



# Inside Earth

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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:** Brian Killingbeck in the entrance to Palma Vista Cave in Everglades National Park. See featured article on page 3. (Photo by Alan Cressler – USGS).

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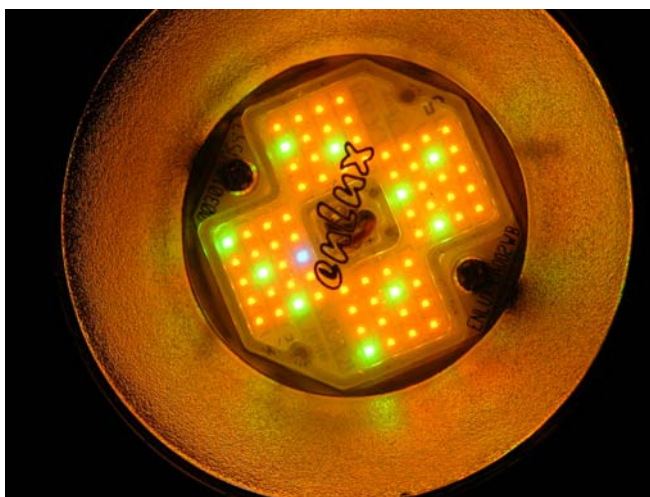
**Accelerated Cave Lighting/Lampflora Tests**

*By Rick Olson, Ecologist  
Division of Science and Resources Management  
Mammoth Cave National Park, Mammoth Cave, KY*

Last year Rick Toomey, Director of the Mammoth Cave International Center for Science and Learning, and I submitted a multi-park proposal for conducting lighting tests in Carlsbad Caverns, Great Basin (Lehman Caves), Mammoth Cave, Sequoia and Kings Canyon (Crystal Cave), and Wind Cave National Parks. This project was funded for fiscal years 2008-2009. We will be looking at energy efficiency (lumens/watt), heat liberated, and ability to support (or not support) the growth of lampflora. We will test some lamps at all five sites in order to compare results between sites, and will also test lamps of particular interest to individual parks. The reason for this is that lamps that might perform well in one location (for instance, Carlsbad's Big Room) may not be appropriate for other caves. We will be in touch with the participating parks to see what they would like to test in addition to those common to all parks.



*Fig. 1. Basement light test. Light on the left is the enLux W2050, the light in the middle is the Ledtronics XIW warm-white, and the light on the right is the Ledtronics 592 nm yellow LED lamp.*



*Fig. 2. The enLux W2050 LED lamp has 69 amber, 10 green, and 1 blue chip that blend to make a warm white light with a color temperature of 2050 degrees kelvin.*

Because we have some money to spend on cave lighting, and because we have been working with enLux on a special LED light, accelerated lighting tests are being conducted in my basement. The custom lamp enLux made for us has a pleasant warm white color-temperature (Fig. 1), based upon 69 amber, 10 green, and 1 blue LED that blend nicely (Fig. 2). The light from this lamp supports algae growth only to a very limited degree at 145 foot candles based upon the basement tests (Fig. 3). At reasonable light intensity, they should grow nothing in caves. They cost about \$100 each and so are not cheap, but they have a projected life span of about 50,000 hours. This lamp in a polymer Hadco bullet fixture and a Carlon polymer outdoor-rated junction box will make a fixture-lamp combo that will last for many years. Even the screws on the junction box are stainless steel so corrosion potential is pretty limited. Of course this does add up to about \$186 per fixture-lamp combo, and that's with a bit of a quantity discount. One problem to overcome is that because the W2050 enLux is a custom product, there is a minimum order of 50 lamps. It may be that if enough show caves are interested in getting some of these, then Peter Weinreb of Light Southwest could order 50 and then sell them to the various customers. We've worked with Peter for years, and he's been really helpful. He is an enLux distributor in addition to many other brands.



