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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: The lake in the newly discovered KyPet Caverns in Grand Canyon-Parashant National Monument. As of the date of publication of this newsletter, no one has ventured past the caver seen in this photo. Many leads remain in this exciting new discovery (Photo by Jon Jasper and Kyle Voyles).

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Featured Article:

The Discovery of KyPet Caverns

*By Kyle Voyles, Physical Science Technician
Grand Canyon-Parashant National Monument*

In 2005, the Parashant National Monument started a cave ecological inventory with the hopes of identifying the invertebrates that live in and use our caves. To our surprise, the very first sample of inverts produced a new genus of cave cricket and couple of new species of other inverts. Due to this little discovery, we leveraged more money to continue our work.



*The helicopter hauling gating supplies to KyPet Caverns.
Photo by Jon Jasper.*

In our initial inventory we selected and sampled 24 caves, but regularly discovered more caves as work continued. This process has continued for the previous three years and we are still going strong, with many more caves to be inventoried.

When we started, we had about 140 known caves in the area and we are now up to 271 documented caves.

In late May, my crew and I were wrapping up a week long ecological inventory in several caves located in very rugged area of the monument. Peter Druschke and I thought ridge walking after a hellishly long day of hiking and caving was a great way to relax, so off we went. We had seen a couple of small holes in a cliff face from across the large canyon that we were in, so we decided that was a great place to start our search. To our complete surprise, the first hole we checked actually went. It was a nice phreatic tube measuring 2 x 3 feet and went for about 40 feet before turning into a 6-inch high belly crawl on silt.



*Kyle Voyles in the entrance of KyPet Caverns. Photo by
Doug Powell.*

After a bit of digging, I could see some formations ahead of me, but I still had to dig some more before it opened up. After about 30 feet or so, the passage opened up into a sizeable room full of

pretties and I could see large passages going in opposite directions.



Formations in KyPet Caverns. Photos by Jon Jasper and Kyle Voyles.

Neither of us were well equipped for caving because we did not expect to actually find anything, so it was to our relief that the cave turned out to be quite large with all walking passages. The passage soon turned into a series of large rooms and great leads that were extremely decorated. We quickly realized we found something nice and retraced our steps back towards the entrance, where we got sidetracked by the right-hand passage, which was beckoning us too. We had to at least take a peak. This passage ended up being full of rimstone pools, large emerald green pools, and every type of formation that you can imagine. As a result, we were sort of walking on eggshells. After 500 feet or so, we turned back and headed out.

It was decided that the cave, now called KyPet Caverns after the two discoverers Kyle Voyles and

Peter Druschke, should be protected. I procured the proper funds, a helicopter, and 5 great volunteers to help gate the cave. My gating crew, which included Peter Druschke, Doug Powell, Jon Jasper, Justin Epps, Jason Knight and myself, headed out on Thursday, July 24, 2008 and drove 6 hours to the canyon rim where we set up camp and our supplies for the chopper the next morning. On Friday, we hiked in three miles to the cave and met the chopper as it slung in all our gear and supplies. The crew spent the next two days building the cave gate.



Kyle Voyles working on the bat gate for KyPet Caverns. Photo by Peter Druschke.

Due to the high daytime temp, we ended up working late at night and finished the gate at almost midnight on Saturday.



The completed bat gate on KyPet Caverns. Photo by Jon Jasper.

As a result of working in the cave entrance late at night, we had the opportunity to witness some of the caves wildlife. Just after dark, the first bats

exited the cave and gave me a nice greeting by flying into the back of my head and trying to crawl into my helmet. Shortly thereafter, Jon and I witnesses the walls of the small entrance come to life, with hundreds of Harvestmen and cave crickets heading out of the cave for foraging and a scorpion sitting in the entrance apparently awaiting their arrival. Sunday, two of our volunteers went home while the rest of us went into the cave to set trails, photograph the cave, and set up photo monitoring stations.



Formations in KyPet Caverns. Photo by Peter Drushcke.

KyPet Caverns is a large, highly decorated cave with a very large body of water. The largest room yet found measures 200 x 300 feet with an average ceiling height of 40 feet which also contains an impressive 40+ foot wall of draperies.



