

Inside Earth

Volume 7, Number 2



Barbara Ruble and Vance Nelson, volunteers from the Western Region of the NSS, work to remove rubble from the demolished and abandoned Crystal Cave restrooms inside Crystal Cave in Sequoia National Park. This work was part of this year's annual Crystal Cave Restoration held October 23 through 31. More than 300 wheel barrow loads of this debris were moved 1/2 mile to the Crystal Cave parking lot during the restoration.

Contents:

Great Basin National Park Update	2
<i>Matt Reece</i>	
Carlsbad Caverns National Park Update	3
<i>Dale Pate</i>	
Wind Cave National Park Update	4
<i>Rodney Horrocks</i>	
Jewel Cave National Monument Update	5
<i>Mike Wiles and Rene Ohms</i>	

Featured Articles:

Cave Temperature Fluctuations Caused by Public Tours at Wind Cave	6
<i>Marc Ohms</i>	
Cave Gates and Cave Restoration at Sequoia and Kings Canyon NP	8
<i>Joel Despain and Shane Fryer</i>	

Great Basin National Park Update

Matt Reece

It was a busy summer for the cave crew at GRBA. Krupa Patel left us for graduate work at Yale in May, and we added Jason Mateljak and Rob Pleszewski for the summer to help out with all things cave.

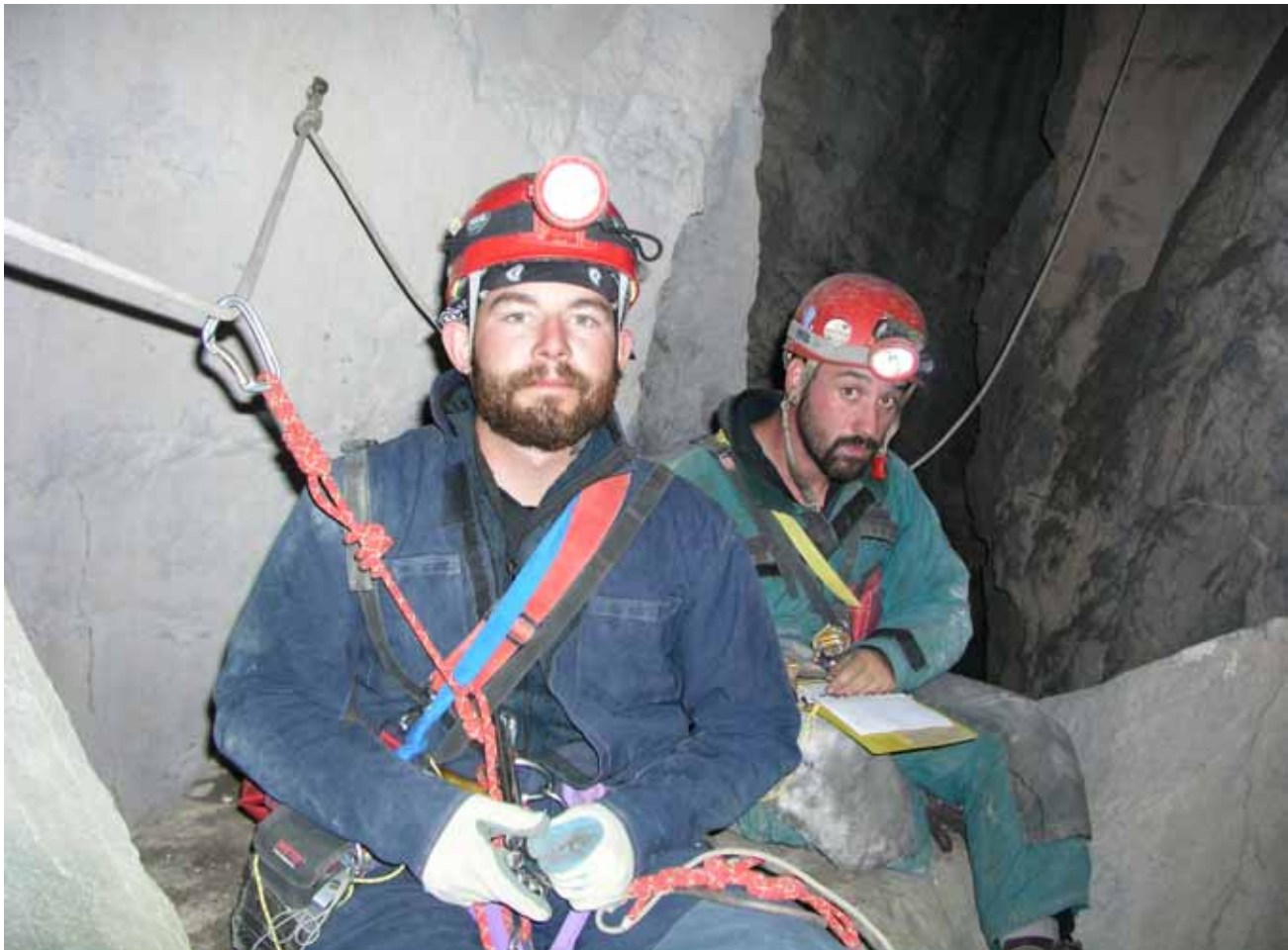
Wild Cave Inventory and Management Project -