*Fig. 3. Lampflora growth at 51 days under 592 nm yellow and W2050 white light at 145 foot candles. The results are similar, which is encouraging because the yellow LEDs have been in Frozen Niagara for 7 years and not grown any lampflora at a reasonable light intensity of about 4 foot candles.*

One lamp that Peter brought to our attention is the Ledtronics XIW warm white (Fig. 2), which grows algae more than the enLux W2050 at 145 foot candles in the basement test, but at realistic intensities in the cave, it may support very limited or no growth. Time and the multi park lighting test will tell. One good thing about the XIW is that it comes in beam dispersion angles as tight as 20 degrees, which is a nice spotlight. The enLux W2050 comes in 80 degree standard beam spread and a 40 degree spread for \$20 more. So if you need to reach up high into a canyon, the XIW may perform better, and may still not grow algae if you keep the intensity on the cave features to somewhere around 4-5 foot candles or less. This is

a pleasant amount of light on a wall or flowstone feature.

## **Everglades National Park – Surveying the southernmost cave in the continental United States**

*By Lee Florea – Florida Integrated Science Center,  
US Geological Survey*

*Amber Yuellig – Tribal Historic Preservation Office,  
Seminole Tribe of Florida*

Everglades National Park encompasses 1.5 million acres of grassland glades, tree islands, cypress strands, and mangrove marshes and is world renowned for natural vistas and wonders at the surface. The cave and karst resources in this park, however, are little known even though much of the park is underlain by limestone. In a recent communication to the authors, Alan Cressler (U.S. Geological Survey, written communication, 2006) described his visit to Palma Vista Cave in Everglades National Park last November that he originally explored and described over 13 years ago (Cressler, 1993).

Palma Vista Cave is located on one of the several small hardwood hammocks that occupy the eastern portion of Everglades National Park. These hammocks are related to the southwestern limits of the much larger, relatively high, but low-relief topographic feature in southeast Florida called the Atlantic Coastal Ridge. Most of the coastal ridge has been developed in the past century; the relatively higher elevations now host the Greater-Miami metropolitan area and the large agricultural district surrounding Homestead. Cressler (1993) noted that several caves have been found throughout the coastal ridge in Miami-Dade County. In his e-mail, however, he acknowledges that this site may be the only cave left in Dade County that remains undisturbed by development. At this time, Palma Vista Cave is the southernmost explored cave in the continental United States. William Loftus, a USGS biologist at the Everglades Field Station, has had an interest in the cave since he learned of its existence in 1990. Loftus and the late Durbin Tabb (Everglades National Park, written communication, 1990)

provide a detailed description of the cave in an unpublished manuscript:

Entry into this new cave was made from a sinkhole approximately 7 m long by 4 m wide and 1 m deep, formed by the collapse of the ‘roof’ of a western portion of the cave. The long axis of the sinkhole lies in roughly a west-northwest to south-southeast direction... The entrance to the cave is about 65 cm high at its opening off the sinkhole. From this entry, the cave roof rises and the floor slopes gently down to below water level... The cave chamber extends east from the entrance a distance estimated as 6 m. It also extends to the south along the full length of the sinkhole entrance, but is too low... to permit entry.

map, and cave diving will be necessary to determine the extent of these underwater passages.

Loftus has indicated that aquatic invertebrates have been observed in the cave, including a surface species of crayfish. Additional inhabitants observed in the cave during past winters include alligators and water moccasins. The biota observed during our visit was limited to terrestrial species of spider and millipede frequently encountered on the walls and ceiling, and small fish in the water.

Other caves and sinkholes in the coastal ridge of southeast Florida, such as the Cutler Ridge Fossil Site in Miami, are known to host cultural remains. Our inspection of the sediments that cover the floor of Palma Vista Cave, however, revealed no evidence of prehistoric occupation due to the great amount of organic matter that has accumulated on the cave floor. A thorough archeological investigation to determine any cultural occupation would require a well planned testing strategy that takes into consideration the unique biota that occur in this subterranean environment.

Of particular interest are speleothems within the cave that are underwater. Loftus and Tabb (Everglades National Park, written communication, 1990) noted the importance of these calcite formations in their unpublished manuscript, stating, “We take such deposits to be truly examples of deposition under subaerial conditions and not just some artifice of solution shaping.” This statement implies that the calcite formations developed in Palma Vista Cave during a previous and extended dry period. Such a condition would have existed when sea levels were much lower, such as the period between about 80,000 and 6,000 years ago that ended soon after the settlement of Florida by prehistoric people.

