Cave and Karst Programs

Geologic Resources Division
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Edited by Rodney D. Horrocks, Wind Cave National Park

A Newsletter of the Cave & Karst Programs of the National Park Service

Caption: *Art Palmer leads a science trip on the pre International Congress of Speleology field excursion into Slaughter Canyon Cave. He is seen here explaining a redissolved formation that had been corroded by air currents. NPS photo by Dale Pate.*

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Featured Article:

Something Old, Something New

By John Roth Resource Management Specialist, Oregon Caves National Monument

A dissertation has recently been completed on the paleoclimate and dripstone growth rates of Oregon Caves. It is one of the longest high-resolution records of past climate in the Pacific West. The study suggests that most cave enlargement and infilling occurred during interglacials when the ground remained unfrozen for much of each year.

This study also indicates that most of the present interglacial has been warmer and drier than past interglacials. Past studies in many other caves in Canada and the US indicate that most of the cave decorations that have been added in the last 13,000 years or so have been the translucent ends of soda straws. These additions in Oregon Caves appear to range from less than a tenth of an inch to about an inch or so in length. The most noticeable and definite (of that age) are those on broken speleothems mostly vandalized in the last century or so. An example located above Niagara Falls is just about the fastest growing formation known from the cave, most likely because this area was ideally situated to receive water running down bedding plane cracks widened by loss of pressure from overlying rock eroding away. Since <1% of the soda straws in Oregon Caves show any regrowth, the average growth rate is <.0014"/century or around .015" (.032mm) per millenium. Based on three separate studies at Oregon Caves, this is far less than paleoclimate estimates of interglacial growth rates in the more distant past. None of the marble blocks placed in the cave for close to two years show any speleothem deposition even where the water chemistry indicates that calcite should be depositing. So, along with the added effects of a drier than usual interglacial and fire suppression that increases evapotranspiration, climate and vegetation changes appear to have already stopped most cave formation growth in Oregon Caves. Further evidence of reduced soil water comes from a surface study in which vegetation plots done from 1949 to 1950 were re-surveyed in the last two years. Based on vegetation changes in the last sixty years, all the sites now appear to be significantly drier regardless of elevation, slope aspect, or the type of soil.

Still, until the late 1800s, the global climate and extinction rates of the last 13,000 years have been the most stable of the last few million years. So it's not surprising that many if not most visitors to the Monument who don't have a science background dismiss mass extinctions, climate meltdowns, or even the much milder terms like human-caused climate change or global warming. They say that there have always been slight changes in extinction and climate change. The difference is that today's rates of extinctions and global warming are thousands of times faster than at nearly any time in the past. The start of the Industrial Revolution and the last warming trend at Oregon Caves began about the same time. Since then, carbon dioxide in the atmosphere has risen by 100 parts per million, with a rise of 2.4 parts per million just in 2007. That means human activities are putting carbon dioxide into the atmosphere about 16,000 times as fast as nature. The previously fastest known input of carbon dioxide in the atmosphere occurred at the close of the last Ice Ages. This was when carbon dioxide increased by 80 parts per million within 6,000 years. Current human-caused increases in carbon dioxide is about a hundredfold faster than this rate. This is why most areas worldwide will soon see their warmest climates in two million years or more. As with Earth's hottest years, most of the hottest days on record in the Monument (up to 102^0 F. at 4,000' elev.!) have only occurred in the last decade or so. High summer temperatures at Oregon Caves for the last decade or so are often in the low nineties whereas they were more often in the high eighties before then.

In accord with other North American paleoclimate studies and recent climate trends, the rapid climate warmings of the past 250,000 years at the Caves were also associated with greater variability in climate and likely even in weather. So not only is warming happening too fast for many if not most

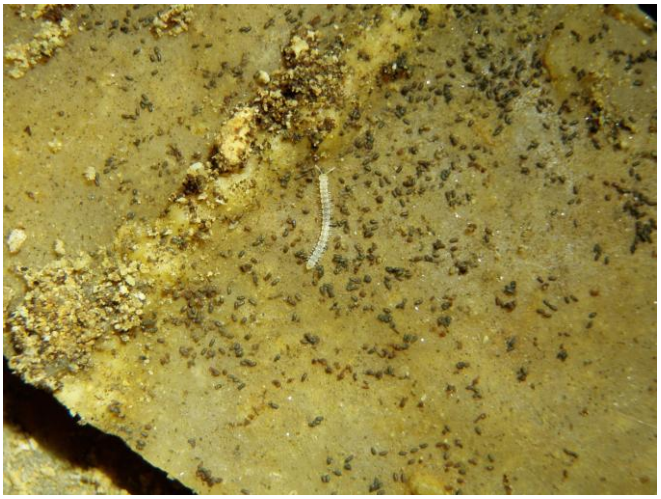
species to adapt to through evolution or even migration, climatic variation is also becoming more unpredictable in both rainfall and temperatures at all levels from within a single season to years to decades to centuries. Like the overall rapid warming itself, these changes tend to be so fast that species cannot easily adapt to them even by migrating to more climate predictable areas, like coastal areas to the west of Oregon Caves. Compared to surface species, migration is usually slower in most cave species anyway. Long distance migration, usually hitchhiking on other animals, even more rarely occurs in troglomorphic species compared to cave species in general. This probably is especially true when the surface is often seasonally drier than the underlying caves are, as is our case. These species are not only troglobites, those species restricted to cave and very similar habitats; sometimes these troglomorphs are called the "true or pure troglobites," being more modified to save energy when compared to less-cave adapted "cousin" species.