A corner of the largest room in KyPet Caverns. Photo by Kyle Voyles.

We set trails and surveyed thru 2,000+ feet of virgin passage and found a “lake” that is currently almost 1,000 feet in length and varies from 20-feet across to an undetermined width. We haven’t

reached the end of the lake yet, so it may be much bigger.



A corner of the lake in KyPet Caverns. Photo by Kyle Voyles.

The cave also contains numerous skeletons and bones of unidentified mammals and at least one large bird. One of the skeletons is at the bottom of a dry pool and is covered in calcite pool spar (see photo below). Many leads remain to be surveyed and inventoried in this exciting new cave.



A skeleton covered with pool spar. Photo by Kyle Voyles.

Lampflora Research Update: This Just In

By Rick Olson, Ecologist,
Mammoth Cave National Park

(Ed. Note: This is an update of Rick's earlier article published in Inside Earth in 2007, Vol. 10, no. 1) Awhile back, Rick Toomey posed the question: "I wonder if enLux could make us a lamp a little whiter than the W2050?" I figured they could, and contacted enLux's head of engineering Dr. D.J. Chou. My question was "How many blue LED chips would have to be added in order to get a color temperature in the 2700 – 3000K range?" He replied that he could reach 2700 K with three blue chips, so I asked if he could get one for us, and it arrived direct from Taiwan a couple of weeks later. Clearly enLux is competitive!



Figure 1. Latest bench test May 31-August 31, 2008. The enLux 2700 K lamp is at left, enLux 2050 lamp is in the middle, and the compact fluorescent is on the right.



Figure 2. The enlux 2700K lamp grew almost nothing on the limestone cube and supported a thin skim of biofilm on the bottom of the container. The ring is where a washer shaded part of the upper surface.

I was concerned about the effect on lampflora growth of going from one blue chip in the 2050K lamp to three in the 2700K lamp, and so set up another bench test in my basement (Figure 1). The test ran for 92 days constant at about 150 foot candles; brightness ranged from 142 fc to 150 fc. Temperature ranged from 61F to 74F. Results were better than I expected (Figures 2-4). The 2700K lamp grew slightly more algae than the 2050K lamp, but far less than the white compact fluorescent lamp used as an experimental control. For a real world test, the 2700K lamp will go to Great Basin National Park to be tested in Lehman Caves. This is part of the multi-park lighting test that also includes Wind Cave, Carlsbad, Crystal Cave (SEKI), and Mammoth Cave.

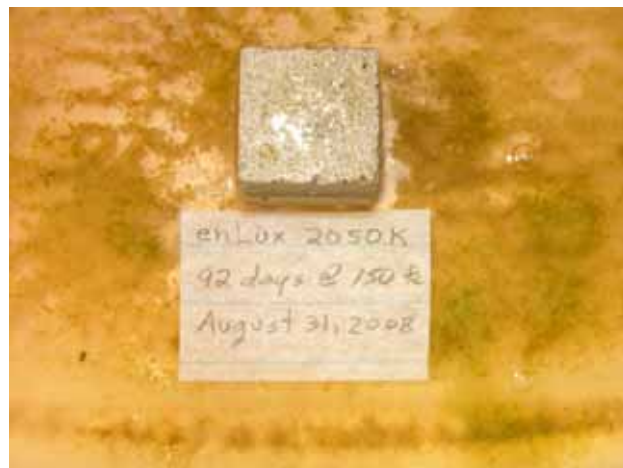


Figure 3. The enlux 2050K lamp also grew almost nothing on the limestone cube and supported the least biofilm on the bottom of the container. No ring is apparent where a washer shaded part of the upper surface.



Figure 4. The compact fluorescent lamp grew the most on the limestone cube and supported a mat of biofilm on the bottom of the container.

Park Updates (Listed alphabetically):

Carlsbad Caverns National Park

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

Visitor Center Rehabilitation nearly complete

The 9-million dollar project that began in May of 2007 is essentially complete. The aging visitor center was completely gutted and rehabilitated with a modern and efficient heating/cooling system and solar panels. As of August 2008 there are items on the contractor's check list to fix, but visitors and staff are now using the new visitor center.



The new solar panels on the completely remodeled Carlsbad Caverns Visitor Center. Photo by Stan Allison.

