Cave and Karst Programs

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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

A group from the National Honor Society from Hot Springs High School in South Dakota, is seen here helping Wind Cave National Park restore the St. Domonics Chamber on the new Blue Grotto Tour Route in Wind Cave. Participants: Angelica Cachro, Leisha Dennison, Cassie Palo, Lauren Lund, Sandra McPherson, Rod Horrocks, & Daniel Friendshuh. NPS photo by Jason Walz.

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Featured Article:

Cleaning the New Blue Grotto Tour Route in Wind Cave

By Rodney D. Horrocks, Physical Science Specialist, Wind Cave National Park

In early spring, Dan Hanley, a High School teacher from Cashton, WI, called me and asked if he could bring a field trip to the park for a week-long volunteer project in Wind Cave. Dan's interest in Wind Cave stemmed from a time when he worked one summer as an intern giving tours. It just so happened that we had a perfect project for his group. Since we had recently completed concreting of the Blue Grotto Tour Route and had just finished adding the new LED lighting system to that route, we have been concentrating on cleaning that route in preparation for our first official tours this winter. The Blue Grotto Tour Route is going to become our main winter tour route from now on. In the future, we're only going to use the Garden of Eden Tour Route, the historically used winter tour route, when we need a shorter tour.

Cleaning of the new Blue Grotto Tour Route was necessary for two reasons: 1) there is a tremendous amount of silt that has been kicked up on that route by candlelight tours since the asphalt trail was removed in 1986, and 2) there is a lot of trail blasting debris left from trenching the floors when that route was first created in the 1930's. Since Jason Walz and the cave lighting crew had already cleaned that route from the Three-Way Stairs to the end of the St. Dominiques Chamber as of last spring, we decided to concentrate on the Council Chamber for this project. We'll actually continue this restoration project during our normal Black Hills Cave Restoration Camp this September, when we'll do the final finishing work on that room.

Dan Hanley brought two adults and ten kids out for this project. We gave the group a fee waiver to camp in the group site in our campground and then let them shower in the VIP Center each night, which they really appreciated. As a reward for their efforts, we took them on three of our regular cave tours during the week and then gave them a Wild Cave Tour at the end of the week.

Before we started this restoration project, we knew that the Council Chambers was one of the dirtiest areas on the Blue Grotto Loop. As expected, we found a tremendous amount of silt and trail blasting debris in that room. We also found historic artifacts scattered throughout the trail construction debris, especially along the edges of the trail and on ledges in the trench. Most of the artifacts seemed to date from the 1930's, which is when I assume that the trench through the Council Chamber was blasted by the CCC. We found worn-out chisels, Beechnut chewing gum wrappers, bones, a heel of a boot, Camel Cigarette packages, broken glass bottles, a little tank "Monopoly" piece that had been secreted into a little boxwork alcove, and various paper products. The kids got a real kick out of discovering the historic artifacts and then watching as the artifact labels for their discoveries were completed. Each artifact, along with its label, was then bagged in a Ziplock baggie. These will be given to our Cultural Resource Specialist and he will decide if they will be cataloged into the museum collection or not.

Dan Hanley's Cashton, WI High School class with the 2,202 pounds of trail construction debris they removed from the Council Chamber on the new Blue Grotto Tour Route in Wind Cave between 7/6-9/2010. NPS photo.

We had the stronger ones of the group haul out the collected debris in five-gallon buckets each day at lunch and then at the end of the day. We then weighed the buckets on the surface. To be as accurate as possible, we subtracted out the weight of the actual bucket itself from each weight measurement. The measurements that we wrote down for each bucket were the corrected amount, with the bucket subtracted out. The kids were able to remove a little bit more debris each day of the project (see totals below). The project was a great success and Dan said that he wants to bring another group of kids out next summer to continue volunteering for Wind Cave restoration projects.

Totals for the Council Chamber Project:

July 6, 2010 - 656 pounds removed
July 7, 2010 - 751 pounds
July 9, 2010 - 795 pounds

Total: 2,202 pounds of debris

Park Updates (Listed alphabetically):

Great Basin National Park

By Ben Roberts, Chief of Natural Resources

2010 Lint Camp at Great Basin National Park
On Saturday, May 1st, 2010 Great Basin National Park hosted a combination Lint and Restoration Camp at Lehman Cave. The last Lint Camp was in 2008. A total of 19 volunteers from Nevada and Utah, representing several National Speleological Society grottos, as well as some non-affiliated cavers, traveled to the park to participate. This event was organized to introduce cavers to the park, train staff and cavers in lint and restoration techniques, and address a critical park need; to reduce the significant accumulations of lint throughout the cave. Lint is introduced to the cave environment by the average 30,000 thousand visitors and staff who enter the cave each year. Lint is composed of fibers, hairs, skin cells, dust, and other foreign particles. Lint can become cemented into cave formations, causing discoloration or even dissolution of natural cave surfaces. Lint also acts as an artificial food source, potentially causing imbalances in cave biota communities. Lint also reduces the aesthetic appeal of the cave.