New Genus of Millipede Found in Great Basin National Park

By Gretchen Baker, Ecologist, Great Basin National Park

Editors note: also published in The Midden, the GRBA RM newsletter.

A tiny white millipede that has only been found in a handful of caves at Great Basin National Park, including Lehman Cave, has recently been described as a new genus. This addition to science took many years, with collections of the millipede occurring in 2003 and 2006 under the lead of Steve Taylor and Jean Krejca, who are co-authors on the paper. The subsequent study and description was undertaken by William Shear of Hampden-Sydney College in Virginia, the lead author. The name of the millipede is *Nevadesmus ophimontis*, with "*Nevad*" referring to the state where it's found, "*desmus*" a common ending for millipedes in the Polydesmidae Family, "*ophi*" meaning serpentine, and "*montis*" meaning mountains. Thus the common name is Snake Range millipede. It is believed that this millipede only lives in caves. Millipedes like cool, moist conditions, so they are relatively rare in deserts. Caves have provided an environment where millipedes can find relative constant humidity and temperatures. *Nevadesmus ophimontis* joins several other named endemic species in the Great Basin National Park area, including the pseudoscorpion *Microcreagris grandis* Muchmore, the harvestman *Cyptobunus ungulates ungulatus* Briggs, and the conotylid millipede *Idagona lehmanensis* Shear. The entire article about *Nevadesmus ophimontis* can be found at: http://www.mapress.com/zootaxa/list/2009/zt02151.html



A new genus of millipede discovered in the caves of Great Basin National Park. The millipede was recently named Nevadesmus ophimontis. Photo by Ben Roberts.

Photos and descriptions of many cave species can be found on the park's website: www.nps.gov/grba in the Nature and Science section.

Cave Vital Signs Workshop held in Lakewood, Colorado

By Rod Horrocks, Physical Science Specialist, Wind Cave National Park & Dale Pate, Acting National Cave and Karst Program Coordinator, Geologic Resource Division

On November 18, 2008, a Cave Vital Signs Workshop was held at the NPS Lakewood,

Colorado office. Thirty three people representing three groups, including: various National Park Service sites with cave and karst resources, NPS programs that could potentially monitor cave and karst resources, or groups working on contracts to monitor cave and karst resources at NPS sites, got together to discuss creating protocols for long-term monitoring of cave and karst resources. This meeting was a follow up on the Cave Ecosystem Workshop held on April 23, 2003 at the Cave Research Foundation's Hamilton Valley Center near Mammoth Cave National Park. The 2003 meeting was held to start the long-term ecological monitoring program in the Mammoth Cave area. That meeting was held at Mammoth Cave because that park had been chosen as the prototype for NPS cave and karst parks. The 2009 meeting was held in Lakewood to determine which type of resources could be monitored at all NPS cave sites and to form task groups to write up a protocol or Standard Operation Procedure (SOP) for each of the parameters identified.

Participants in the Cave Vital Signs Workshop in Lakewood, Colorado on 11/18/2008.

Steve Fancy, the NPS I&M Coordinator, opened the meeting and he was followed by Dale Pate, the Acting NPS Cave & Karst Program Coordinator. Dennis Davis, the Superintendent of Timpanogos Cave National Monument, facilitated the meeting. The following objectives were identified for the workshop.

- Define a set of specific, measurable monitoring objectives for a modest set of priority indicators for long-term monitoring of cave resource condition.
- Scope out some simple but effective methodologies for addressing these monitoring objectives, and discuss simple but effective approaches for managing, analyzing, and reporting the monitoring results.
- Set responsibilities and schedule for parks to take lead role with one or more of the agreed to protocols for their development and completion.
- Establish a communication network of cave parks for the distribution of protocols and future communication and coordination among cave parks.

After two days, the group decided that the monitoring priorities that would be applicable to all cave and karst sites were: cave visitor impacts, hydrology, cave meteorology, and cultural/paleontological resources. It was decided that SOP's would be developed for inventory, ecology, and cultural/paleontology. It was also decided that a monitoring protocol would be developed for cave visitor impact, hydrology, and cave climatology. A lead was then chosen for each protocol and SOP. It was decided that Rod Horrocks would lead the cave visitor impact protocol, Cami Pulham would lead the Hydrology protocol, and Mike Wiles would lead the cave meteorology protocol. It was also decided that Ben Roberts would lead the Inventory SOP, Joel Despain would lead the Ecology SOP, and Bob Ward or Dana Sullivan would lead the Cultural/Paleontological SOP. The group is hoping that all their documents can be written, peer reviewed, and implemented within two years.