Sewage System Rehabilitation nearly complete

The old main sewer line that ran from the Visitor Center to the sewage lagoons was buried directly on top of the Left Hand Tunnel and Bat Cave sections of Carlsbad Cavern. Since the line was buried, it was not possible to detect or fix any leaks that may have occurred due to its age. Those undetected leaks probably did occur as several leaks happened in the main line where it was above ground going down the escarpment to the sewage lagoons.

A new sewer line was installed along a different route designed to minimize impact on Carlsbad Cavern. The new sewer line is double walled with sensors to indicate leaks of the inner line. The new

sewer line is above ground so that it will be easier to detect and repair any future leaks. The buried section of sewer line between the Bat Cave lift station and the visitor center was also replaced with double walled sewer line. The collection lines from the offices and housing north of Bat Cave draw are also aging and are planned for future replacement.



The new above ground sewer line installed so it is not on top of the Left Hand Tunnel and Bat Cave in Carlsbad Cavern. Photo by Stan Allison.

Inside of Carlsbad Cavern at the base of the elevator shaft in the Underground Lunchroom several improvements were also made. The old sewage pumps were replaced with new pumps and the sewage holding tank was re-lined to prevent any leaks into the cave. This fall, the bathrooms in the underground lunchroom area will be reduced in size and re-furbished in order to decrease cave impacts, maintenance costs, and to improve facility operations.

Removal of old ladders from Carlsbad Cavern

Two summer seasonal employees were hired to remove rusty, steel ladders from Carlsbad Cavern and replace them with stainless steel ladders. In some cases the ladders were replaced with handlines or traverse-lines when appropriate. Shawn Thomas and Steve Record did an excellent job of replacing these ladders in addition to accomplishing other restoration projects, such as removing decaying wood from old ladders and lint removal.

Seven steel ladders were removed from the route to the New Mexico Room and replaced with five stainless steel ladders. Three steel ladders and two steel walkways were removed from the Left Hand Tunnel and replaced by two stainless steel ladders. The steel walkway going to the Mystery Room was replaced by a rigged traverse requiring Single Rope Technique skills to negotiate.

Lechuguilla Exploration

The survey of Lechuguilla Cave is now up to 125.4 miles. Highlights of recent exploration include the discovery of the Emerald City area on the Peter Bosted and John Lyles expedition in November 2007. This area was discovered via a small crawl near the Sewing Room in the Western Branch of the cave. This area has an unidentified green mineral associated with gypsum that prompted its name. Large passages lead to the base of a 230-foot high dome which has yet to be climbed. Emerald City fills in a blank section of the map south of Hudson Bay.

On the January 2008 John Lyles' expedition a significant discovery was made in the Far East. Once again a tight lead led to a major discovery called the Northeast Corridor. Large passages led to the base of a 170-foot high dome lead that remains as an exciting climbing lead. Selenite chandeliers were discovered in this area. Prior to this discovery, no chandeliers were known from the Eastern Branch of Lechuguilla even though the Southwest and Western Branches have numerous chandeliers.

The quadrangle maps of Lechuguilla Cave were updated in 2007. Copies of these quadrangles can be obtained by those performing research and survey in Lechuguilla Cave by contacting Stan Allison, Cave Technician or Paul Burger, Park Hydrologist/Geologist.

You can find more information on Lechuguilla Cave in the park-generated Lechuguilla Newsletters which can be found at:
http://www.nps.gov/cave/naturescience/lechuguilla_cave.htm



John Lyles looks at some gypsum chandeliers located in the Northern Lights area, a room that soars over 170-feet high into an area they named Mount Washington. These are the first chandeliers discovered in the Far East section of Lechuguilla Cave. Photo by Andy Armstrong.



Close up of John Lyles admiring some of the gypsum chandeliers found in the Northern Lights area in the Far East area of Lechuguilla Cave. Photo by Brian Kendrick.