This was the third and final year of the project, and this time around we concentrated on the park's known alpine (above 9000') caves. There were fourteen documented alpine caves in the park, and three of those had been surveyed. During the summer, we discovered that four of the previously known caves were actually two caves with two names each, giving us twelve caves. We found three small caves in the course of locating and surveying the other known caves. A total of eleven caves were surveyed, including the deepest and highest elevation caves in Nevada. Two caves are left in the high country, located in the cirque of Lincoln Peak, and they are incredibly difficult to reach. In addition, a cave rescue preplan and sop's have been completed for all of the alpine caves.

Cave Invertebrate Study - Steve Taylor and Jean Krejca completed their invertebrate inventory last year in our eight permitted caves. We recently received some exciting information from Dr. Douglas Zeppelini, a Brazilian biologist who was doing species identifications for some of the animals collected in the inventory. Two species of *Collembola* collected from Snake Creek and Model caves are new to science. We're hoping to be able to collect a few more of these critters so Dr. Zeppelini can do a full species description.

Lehman Cave Stuff - Steve Deveny and the Southern Nevada Grotto are still conducting their Total Station survey of Lehman. We hope to use this data, in conjunction with the surveys done by Rod Horrocks and others in the 1990s to create a new map of Lehman with very high resolution, and a lot of detail. This map will be invaluable for all future management actions in the cave.

Dr. Steve Burns, and his grad student Jerney Shakun from UMass are currently working up dates from



Jason Mateljak and Matt Reece surveying in the vertical, Roaring Wind Cave.



Cave Inventory at Great Basin National Park, including on left, Rob Pleszewskia at High Pit, Nevada's highest cave at 11,260 feet, and, on right, Jason Mateljak rappelling into Pine Cone Pit.

stalagmite samples they took from Lehman this summer. Dr. Rhawn Denniston of Cornell College has re-run some of his samples collected in the late 90's, and coming up with better dates. We hope to have the data soon. We're currently looking at the lighting in Lehman. Gretchen Baker, our Ecologist has an algae study running, using LED lights in an attempt to limit algae growth. We are developing plans to completely rework the lighting system sometime in the next five years.

USFS Cave Inventory - Matt recently traveled to California to assist Kelly Fuhmann from CAVE with a cave inventory project for the Shasta-Trinity NF. This is a continuation of the project they worked together on at Lava Beds. Matt will be presenting a paper about this project at the GSA meeting in Denver this November.

Carlsbad Caverns National Park Update

Dale Pate

Cave Research Foundation Receives Award - At this year's annual National Speleological Society Convention in Marquette, Michigan, members of the Guadalupe Area Cave Research Foundation (CRF) were awarded a Certificate of Merit for their dedication to conservation and restoration projects at Carlsbad Caverns National Park. Under Barbe Barker's leadership since 1996, dozens of individuals have donated thousands of hours of their time and expertise to restoring many areas in Carlsbad Cavern. Without the CRF members' interest and hard work, Carlsbad Cavern would not be the place it is today.