A listserve has been developed for interested parks to send and receive email messages concerning any cave and karst related topic. To subscribe to the listserve, interested parties can send an email to majordomo@webmail.itc.nps.gov with a single line saying the following: subscribe cave-karst. Additionally, the idea of forming a cave advisory group to address major cave and karst issues and to facilitate communications among parks with caves is being evaluated.

Contacts – For more information contact Denis Davis, Superintendent at Timpanogos Cave National Monument at 801-756-5239 or Dale Pate, Acting National Cave and Karst Program Coordinator at 575-785-3107.

Park Updates (Listed alphabetically):

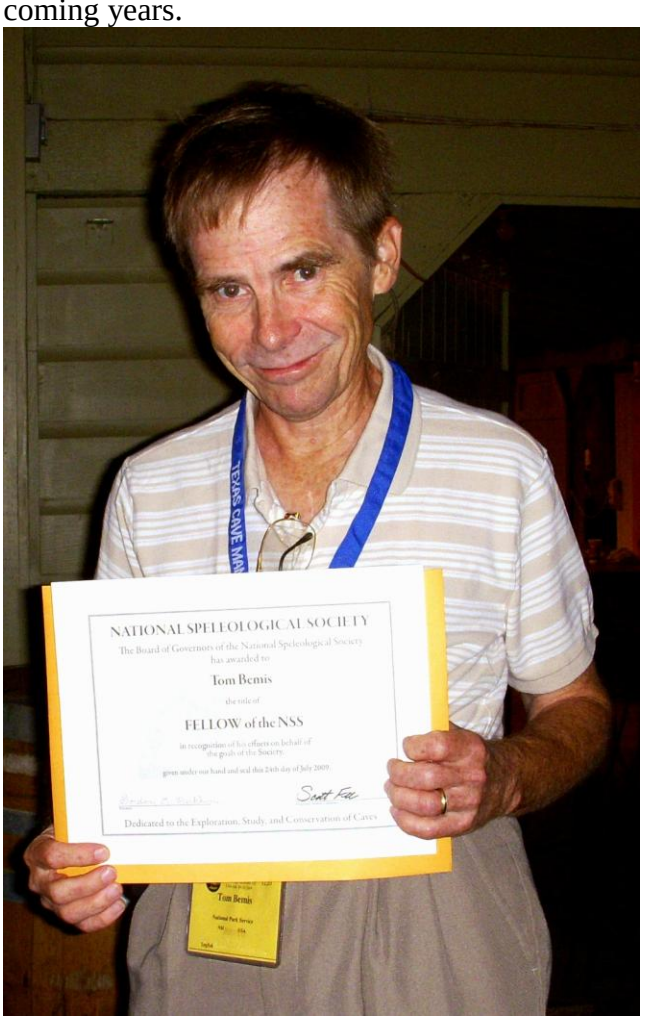
Carlsbad Caverns National Park

By Stan Allison, Physical Science Technician & Dale Pate, Supervisory Physical Scientist

Tom "Boomer" Bemis Retires

After slightly more than 30 years of federal service at Carlsbad Caverns National Park, Tom "Boomer" Bemis retired August 3, 2009. Tom started at CAVE in July 1979 working in Interpretation; then moved to Facility Management, and finally Resource Stewardship and Science as a Cave Resource Technician. Tom has had a hand in many projects over the years, from maintaining the radio systems to replacing and testing various cave lights to participating in the annual winter bird counts. During his time at the park, Tom has had some hair-raising experiences, such as witnessing park employees, visitors, and the underground lunchroom taken hostage by gunmen, and when he and a fellow employee did "white water rafting" down Walnut Canyon in a flood.

Still, Bemis is perhaps best known in the park and the state as a Search and Rescue Coordinator. Boomer is a native of Carlsbad, New Mexico and has long been involved with vertical caving, which requires ready skills with rope rigging and climbing. Eventually, he began sharing his skills and knowledge by teaching others how to safely be on rope and became involved in search and rescue after "saving" a friend whose hair got caught in his rappel device. Tom has taught scores of people everything about ropes from basic knots to methods of rigging multiple pulley systems for high-angle rescues. Without a day of rest, Tom will start his new job as an adjunct instructor of search and rescue at the Permian Basin Regional Training Center in Carlsbad. Although he will be missed on a day to day basis, he assures us that he'll be back in the park to help with ongoing cave restoration projects and sharing his expertise on cave lighting as the park plans to upgrade the entire electrical system in Carlsbad Cavern in the coming years.