Research

Numerous studies are ongoing in Lechuguilla and Carlsbad Cavern. Hazel Barton continues to work on her studied titled "Oligotrophy in Caves: The

Biochemistry and Metabolic Activities that Support Microbial Community Survival in Nutrient Limited Environments". Dave Levy continued sampling in Lechuguilla Cave for his study titled "Chemical and Physical Limnology of Lechuguilla Cave Pools". Diana Northup continues her study titled "Collaborative Research: Identification of Microbial Signatures in Biogenic Cave Ferromanganese Deposits". Diana Northup and Leslie Melim have been active in Carlsbad Cavern and Lechuguilla Cave doing research on pool fingers. Greg Stock and Joel Despain continued their Lechuguilla study titled "Dated cave pool shelfstones as indicators of climate change". Their preliminary results indicate that most of the pools in Lechuguilla Cave were full near the end of the last Glacial Maximum considered to have ended 18,000 to 20,000 years ago. Following are some preliminary dates on the high stands of the pools based on Uranium/Thorium dating by Victor Polyak, University of New Mexico:

Lost Pecos River: 15,032 +/- 647 yrs BP*
Pool Hall: 14,317 +/- 344 yrs BP
Orange Bowl: 19,648 +/- 603 yrs BP
Oasis Pool Room: 20,952 +/- 365 yrs BP

* BP is Before Present

Carlsbad Cavern Restoration and Exploration

The Cave Research Foundation spent one year completing the restoration of Red Pool in the Big Room of Carlsbad Cavern. This pool had large amounts of red clay deposited into the pool during early trail building activities. Thanks to the CRF volunteers, the pool has now been restored and looks great.

Survey in Carlsbad Cavern continues by both CRF and non-CRF groups. The majority of survey is being done in the New Section including the Guadalupe Room. A resurvey of the Mystery Room has been initiated as well. The resurvey of Carlsbad Cavern is at 28.02 miles nearing the pre-resurvey total of 30.9 miles.

Carlsbad Cavern Trail Lighting

The park recently received money to purchase LED lights and compact fluorescent lights. Tom

Bemis has been experimenting with the different lights in the Dome Room and Papoose Room in order to prepare for a future upgrade of the Carlsbad Cavern trail lighting system.

Grand Canyon-Parashant National Monument

By Kyle Voyles, Physical Science Technician

The cave inventory project that was started in 2005 in Parashant National Monument has continued, with many significant biological and cultural discoveries having been made. After the initial discovery of a new genus of cave cricket and a couple of new species in 2005, the inventory project has been expanded. When we started, we had about 140 known caves in the area and we now have 271 documented caves. Although, we have only inventoried a very small portion of the known caves, the inventory has yielded 1 new genus of cave cricket, 1 new genus of psocoptera, 1 new genus of millipede, and 15 other new species.



Native American pictographs found in La Cueva de los Dos Manos Negros. Photo by Kyle Voyles.

Many of the great resources discovered are not in great caves. We recently found several small, dry caves that contain outstanding cultural resources. The first big find was in a new cave that I discovered while examining aerial photos for sinkholes. The new cave, Dos Manos Negros, is a dry cave, 900-feet long and 80-feet deep. During the initial exploration, at the bottom of a 30-foot

pit, I discovered a large (20 x 21 inch) Native American woven basket.



Monument archaeologist, Arch Van Alfen, with a large basket in Chamberpot Cave. Photo by Kyle Voyles.

The basket was lying upside down but partially full of blue clay that the Native Americans were mining from a nearby ledge. There was a second, but smaller (8 x 8 inches), basket found closer to the entrance. The C-14 dates on the baskets came back at 1,600 yrs BP.

The second cave, Chamberpot Cave, is a small 250-foot long cave. In this cave, we discovered 6 complete ceramic pots (the largest is 20 x 21 inches), 2 painted bowls (black on white), 5 large partial ceramic vessels, one basket, and 3 sets of hunting tools. The tools are believed to be for hunting rabbits due to the rabbit snares and curved sticks in the “kits”. There were also numerous torches found in the cave and a set of arrows in the far reaches of the cave.



Three complete Native American ceramic pots found in Chamberpot Cave. Photo by Kyle Voyles.



Native American wooden hooks found in Chamberpot Cave. Hooks were used to pull rabbits and other animals out of their burrows. Photo by Kyle Voyles.



Small basket found in La Cueva de los Dos Manos Negros. Photo by Kyle Voyles.