Volunteers removed nearly 100 lbs of material composed of sand, rocks, concrete, trash, and lint from 2 main locations in the cave, the Inscription Room and the Grand Palace. Sand was the primary component in both locations. Historic passages in the cave were artificially enlarged with explosives in the 1930s. To contain blasts, sandbags were used and consequently, sand can still be found coating the ceiling and walls of many passages. The first trails through the cave were also comprised of sand and gravel and many low lying areas next to the trail were filled with extra material.

Before picture taken in the Inscription Room in Lehman Cave. NPS photo by Ben Roberts.

After picture taken in the Inscription Room in Lehman Cave. NPS photo by Ben Roberts.

Volunteers also contributed significant time and effort to remove 5 gallon buckets filled with cement, asphalt, sand, and gravel that the park staff have been generating as they remove the section of trail in the Sunken Gardens area. Park staff had previously filled 60 buckets, which the volunteers hauled nearly 1,500 feet. Volunteers also filled and hauled and additional 47 buckets, bringing the total to 107. At an average of 55 lbs. apiece, that equals 5,885 lbs.!

After the work was done, volunteers visited some of the parks wild caves and had a special tour of Lehman Cave. The park thanks all of our hard-working volunteers and hopes that they return in the fall for another camp.

Jewel Cave National Monument

By Mike Wiles & Rene Ohms, Chief of Resource Management & Physical Science Technician

Dye Trace Update

The last issue of *Inside Earth* included a report on injection of dye at three locations: Jewel Cave Spring, Prairie Dog Spring, and the park's sewage system. Dye samples have now been collected three times at each of the 12 in-cave sample sites, and so far there has been one positive trace. Jewel Cave Spring was traced to the Dungeon Room less than one month post-injection. The next samples are scheduled to be collected in October, 2010.

Historic Area Restoration Project

A four-year project to remove lint, candle wax, and dust from the Historic Area of the cave is now underway. Little has been done to mitigate human impact in this part of the cave since visitation first began in 1900, and as a result foreign material has been compacted into thick cakes on the cave floor throughout the Lantern Tour routes. Putty knives, brushes, and battery-powered vacuums are being used to loosen and remove the accumulations, which are hauled to the entrance in buckets. Three term employees have been hired to work on the project, and will assist with other cave management projects during the winter months when the Historic Area is closed for the protection of hibernating bats.

Compacted lint, dust, and wax on the Dungeon Route in Jewel Cave. NPS photo.

150+ Miles of Survey

More than five miles have been added to Jewel Cave's surveyed length in the last year. The landmark 150th mile was reached in February, when five survey teams explored leads in the Ant Farm, Hobgoblin's Ballroom, and Cloud Sky Room areas. Jewel Cave is now 151.21 miles long, and remains the second-longest cave in the world.

The cavers that helped the Jewel Cave survey reach 150 miles. From L to R back row: Steve Langendorf, Andy Armstrong, Bonny Armstrong, James Hunter, Marc Ohms, Lydia Poppen, Woody Woodward, Derek Bristol, & Dan Austin. From L to R front row: Sammi Langendorf, Larry Shaffer, Rene Ohms, Steve Baldwin, Heather Levy, & John Lyles. NPS photo.

New Staff
The resource management staff at Jewel Cave has grown significantly this year! In addition to the three term employees hired for the restoration project (Matt Busch, Kelly Mathis, and James Tabinski), Dan Austin joined the staff in April as a permanent resource technician, and Lee-Gray Boze was hired into a term appointment in June 2010.

New Superintendent
Todd Suess left Jewel Cave in February 2010, and is now the deputy superintendent at Olympic National Park. Larry Johnson, Chief Ranger at Sleeping Bear Dunes National Lakeshore, was selected as Jewel's new superintendent, and will arrive in early July.