Other intriguing evidence of inundated cavities with subaerial speleothems exists within Everglades National Park. For example, John Small (1921) commented on a striking discovery made in 1917 by engineers constructing the Old Ingraham Highway between Royal Palm State

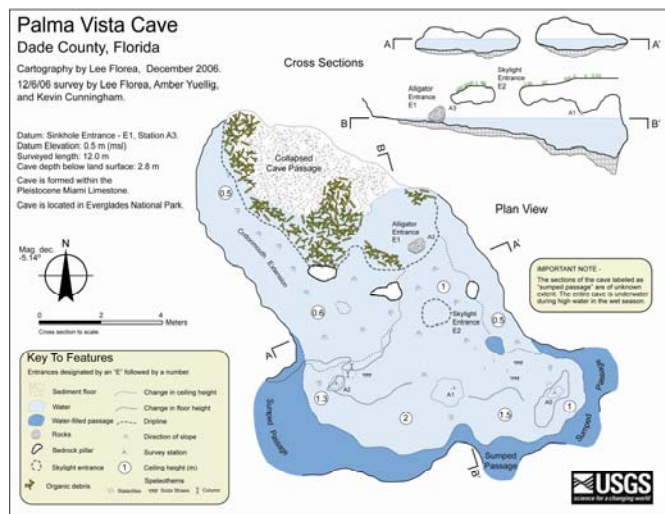


Figure 1: Map of Palma Vista Cave.

Our survey and inventory of the cave on December 6, 2006, resulted in a detailed map (Fig. 1). The cave contains a perennial pool of clear water that traps a large volume of organic matter (see cover photo). Water levels fluctuate seasonally in the cave. High water levels that completely fill the cave occur after the summer rainy season, followed by low water levels that permit exploration during the dry season. The cave does continue underwater beyond the limits of the

Park and Cape Sable (both of these sites are now part of the National Park):

The blast shattered the top of a subaqueous cavern! Stalactites varying from the diameter of a finger to over four feet were thrown out... The dipper of the dredge, terminating a boom nearly thirty feet long, was let down into the cavern and swung around in all directions without encountering any obstructions. Here in the wet Everglades is a subaqueous cave. Yet the sections of stalactites indicate great length and they could only have been formed in a cavern in which the floor, or at least the upper portion of the cavern, was elevated above the water table.

No evidence of this cavern is now known to exist, and the speleothems, once on display at Royal Palm State Park, have since disappeared.

For decades, karst within Everglades National Park has been described only in terms of surface features such as sinkholes and solution pits. Our recent survey of Palma Vista Cave adds an underground perspective of the karst processes occurring in southeast Florida, and furthers our understanding of the geology and hydrology of the Everglades ecosystem.

Cressler, Alan, 1993. "The Caves of Dade County, Florida". *Georgia Underground*, vol. 30, no. 3, p. 9-16.

Small, John, 1921. "Historic Trails by Land and Water". *Journal of the New York Botanical Garden*. vol. 22, p. 193-222.

## Testing Light Intensity Dataloggers at Mammoth Cave

*By Rick Toomey, Director, Mammoth Cave International Center for Science and Learning*

During May 2007 Rick Olson (Mammoth Cave, Ecologist) and I installed a mixture of light intensity and light on/off dataloggers in an area on

the Mammoth Cave Wild Cave Tour Route. These dataloggers were installed to test how well they detect tours to provide guidance on their use in detecting visitation in backcountry caves. This study resulted from discussions associated with a talk that Jon Jasper presented at the 2005 NSS Convention. Jon had deployed a logger at Nutty Putty Cave in Utah in an attempt to monitor visitation. Discussion after the talk centered on whether independent data existed to indicate how well intensity meters detected groups, whether different sized groups could be distinguished, and whether hidden dataloggers could detect as well as more obvious, and thus vulnerable, dataloggers.



Fig. 1. HOBO H6 Light On/Off Logger, HOBO StowAway Light Intensity Data Logger, and HOBO Pendant Temperature and Light Intensity Data Logger being tested along the Mammoth Cave Wild Cave Tour route.