Tom Bemis was recognized as a Fellow of the National Speleological Society in July of 2009. This special designation is extended to a limited number of people who exemplify, over many years, their dedication to promoting caves and advancing cave research and protection. NPS photo by Paula Bauer.

The park will hopefully be rehiring this position in the coming months.

Pre-and Post ICS field Trips

Carlsbad Caverns NP hosted pre- and post field trips and one bus excursion for the International Congress of Speleology during the month of July 2009. The Pre-ICS trip was a science-based field

trip which included about 30 national and international cavers and scientists led by Louise Hose. The post-ICS field trip was led by Pat Seiser with help from Phyllis Boneau and was geared more to general caving and included about 25 cavers and scientists. The group was provided free admission to the general tour area of Carlsbad Cavern and a guided trip through the King's Palace area. In addition, the park provided free admission to the general self-guided tour of Carlsbad Cavern to a number of the ICS participants.

Infrastructure Changes Coming

Slated for this fall, two separate projects will continue significant changes to the infrastructure that are located directly on top of Carlsbad Cavern. This includes the abandonment of most of the parking area within Bat Cave Draw. A new turn around and handicap parking area will be constructed on the west end of this parking lot and all asphalt will be removed from the rest of the current parking lot. This parking lot is a part of a Historic District and so the rock walls will be left in place while native vegetation will be planted where most of the asphalt is now. The second project slated to be accomplished this fall is the removal of the west pod of six 3-bedroom Mission 66 apartments now located on the very top of the ridge. These projects were initially approved through the Carlsbad Cavern Resource Protection Plan completed in October 2002.

In addition to these two projects, the park has also been slated to receive over $8 million to completely replace the entire electrical/lighting system in Carlsbad Cavern beginning in 2011.

Wooden Gate Replacement in Left-Hand Tunnel

The park is also currently in the process of removing the solid wooden gate and barrier that is located at the beginning to Left-hand Tunnel just off the east end of the Underground Concessions Area (UCA). A new stainless steel bar barrier and gate is in the process of being constructed to replace the wooden structure. This barrier helps keep visitors from wandering out of the UCA and entering Left-hand Tunnel without a guide. The old barrier is slowly deteriorating in the cave environment and has completely changed airflow patterns in its immediate vicinity. A new bar barrier will allow airflow patterns to return to a natural state.

Current Survey Stats

Lechuguilla Cave - Currently 127.02 miles (204.4 kilometers) long and 1,604.2 feet (489.0 meters) deep.

Carlsbad Cavern - Currently 28.73 miles (46.2 kilometers) and 1,031 feet (314.2 meters) deep.

Great Basin National Park

By Ben Roberts, Natural Resource Program Manager

Great Basin National Park began work in the summer of 2008 to restore large areas of the cave floor in Lehman Cave to a pre-disturbance condition. Restoration will be accomplished by removing 1,800 feet of unused electrical system wiring and 800 feet of paved walkways. The trail section through the West Room and Talus Room has been permanently closed since 1981 due to safety concerns about rock fall. The trail walkways are being removed with power and hand tools, loaded into 5 gallon buckets and then hauled out of the cave in wagons.

Approximately 380 feet of trail and over 1400 feet of electrical wire have been removed so far, all in the Talus Room section. In spite of its name, during this summer's restoration, dozens of buried formations have been rediscovered including large sections of flowstone and stalagmites. The layer of asphalt (above the crushed rock and sand but below the cement) has permanently stained many of these features. The park is currently transitioning from the Talus Room area to the narrow passage near the Sunken Gardens. We hope to have this section completed by next summer and the large flowstone to pool features restored.

A recent newspaper article about cave resources at Great Basin National Park can be found at:

http://www.lvrj.com/news/new-cave-species-have-been-identified-at-great-basin-national-park.html

Before photo: Flowstone in the Talus Room that had covered with trail construction debris. NPS photo by Ben Roberts.

After photo: Flowstone in the Talus Room after the trail construction debris had been removed. NPS photo by Ben Roberts.

Paved trail impeding natural water flow route in the West Room in Lehman Caves. NPS photo by Ben Roberts.

Jewel Cave National Monument

By Mike Wiles, Cave Specialist
& Rene Ohms, Physical Science Technician

Jewel Cave is conducting a hydrologic dye trace to determine whether water from three different surface locations makes its way into the cave, and where it appears in the cave. This will give park management information that can be used when making critical management decisions regarding the highway, sewage system, herbicide use, fire, and other potential projects.

The cave management staff is using charcoal "dye bugs" and grab samples to detect dye that enters the cave. The charcoal bugs pick up any dye present in the water, giving a positive or negative for the time period that the bug is at the site. Grab samples provide information about the amount of dye that is at that location at the moment in time that the sample was taken, and can be used to

resolve technical issues that can arise in the lab when the charcoal bugs are tested. The dye analysis will be conducted by Crawford Hydrology Lab, in Bowling Green, Kentucky. Sampling will be done at 12 in-cave sites at intervals of one, three, six, and 12 months after injection. Grab samples will be taken at each sampling interval and charcoal bugs will be replaced. If dye is not recovered at some or all of the sites during the first 12 months, the study will continue for an additional two years.