Lava Beds National Monument

By Shawn Thomas, Physical Science Technician

Cave Rehabilitation Project
A major cave rehabilitation project was initiated in the fall of 2009 through funding from the American Recovery and Reinvestment Act. The project was developed to systematically clean highly-visited caves in the monument that have suffered impact from years of visitation, while also collecting data that can be used to guide future management actions. Because this was the first intensive cave cleaning project attempted at Lava Beds, many of the caves contained trash that had been accumulating for decades. Trash that has been removed from caves includes all the usual suspects such as beer cans, shattered glass, food wrappers, gum, sunflower seeds, and some pretty gross hair/lint balls. There have also been a few surprise items pulled from caves, such as numerous combs, a gold-painted brick, a sea shell, a rubber bouncy ball, sunglasses, reading glasses, rhinestones, air gun pellets, bullet shells, and even a garbage can lid. And given the nature of lava caves, with their sharp, coarse floors, much time has been spent cleaning shredded plastic from flashlights and kneepads. There have also been occasional finds of items that the cleaning crew would prefer to have overlooked and required the extra precautions of surgical gloves and a face mask. This type of cleaning required following the *Human Waste Cleanup in Lava Caves* SOP that was developed last year in response to these incidents. Macroinvertebrates, including millipedes, springtails, diplurans, spiders, and centipedes were commonly encountered during the cleaning project.

This centipede was observed deep in Catacombs Cave during the cave cleaning project. Note the fine bits of trash nearby. NPS photo by Shawn Thomas.

In addition to the actual cleaning of caves, the project has focused on data collection and the use of GIS to perform analysis of impact levels. Cleaning proceeded along transects generally spaced five feet apart, and for each transect, cleaning crews recorded the amount of time spent cleaning, the dimensions of the transect and the types of trash found. The data was used to determine an impact coefficient for each transect, which was calculated by dividing the cleaning time by the transect area. Cave impact maps and display posters were created in GIS to show the relative levels of impact both within a single cave and between multiple caves. These maps provide visual references that illustrate specific caves and areas within caves that have received the most impact. This information can be used to prioritize future rehabilitation efforts by targeting the areas that are most likely to become impacted again.

The project is now in the third phase of cleaning, and three different crews, encompassing 14 staff members, have logged hundreds of hours removing trash from all varieties of cave passages,

from comfortable walking passage near entrances to remote cave areas that require difficult crawling and climbing to reach. As of September 2010, over 600,000 square feet of cave passage has been cleaned in 22 caves and has yielded nearly 300 pounds of trash.

The Lava Beds summer 2010 Cave Rehabilitation Crew (left to right): Amy Gentry, Ryan Janway, Abby Tobin, Phil Turner, and Ryan Loomis pose with trash collected over the course of one day in a Lava Beds cave. NPS photo by Shawn Thomas.

I & M Cave Monitoring

The Klamath Network of the National Park Service held a vital signs selection process in 2004 which resulted in Cave Environments and Cave Entrance Communities being chosen as two of the top 10 vital signs to monitor in the Network. Lava Beds National Monument and Oregon Caves National Monument are the two units in the Network that contain significant cave resources, so development and implementation of a cave monitoring program focused on these parks. In 2008, scoping meetings occurred between Network staff, park staff, and cave experts from Zara Environmental LLC. Ultimately, eight cave parameters were selected for monitoring: 1) cave meteorology, 2) ice and water levels, 3) dust and lint accumulation, 4) human visitation, 5) cave entrance vegetation, 6) bat populations, 7) scat and visible organics deposition, and 8) cave invertebrates. For each of these parameters, a draft standard operating procedure (SOP) was developed by Zara and submitted for comments and testing.

During January through March of 2010 a pilot study was conducted to evaluate the operational feasibility of the field methods and appropriateness of equipment, and to gain a better understanding of the type and variability of the data collected. Each of the SOPs was implemented during the pilot study or evaluated based on past park monitoring and current procedures in place at the parks. The pilot study determined that one of the parameters (dust and lint) should be thrown out due to lack of effective monitoring methods, whereas the seven remaining parameters can be monitored as part of the protocol. With input from the pilot study, some of the monitoring procedures were modified to increase efficiency and reflect conditions unique to Lava Beds and Oregon Caves. An updated protocol was produced by Zara and submitted for peer review in early June of 2010.

With approval of the protocol, monitoring will be implemented in Oregon Cave and Blind Leads Cave at Oregon Caves N.M. and in 31 caves at Lava Beds N.M. Oregon Cave is a show cave containing a developed tour route, though much of the cave remains wild and undeveloped. Blind Leads Cave is a small, undeveloped cave located along a nature trail in the monument. At Lava Beds, 31 caves containing a diverse assemblage of resources were selected for monitoring, and these caves fall along a spectrum of heavily visited to sparsely visited caves. Also within the set of 31 caves are caves known to contain hibernating bat populations during the winter and caves known to contain year-round ice resources. Monitoring will primarily be conducted by park staff, though partnerships with universities and volunteer organizations may be fostered to assist with the workload demands.