Wild cave tours, such as the one at Mammoth Cave, provide an excellent opportunity to experiment with light intensity dataloggers to address these issues. Wild cave tour routes have known numbers of known-sized tours that can be correlated with the results of the light intensity loggers. For that reason we have deployed a constellation of eight light data loggers (3 HOBO StowAway Light Intensity Data Loggers, 3 HOBO Pendant Temperature and Light Intensity Data Loggers, and 2 HOBO H6 Light On/Off Loggers) along the Wild Cave Tour Route. Examples of the loggers can be seen in figure 1. This project was planned in consultation with park Interpretation staff to be sure the guides knew why the loggers

were in place and to allow them to accurately interpret them (Fig. 2).

We have deployed all of the loggers in the same area, but they are in three groups. The area is a wide spot in a walking canyon passage with a breakdown pile along the left wall. The area is about 10-feet wide and 10-feet high. The area is on a portion of the Wild Cave Tour Route that is used by all tours, as opposed to one of the optional routes. One set (consisting of a StowAway Light Intensity Data Logger, a Pendant Temperature and Light Intensity Data Logger, and an H6 Light On/Off Loggers) was placed in plain sight on a ledge that the group passes under while walking in the passage. This group of loggers should easily detect all groups. It will allow the loggers to be compared in optimum cave conditions. A second set of loggers (like the first) was placed on top of a flat boulder near the top of the breakdown pile on the left. The loggers are lying on the top, facing toward the ceiling. The loggers cannot be seen from the trail. They would rely on ambient and reflected light to detect the group. The third set of loggers (one StowAway Light Intensity Data Logger and one Pendant Temperature and Light Intensity Data Logger) have been hidden in a small gypsum-encrusted crack on the back wall of the area away from the direction of travel. This logger would probably also rely on ambient and reflected light.



Fig. 2. Rick Toomey (right) with Mammoth Cave Guides Johnny Merideth (left) and Chuck Decroix (center) discussing the use of dataloggers in the cave.

The loggers are being left in place for the summer season, during which Wild Cave Tours are offered daily. We will be downloading the loggers as needed and potentially redeploying them to test different kinds of hiding spots. We will analyze the data over the winter and will be reporting the results. We hope that the study results in a set of preliminary recommendations for using light detection loggers to monitor cave visitation.

**Park Updates (Listed alphabetically):**

**Carlsbad Caverns National Park**

*By Paul Burger, Hydrologist*

**Visitor Center Rehabilitation is Underway**

Visitors to Carlsbad Cavern will see something new on the surface for the next year. The long-delayed rehabilitation of the park visitor center is now underway and all visitor operations are being conducted from temporary trailers in the west parking lot. The interior of the visitor center will be completely gutted and reconfigured to make better use of space and to provide more efficient traffic flow throughout. Construction is expected to be complete by the middle of next year.



Visitor Center services at Carlsbad Caverns National Park are being conducted in these temporary trailers while the existing building is being completely remodeled.

### Cave and Karst Management Plan Complete

The new park Cave and Karst Management Plan has been completed and is awaiting final approval from the Regional Director. The plan includes updates to guidelines for entry into park caves, cave survey and inventory, cave restoration, emergency planning, research, and monitoring. The final EA and FONSI will be made available on the park webpage and the NPS Planning, Environment and Public Comment (PEPC) webpage.

### Fuel Tank Decommissioning

The park has decided to take out of service the two refueling tanks housed in the maintenance area. These tanks are located above the Guadalupe Room, one of the largest rooms in the cave. First proposed under the Carlsbad Cavern Resource Protection Plan as a way to help protect those parts of Carlsbad Cavern that lie directly under the area, the idea was ultimately rejected. The fuel system is now in need of major repairs so several alternatives were examined again. Ongoing resource concerns and prohibitive costs led the park to decide to decommission the tanks. Fuel for park vehicles will now be purchased in nearby Whites City or in the city of Carlsbad.

### Lechuguilla Update

Lechuguilla Cave is now 120.86 miles long, the fourth longest in the United States and the fifth longest in the world. Exploration, survey, and inventory will continue with nine expeditions approved for 2007.