On September 28, 2009, fluorescent dyes were injected at three locations: Jewel Cave Spring, Prairie Dog Spring, and a sewer manhole near the Administration building. Three different tracer dyes are being used, so that any positive tests can be definitively traced back to their source. They are: Rhodamine WT, Fluorescein, and D&C Green #8.

Injecting D&C Green #8 at Jewel Cave Spring (cistern) for the Jewel Cave dye tracing project. NPS photo by Mike Wiles.

Injecting Fluorescein at Prairie Dog Spring for the Jewel Cave dye tracing project. NPS photo by Mike Wiles.

Injecting Rhodamine WT into the sewage system as part of the Jewel Cave dye tracing project. NPS photo by Mike Wiles.

Oregon Caves National Monument

By Shawn Thomas, Physical Science Technician

Cave monitoring continues to be a major emphasis in the Resource Management division at Oregon Caves. We are currently in the final year of a 3-year biomonitoring project, a study designed to determine whether species richness and diversity differ in areas with varying levels of lint accumulation. This study is being conducted using 7 baited sites, 5 in Oregon Cave and 2 in lesser caves within the Monument. Though less than 10 species are commonly seen in the cave, over 40 types of macroinvertebrates have been observed in and around the traps during this study. Additional cave monitoring includes stream depth

and temperature, infiltration rates, seasonal pool depths, cave climate, and CO_2 levels.

Another long-term project we're involved with is a marble dissolution study, currently in its second year. Five marble slabs have been placed in the cave, either under constant drip sites or submerged in streams or pools. The water at these sites is monitored for temperature, pH, and conductivity on a weekly basis. Each month the marble slabs are removed from the cave to be dried and weighed. Preliminary data suggests dissolution is strongest in the lower entrance of the cave, where the cave stream is most aggressive due to mixing of multiple source waters. We have also conducted "critter surveys" for several years, which consist of a timed visual search of the tour route. Typically we see harvestmen, moths, spiders, crickets, and bats. Over the past winter we documented stable numbers of hibernating Townsend's big-eared bats, with a population hovering around 30 individuals.

We have hosted two cave restoration weekends over the past six months. Last fall we participated in National Public Lands Day (NPLD) by inviting the public to join us for a day of lint removal. Through newspaper and radio spots we recruited 10 participants from southern Oregon, and most were new to the idea of cave cleaning. Everyone involved had a great time, and we removed over a pound of lint and trash in one day. This marked the second consecutive year that Oregon Caves has served as a host site for NPLD, and to our knowledge we are the only cave park involved with the event. During winter we were joined for a weekend by members and friends of the Cascade Grotto, based in Washington. The Cascade Grotto has held their annual Oregon Caves visit over Presidents' Day weekend for the past several years. This year 10 volunteers spent 2 days in the cave picking lint and trash, cleaning stairs and trails, and removing lampenflora.

One of the most recent projects in our division has been the survey of the small caves within the Monument. In addition to Oregon Cave, at over 3 miles in length, there are 5 other caves within the same marble band that average just over 100 feet in length. The park previously had very little information on these caves, incomplete survey data, and no proper maps. Over the fall and winter, the survey and cartography was completed for all 5 caves. Additional work on the small caves will include conducting cave resource inventories, hazard-fragility assessments, and visitor impact inventories. Data for the small caves will be incorporated into the park GIS.

In other news, 2009 marks the centennial of Oregon Caves National Monument. The Monument was dedicated on July 12, 1909 by President Taft, who set aside 480 acres of land within the Siskiyou National Forest to protect "certain natural caves . . . of unusual scientific interest and importance . . ." The Forest Service administered the Monument until 1933, when it was transferred to the National Park Service. The centennial will be celebrated on July 12 and throughout the summer with a variety of special events and activities.

Timpanogos Cave National Monument

By Bonny Armstrong, Physical Science Technician

Cave Bio-inventory Project

Immediately following the cave biodiversity workshop, while the new knowledge was fresh and enthusiasm was high, the 2009 Timpanogos Caves bio-inventory was begun. This year, 3 goals of the inventory were to 1) continue to identify species that use the Timpanogos Cave system, 2) test and compare different kinds of traps for their efficiency in attracting macroinvertebrates while minimizing impacts on local populations, and 3) create a voucher collection to be kept in the Monument's museum.

A total of 304 organisms were caught in baited and unbaited pit fall traps or observed near them. It was found that pitfall traps baited with cat food or Limburger cheese were generally more successful than unbaited traps. To minimize effects on the local population, traps were checked every 3-4 days and 95% of organisms captured were released unharmed. Specimens have not been

formally identified as yet, but include at least 16 different species of cave crickets, centipedes, springtails, and various beetles, spiders, and flies. One of each of these species has been preserved for the museum collection. This collection will not only help to augment the baseline inventory, it will also give the RM and Interpretation staff a chance to view, and better understand, the cave life of the Timpanogos Cave system.