The initiation of cave monitoring at Lava Beds and Oregon Caves is a great opportunity to detect long-term trends in physical processes and biological communities. Additionally, conducting monitoring of multiple parameters at shared sites may reveal patterns and relationships among the parameters, which could greatly contribute to understanding caves as an integrated system. Ultimately, cave monitoring will help inform management decisions and guide actions promoting cave conservation and sustainable use.

Bat Monitoring

The 2010 winter season was very productive in regard to conducting hibernacula counts. Throughout January and February, 25 caves were searched for hibernating bats. The hibernacula counts yielded a total of 1017 Townsend's Big-eared bats (*Corynorhinus townsendii*), the highest count yet recorded in over a decade of winter bat monitoring at Lava Beds. Population counts obtained through hibernacula monitoring have established Lava Beds as an extremely significant site for the Townsend's Big-eared bats, which are also present in the monument during the summer. Multiple maternity colonies are known to use specific cave areas to give birth and raise their pups. Summer bat management efforts are largely focused on maintaining cave closures on caves that are known to be used year after year by the Townsend's Big-eared bats. Additionally, evening outflight counts are conducted during the summer to determine approximate colony sizes. The first 2010 outflight count was conducted in early June, and despite unusually cool weather delaying bat activity, the colony size determined by the count suggests a normal, healthy bat population.

Monitoring of the Brazilian free-tailed bat (*Tadarida brasiliensis*) colony continues every summer through the use of an evening outflight photo-estimation method that yields approximate population counts. During July and August of 2009, counts were captured before and after pups became volant (able to fly) and established a colony size of over 100,000 bats pre-volancy and over 300,000 bats post-volancy.

Lava Beds has recently been collaborating with Ted Weller, a bat biologist with the Forest Service Redwood Sciences Laboratory in Arcata, CA. Ted assisted with winter 2010 bat monitoring efforts at Lava Beds, and he is currently in the process of reviewing all past bat monitoring in the monument to help design a new database and make suggestions for future monitoring efforts.

With the increasing threat of White Nose Syndrome (WNS), Lava Beds is working to develop potential actions for protecting bat colonies. Education has been used as the primary tool for preventing the introduction of WNS by visitors. Adaptive management strategies and risk assessments will be developed in the near future through collaboration with the California White Nose Syndrome Steering Committee.

Cave Ice Research

Through a Cooperative Ecosystems Study Unit (CESU), Lava Beds has enlisted Dr. Edward Brooks of Oregon State University to conduct an investigation and characterization of ice resources in the monument. Through limited coring of persistent ice floors, an assessment can be conducted with a focus on the age and physical characteristics of the ice. This project was initiated due to the need to collect and preserve valuable information while it is still possible, i.e., before ice resources are lost to melting. The loss of ice in Lava Beds caves has been documented over the past three decades, including some alarming instances of rapid ice loss. The ice investigation began with field work in 2009, when two ice cores were taken from two separate caves; additional sampling is planned for 2010. The results of the investigation, in addition to increasing our knowledge of ice resources, will assist with the development of future management actions.

Planning Documents

Lava Beds is currently working on three new planning documents, including a General Management Plan (GMP), Resource Stewardship Strategy (RSS), and Cave Management Plan (CMP). Though the CMP will provide the most detail on the direction of the cave program at Lava Beds, the GMP and especially the RSS will also provide guidance for cave management activities. The new Cave Management Plan, when approved, will update the existing 1990 CMP and will be geared toward improving the monument's ability to protect cave resources and encourage cave conservation.

Oregon Caves National Monument

By Elizabeth Hale, GIS Specialist

Recent Studies and Findings:
GeoCorps interns continue to expand our knowledge of Oregon Caves' natural history through geological investigations. An analysis of structural controls on the development of Oregon Caves by GeoCorps interns in 2008 concluded that bedding orientation played a significant role in passage orientation as well as the fractures that cross-cut those planes. A study of igneous dikes in Oregon Caves by a GeoCorps intern in 2009 found evidence of at least two separate igneous events after the metamorphism of the marble. We look forward to working with the two GeoCorps interns as well as two International Volunteers (geology students from England and Germany) this summer.

A strong seasonal dissolution pattern (May to September) in the cave stream at the lower entrance has been observed in our ongoing marble dissolution study. This observation correlates with seasonal cave CO_2 levels, which rise throughout the cave beginning in May and peak in August. Dissolution/deposition at other sites, including the deeper cave stream and several drips, has been negligible.