We just received the C-14 dates for these artifacts. The oldest was 3,500 BP and the rabbit snare was

1,170 BP. The other artifacts ages all fell in between these two dates.

Great Basin National Park

By Ben Roberts, Natural Resource Program Manager

Great Basin National Park began work this summer to restore nearly 4,700 square feet of cave floor in Lehman Cave to a pre-disturbance condition. Restoration will be accomplished by removing 1,800 feet of unused electrical system and 800 feet of paved walkways.



Example of the impact from the old lighting system in the Talus Room of Lehman Cave. June 2008. (NPS photo).



The on-going work of trail removal in the Talus Room of Lehman Cave. June 2008. (NPS photo).

An interpretive component will reach and inform park visitors about the project and the need to protect natural and cultural cave resources.



Before photo: A portion of the trail in the Talus Room of Lehman Cave that is being removed. June 2008. (NPS photo).



After photo: A portion of the trail in the Talus Room of Lehman Cave that has been removed. June 2008. (NPS photo).

The trail section, through the West Room and Talus Room, has been permanently closed since 1981 due to safety concerns about rock fall. The physical deterioration and chemical decomposition of the trail and lighting system significantly threatens cave natural resources by disrupting cave processes, harming cave biota, and adversely impacting water quality. The trail also presents a safety hazard to park visitors and increases the potential damage to cultural and natural resources if visitors leave the normal tour route. The trail is being removed with power and hand tools, loaded into 5 gallon buckets and then hauled out of the cave in wagons. The trail consists of a base layer of rubble, a layer of sand/dirt (the original trail), an asphalt layer, and then a concrete layer.

Approximately 160 feet of trail and over 1,200 feet of electrical wire have been removed so far.

Jewel Cave National Monument

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

New Airlock Doors

In order to evaluate the need for new airlock doors at the cave elevator landings, Mike Wiles has calculated the exchange of moisture, heat, and air mass through the current doors. Based on data recorded by Dr. Andreas Pflitsch inside the current "airlocks," the maximum amount of moisture removed from the cave due to leakage is about 1 gallon per day. However, the amount of moisture being added to the cave by public tours is about 50 gallons per day, from 600 people exhaling and sweating 1/3 quart each. The maximum amount of heat introduced into the cave via leakage through the existing doors is 540 watt-hours. This is the same as a 60W bulb running for nine hours, and is 0.15 % of the heat generated by the cave lights plus 600 people taking the Scenic Tour. Any leakage through the doors will alter natural airflow patterns, but the measured amounts are negligible. The volume of air diverted through the doors is less than 0.05% of the volume flowing into or out of the Historic Entrance.



Rene Ohms holding an ultrasonic anemometer in the Upper Cave airlock in Jewel Cave (NPS photo).

Although these calculations have demonstrated that leakage through the elevator airlocks is not a

great concern, the park still plans to install additional airlock doors at each elevator landing. The installation of new doors will reduce the microclimate effects to practically zero, and cover unusual circumstances like a door being accidentally left open or elevator work that requires extended open access to the shaft.

Cave and Karst Management Plan Completed

The Cave and Karst Management Plan was finalized in November 2007, and delineates policies and direction for science-based management of the caves and karst resources at Jewel Cave National Monument. The plan and FONSI can be found online at: <http://www.nps.gov/jeca/parkmgmt/index.htm>

New Trip Leader Program

The Cave and Karst Management Plan established a new cave trip leader training program, with two different types of trip leaders: On-Tape Trip Leaders, who are qualified to lead trips into Jewel Cave on established routes marked with flagging tape, and Off-Tape Trip Leaders, who can lead trips anywhere in the cave. The park has taught three trip leader training sessions so far, and there are now 6 approved On-Tape Trip Leaders and 11 Off-Tape Leaders. Another Off-Tape training is planned for October 2008.