## Geologic Resources Division Cave & Karst Program

*By Dale L. Pate, Acting National Coordinator NPS  
Cave and Karst Program*

**Ronal Kerbo Retires** – After almost 15 years as the Cave Specialist for Carlsbad Caverns National Park and about 16 years in several phases as the National Cave & Karst Program Coordinator, Ronal Kerbo retired as of March 1, 2007. Ron's accomplishments during his career have been many and he has been considered a leader and mentor in national and international cave and karst management. Through Ron's enthusiasm and

perseverance, cave and karst management within the National Park Service has become more mainstream. This proactive approach has directly led to better protection for many NPS caves and has led to the creation of numerous cave specialist positions within a number of cave parks. With accomplishments too many to mention, suffice it to say that Ronal Kerbo has made a significant difference in his roles as cave manager and as National Cave and Karst Program Coordinator.



*Ronal and friends use 3-D glasses to view a 3-D photo of Ronal at his going away party.*

A retirement party was held in Golden on March 10 to celebrate Ron's work as a cave and karst advocate. Over 100 friends, colleagues, and family members showed up to wish Ronal well on his retirement.



*Greg McDonald (the emcee for the party) demonstrates the proper use of a Ronal Kerbo mask (these were handed out to party goers).*

### **Cave and Karst Knowledge Center Now Online**

The Cave and Karst Knowledge Center has recently been developed and placed online as part of an effort to provide educational materials to teachers on different geological phenomenon. This material as well as access to the other Knowledge Centers and other educational materials can be found at the following website:

<http://www2.nature.nps.gov/geology/education/index.cfm>

Once there, click on the box for Cave and Karst Knowledge Center and follow the prompts.

This website briefly discusses the importance of cave and karst resources including water, mineral, archeological, paleontological, biological and environmental resources, including the use of cave and karst areas as natural laboratories and the research opportunities these areas hold; the different types of minerals, speleothems, cave animals including microorganisms, cave art, and the different people who go into caves and karst areas; different types of threats to these resources such as water contamination, poorly placed and designed structures, vandalism and lint accumulations, sinkhole collapse and poor water drainage particularly in urban areas; how to get started exploring caves including safety tips, case studies from some NPS cave parks, and a list references to continue learning about cave and karst areas.

### **Dale Pate Detailed to GRD through September**

Dale Pate, Supervisory Physical Scientist (Cave Specialist) from Carlsbad Caverns National Park has been detailed to the Geologic Resources Division (GRD) through September 2007 as the National Cave & Karst Program Coordinator. Initial project assignments will include coordinating GRD responses to three specific technical assistance requests received from parks, providing oversight and technical support on cave resource assessment projects on-going at four parks, providing cave and karst resources management technical assistance to the GRD Geologic Resources Evaluation Program, maintaining coordination with other Federal

agencies and NCKRI on issues of mutual concern, coordinating GRD response to new technical assistance requests received from the field, and coordinating the preparation of a Service-wide cave and karst resources management program needs assessment to assist GRD in the development of a five-year strategy to advance the program.

## **Timpanogos Cave National Monument**

*By Cami Pulham, Physical Scientist*

Early in the 2007 fiscal year, Jon Jasper left Timpanogos Cave National Monument for a position with the Carlsbad BLM office. While the TICA resource management position remains vacant, Cami Pulham is filling the role of Cave Specialist. Cami has worked at the monument for several years in the resource management division and will continue the on-going cave projects.

The Resource Management division at TICA is lean this season, so to assist the Cave Specialist with cleaning and conservation efforts, the monument is sponsoring Cave Conservation Nights throughout the summer. One night each month, cavers and rangers are coming to Timpanogos Cave to volunteer doing lint removal, algae cleaning, and other conservation projects. Nearby grotto members are eager to support park staff in any conservation projects and already the cleaning nights have shown to be popular and successful. This project is not only to achieve cave cleaning goals but to give park staff and nearby cavers a better understanding of Timpanogos Cave.

Also in 2007, the monument staff will be replacing light timers located along the cave tour route. Natural noises are valuable elements of the cave environment and can enhance the visitor experience. To restore a more natural soundscape inside the Timpanogos Cave System, the ticking mechanical timer switches will be replaced with digital switches.