Areas in Carlsbad Cavern that are in the process of

being restored by CRF members include portions of the Main Corridor, Scenic Rooms, Big Room, Lower Cave, Left-Hand Tunnel, Lake of the Clouds, New Mexico Room, New Section, Hall of the White Giant, and the Guadalupe Room. Restoration of these areas has taken thousands of hours of meticulous work by dozens of individuals—and many of them are still being worked on. The dedication of numerous individuals within the Guadalupe Area CRF makes these significant long-term projects possible. Though we all know that the true reward from the restoration efforts in Carlsbad Cavern has been the transformation of impacted areas to beautifully restored areas, it is also important that the organization

and the unique individuals that form the Guadalupe Area Cave Research Foundation be recognized for their efforts and contributions. Carlsbad Caverns National Park is pleased that this organization has been recognized nationally for the work they have done and the park looks forward to working with the CRF for many years to come.

New Bat Species for The Park – On August 4, 2004 an eastern pipistrelle (*Pipistrellus subflavus*) was captured in mist net at Rattlesnake Springs by Dr. Troy Best and 11 students from Auburn University. A new record for the park, it was only the second eastern pipistrelle ever captured in New Mexico. Other recent records in west Texas and the northern Great Plains suggest a westward range expansion for the species. Eastern pipistrelles are not long-distance migrants like Mexican free-tailed bats, so their presence here indicates a real change in their distribution.

New Book Due Out Soon - *The Mammals of Carlsbad Caverns National Park* by Ken N. Geluso and Keith Geluso is nearing publication and should be available in the Carlsbad Cavern Guadalupe Mountains Association bookstore later this fall. This book covers everything that is known about mammals in the park from Vernon Bailey to the present (2000) including many observations from park staff throughout the years. This book will be a superb reference for the park and for visitors who want in-depth information on bats, pocket mice, skunks, and all of the other mammals of the park.

Two New Caves – Two new caves have been documented recently to bring the total number of caves in the park to 109.

Working With the Discovery Channel – Park personnel have recently been working with a Discovery Channel film crew to produce a documentary on caves of the National Park Service. Caves of Carlsbad Caverns, Mammoth Cave, and Hawaii Volcanoes National Parks will be highlighted.

Cave Resource Assessment on The Shasta-Trinity National Forest, California - Kelly Fuhrmann and Paul Burger from the Resources Stewardship and Science Division conducted a cave resource assessment for the U.S. Forest Service on the Shasta Trinity National Forest in northern California June 14-18, 2004. This ongoing project is part of a cooperative agreement set up between the USFS and the NPS for cave resource inventory purposes by Kelly while he was working at Lava Beds National Monument. This agreement provides a link between the two agencies and a unique working relationship focused on the sole purpose of gathering cave resource information to be used for the protection and preservation of caves on National Forest lands. The agreement provides NPS cave resource specialist services to the USFS for the purpose of assessing lava tube and solution cave resources on four national forests in northern California.

The initial plan for the week was to do a cave resource assessment in a recently discovered solution cave. Upon arriving at the cave, a large maternal colony of Townsend's big-eared bats, a State of California and Federal species of special concern, was found near the entrance. The presence of the maternal colony forced the U.S. Forest Service to cancel the trip into the cave and reschedule the assessment for later in the summer. Once completed, the information gathered from this assessment will be used for establishing a Research Natural Area in the Shasta-Trinity National Forest for future scientific research.

Paul and Kelly were able save the trip and redirected the week's efforts on surveying and inventorying a couple of lava tubes and a volcanic feature on the south side of the Medicine Lake Volcano, the largest shield volcano in the Cascade Range, covering over 900 square miles. The resource information gathered from this project is used by USFS officials for making cave resource management decisions and provides insight for other resource planning projects.