The two-year "biomonitoring" study on the effects of cave visitation and restoration on invertebrate biodiversity concluded in 2009. In terms of invertebrate biodiversity, most sites along the tour path had a higher evenness in the year they were subject to lint removal, and the off-trail sites that were not subject to high visitation or lint removal showed little difference between years. These results suggest that a healthier ecosystem was present when the cave section was restored, though more replicates and experimental controls would have been needed for the results to be statistically significant. Forty-six invertebrate species were encountered in this study and we were able to photograph organisms we previously had no photos of.

A silver springtail photographed in Oregon Cave during a recent biomonitoring study. NPS Photo.

A white springtail photographed in Oregon Cave during a recent biomonitoring study. NPS Photo.

Cave Cleanup and Restoration:
National Public Lands Day 2009 was our third annual cave cleanup with community members and the most successful yet, with more volunteers than previous years (14), including some returning. Participants spent the day cleaning lint and trash in the cave with brushes and tweezers.

President's Day Weekend 2010, our seventh annual cave restoration event with the Cascade Grotto, was enthusiastically attended by thirteen volunteers. Cave restoration projects included removal of old iron bars at Paradise Lost, continuing work to restore the largest rimstone formation in the cave, and of course lint and trash removal with tweezers and brushes.

Before picture of some old iron bars in the Paradise Lost area in Oregon Caves. Photo by Nikki McCormack.

A restoration project to remove the iron bars in the Paradise Lost area of Oregon Caves. Photo by Nikki McCormack.

Projects:
A fiber optic line was installed in the cave in late fall 2009 to make way for new cave phones and subsurface data capabilities. The old communication system in Oregon Caves only had three "phone" stations along the 0.6-mile cave tour path and was basically an intercom system that connected the cave phones to a single surface phone behind the visitor center desk. The new system will increase the number of phones to seven and tie into the surface phone system, enhancing safety. Plans for data capabilities include real-time data from environmental monitoring sensors and infrared bat cameras.

An employee educational caving program was developed in late fall 2009 and approved by the park superintendent in late winter 2010. Five educational caving trips outlined in this written plan will meet educational objectives and the constraints necessary for long-term protection of the cave and its resources while permitting park employees to do some off-trail caving.

Monitoring:
The Klamath Inventory & Monitoring Network is developing the long-term cave monitoring protocol for the cave parks in our network (ORCA & LABE), which will go out for peer review later this year. We assisted with the pilot study in spring.

In-park monitoring is ongoing, with regular critter counts, carbon dioxide measurements, and data logger measurements of drip rates, stream depth, water and air temperatures, and humidity. Photo-monitoring was repeated in 2009 with no new visitor impacts detected, although minor rockfall at the 110 entrance was apparent.

In Other News:
-Off-trail caving tours are entering their fourth season.
-The Weather Channel filmed segments for the show *Weather Proof* in Oregon Caves. The episode may air in July 2010.

Timpanogos Cave National Monument

By Cami Pulham and Andy Armstrong, Chief of Resource Management & Physical Science Technician

Timpanogos Cave Management Plan
Timpanogos Cave National Monument has begun efforts to write a Cave Management Plan. TICA has been in existence since 1922 and has been offering cave tours through the monuments primary resource for nearly 90 years without an official cave management plan providing guidelines to the monument staff. Scoping began Fall 2009 with several staff meetings. The Resource Staff also visited all area grottos and hosted an open house at the visitor center. Through internal and external scoping, many topics have been identified to be addressed in the Plan, including:

- Cave Lighting and infrastructure

- Lampenflora and lint mitigation
- Tunnel doors and airflow
- Tour size, frequency, and impacts
- Allowed behaviors/objects
- Cultural Resources
- Management of backcountry caves
- Identification of research needs

Monument staff invited Dale Pate to conduct a site visit and give recommendations regarding cave resources to be used for the Cave Management Plan. Staff members from all divisions are working to research various alternatives to each selected issue to be comprised in the final document. It is expected that the new plan will be out for comments this winter.

Lower Passage Restoration

Restoration efforts continue in the Lower Passage of Timpanogos Cave. In an effort to return Lower Passage to a near-natural condition, the Resource Management Division is leading a multi-year effort to remove man-made materials from this part of the cave. Lower Passage was used as a tour route in the 1920s and contains a large amount of deteriorating infrastructure. Materials include galvanized trail grating, wooden trail supports, wiring conduits, blast rubble, and others. All artifacts and materials are protected as historic under the National Historic Preservation Act and are being documented accordingly. RM staff conducted a preliminary survey of the passage in order to establish survey stations no more than 10 feet apart to serve as reference points. Each item that is uncovered is recorded as to its identification, location, date found, and who found it. Artifacts will be retained in the park museum and include tour tickets, candy wrappers, film boxes, and flashbulbs. Some of the more interesting and representative examples of tour infrastructure will also be retained.

