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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: Frostwork on top of popcorn along the CM survey in the Historic Section of Wind Cave. Photo by Ken Geu.

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Feature Article:

New Cave Discovered in Sequoia National Park

*By Joel Despain, Cave Management Specialist
& Ben Tobin, Physical Science Technician*

On August 19 four park volunteers discovered a significant new cave within Sequoia National Park that has been named Ursa Minor, after the Little Dipper constellation. The cave features large passages – often more than 50-feet wide – and beautiful cave formations. These include long and graceful draperies, some more than 30-feet long, ever fragile soda straws up to 6-feet long, many cave pearls, and large areas of multicolored dripstone and flowstone. Crystal faces in the flowstone, often called cave velvet, produce a brilliant sparkle when struck by a caver’s light. Ursa Minor also has a cave lake that may be as much as 100-feet long and 35-feet wide and vertical drops that must be traversed using ropes. The estimated current length of the known cave is 1,000 feet with several very good climbing leads and un-dropped pits remaining. It is clear that several of the cave’s larger passages continue and the actual length of the cave remains unknown at this time.



Caption: The second room in Ursa Minor Cave contains a 100-foot long by 35-foot wide lake, which may be seasonal. Photo by Dave Bunnell.

An ancient animal skeleton was found in the cave that resembles a bear, which influenced the naming of the cave. Cave-adapted invertebrates that may be new or rare species have also been seen in the cave. Thus far, three of the 31 new species recently discovered in the park’s caves appear to make their home in this cave.

Park Cave Specialist, Joel Despain, said, “we are very excited about the discovery of this beautiful new cave. It will add to our knowledge of the park’s wildlife and features. It is a fine new addition to the many wonderful caves in the two parks.” Joel also said that, “Knowing that the cave exists, will allow park officials to better manage the surrounding area.”

In keeping with park policies from the Park’s Cave & Karst Management Plan, this new cave is automatically placed in Management Class 4. Such caves are closed to recreational visits pending evaluation and scientific study. Park cave management staff will be planning a series of trips with subject matter experts to conduct this work. Tasks on these trips will include: creating an accurate and detailed map of the cave, conducting an inventory of its features, conducting a biological inventory, photo documenting cave features and formations, and gating the cave entrance to protect access into the cave. At this point, park staff will be on all trips into the new cave.



Caption: Cave Pearls in Ursa Minor Cave. Photo by Dave Bunnell.

The new cave was found as part of an on-going park-approved project managed by the Cave Research Foundation that allows small excavations with hand tools in a search for new caves and cave passages. The cave was found during the first weekend of the dig project overseen by Mark Scott. The discoverers of Ursa Minor cave spent approximately two hours excavating the entrance area before it was possible to enter the cave. The original hole was roughly baseball size and had no airflow.

Ursa Minor is the latest of dozens of caves discovered in the two parks during the past 20 years. To date, 240 caves have been documented within these parks. These parks are already home to California’s longest cave, Lilburn Cave (21 miles), a developed cave named

Crystal Cave (2.9 miles), and the spectacularly decorated Hurricane Crawl Cave (1.9 miles).



Caption: One of the four discovers standing next to some formations in one of the upper rooms in Ursa Minor Cave. Photo by Dave Bunnell.

Using SpeleoWorks and the Wind Cave Inventory Database to Locate Paleontological Sites in Wind Cave

By Rodney D. Horrocks, Physical Science Specialist

During the April 8, 2006 Wind Cave Weekend, I led a survey trip to a passage called, “No Don’t Stop” in the Historic Section of Wind Cave, when a woodrat skeleton was discovered in a small crawlway (see accompanying map). Located 90 feet from the northeastern edge of the cave, the No Don’t Stop passage parallels that edge of the cave. The Point and Inventory person on that particular trip, Ken Geu, discovered the partially articulated skeleton in a bellycrawl off of the main passage. Although the bones were not fossilized, the skeleton has been defleshed and is probably hundreds of years old. Although, the Natural Entrance is only 700-hundred feet away, it would have been a much longer traverse via traversable cave passages for a lost woodrat. It seems more likely that the woodrat entered the cave through a nearby and now plugged former entrance or through a nearby blowhole.