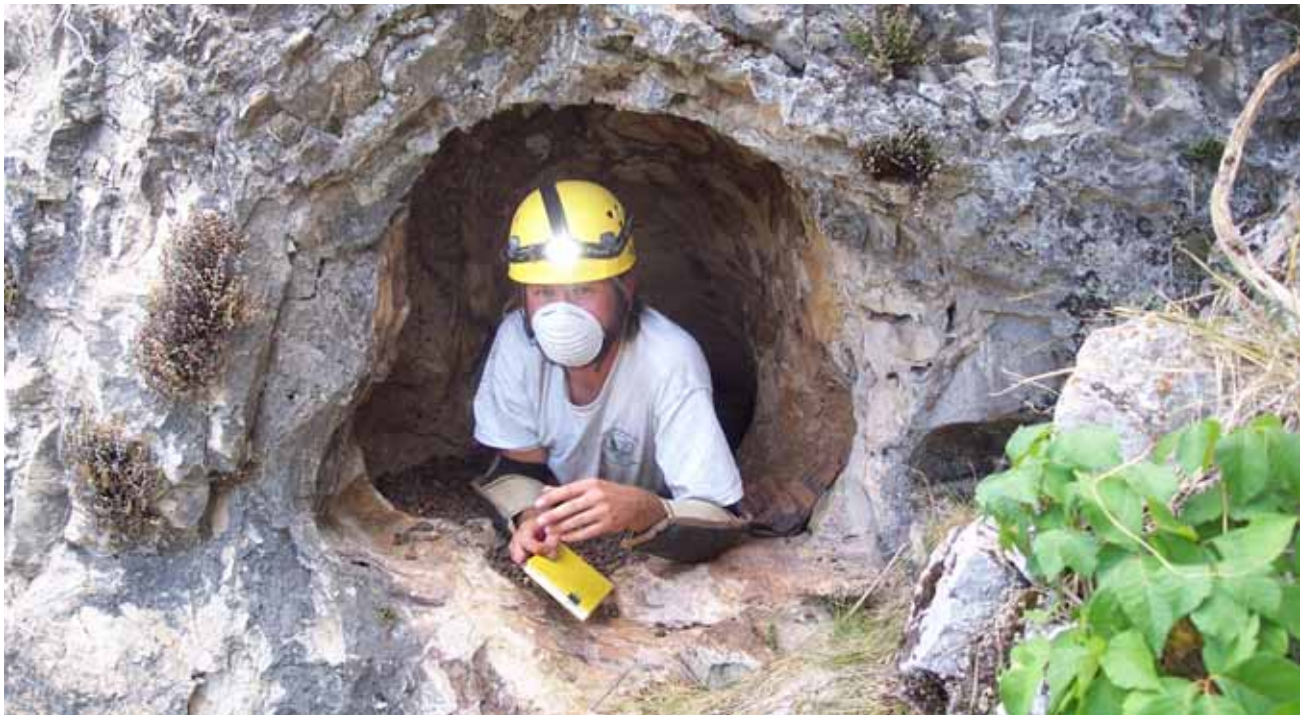
Wind Cave National Park Update

Rodney Horrocks

At lot has happened in Cave Resource Management at Wind Cave National Park this summer. Some of the highlights that have occurred in the park since the last issue of Inside Earth include:

Our seasonal cave and karst inventory crew, Seth Spoelman and Jason Walz, had a busy summer documenting caves and karst features throughout the park.

They began their project by integrating previous cave and karst inventory data into a central database of cave and karst features. As fieldwork progressed, the new database served as a planning guide that prevented duplication of effort and also as a means to document their work. By plotting the inventory database against GIS layers showing regional geology, drainages, and areas where steep slopes indicate rock outcrops, a



After completing a survey, Seth Spoelman emerges from a newly discovered WICA cave, Cheese Rock Cave.

successful ridgewalking strategy was developed. As a direct result, the crew increased the total number of caves in the park from 27 to 42, the number of rock shelters to 28, and the total number of all features from 150 to 254. In the process, they walked around 150 miles in the 28, 292 acre park.

This years Black Hills Restoration Camp was held jointly between Wind and Jewel Cave. This years group volunteered 117 hours and removed 1,432 pounds of sediment, dust, hair, and lint from the trail on the Fairgrounds Tour route. Between this project and winter work by Marc Ohms, we were able to completely clean that route this year.

On August 18, 2004, the sump at What the Hell finally reopened after being impassable for nearly five years. Once we were able to get to the deep point in the cave and were able to check on the level of the water table, we found that it had dropped 2.5 feet since the last visit in July of 1999. However, cave rafts on top of the staff gage indicated that it reached an even higher stage at some point during the five years.

