personnel, aided by considerable help from OZAR resource management, fire protection, and facility management. Labor and other contracted expenses were only $2500 with some additional funding from CRF.

A joint agency/organization cache of gating supplies and equipment is maintained at the park's Powder Mill Research Center. In addition to NPS and CRF funding, other materials have been supplied by the Missouri Caves and Karst Conservancy (MCKC) and with U.S. Forest Service (USFS) funds. Other gates in Missouri have been built utilizing this joint gating cache, including (most recently) a massive gate on Bat Cave, Oregon County, on USFS land.

Bat detecting continued in the park during the summer of 2012, utilizing Anabat detectors placed at strategic locations. And the U.S. Geological Survey (USGS) continued a project using broken cave formations as possible indicators of past seismic activity related to the New Madrid seismic zone. So far, several sites have shown a strong relationship to known seismic events.

The Powder Mill Research Center is used extensively by CRF, other cave monitors, Ozark Trail workers, archaeologists, bat researchers, invasive plant researchers, state conservation agency folks, and oth-

Before and after pictures of the new gate at Lost Man Cave in Ozark National Scenic Riverways. The old gate was installed in the 1990s and was breached repeatedly. The new gate was installed in August 2012 with the help of volunteers. Photos by Eric Daniels and Jim Cooley

In the entrance passage of Round Spring Cavern, OZAR Terrestrial Ecologist Kim Houf swabs a bat while CRF members Mick Sutton and Billy Dooling observe. Grating on the floor keeps visitors above the ephemeral stream and protects the aquatic life, including salamander larva. Photo taken by Scott House.

er volunteers and researchers. CRF and the park share minor maintenance duties; major maintenance and utilities are NPS responsibilities. This fall an office area was renovated for use as a cave resource office.

Timpanogos Cave National Monument

Submitted by Cami McKinney

Cave Management Plan

Timpanogos Cave National Monument is in the final stages of a Cave Management Plan Environmental Assessment. The final comment period ended April 4, 2013. In an effort to improve cave preservation, safety, and evaluate impacts from activities in the cave, the park created four alternatives. A no action alternative, a minimal cave management alternative, an expanded cave management alternative, and moderate cave management alternative.

The park selected the moderate cave management alternative as the preferred alternative. It establishes policies regarding the uses of the caves that would balance resource protection and visitor enjoyment. One key recommendation is an alteration in the carrying capacity and frequency of cave tours.

It is anticipated that the FONSI will be completed and signed by early summer.

Middle Cave Lake

Early in the 2012 season, and carrying through 2014, Timpanogos Cave staff are working on a restoration of Middle Cave Lake project. In 1939, tunnels were blasted to connect the three caves now seen on tours at Timpanogos Cave National Monument. To facilitate the tours through Middle Cave, a bridge was placed across the lake. Now more than 70,000 visitors walk over the lake annually leaving behind hair, lint, litter, and debris falling into the lake and filling the lake bed.

Cleaning the lake bed required, both waiting until lake levels were at their lowest in the Fall and then draining the remaining amount to allow full access to the lake floor. In the first year of the project, three seasonal employees worked full time at this project and were able to remove several thousand pounds of unnatural debris from the lake floor. This project will continue into the next several years with more detailed and delicate cleaning of speleothems, and the installation of a catchment system that will decrease debris from staff and visitors in the future.

Wind Cave National Park

Submitted By Rod Horrocks

Projects:

Our project to digitally draft the Wind Cave map with all the detail from the in-cave sketches is progressing. We have now finished nine of the twenty two Wind Cave quadrangle maps and have four more in various stages of completion. In order to add this much detail to such a complex cave map, we divided the new quads into eight levels, up from the three on the 2009 digital map. Once all the quads are completed, we will be combining the quads into nine section maps, which we will provide as PDF's to surveyors working in Wind Cave.

We recently completed a bat survey of Wind Cave and Two Snakes Cave. The Wind Cave bat survey is the second annual survey before we build an airlock on the Walk-In Entrance, which will probably exclude bats that currently squeeze through the revolving door. During this survey, five bats from the genus Myotis were found along the Natural Entrance Tour Route. In Two Snakes Cave, one of our backcountry caves in the Minnelusa Formation, we found a couple of bats hibernating in the entrance area, a Big Brown and a Townsends Big-Eared bat.

Park Updates

We have made resurveying problem Wind Cave surveys a priority this year. Thus far, we have resurveyed 7,307 feet of problem survey. If this pace is maintained for the rest of the year, we will double our previously most productive resurvey year. This brings the total amount resurveyed under this fourteen year-long effort to over 7 miles.