*Park interpreters and volunteers participating in the once monthly Cave Conservation Night at Timpanogos Cave National Monument.*

Finally, in 2007 a complete Administrative History will be published of Timpanogos Cave National Monument. This history will cover discoveries of the caves, evolution of management at the monument, as well as interpretive, resource, and research projects that have occurred in the monument up to the present day.

### **Wind Cave National Park**

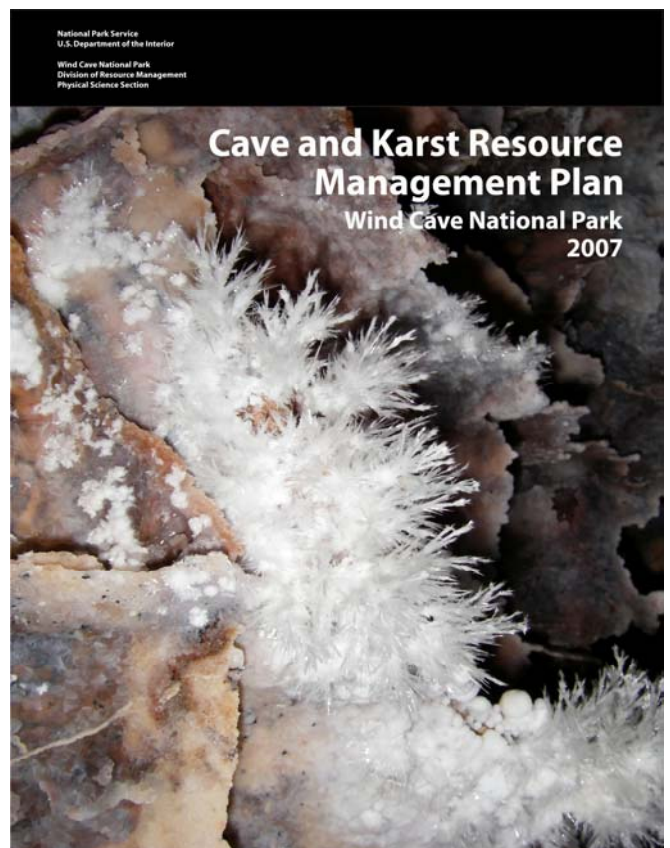
*By Rodney D. Horrocks, Physical Science Specialist  
& Marc Ohms, Physical Science Technician*

### **Cave & Karst Resource Management Plan:**

We recently had our Cave and Karst Resource Management Plan signed. This update is the culmination of a three-year project to rewrite the 2000 plan. This plan contains numerous color

maps, and has sections on desired future conditions of cave and karst resources and the history of the cave management program at the park. This comprehensive plan addresses such issues as low impact cave camping and diving in Wind Cave. It also made some policy changes, including changing the surveying days allowed each month to include the 1<sup>st</sup> Tuesday and the 2<sup>nd</sup> and 4<sup>th</sup> weekends of each month. The cover photo for the plan was taken by Wind Cave caver Ken Geu, from Nebraska. Ken was recently presented with a Volunteer Achievement Award in recognition for all of the digital photographic documentation he has done of features within Wind Cave. A PDF of the plan can be found on the Wind Cave web site at:

<http://www.nps.gov/wica/parkmgmt/upload/Cave%20Management%20Plan%20-%202007.pdf>



*The cover of the New Cave & Karst Resource Management Plan for Wind Cave National Park. Photo by Ken Geu.*

**Research:**

The Southern Black Hills Water System (SBH) recently requested two permits from the State of South Dakota to tap into the Madison Aquifer for a rural regional water system for the southern Black Hills. The Park views their proposal to drill two wells near the south and southeastern borders of the park as a potential threat to cave and karst resources. The Park was initially concerned because both of these proposed wells are located very close to the recharge zone for the Madison Aquifer (2 and 4 miles), which in this area is located largely within the Park. Dr. Paula Cutillo from the NPS Water Resources Division (WRD) in Fort Collins, Colorado conducted preliminary modeling that showed that after ten years of continuous pumping at the rate requested in the SBH application, the water table in the vicinity of Wind Cave could drop from 40-70 feet, potentially threatening the water table lakes in Wind Cave. On June 30, 2006 WRD filed a Petition to Intervene with the Chief Engineer for the State of South Dakota. Staff from the WRD office and the park traveled to Pierre to testify at a hearing before the state board. At the end of the hearing the board rendered a decision to accept the recommendations of the State Chief Engineer and grant one of the future use permits, but stipulated that SBH would have to conduct a pump test at the second site to determine if the Lakes in Wind Cave or Beaver Creek Spring might be impacted. A flow test and water quality testing are currently planned at sites throughout the area before SBH decides if they want to drill a test well to conduct the required pumping test.