We hosted an internal scoping meeting for the revision of the Cave and Karst Resource Management Plan for Wind Cave National Park. Ron Kerbo, the National Coordinator for Cave and Karst in the National Park Service, along with various local government specialists participated in that two-day meeting. This meeting identified desired future conditions and action items for identified cave and karst issues in the park. Since

then, we have also completed internal scoping on the document and will be sending it to our region for a 30-day review period.

Dr. William B. White, from Penn State University, donated the original field notebooks from the 1959 NSS Survey Project in Wind Cave to the park's museum collection. This donation included the geology notes from George H. Deike and William White. It also included three survey notebooks for the Bishop Fowlers Loop, Gypsum Attic Passage, commercial trail, and the Pearly Gates area.

Rod just returned from a trip to Eastern Europe to look at cave lighting and cave management issues in 21 developed caves in three countries; Hungary, Slovakia, and Check Republic. He was hosted by Zsuzsa Tolnay and Gabor Salamon at Aggtelek National Park in Hungary, a World Heritage Site where the famous Baradla Cave is found.

Recent survey work in Coyote Cave has brought the survey of that cave to 5,077 feet. Coyote Cave, which is located in a thin bed of limestone in the Minnelusa Formation, is the second longest cave in the park with a lot of potential remaining.

Since the last reported length of Wind Cave in Inside Earth, volunteer cavers have increased the surveyed length of the cave by 1.14 miles, establishing the current length of 112.11 miles.

Jewel Cave National Monument Update

Mike Wiles and Rene Ohms

Restoration Camp - In June, six volunteers assisted with lint and wax removal in the Heavenly Room. This section of the cave has never undergone a thorough cleaning, and a thick coating of lint, wax (from candle lanterns that are no longer used), dust, hair, and other unnatural debris covers the natural cave floor. Over 2,000 pounds of material was removed from the cave in two days!

New Sleeping Bags at Camp - After seven years, the sleeping bags at the cave's base camp have been replaced. Although the bags were stored in knotted trash bags with desiccant, they were beginning to take on a musty smell and were losing their loft. The new bags are synthetic fill mummy bags with a 20° F temperature rating. Warmer bags will allow cavers to wear lighter long underwear, reducing the size and weight of camp packs. Two new Thermarests were also carried to camp to replace those that had developed leaks.

New Ladders - A Lyon wide-rung fiberglass and rope ladder has been rigged at the Point of No Return, a 20-foot drop along the eastern route to Camp. This ladder replaces the aluminum and webbing ladder that had been used for over ten years. With the old ladder, it was necessary to periodically re-string the webbing because the slots in the aluminum rungs rubbed against it. The new ladder should be maintenance-free. Four additional ladders have now been purchased for other short drops in the cave where aluminum and webbing ladders are still in place.

Cave and Karst Management Plan - Progress is being made on the Cave and Karst Management Plan and Environmental Assessment. Comments received from internal review of the draft document and at a status report meeting held at the 2004 NSS Convention will be incorporated in the coming months. A draft is expected to be submitted to the Regional Office for review by the end of the calendar year.

Intern Projects- Cave Management Intern Peggy Renwick has been hard at work since her arrival in early June! She has participated in several caving trips to fix ladders, inventory rescue packs, collect water samples, and replace sleeping bags at camp. She attended Level 1 NCRC training in June, then helped to plan a rescue exercise in the Historic Area of the cave in July. In October, she will attend the Level 2 NCRC seminar. Peggy has completed a data entry project; she entered all of the cave trip reports from 1963 to 1986 in the Monument's trip database. The database is now complete, and all trips from 1959 to 2004 can be

queried for a variety of parameters: number of trips, total hours spent in the cave by particular people, numbers of trips through the Miseries, etc. For example, Stan Allison has made 63 round trips through the Miseries! The database will also be a useful tool for impact assessment.

Rescue Exercise - The cave management division hosted a litter-handling exercise in the Historic Area of the cave in July, to familiarize park staff with basic cave rescue operations. "Patient" Stephanie Peek was packaged, then carried from the Chert Room to the entrance by eight people. Although difficult maneuvers were required through Fat Man's Misery and the Trap Door, Stephanie was safely transported to the surface.