Graham Schindel screening sediment in the Exit Shelter from the Lower Passage cave restoration project. A one cm sieve is used to locate historic artifacts such as metal grating, linoleum, coins, bottle caps, hair pins… NPS photo by Karissa DeCarlo.

Work is being done 10-20 hours during the work week by RM staff, with much help from other divisions, and caver volunteers. New for 2010, Lower Passage Saturdays have been implemented in order to allow more volunteers an opportunity to help. This was suggested by volunteers in 2009 and has been a great success so far. Once a month, up to 10 volunteers come up to the cave on a Saturday and put in a full work day. Work includes digging at the floor to remove fill and uncover artifacts, carrying buckets of material out of the cave for sifting, cleaning flowstone, and removal of blast rubble. Although the work is strenuous, it is often rewarding and has been a hit with volunteers from other divisions and the local caving community.

A cave ticket found during the cave restoration project in the Lower Passage of Timpanogos Cave. Since this photo, a paper conservator from the University of Utah has restored this ticket. NPS photo by Graham Schindel.

Work will continue throughout 2010 and 2011 in order to restore this passage to the fullest extent possible.

Wind Cave National Park

By Rod Horrocks & Marc Ohms, Physical Science Specialist & Physical Science Technician

White Nose Syndrome:
Because the White Nose Syndrome (WNS) has been reported as close as Oklahoma, the park has developed a proactive action plan to address this potential threat. Although, the park does not host any large colonies of bats, eleven species have been reported in the park, eight of which are cave-dwelling. Including Wind Cave there are a total of 43 known caves within the park. All back country caves in the park were already closed to human access, except via ranger-led work trips or by research permit. Bats have been documented in seven caves within the park including Wind Cave. However, the bats seen in Wind Cave are generally found near the Natural Entrance and have entered the cave through the revolving door. Once a true two-door airlock is built on the Walk-In Entrance, bats would probably be prevented from entering Wind Cave. They actually do not enter the Natural Entrance due to its small size and strong barometric airflow.

In early August Region 2 of the US Forest Service, which includes South Dakota, ordered that all caves and mines within that region will be closed for a period of one year. USFS lands are found immediately to the west of the park. Wind Cave National Park has undertaken the following actions to mitigate the potential spread of WNS by humans.

- All visitors taking the Wild Caving Tour as well as all cavers going off-trail must have clean clothing and caving gear. If they have been in a cave within an affected state, they cannot use that gear unless they clean everything using the current USFWS decontamination procedures.

- Entry into caves within the park other than Wind Cave are restricted to research and management related tasks. No recreational caving is allowed.

- The park will conduct a bat survey within park caves during the winter of 2010-11 to determine the current winter use of caves by bats. If funding is available the park will conduct surveys during the summer months to help establish a year-round record of bat usage in the park.

- The park will provide information regarding WNS to park visitors by having brochures available and adding information to the park website.

Research:
Dr. Hazel Barton, from Northern Kentucky University, has been given a contract to isolate microbe species from the Lakes in Wind Cave. Dr. Barton has completed one round of sampling and because of the preliminary results her contract was modified to do additional work.

With the additional funding, Barton Labs will be able to employ state-of-the-art methods to further sample the microbial diversity in Wind Cave at much greater depth and detail than possible with previous methods. They will further examine the previously collected microbes from Wind Cave by

using a DNA sequencing method developed by Roche/454. This method, which was developed in the last 5 years, allows hundreds of thousands of DNA sequences to be examined simultaneously and produces a much greater breadth of analysis. Through this sequencing method Barton Labs will attempt to identify the unique DNA signature for up to 400,000 microbes that could be present within the Wind Cave aquifer. Following the identification of the microbial sequences Barton Labs will use computational approaches to contrast each microbial DNA signature. This will allow them to attempt to fully realize the depth and diversity of the microbes present in the Wind Cave lakes and aquifer, including a rare biosphere of under-sampled species.

Dr. Hazel Barton and Juan Giarrizzo from Barton Labs at Northern Kentucky University collecting microbial samples at Calcite Lake in Wind Cave. NPS photo by Jason Walz.