Dr. Andy Long, a hydrologist from the USGS, received funding from the WRD and is collaborating with WRD hydrologist Jennifer Back to trace groundwater flow to and from Wind Cave using multiple environmental tracers, estimate the age of groundwater in the cave, aquifer, and in springs, and the proportions of young versus old water at those sites. The combined information from multiple tracers, age dating, and water monitoring will be used to estimate source-water areas, discharge areas, transit times, flow paths, and hydraulic responses of groundwater in the park. Based on the results

we will assess the potential impacts from drought or anthropogenic influences to ensure proper management and protection of the cave, the park's water resources, and the park's water rights.



*Marc Ohms, Andy Long, and Jennifer Back set up a drip collector in Room Draculum in Wind Cave.*

The Northern Great Plains I & M program recently supported the park by funding the purchase of three multiprobes to place within Wind Cave. These probes, which will be placed in two groundwater lakes within the cave and at a drip site, will be continuously monitoring pH, conductivity, temperature, and dissolved oxygen. The park is using water quality within Wind Cave as one of the vital signs in monitoring the health of the cave and karst resources of the park.



*Dr. Andreas Pflitsch and Julia Ringeis setting up environmental monitoring equipment in one of the parks blowholes in the Madison Limestone.*

In March, the park hosted presentations by Dr. Andreas Pflitsch and his students from Ruhr University in Bochum Germany. They reported on their latest cave climatological research in Wind Cave, Jewel Cave, and associated caves and blowholes in the region. They reported that the Cold Brook Blowhole, located 2,800 feet to the SW of Wind Cave, is related to Wind Cave. They also reported that S&G Cave, located half way between Wind and Jewel Caves, seems to be related to Jewel Cave, or at least it has the same airflow patterns as Jewel Cave.

### Projects:

Physical Science Technician, Jason Walz, recently completed his winter season for the park. He worked primarily on the 360 photography project and entering backlog cave inventory data into the SpeleoWorks database. For the 360-degree photo project, a total of 50 scenes were photographed along the tour routes in Wind Cave, in off-trail areas of Wind Cave, and on various ridges throughout the park. Jason was also able to enter 90% of the backlog cave inventory data into the SpeleoWorks database. This has brought the park closer to its goal of having all of the cave inventory data for Wind Cave entered into a digital database that can be searched with geographic information systems (GIS). After completing his seasonal appointment at Wind Cave, Jason went to work for the summer at Jewel Cave National Monument, where he will be primarily working on updating the cave quadrangles maps.



Jason Walz is seen here working on a 360 degree photo in Jewel Cave.

### Cave Survey & Inventory:

We recently completed a map of Jim Wilson's Kneebone Room discovery in Wind Cave. At 3.18 miles, it is the largest single discovery in Wind Cave since the Southern Comfort discovery in 1991. We framed a copy of the Kneebone map and presented it to Jim in recognition for his long-term service to the Wind Cave survey project. In related news, we recently completed the process of creating digital cave quadrangles for an additional four Wind Cave quadrangles. This brings the number of digital quads up to 34 out of the total 37 quads. Since the last reported length of Wind Cave in Inside Earth, volunteer cavers have increased the surveyed length of the cave by 6.9 miles; establishing the current length of 124.74 miles and maintaining its status as the fourth longest cave in the world.



Caver Jim Wilson, seen here participating in a survey and inventory trip during a Wind Cave Weekend, was recently recognized for his discovery of the Kneebone Room area in Wind Cave (3.18 miles of survey thus far) and for his long-term involvement in the Wind Cave Survey Project.