After this discovery, we used our new SpeleoWorks program to query the Wind Cave Inventory Database to determine where bones have been documented in Wind Cave. Our query showed that bones have been found at nineteen sites in Wind Cave (see accompanying map on the next page). Notice that the nineteen paleo sites are mostly clustered in the northern section of the cave, where the cave is

shallower and where old entrances have opened and closed over time. There seems to be a cluster around the Snake Pit Entrance, another near the Natural Entrance, and another near the Elevator (although the bones in that area certainly predate the Elevator and probably have more to do with flooding into a low-lying area). The woodrat skeleton in the Lakes Section is a surprise, as is the site at the end of the Half Mile Hall Section, which may actually be a bat skeleton. As a whole, these nineteen paleo sites primarily represent lost woodrat and bat individuals, except for the Chamber of Lost Souls site, which includes bones from many species washed into the cave through a now plugged former entrance (Martin, 1984).

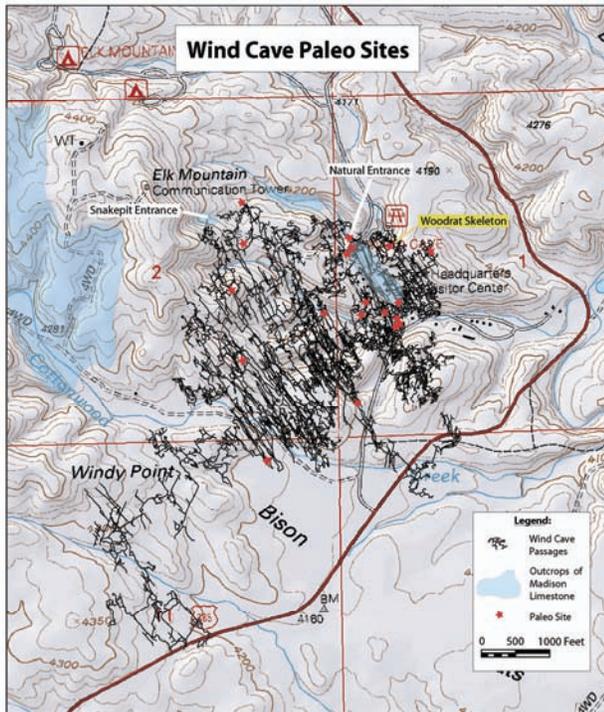


Caption: A woodrat skeleton discovered near the north edge of Wind Cave during the February Wind Cave Weekend. Photo by Ken Geu.

To date, we have entered feature inventory data for 18,267 stations into the Wind Cave Inventory Database. We still have a lot of data for an additional 5,000+ stations to enter into this new database. Undoubtedly, many more paleo sites will be discovered as this backlogged inventory data is entered into SpeleoWorks and as the on-going survey and inventory project continues to document additional paleo sites within Wind Cave. This query of the Wind Cave Inventory Database is just the first of countless searches that will become possible with SpeleoWorks once all the data is entered. As this database is interfaced with ESRI’s ArcMap in the future, it will be possible to conduct complex queries that identify all the stations with a set of common features and produce maps of those results. We will undoubtedly learn a lot about Wind Cave from these queries.

This query of the Wind Cave Inventory database was made possible as a result of the SpeleoWorks computer

program developed in Microsoft Access by Tom McBride in 2005.



Caption: Nineteen paleontological sites found within Wind Cave that have been documented in the Wind Cave Inventory Database, which was created with SpeleoWorks.

Martin, James E. 1984. "Vertebrate Remains From Wind Cave, Custer County, South Dakota". Department of Geology and Geological Engineering South Dakota School of Mines and Technology, September 29, 1984. Unpublished report, Physical Science files, Wind Cave National Park. 19 p.