Cave Rescue Meeting and Training

In November 2007, the cave management staffs of Jewel Cave and Wind Cave met with Wind Cave law enforcement staff to review and update our current cave search and rescue plans and discuss cave rescue readiness. In this meeting, we discussed callout procedures and callout lists, locations of maps and other important information, and training needs. Both parks would like to get more cave rescue training for local cavers and park staff, since there are currently only 3 cavers in South Dakota who have completed NCRC Level 1 or higher. In April 2008, Marc Ohms taught an NCRC Orientation to Cave Rescue for Jewel Cave and Wind Cave staff, which built on topics that had been discussed in the meeting and trained staff from interpretation, fire, maintenance, administration, law enforcement, and resource management in the

basics of cave rescue. In May, Rene Ohms completed Level 3 at the national NCRC training seminar in Alabama, and Andy Armstrong completed Level 2. Both parks will host a regional NCRC Level 1 seminar this fall for park staff and volunteer trip leaders.

New Vinegar Herbicide Approved For Use

The NPS Midwest Regional Office has recently approved Jewel Cave's request to use a new EPA-approved 20% acetic acid vinegar herbicide for control of exotic plants. The herbicide is the first organic, food-grade herbicide, and has very low leaching potential. The acetic acid breaks down quickly into carbon dioxide and water. The park will begin using the vinegar to treat weeds in the "negligible risk treatment zone" that was established in the Cave and Karst Management Plan, and will monitor pH levels at potentially affected drip sites in the cave. This herbicide is non-selective, and does not translocate into the root systems of troublesome perennial weeds like Canada thistle or leafy spurge, but shows great promise for treatment of annual weeds and for top-kill of perennials.

Cave Maps

Seasonal physical science technicians Jason Walz and Andy Armstrong updated the Jewel Cave quadrangle maps with several miles of recent survey. The new survey was drawn in pencil on vellum overlays of each Mylar quadrangle. Approximately 140 of Jewel's 143 miles of survey have now been drafted. In July 2008, all 60 Mylar quadrangle maps, plus 38 vellum overlays, were scanned. The digital files can now easily be printed at any desired scale, shared with cave trip leaders, and brought into the cave on an electronic handheld device.

Recent Survey

More than three miles have been added to Jewel Cave's surveyed length in the last year. There have been 4 multi-day trips, and 18 single-day trips. In July 2008, a 3-day trip led by Larry Shaffer yielded more than 2,600 feet of survey. The team surveyed in the Screeching Halt and Western Motif areas, and left several leads with significant airflow. Jewel Cave is now 143.03

miles long, and remains the second-longest cave in the world.



Gypsum speleothems discovered during a 3-day exploration camp trip in Jewel Cave, July 2008. (NPS Photo).

Sequoia Kings Canyon National Park

By Joel Despain, Cave Management Specialist

Research:

This is the last year for field work with the Lilburn Cave fire effects study in collaboration with CRF. A few more water samples will be collected hopefully after a burn, and data will be collected from the data loggers for a few more months. The future of the project will involve lab results and analysis.

We are working on a new grant proposal with the Sierra Nevada Conservancy, a state agency, to characterize discharge and chemistry of park karst springs in a multi-year effort focused on seasonal variations and retention.

We continue to host many climate researchers in park caves with four universities now working on

stalagmites, flowstone, and mineral deposits on glass slides. The park is in an on-going process of carefully weighing the impacts of this work and determining the most appropriate compliance process.

Projects:

The Crystal Cave Optimal Lighting and Solar Power System projects are both moving along steadily. We look forward to hosting Rick Toomey and Rick Olson here next month to set up our experimental light array.

As part of both the solar and optimal lighting projects, this year's Crystal Cave Restoration Field Camp (October 18 to 26) will focus on removing or replacing about 50% of the lights in the cave with the combined purposes of reducing load in support of the new solar powered system, reducing exotic plants in the cave, and improving visitor experiences by focusing lights on specific sights and objects with less general lighting of rooms.

Cave Management:

A major revision of the Parks' Cave Management Plan remains held up in compliance limbo. We hope to have a decision on our NEPA path and move on to public scoping before the year is out.

The park has just begun a major project to revamp the visitor facilities in the Crystal Cave area. This will include new restrooms (vault toilets, so we will get the septic system off the karst!), repaved and reorganized parking lot, rebuilt trail to the cave, rebuilt reception booth and book store, building for staff near the cave entrance, and restoration at several sights in the cave. We will be pursuing Fee Demo funds for this and expect it to take five years plus to complete.