Rescue Packs - Eight emergency rescue packs were established in the cave between 1995 and 1997. Over the last couple of years, several of these packs have been found to be moldy, and many perishable items (such as warm packs and ibuprofen) are beyond their expiration date. A vacuum sealer was recently purchased to repackage the rescue pack items, which should prevent the introduction of moisture and prevent mold. Moldy and expired rescue pack contents will be replaced at Cloud Nine and Seventh Heaven over the next few months, and the remaining packs will be checked and refurbished in the coming year.

Airflow Study - The airflow study being conducted by Dr. Andreas Pflitsch is continuing this year. One of Dr. Pflitsch's graduate students, Thorsten Stock, will be here through December. Thorsten is working on temperature monitoring near the Scenic Tour route and will camp at the entrance to nearby Jasper Cave to measure airflow with an ultrasonic anemometer.

PDA's for Cave Survey - Four Palm III PDA's have been purchased for use with Auriga cave survey software. The PDA's will replace cave survey notebooks and allow for instant viewing of the line plot as survey progresses. Because the data can be directly uploaded to an office computer, there will be no need to re-enter the field data. The data is automatically converted to COMPASS, and can then be integrated with the rest of the cave survey data.

Digital Cameras for Cave Survey/Inventory - Digital cameras will now be a part of our normal survey/inventory gear, and photos will be entered into the feature inventory database.

Cave Temperature Fluctuations Caused by Public Tours at Wind Cave, South Dakota

Marc Ohms

Introduction - Wind Cave became a national park in 1903 but public tours have been conducted in the cave since the late 1800's. The current public tours cover over one and a half miles of passage on five different tour routes. Approximately 90,000 people take tours of the cave annually, with the vast majority of visitation from June through the end of August. This study is part of a comprehensive project investigating all possible causes of unnatural temperature fluctuations within the cave. These include the lighting system, human presence, and manmade or modified cave entrances.

Methodology - Onset Hobo Pro Series data loggers were used to record temperature. All temperature readings were recorded every 15 minutes, in degrees Fahrenheit.

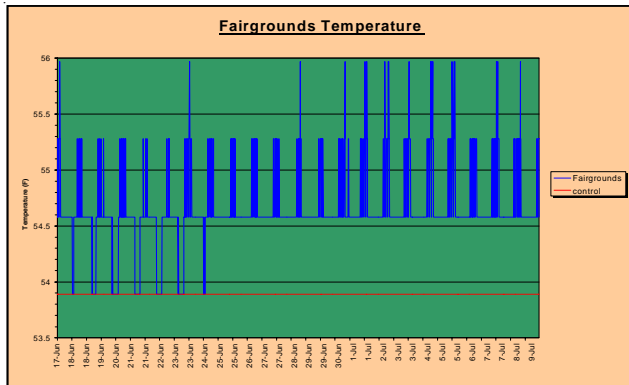


Figure 1: Temperatures in the Fairgrounds of Wind Cave

Three sites in the cave were chosen for the study based on the location, lack of additional heat sources, and the frequency and size of tours given. The tour routes used in this study had a maximum of 40 people per tour and 8 tours per day during the study period. Two of the sites, the Fairgrounds and Assembly Room, are large rooms where the tours stop for up to 10 minutes or more. The third site, the Giant's Stone Quarry, is a narrow passage that the tours walk through without stopping. For each site, a control was established in a location not influenced by a heat source to ensure that the only cause for any recorded temperature fluctuation would be from the tours. Although the temperature fluctuates near the entrances to the cave due to air exchanges with the surface caused by changes in barometric pressure, the sites chosen for this study are not influenced by this phenomenon.