Brian Fagnan, from the South Dakota Geologic Survey, has completed mapping the geology of the park at a scale of 1:12,000. This new map will be a valuable tool in the on-going cave and karst inventory of the park. Several formations in the park contain caves or karst features. Although, caves are primarily found in the Madison Limestone in the park, they are also found in the Minnekahta Limestone and the Minnelusa Formation. In addition to the limestone formations, rock shelters have been found in the Fall River Formation and the Precambrian pegmatites. To date, 43 named caves and 27 rock shelters have been identified within park boundaries.

Using Brian's geology map of the park, we have created a map that identifies pesticide application zones for exotic weeds within park boundaries. This map creates buffers around karst areas and stream drainages. It also identifies methods for acceptable application of pesticide, including: hand wipe only, mechanical wipe, or unrestricted spray areas.

Dr. Andy Long of the USGS has continued his project of sampling water from wells, springs, and Wind Cave in order to gain a better understanding of the chemistry of the various aquifers, how they relate, and potential flow paths.

We have continued the monitoring of the levels of the groundwater lakes within the cave, various wells, spring and creek discharge, and in-cave drip rates. Due to the above average precipitation received so far this year, everything is on the rise.

Dr. Andreas Pflitsch is continuing his research on the barometric breathing caves in the Black Hills. He most recently has expanded his monitoring to a blowing well southwest of the park on US Forest Service land.

Rick Toomey and Rick Olson from Mammoth Cave have continued to run their optimal cave lighting experiment in the Isolation Room in Wind Cave. This experiment is testing four types of light (including LED, quart halogen, and incandescent) in an attempt to determine which type of light discourages lamp flora from growing in the cave. The experiment is using limestone cubes dipped in a solution of algae from Wind Cave.

Projects:

We just completed a project that replaced the entire incandescent lighting system in Wind Cave using LED lights. This included adding lights to the recently paved Blue Grotto Tour Route. We ended up using 1,100 lights and ten miles of cabling along the four tour routes, which includes just under a mile of paved trails. Even though the

number of fixtures has significantly increased along these routes, this lighting system has reduced energy consumption by 78%, dropping our usage from 36 KW to 8 KW.

Designing the LED lights for the Council Chamber on the new Blue Grotto Tour Route. Rod Horrocks is seen here directing Jeff Symstad and Jason Walz where to aim their test lights. NPS photo by Tammi Motiff.

We just completed a new poster-sized map of Wind Cave. This map used the new 10' x 12' digital map of Wind Cave as its base. On this map, the cave is divided into three colored layers with the top two made transparent so every passage can be seen in their entirety on the plan view. We have also added the tour routes to the map, which have been color-coded to match the colors found on the individual tickets purchased for each route. In addition, we have added a blowup of four of the tour routes. This new map has 121.5 miles of the survey represented, up from 76.84 miles on the previous poster.

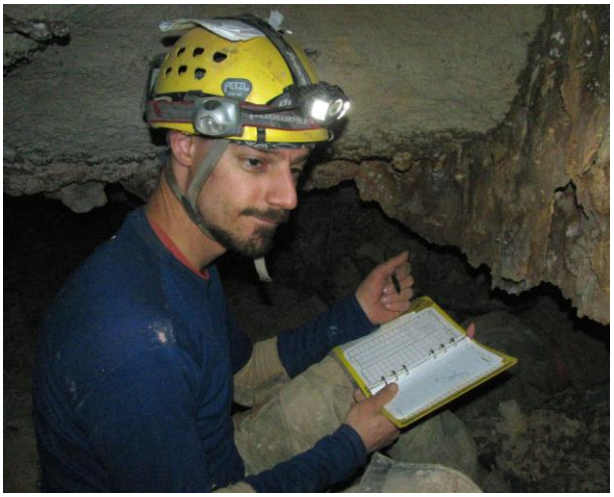
We just finished a large-scale map of the Bishop Fowler Loop. This is a flagged, off-trail route that begins in the Chert Room on the Fairground Tour Route and ends at the Middle Cave Elevator Landing. This route is used for limited Orientation and Education tours by approved trip leaders.

Personnel:
Jason Walz, who has been working as a cave management technician at Wind Cave since 2002, just accepted a permanent cave management technician job at Carlsbad Caverns National Park. His skills and positive outlook will be missed at the park.