Survey & Inventory:

The Mineral King Karst GIS project undertaken with graduate student Pat Kahn has revealed 25 new caves and three previously unrecognized areas of karst within this alpine region of Sequoia. The CRF Labor Day expedition will begin mapping efforts in some of these caves.

Newly discovered Ursa Minor Cave will receive a few visits this year. Two mop-up trips have entered the cave so far. There is more mop-up to do and several hundred feet of passage in the "Parachute Complex" (named for a shield) that needs to be mapped. There are probably two more good leads in the cave that are not major climbs. We may wait until next year to push these leads. The survey of the cave currently stands at 1,603 feet.

Biological monitoring is on-going and trips commonly are worked into our schedule. Most recently was work in Soldiers Cave with assistance from our cooperating Natural History Association staff from Crystal Cave.

Personnel:

We have a new division chief, Charrise Sydoriack previously from Bandalier, Lava Beds and the BLM. She seems to be highly motivated and to be a compliance wizz. She has already been out with us on cave excursions, and we have had a number of important conversations about the cave program. So, we think we are off to a great start with her.

Wind Cave National Park

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

Research:

Dr. Andy Long, a hydrogeologist from the USGS, and Marc Ohms have been working on a project funded by WRD to determine the source of arsenic within the local groundwater in the park. They are trying to determine where the arsenic that has been detected at elevated levels in our new well and several cave sites, is originating from.

In related news, they recently received NPS funding for a three-year project titled, "Tracing Karst Ground-Water Flow to Assess Water Quality Impacts in Wind Cave National Park". This project will determine the affects upon the groundwater resources of Wind Cave National Park from anthropogenic stresses; such as proposed production wells south and east of the

park and land use in the stream watersheds north of the park, especially along Beaver Creek. Their project will also trace groundwater flow to and from the cave using multiple environmental tracers and estimate the age of groundwater in the cave, in the aquifer, and in springs, and the proportions of young and old water in collected samples.



Marc Ohms dumping Rhodamine dye in the newly opened sink point in the bed of Highland Creek. Notice that the sink is capturing the entire flow of Highland Creek at the time of this photo. A month later, the sink started collapsing and water began flowing past the sink. June 2008. Photo by Rod Horrocks.

Marc Ohms has conducted two dye traces to date, one in the lakes in Wind Cave and the other in a newly opened sinkhole in the streambed of Highland Creek. Injecting dye into What the Hell in the Lakes Section of Wind Cave, Marc got a positive trace in nearby Rebel River and later in Calcite Lake. Tests from the park wells have so far been negative. The dye that was injected in the sinkhole in Highland Creek has not been detected anywhere to date, however sampling will be ongoing for some time.

Dr. Jean Krejca from Zara Environmental and Dr. Hazel Barton from Northern Kentucky University, were awarded a contract to look for macroinvertebrates and microbes in the groundwater lakes in Wind Cave. They will be starting their project shortly.

Dr. Andreas Pflitsch has been continuing his environmental research in the caves and blowholes in the Wind and Jewel Cave areas. He recently confirmed that nearby Reeds Cave blows barometrically, and that the cave shows a breathing pattern similar to Jewel Cave rather than Wind Cave.

Brian Fagnan and Mark Fahrenbach from the SD Geologic Survey, along with Tim & Beth Lincoln from Albion College in Michigan, have started a three-year geologic mapping project of the entire park. The state survey hired two additional geologic interns to assist with this mapping project. The group was able to map nearly half of the park during their first summer. In addition to mapping geologic contacts, they are also mapping structure and individual units within the Minnelusa Formation. When completed, the Survey will publish a Geology Map of Wind Cave National Park.



Brian Fagnan mapping geology in Wind Cave National Park. September 2008. Photo by Jake Tielke.

Projects:

This last spring we completed a project to completely replace the entire lighting system on the Fairgrounds Tour Route in Wind Cave. We

used LED and compact fluorescent lights in this new system. This lighting system has reduced energy consumption by 70%, reduced impact from visitors and maintenance changing bulbs, nearly eliminated algae, and increased safety by adding trail lighting to the stairs. The lights were also placed on circuits so that our Interpreters could turn lights on and off, ahead of and behind their tours. We ended up placing 305 new lights along this established tour route. We will be working on the Natural Entrance and Garden of Eden Tour Routes this upcoming winter and adding a new tour, an 800-foot long tour known as the Blue Grotto Loop. This undeveloped route was formally part of the Candlelight Tour Route. This route will have its trail concreted and then the walls will be cleaned using cave restoration techniques to remove many decades of dust, before it is opened up as a lighted tour. We feel that this new route will be a spectacular new tour.