Wind Cave Survey Becomes the Fourth Longest Cave in the World

By Rodney D. Horrocks, Physical Science Specialist

Before the February Wind Cave Weekend, the Wind Cave survey was nearly a half mile behind the fourth-longest cave in the world, Hoelloch Cave of Switzerland. Wind Cave had been the fifth-longest cave in the world for the previous 13 months. On February 11, 2006, ten out-of-state and eight in-state cavers, coming from Colorado, South Dakota, & Nebraska, participated in the February Wind Cave Weekend. Dividing up into six teams, they surveyed 0.67 miles or 3,545 feet of new passage, pushing the Wind Cave survey past Hoelloch's 119.24 miles. With

a new length of 119.58 miles, the Wind Cave survey easily became the fourth-longest cave in the world. Each of the six groups made significant discoveries that day, averaging as a group nearly 600 feet per survey team. The Wind Cave survey is now 13 miles behind the third-longest cave in the world (Optimisticheskaya in the Ukraine). Although the Wind Cave survey project surveys an average of 5 miles each year, the third-longest cave survey is still growing, which means it will be many years before Wind Cave has a chance to move up another slot in the world long cave list.



Caption: Bonnie Armstrong admiring the formations in the Stalactites Galore area of Wind Cave. This area was discovered on 2/11/2006, the day the Wind Cave survey passed Hoelloch Cave of Switzerland to become the fourth longest cave in the world. Photo by Andy Armstrong.

Announcement:

The book, "Cave Conservation and Restoration, 2006 Edition", edited by Val Hildreth-Werker and Jim C. Werker has been released and can now be purchased. This 600-page book contains 87 articles with 25 side bars, written by a total of 46 subject matter experts. Nine National Park Service employees contributed to this volume.

Park Updates (Listed alphabetically):

Buffalo National River

By Chuck Bitting, Geologist

Cave Rescue:

On August 12, a group visiting Fitton Cave became separated in an area of the cave with extensive breakdown. Four of the cavers exited, thinking the other two were in front of them. The remaining two, who had each been in the cave at least twice previously, attempted to make their way out. They became confused at a key point in the East Passage and sat down to await rescue. At 23:00 the park was notified of the situation and a search and rescue operation was commenced. At 03:00 on 8/13 a hasty search team composed of one NPS employee and three caver volunteers entered the cave and began heading toward the point last seen. The cavers were found at 05:35 in good shape about one mile into the cave. The hasty team and tired cavers exited the cave at 07:00. Another team entered to de-rig the communication wire and remove flagging from the cave at 06:00 and exited at around 09:00. In all, 40 people responded to the search. Buffalo National River is grateful for the assistance of all personnel who mobilized in the middle of the night to assist with the search and rescue effort.

Carlsbad Caverns National Park

By Dale Pate, Supervisory Physical Scientist

Oil & Gas Issues:

With the BLM fast-tracking oil and gas leases, the park is once more looking at drilling getting closer and closer to our boundaries. Though no drilling is occurring in the Cave Protection Zone (CPZ) established by the Lechuguilla Cave Protection Act of 1993, leases have recently been let on State of New Mexico land and private land north of Carlsbad Cavern and east of the CPZ. Combined with grandfathered leases within an 8,000 acre mineral withdrawal on BLM land in the area, there is high potential for drilling within 1.5 to 2 miles of Carlsbad Cavern. Additional leasing of BLM, State, and private lands south of the park is also occurring. Though these potential drill sites to the south are no threats to cave resources within the park, the park is concerned about discreet water channels that lead from the park to Rattlesnake Springs (the park's water source) and other

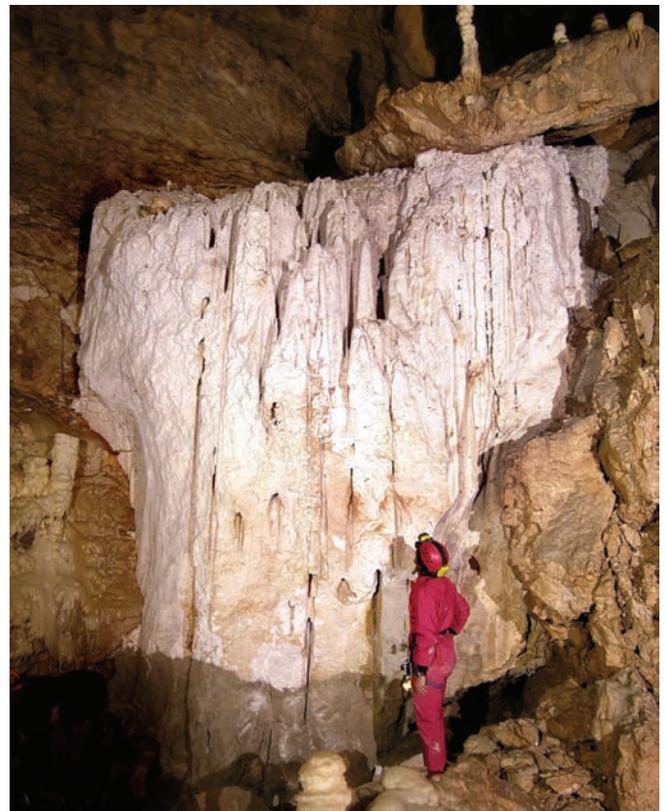
significant springs along the Black River. A project to detect these discreet channels within the alluvium from several major canyons in the park has been awarded with the hopes that potential drilling sites can be moved away from detected channels.