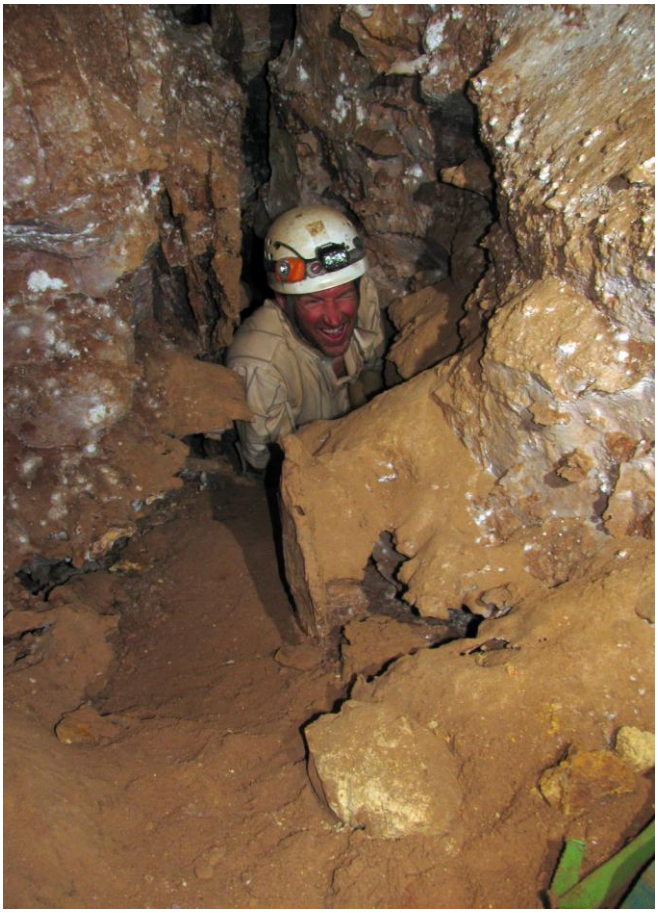
Jason Walz on a survey trip in Wind Cave. NPS photo by Nick Smith.

Cave Survey & Inventory:
Carl Bern led his third four-day camp trip to Camp Cosmos in the Southern Comfort Section of Wind Cave between January 29th and February 1st. The goals of this camp trip were to survey in the northern and middle areas of the cave passages beyond the Skinner, in the Dangaroos Crossing and Flour Box North areas, areas where the airflow is stronger. They were able to survey 1,447 feet in a series of middle level crawls, some of which were very gnarly. They found that following the wind in this area has proven to be difficult. However, there are still many small leads remaining past the Skinner to be checked on future camp trips. The Cold Brook Blowhole, which is located 3,200 feet to the southwest of known cave is a good incentive to keep pushing this area of the cave.

Since the last reported length of the Wind Cave survey in Inside Earth, volunteer cavers have increased the surveyed length of the cave by 1.98 miles; establishing the current length of 134.41 miles. This new survey maintains Wind Cave's status as the fourth longest cave in the world.



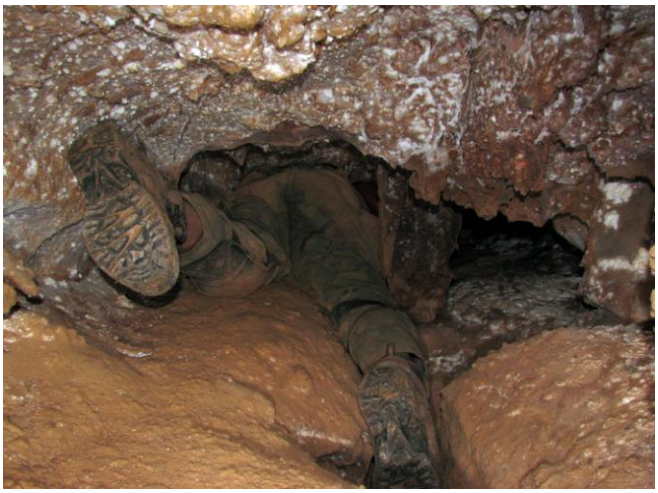
Carl Bern sketching in the Southern Comfort Section of Wind Cave during the February camp trip to Camp Cosmos. Photo by Evan Blackstock.



Marc Ohms pushing a tight lead in the Southern Comfort Section of Wind Cave during the February camp trip to Camp Cosmos. Photo by Evan Blackstock.

Andrew Blackstock in the Skinner in the Southern Comfort Section of Wind Cave during the February camp trip to Camp Cosmos. Photo by Evan Blackstock.

Marc Ohms in the Skinner in the Southern Comfort Section of Wind Cave during the February camp trip to Camp Cosmos. Photo by Evan Blackstock.



Carl Bern pushing a lead in the Flour Box North area in the Southern Comfort Section of Wind Cave during the February camp trip to Camp Cosmos. Photo by Evan Blackstock.