A resident of the Timpanogos Cave System, class: Chilopoda. NPS photo by Andrew McKinney.

Bat Survey

This summer will conclude a two-year bat baseline survey project conducted by TICA's resource management division. The project was planned to determine the presence and diversity of species occurring in American Fork Canyon. For each bat caught in a mist nest, data was recorded regarding its weight, measurements, species, sex, reproductive status, and wing score. Each individual was photographed and upon release their calls were recorded with an Anabat.

Examining the wing of a Hoary bat, Lasiurus cinereus. NPS photo by Andrew McKinney.

Bat nights varied in productivity; some nights no bats were caught while other nights the staff inventoried 27 bats of 7 different species. Several local residents assisted as volunteers and were rewarded with the experience of seeing these bats up close and personal.

Cave Biodiversity Workshop

Timpanogos Cave National Monument hosted a cave biodiversity workshop May 6-7, 2009. Led by Dr. Jean Krejca, the workshop was attended by 28 people, from as far away as Alaska and Tennessee, representing the NPS, NFS, BLM, U.S. Army, and State of Utah. The 2-day workshop covered topics including diversity of cave life, energy flow and cave food chains, evolution of cave species, how to conduct a cave inventory, management tools, and how to defend your resource. A field trip into Timpanogos Cave provided some hands-on experience and several interesting organisms were found.

Dr. Jean Krejca and TICA Resource Management Specialist Andy Armstrong. NPS photo by Bonny Armstrong.

Tunnel Monitoring

This summer, we are studying airflow through the cave tunnels in an attempt to determine how much air is leaking through the airlock door seals. The tunnels are man-made connections in the cave system, and any air exchange through them is an unnatural, human-caused impact. Twelve HOBO dataloggers have been placed in the Hansen and Timpanogos tunnels. These devices record temperature and relative humidity every three minutes and are placed in pairs, one at ground level and one at ceiling level. Loggers are located

within the airlocked portion of the tunnels, and also within the cave atmospheres on either side. The dataloggers will allow us to graph changes in the cave climate and make determinations about how to better manage airflow through the tunnels. A recently acquired ultrasonic anemometer, courtesy of cave climatologist Dr. Andreas Pflitsch, will soon be installed in the Timpanogos Cave tunnel to provide additional data.

Lower Passage Restoration

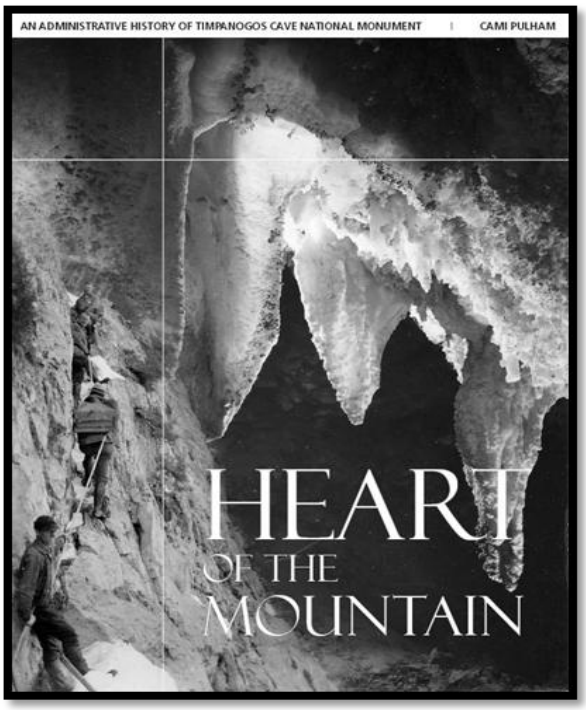
The Lower Passage is a 300' long narrow passage connecting the richly-decorated Chimes Chamber back to the tour trail near the famous Saint Bernard Formation.

Staff and volunteers working on the Lower Passage restoration project in Timpanogos Cave. NPS photo by Daniela Chavez.

Used as a tour route from 1922 through 1938, this passage contains many artifacts of that bygone era, including trail infrastructure such as wood, metal grating, and electrical conduits, as well as cultural objects like old candy wrappers and film containers. It is the desire of TICA's resource management staff to restore this area to a more natural state by removing all unnatural artifacts. Because these items are over 50 years old, they fall under the protection of the National Historic Preservation Act. This historic designation requires cave managers to meticulously survey the location of each artifact, photograph it, carefully remove it from the cave, and accession it for the Monument's museum. Since this area of the cave has been considered "closed" for several years, the project has the added benefit of offering an opportunity for staff and volunteers to see this seldom-seen part of the cave.