Updated Cave & Karst Management Plan:

An updated draft plan that replaces the 1995 Cave & Karst Management Plan has been completed and submitted to the Intermountain Region compliance team for review. It is hoped that the plan and Environmental Assessment will be finalized by the end of the 2006 calendar year.

Lechuguilla Cave:

Exploration, survey, and inventory continues for 2006 with 10 expeditions being awarded. Expeditions led by Andy Armstrong, Hazel Barton, Ron Miller & Rich Sundquist, and Steve Reames have added 1.6 miles of survey bringing the total length of Lechuguilla Cave to 118.32 miles (190.4 kilometers).



Caption: A gypsum glacier in Glacier Bay in Lechuguilla Cave, Carlsbad Caverns National Park. Photo by Art Palmer.

Carlsbad Cavern:

A Cave Research Foundation (CRF) project led by Barbe Barker completed the restoration of Longfellow's Bathtub in the Big Room. This large pool

at one time had the visitor trail going directly through it. The park built a bridge to replace the fill that had been placed in the pool, but unfortunately red clay and other materials had been accidentally released into the pool during the removal process. The CRF took considerable effort to clean the pool and it looks really great. They have done an excellent job. The CRF is also close to completing the cleanup of the Rookery in Lower Cave. This project has taken more than 10 years, but the tremendous effort put forth by the CRF has produced some amazing results. In addition, the CRF has worked in numerous locations continuing restoration, survey and inventory in Carlsbad Cavern.

Other groups and individuals also continue to perform restoration, survey and inventory work in the cave. This includes: the Permian Basin Speleological Society, Karen Perry, the Lubbock Area Grotto, the Central Oklahoma Grotto, the Pecos Valley Grotto, and survey teams led by Dan Montoya and Paul Burger. The resurvey of Carlsbad Cavern now stands at 26.03 miles (41.89 kilometers).

Grand Canyon-Parashant National Monument

By Kyle Voyles, Physical Science Technician

In late 2005, we discovered cave dwelling salamanders just outside of the park and conducted a short salamander inventory. During this inventory, we discovered numerous caves with significant biological aspects to them, so it was decided to conduct an inventory of the caves on the Parashant National Monument.

In early 2006, we received funding to conduct a baseline ecological inventory of the caves on the Monument. The project was a joint effort between NPS, BLM, USGS and NAU (Northern Arizona University) and was headed by myself and Jut Wynne from the USGS.

The Baseline Ecological Cave Inventory is a large scale cave inventory with the primary emphasis on cave dwelling invertebrates. The project consisted of in-depth inventories in the categories of Geology, Hydrology, Paleontology, Cultural, Biology and Recreation/Human use. All 24 known caves of the Parashant National Monument were inventoried, with an additional 2 new caves being found during that time.

The project resulted in 12,000+ feet of cave passage being surveyed, which produced high quality and accurate digitized cave maps of all caves on the monument. We also discovered four species of invertebrates and one new Genus of cave cricket. Of the 15 vials of inverts collected, there are currently 13 vials of invertebrates waiting to be identified.

Of the 24 caves inventoried, we sampled 15 caves for invertebrates. Shelter caves were not sampled. Of those 15 caves, 5 were identified as containing significant bat Hibernaculum/day roost sites.