Research:

Brian Fagnan from the South Dakota Geological Survey is in the process of publishing a second geology map of the park at a scale of 1:12,000. This version includes the recently acquired Casey property. A digital version of this map will soon be available at: http://www.sdgs.usd.edu/publications/index.html.

Dr. Art and Peg Palmer are now working on analyzing the data from a two-year cooperative project with Jim Paces and John Stamm from the USGS to date calcite wall coatings in the Lower and Middle Levels of Wind Cave in order to interpret the water-table decline of the Madison aquifer. The Palmers are doing thin-section preparation and analysis of samples with a petrographic microscope and Jim Paces is doing U-series dating of samples at USGS Denver. U-series analysis can be used for dating these samples because the ages of the calcite (at least those samples measured so far) do not exceed the approximate 500,000 year limit of this technique. Older dates will probably require the more expensive U/Pb method. It is hoped that this project will eventually provide the chemical and climatic environments at the time that these coatings were deposited in the lower levels of Wind Cave.

South Dakota School of Mines and Technology student Everett Brill, completed his senior geology research project to study stream cobbles from four sites in Wind Cave. He found that the cobbles in Cobble Hall, Cobblestone Crawl, and WCTU Hall are all composed of quartz, quartzite, sandstone, silty clay stone, and limestone and all originated from flood pulses into three paleo entrances in the bottom of Wind Cave Canyon. He theorized that the larger cobbles found in Room Draculum likely originated from a small side canyon located northwest of

Brad Phillips, Marc Ohms, & Rod Horrocks in the entrance sinkhole of Two Snakes Cave. Photo by Dan Roddy.

the Visitor Center and through a fourth paleo entrance.

Dr. Andreas Pflitsch is continuing his research on the barometric caves in the Black Hills. He is currently conducting more in-depth monitoring of the barometrically breathing well on the Lady C Ranch, located just SW of the park and other blowholes in the vicinity. Dr. Pflitsch's student, Mathias Oppolozer, spent 3 months at the park conducting daily air and rock temperature measurements along the Natural Entrance Tour Route. Mathias will be using his data to write a Master's Thesis.

Personnel:

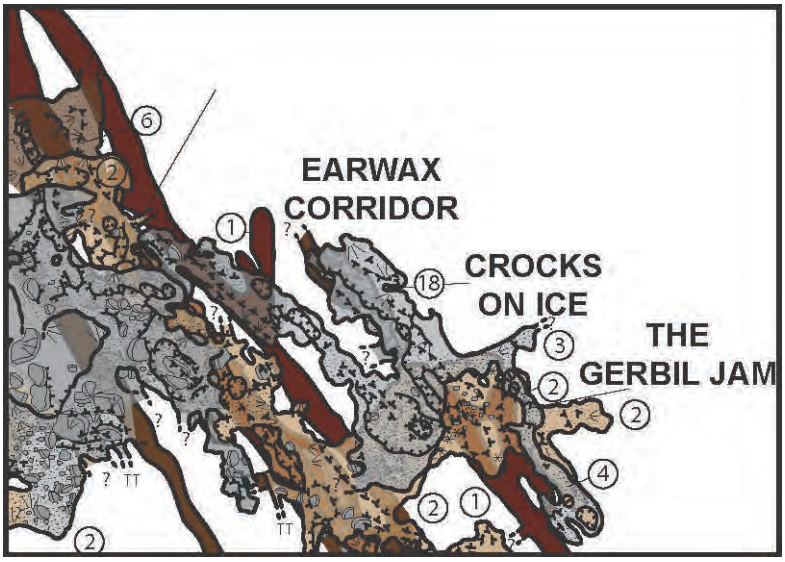
Dan Austin worked for the park's Physical Science Branch of the Resource Management Division as a seasonal Physical Science Technician starting on October 4, 2012. He worked two days a week throughout the winter with us, with his last day on April 4, 2013.

In the last issue of *Inside Earth* we announced a 2013 summer intern position. Unfortunately, we had to cancel this position due to budget restraints.

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 2.85 miles; establishing the current length of 140.58 miles. Since the last issue of *Inside Earth*, Sistema Sac Actun survey in Mexico passed Wind Cave to move up to the second longest cave in the world, dropping Wind Cave down to sixth place in the world rankings.

Marc Ohms has continued working on a project to ridgewalk the newly acquired Casey property, looking for cave and karst resources. As part of this we recently completed a survey of the geologically interesting Two Snakes Caves. The cave is in the Minnelusa Formation and is 341 feet long with 60 feet of vertical relief. It is now one of the longest caves known from the Minnelusa Formation. So far, we have found 3 caves, 20 rock shelters, and 31 karst features and two gypsum karst areas on the Casey property.



A section of one of the new eight level digital cave quadrangle maps that Dan Austin is currently working on.

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