The first three of a twelve-man crew who hauled the 480-volt primary feeder cable into each of the three main tour routes in Wind Cave. Each coil slung over the shoulders of this crew weighed 100 pounds each. Photo by Jason Walz.

We just completed a long-term drafting project where we finished hand drafting the 37 Wind Cave Quadrangle maps on pre-printed Mylar sheets. Due to the complexity of Wind Cave, many of these Mylar quadrangles were divided into three layers. This was done so that the same amount of detail could be shown on each of the maps. These maps contain 3,190 question marks that identify leads that have not yet been surveyed. These 37 maps represent nearly 120 miles of Wind Cave survey that has now been drafted onto the

quads. We have just started a project to completely digitize these 37 quadrangles and two new ones we just added to the list. At this point, we have completed digitizing 10 of these maps and have switched to drawing all new cave survey on the computer (no more hand drawn maps at Wind Cave National Park!).

We just completed a project to install InSitu multi-parameter probes in the lakes in Wind Cave. These probes will continuously collect several parameters, including: temperature, pH, conductivity, and turbidity. Probes were installed in What the Hell and in Calcite Lake. In addition to these probes, we have installed two drip collectors to gather drip water for water quality studies along the Wind Cave Tour Route and in Room Draculum, both in the Historic Section of the cave.



Jennifer Back, Andy Long, and Marc Ohms collecting water samples from What the Hell lake. Photo by Jason Walz.

Cave Survey & Inventory:

Dr. Andreas Pflitsch discovered and reported to the park that a flash flood had entered Coyote Cave sometime within the previous year and washed one of his probes away. Since the cave was discovered in 1974, the park had always feared that the cave might be prone to flooding, even though the adjacent canyon is normally dry. Upon inspection of the cave, park staff found Dr. Andreas Pflitsch's probe and data logger had washed 200 feet into the cave. It is hoped that this probe will reveal the exact time when this flooding event occurred. In addition, the cave gate was

nearly buried by organic debris, and sand and gravel had filled the main passage to within a few inches of the ceiling for an undeterminable distance. The group found a 2 x 3-foot slab of flowstone that was four inches thick that had been washed nearly 40-feet down cave. Although, the cave was breathing out at the time, the cavers discovered that it had bad air, as they all experienced headaches. Decaying organic debris is the likely culprit, as it created elevated CO2 levels that partially displaced some of the oxygen.

This coming October, the park, with assistance from Jewel Cave, will be hosting a week-long NCRC level 1 class for park staff and local cavers. This course will substantially increase the number of local cavers that would be available for potential cave rescue callouts.

Carl Bern led the first multi-day camp trip into Wind Cave in 36 years. They stayed in the newly established Camp Cosmos, in the Southern Comfort Section of the cave. Although they had to deal with a seriously sick participant, they were still able to survey a total of 1,165 feet of passage during this historic trip. They plan to return to the camp during this upcoming winter season to continue pushing and following the air on the southwestern edge of the cave, past a miserable crawl known as the Skinner.

Since the last reported length of Wind Cave in Inside Earth, volunteer cavers have increased the surveyed length of the cave by 5.0 miles; establishing the current length of 129.74 miles. This was accomplished during 72 survey trips. This new survey maintains Wind Cave's status as the fourth longest cave in the world.

Personnel:

Jason Walz and Dan Austin have both just accepted Physical Science Technician positions at Wind Cave National Park. They will be splitting their time between working on the cave lighting installation project and various cave management projects.



Andrew Blackstock sits next to the newly expanded water collector at Route 66, near Camp Cosmos. This drip collector accumulates water at a rate of 4-gallons in 14 hours, faster than the group can use it. Photo by Evan Blackstock.



Carl Bern, Larry Shaffer, and Andrew Blackstock at Camp Cosmos in the Southern Comfort Section of Wind Cave. They are using very low impact cave camping techniques. Photo by Evan Blackstock.