This is just a baseline study, so there is much more work to be done and many more caves to be found. We are hoping to continue the project on the monument and expand to lands of the AZ strip, where there are over 100 caves that have not been inventoried and many that have not been surveyed.



Caption: This female cricket is from a new genus of cave crickets found in Resort Cave in Grand Canyon-Parashant National Monument. Photo by Kyle Voyles.

We have discovered the first known sign of bear use in a cave on the monument or the AZ strip. The scat was identified by Jim Mead of NAU and dated to ~1,100 years old. In the same cave we discovered the first prehistoric human feces, which dated at ~1,200 years old.

Jewel Cave National Monument

*By Rene Ohms, Cave Management Technician
& Mike Wiles Cave Management Specialist*

A New Way to Kill Algae:

This summer, the park experimented with a germicidal ultraviolet light (the type used for disinfection in

hospitals) at one light along the Scenic Tour with moderate algae growth. The idea for this project came from Lee-Gray Boze, a caver and seasonal biological science technician. A patch of algae was exposed to the UV light for up to 24 minutes, after which there was no immediate visible change. Within one week the algae had clearly diminished, although it did not disappear completely.



Caption: Algae before a 24-minute treatment with ultraviolet light. Photo by Rene Ohms.



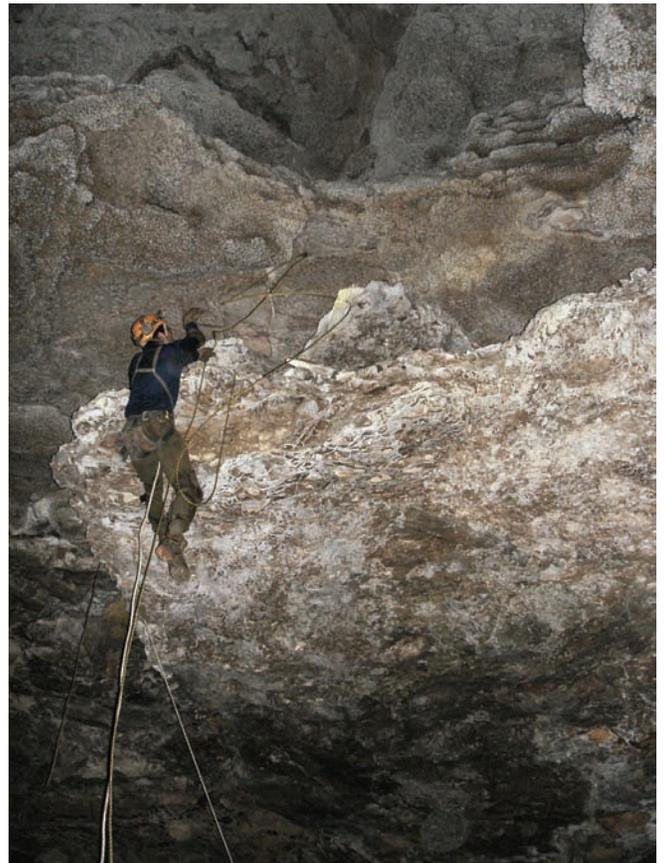
Caption: Algae seven days after a 24-minute treatment by ultraviolet light. Photo by Rene Ohms.

The ultraviolet light appears to have great potential for killing algal growth without the use of harmful chemicals such as hypochlorite bleach. Longer exposure times, or a light with greater wattage, may be necessary in order to kill the algae completely. The park will continue to explore this promising alternative to traditional bleach treatments.

Recent Discoveries:

Since the last issue of *Inside Earth*, there have been eleven exploration trips into Jewel Cave, yielding a

total of 1.7 miles of additional survey. Two of these were four-day trips, which pushed open leads at the southeastern edge of the cave, where there is still going passage and strong airflow. There have also been successful survey trips near the Big Deal (in the western section of the cave), the PHI area south of the Target Room, and below Geologist's Delight along the Hub Loop. In August, a team led by Andy Armstrong investigated a high lead above Seventh Heaven. Larry Shaffer made the initial climb, after lassoing a rock projection 30-feet above (see photo below). Once the others had climbed into the upper passage, the team surveyed 121 feet, leaving two going leads.



Caption: Larry Shaffer climbing a lead above Seventh Heaven in Jewel Cave. Photo by Andy Armstrong.