Cave Management Plan

Timpanogos Cave National Monument is in the beginning stages of writing its first cave management plan (CMP). This CMP will establish guidelines that provide long-term management strategies to provide for visitor enjoyment as well as protection of natural and cultural resources. There will be opportunities for the public to share thoughts and ideas with us as to what topics should be included in the plan until September 21, 2009. After reviewing the public's comments, relevant issues and alternatives will be incorporated into the Draft Plan/Environmental Assessment. The draft for the CMP/EA should be available for public review and comment in the summer of 2010 (see timeline below). Newsletters will be distributed periodically during the planning process. For the most up-to-date information, to view newsletters, or to comment, please visit the planning website at http://parkplanning.nps.gov/tica.



Cover of the newly published History of Timpanogos Cave National Monument by Cami Pulham.

Kudos

Congratulations to TICA's Chief of Resource Management, Cami Pulham, on her recently published book: *The History of Timpanogos Cave National Monument*. This exhaustive work is complete with many historic photographs and interviews and pulls together an amazing amount of information that had not been previously available to the general public.

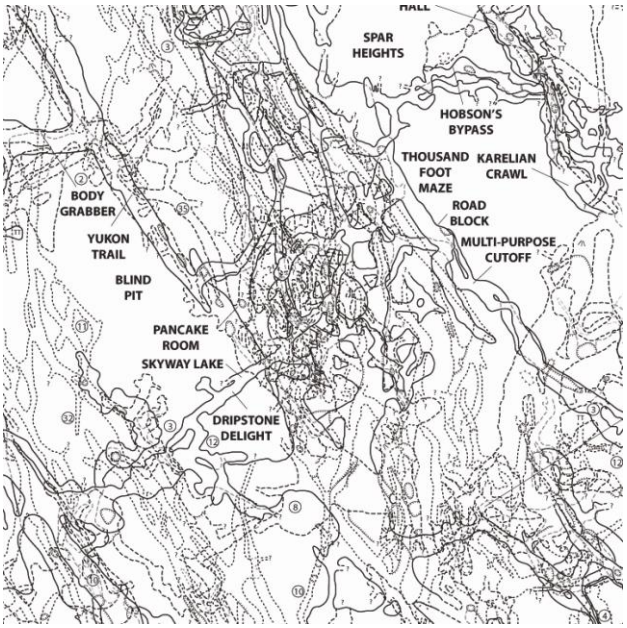
Wind Cave National Park

By Rodney D. Horrocks, Physical Science Specialist & Marc Ohms, Physical Science Technician

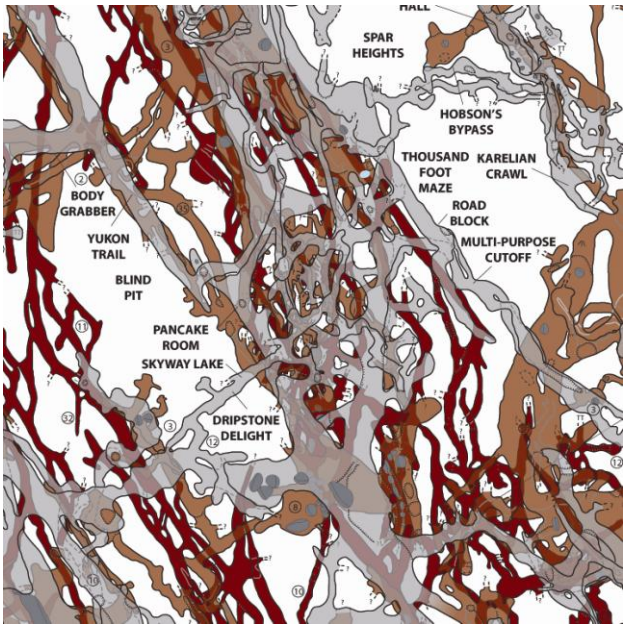
Research:

Dr. Andy Long, a hydrogeologist from the U.S.G.S, and Marc Ohms recently completed the first year of sampling for their 3-year study of the Madison Aquifer and its flow paths within the park and the surrounding areas. They are characterizing and identifying potential sources for the water in that aquifer. Sampling was completed at approximately 30 locations, including: wells, springs, and cave sites (drip sites, pools, and lakes in Wind Cave).

We completed a new digital map of Wind Cave for the International Congress of Speleology in Kerrville Texas in July. Although completing a digital color map in Illustrator was a two-year project, this new map was really the culmination of a ten-year cartographic effort to update the old Wind Cave quadrangle maps. These quadrangles were divided into three major layers and each was assigned a color (reddish brown for lower, brown for middle, and light gray for the upper layer). By making the upper two layers transparent, we were able to show how overlying passages relate to each other. Most importantly, we were able to show that a cave map can be made of a complex maze cave and still be readable and usable, as long as both color and transparencies are used. Once the 17 master quadrangles had been digitized, each master quad was stitched to the adjoining quad, beginning in the southwest corner of the cave. The final map, at 50'/inch, is 10' x 12' in diameter. This map, which has 121.5 miles of passage represented, was displayed at the ICS next to the maps of Lechuguilla, Jewel, and Mammoth Caves, which were also printed at 50'/inch. We believe that this may be the largest cave map digitized to date in the world as a single digital, colorized, vector file. We are now mounting the map downstairs in our Visitor Center amid the other cave displays.