In the Media:

In January, Jewel Cave reached 135 miles of surveyed length. The cave had also recently passed Optimistychna (the Ukrainian name for Optimisticheskaya) to become the second longest cave in the world. As a result, articles about Jewel Cave exploration appeared in newspapers and on internet sites across the globe. Video interviews with cavers from January's four-day trip can be seen at:

http://www.blackhillsportal.com/newsarchives/archive_details.cfm?id=1110

The Potential Extent of Jewel Cave:

Cave Specialist Mike Wiles has developed a GIS model to determine how far Jewel Cave is likely to extend. The model is based on known geology, hydrology, cave survey, and barometric airflow studies. After determining the volume of limestone available for cave development and extrapolating the known “cave density” into that volume, it was determined that Jewel Cave could extend as far as Wind Cave, which lies 18 miles to the southeast. This study has been presented at several conferences, including the National Cave and Karst Management Symposium, South Dakota Hydrology Conference, and National Speleological Society Convention. The model proves to be a valuable tool for management of the resource, and underscores the importance of establishing good working relationships with park neighbors.

Oregon Caves National Monument

By John Roth, Natural Resource Specialist

Cave Projects:

This season staff attempted to control algae by spraying with a hydrogen peroxide solution instead of bleach. Initially, a 15% solution seemed to have no effect. The concentration was increased to 30%, but with only marginally greater effect. A 50% solution appears to do the trick.

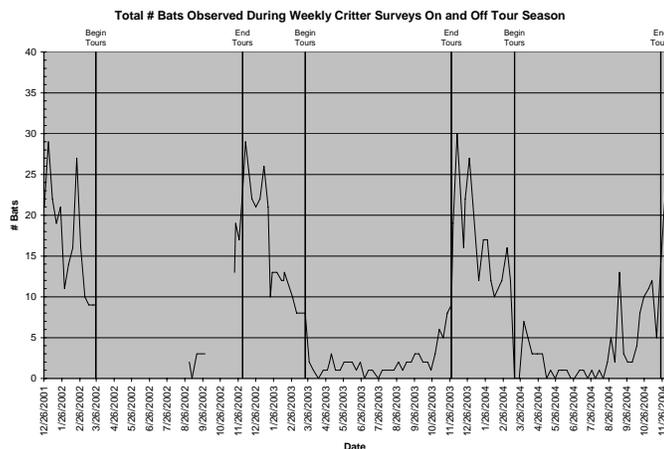
Bat counts from biological surveys conducted weekly along the paved tour route were compiled and graphed. Monument staff and volunteers have been conducting these “critter surveys” since 2001, although not consistently, except in 2003-2004. The line graph shows weekly bat census data 2001 through 2004 on and off tour season (gaps in data where line is discontinuous).

Work is ongoing on developing an initial integrated microbial/ macroinvertebrate/ Neotoma feces biological monitoring protocols that will likely be further developed by funding from NCKRI.

There are now 12 Hobo temperature/humidity sensors located throughout the cave.

A few thousand dollars have been obligated this FY to develop a user-friendly Access database or revise one

already developed such as Bill Elliott’s Missouri one. It will allow the inputting of species data from our cluster and from cave, groundwater, and marine species north of Mexico. Each park unit will be identified and will be able to generate their own state or park lists.



A new lock system will be installed for the cave sometime this fall or next spring. Cyberlocks, manufactured by Videx, are weather-proof and do not require wiring. Keys are programmable, battery-powered, and contain unique identifiers. The system records use in the locks and keys, and periodic docking of keys to a keypad will upload key activity data into a database. Currently, staff, volunteers, and researchers are required to sign in on the clipboard behind the visitor center desk when making any visits into the cave without being on a tour.

Tarps under the stairs and grated walkways were cleaned out, and the debris was collected into filters and taken out of the cave.



Pools in the proposed caving route that were impacted by bootprints have been restored and flagged off more clearly.



Visitor impact mapping and monitoring will be the main project focus of resource management staff through the fall. The project concept was initially based on work done by Hans Bodenhamer and will involve taking inventory of the presence and severity of specific impacts along off-trail corridors in the cave that will be used for the proposed caving route, educational after-hours trips for guides, or research. It will also include mapping specific points to be monitored, photomonitoring, photoinventory, TDS readings for trail-side and off-trail cave pools, designing maps to display levels of hazard, fragility, and susceptibility to damage of various cave passages, marking broken speleothems along the main trail with UV fluorescing ink, and possibly also measuring compaction and biodiversity. Impact mapping work this summer included photographing and mapping five bone sites near the caving route and conducting initial impact inventory of the proposed caving route, testing various methods for assessing impacts in cave passages, and progress toward a map design for displaying hazard and fragility levels mapped in 2005.

One of our Geocorp staff completed a study of the compass direction of broken and re-cemented speleothems. There were no preferred orientation although both failed flowstone and broken speleothems are narrowly vertically distributed in the cave and associated with sediment between flowstone. This suggests that reflooding may have mimicked some of the flowstone-on-sediment failure and broken speleothems seen in other caves with earthquake damage.

Presentations:

Presentations at the NSS convention included two on DNA work at the Caves by Rick Fowler, one by John Roth on historical attitudes towards caves and one on how that affects NPS funding, one by Hester Mallone on volunteering at Oregon Caves, and one by Mary

Schubert (Geologists in the Parks) on Oregon Caves water quality.

Sequoia & Kings Canyon National Parks

By Joel Despain, Cave Management Specialist

The Cave Management Program at Sequoia and Kings Canyon National Parks have had a very busy 2006.

The program is playing host to National Geographic photographers and a writer who will spend a total of 6 weeks in the parks photographing and writing about the 27 new species of cave invertebrates found during the cave invertebrate inventory completed early this year. This work will result in a magazine article next year.

More results from the Invertebrate Inventory have come-in. Three additional new species of millipedes and one new genus of millipede have been identified by taxonomists. This brings the total number of new species from the study to 31.



Caption: A new species of millipede from Crystal Cave, Sequoia National Park. Photo by Jean Krejca.

Park staff have been maintaining a series of data loggers in the Redwood Canyon area of the parks this year for the Lilburn Caves fire effects study, which is examining the water chemistry and sedimentation effects of forest fires on karst systems.

Joel Despain authored an article recently published in the International Journal of Wilderness that examines applying wilderness management to park caves.

Ben Tobin represented the parks at the annual meeting and convention of the National Speleological Society in Bellingham, Washington in early August.

On August 19th four cavers working under an approved research program overseen by the Cave Research Foundation excavated an opening on a park mountain-side and discovered a new significant cave. The explorers named the cave Ursa Minor (see feature article in this issue).



Caption: A new species of pseudo scorpion found in Walk Softly Cave, Sequoia National Park. Photo by Jean Krejca.

Wind Cave National Park

By Rodney D. Horrocks, Physical Science Specialist

Some of the cave management highlights that have occurred in the park since the last issue of *Inside Earth* include:

Awards:

In recognition for 16 years of volunteer service at Wind Cave National Park, we recently nominated the Colorado Grotto for the National Park Service's, George B. Hertzog Volunteer Group Service Award. The Midwest Region (which oversees 54 National Park Service sites) chose the Colorado Grotto to be their nomination for this national award. Unfortunately, the Grotto was not selected at the national level for the award. In recognition for being the Midwest Region's selection, the Region presented the Grotto with an attractive clear acrylic award. Rod presented this award to the Colorado Grotto during the February Wind Cave Weekend. Amy Bern, the Wind Cave Weekend Coordinator, accepted the award in behalf of the Grotto.

Presentations:

Rod presented two slide shows at this year's National Speleological Society Convention, which was held in Bellingham, Washington. The first of those two PowerPoint shows, which he presented at the session on Caves and Karst on Federal Lands, included current cave research and cave management projects at Wind Cave National Park. The research projects discussed included the microbial studies by Dr. John Moore, who is from Colorado State University, and the cave environmental studies by Dr. Andreas Pflitsch, who is from Ruhr University in Bochum Germany. The second PowerPoint presentation was an update on the Wind Cave Survey Project for the U.S. Exploration session, where the 79 survey trips were discussed that surveyed 4.73 miles of passage since the last NSS Convention. Six of the more significant discoveries made during this time period were highlighted for the slide show.