The traditional Black Hills cave map method of representing complex passages by making the walls of the upper level solid, the middle layer dashed and the lower level dotted.



The new digital map of the same area in Wind Cave that uses color and transparencies to show the relationship of overlying passages.

Dr. Jean Krejca from Zara Environmental and Dr. Hazel Barton from Northern Kentucky University, have completed two rounds of sampling for macroinvertebrates and microbes in the groundwater from the lakes in Wind Cave. Due to the low levels and the very unusual microbes found thus far, they may conduct another round of sampling before completing their final analysis and report on the biota of the Wind Cave Lakes/Madison Aquifer.

Dr. Jean Krejca examining a plot for macroinvertebrates at the lakes in Wind Cave. Photo by Peter Sprouse.

Rick Toomey and Rod Horrocks working on the installation of the cave lighting experiments in the Isolation Room in Wind Cave. NPS photo by Rick Olson.

Rick Toomey and Rick Olson, both from Mammoth Cave National Park, installed a cave lighting experiment in the Isolation Room in Wind Cave in July. This experiment is part of a national experiment that is being conducted in five National Park Service caves. They installed several types of lights along with limestone cubes bathed in a solution made from algae found in Wind Cave. Their experiment hopes to determine which type of light best discourages algae growth in Wind Cave.

Cave Survey & Inventory:

Carl Bern led his second multi-day camp trip to Camp Cosmos in the Southern Comfort Section of Wind Cave. They discovered some water table lakes; the first lakes discovered in the southwestern portion of the cave. This area also had six-inch thick deposits of cave rafts and extended the southern boundary of the cave by 225 feet. They were able to survey a total of 1,383.35 feet of passage beyond the Skinner during this camp.

The new lake discovered in the Southern Comfort Section of Wind Cave past the Skinner. These lakes are located at the southern most tip of Wind Cave. Photo by Evan Blackstock.

Since the last reported length of the Wind Cave survey in Inside Earth, volunteer cavers have increased the surveyed length of the cave by 2.69 miles; establishing the current length of 132.43 miles. This new survey maintains Wind Cave's status as the fourth longest cave in the world.

Projects:

On September 14-15, 2009, we hosted the Black Hills Cave Restoration Camp. Eight cavers from four states, including Hawaii, participated in that project. We were able to clean the two worst lint/hair deposits in the cave, the Temple on the Fairgrounds Tour Route and Brickinridge Gallery on the Natural Entrance Tour Route. We were also

able to remove two asphalt dumps located alongside the concrete trail, one of which exposed a passage that had been obscured by debris for many decades. Although, the passage continued into a blank area of the map, the entrance proved too tight for humans. The group was able to remove 821 pounds of lint, hair, and trail construction debris during this two-day project.

The 2009 Wind Cave Restoration Camp participants outside of the Elevator Building. The 812 pounds of sacked debris hauled out of the cave during the two-day camp lies in front of the group, 9/15/09. (L-R: Sandy Krammer, Howard Shumann, Mike Hanson, Janet Serino, Rod Horrocks, Pat Jablonsky, Steve "Woddy" Woodward, and Dan Smith). NPS photo by Mark Greene.

Last winter we completed a project to install a concrete trail on the 800-foot long Blue Grotto Tour Route. This trail replaced the asphalt trail that was removed from the cave in 1986. Removing that asphalt caused the exposed silt to be kicked up and deposited on the surrounding rocks and walls during candlelight tours over the next 23 years. Once the concrete was in place, we started a restoration project to clean up that silt. We were able to completely clean 1/3 of that route. The group used HEPA vacuum cleaners, brushes, and de-chlorinated water for that project. It is anticipated that this new route will be used for tours beginning in the summer of 2010.

The cave lighting crew is seen here carrying concrete in inner tubes to the new Blue Grotto Tour Route trail construction project. NPS photo by Jason Walz.

This last spring we completed a project to replace the entire incandescent lighting system on the Garden of Eden Tour Route in Wind Cave using LED lights. We ended up using 159 new lights along our shortest tour route. Even though the number of fixtures has increased along that route, this lighting system has reduced energy consumption by 70%, reduced the impacts from maintenance staff changing bulbs, nearly eliminated algae, and increased safety by adding trail lighting to the stairs. We will be working on relighting the Natural Entrance and Blue Grotto Tour Routes this upcoming winter/spring.

Sam Frankfort and Rob McIlravy installing the new LED lights in the Garden of Eden Tour Route. NPS photo by MarK Greene.