Projects:

Rod recently completed an oblique view cutaway of a portion of the tour routes in Wind Cave. This 3D illustration will be used in a new interpretive sign showing the relationship of the tour routes with the overlying surface. The new sign will be located between the Visitor Center and the Elevator building.

Marc Ohms recently completed a project where he took 35 digital photographs at each of 15 in-cave sites in Wind Cave. These photographs are part of a 360 degree photo CD sales item that will be sold by the cooperating association and will allow Park visitors to sit at their computer while exploring parts of the cave that would otherwise be impossible for them to see.

During the May Black Hills Restoration Camp, 11 volunteers cleaned the entire Garden of Eden Tour Route trail. In the process, they removed 3,175 pounds of sand, silt, dust, lint, and hair from the cave. This is the first time we've cleaned this route in the previous seven years and it is the most debris removed during any lint camp during that same time period.

Rod just completed a project to update the "Wind Cave Inventory Photo Album" by adding 90 photos of different types of speleothems, geological, and biological features that have been found in Wind Cave (see example of manganese dendrites below). This photo album, which includes nearly 140 photos and descriptions, will be used by new inventory people to familiarize themselves with the types of features found in Wind Cave before they go on their first survey and inventory trip.



Caption: Unusual manganese dendrites on the chert ceiling of the Map Room in the Historic Section of Wind Cave. Photo by Andy Armstrong.

We hosted Dr. Andreas Pflitsch's intern, Andre Baumeister, from Ruhr University in Bochum Germany. He spent two months living at the park last winter while studying environmental conditions in Wind Cave. Andre took measurements using a thermal camera, temperature sensors, and a heat bulb anemometer (for Wind speed) during measurement walks taken twice daily along the Natural Entrance Tour Route. He did measurements at 10 points between the Walk-In Entrance and the elevators, which included taking 20 thermal photos of the walls, ceiling, and floors of the cave to measure the rock surface temperature. He was researching the thermal processes between the moving air and the rocks, especially in the entrance area.

Cave Survey & Inventory:

Seasonal physical science technician Jason Walz, completed a project to update all 21 of the Wind Cave quadrangles maps with recent surveys (6 miles of new survey). Because eight of these quads have now been divided into three separate layers each, there is now a total of 37 individual map sheets that cover the 21 quads. With this update, 121.02 miles of Wind Cave has now been drafted on maps. This was the first time since 1984, that all of the existing Wind Cave survey had been drawn on maps.

Since the last reported length of Wind Cave in *Inside Earth*, volunteer cavers have increased the surveyed length of the cave by 3.82 miles, establishing the current length of 121.66 miles. The Wind Cave survey passed Hoelloch Cave of Switzerland on 2/11/06 to become the fourth longest cave in the world (see article in this issue).

Survey work in Wind Cave continues to uncover additional facts about activities that occurred within the Historic Section of Wind Cave but are not well documented in park records. Recently, while on a survey trip to the UEA area (located next to the Escape Stairs on the Garden of Eden Tour), we found a pencil inscription on the wall that read, "Radiators installed 8-18-35". We had already known that the Park had done extensive modifications of a room 50 feet to the east of that inscription sometime in the 1930's. We could see that they had excavated seventy feet of passage to a depth of 6-10 feet and built a 45-foot long rock retaining wall in a nearby room. After a little research, we now know that the work was done in preparations for installing radiators for cooling the power plant. This plant generated electricity for the elevators. Because of this inscription, we now know when the radiators were installed, August 18, 1935, which was a few months after the excavation of the elevator shaft and two months before the Otis Elevator Company finished installing the new elevator. The coolant system was composed of a 2" pipe that ran down the elevator shaft and out to a room they called "The Isolation Room", where hot water ran through 2,300 feet of coiled pipes and was cooled in the 53 degree F. cave air before being pumped out of the cave and back to the Power House (currently the VIP Center). The only thing remaining today are the extensive excavations, blasting, and rock walls in the Isolation Room. Searching the Superintendents Annual Reports, we learned that the pipes were completely removed from the cave during a "cavern cleanup job" after power lines from Hot Spring started supplying electricity to the Park in the spring of 1953.