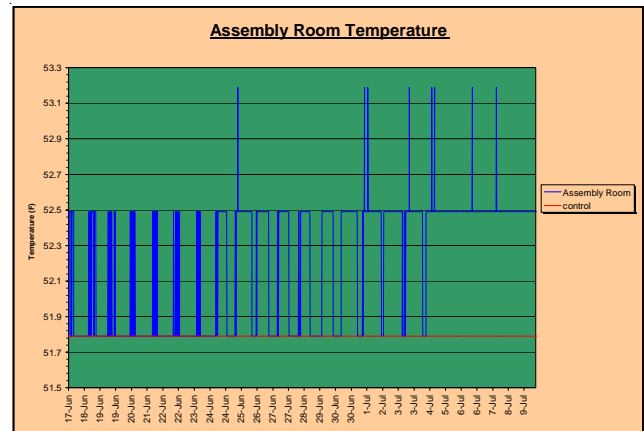


Figure 2: Temperatures in the Assembly Room

Results - The presence of visitors caused a daily rise of 0.7 to 2.0 °F, and at first the temperature at all sites would return to the control temperature during the night. However at the two sites where tours stop, by mid-June in the Fairgrounds (figure 1), and early July in the Assembly Room (figure 2), temperatures no longer returned to normal at night. These two rooms did not return to the control temperature until early September. This means that the temperature was elevated above normal levels for over two months. The steady temperatures of the control loggers indicate that this is not a natural fluctuation, but is a product of the presence of visitors. The temperature reached a heightened plateau at 55.3 °F in the Fairgrounds and 52.5 °F in the Assembly Room. Occasionally, the temperature continued to rise to 2.0 °F above the control, reaching a maximum of 55.9 °F in the Fairgrounds and 53.2 °F in the Assembly Room.

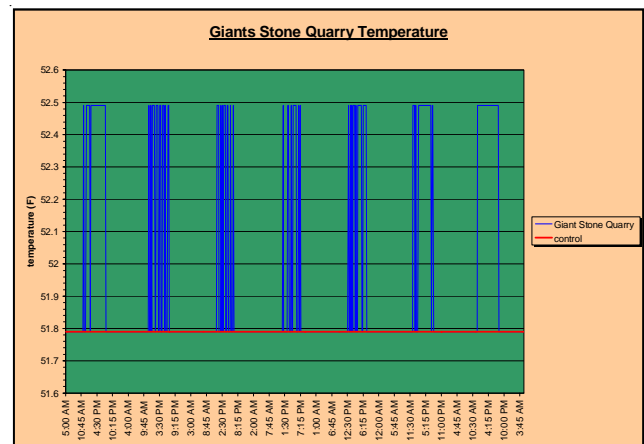


Figure 3: Temperatures in the Giants Stone Quarry

At the third site, the Giant's Stone Quarry (figure #3), where the tours pass through without stopping, the temperature rose in the morning as the tours started and returned to normal temperature within 2 hours after the tours ended. The temperature increased 0.7 °F every day, and fluctuated throughout the day. The maximum temperature recorded here was 52.5 °F.

Conclusions - During the first phase of this project it was concluded that the cave lighting system influences the cave temperature close to a light fixture or transformer, but does not affect the overall temperature of the cave passage (*Ohms 2004*). The results of this second phase of the project indicate that the tours do influence the cave temperature dramatically, especially when they stop in one place for a period of time. This is not a unique discovery, as studies in other caves have had similar results. At Timpanogos Cave National Monument it was determined that the temperature rose 0.5 °F every time a tour passed by the sensors (*Horrocks and Petru 1993*). At Bear Cave in Poland, it was determined that the temperature would rise 2.5 °F when tours were present and a duration of 2 minutes was enough to significantly affect the temperature (*Pflitsch, et. al 2000*).

An increase in temperature increases evaporation by lowering the relative humidity. This increased evaporation can dry out sediments, minerals, and speleothems. Changes in temperature and humidity can influence the type, form, or morphology of a speleothem (*Hill and Forti 1997*). The unnatural temperature fluctuation may also influence the growth of algae and the presence or absence of cave biota, or

impact cultural items found along the routes. This study has proven that there are human-caused temperature changes in the cave; the next step will be to determine what resources are being impacted and to what degree, and develop procedures to mitigate the impacts. Further studies are needed to determine if the size of the tour and the length of stay in a room are variables, and to what degree each causes the temperature fluctuations discussed in this study.

References

Hill, Carol, and Paolo Forti. 1997. CAVE MICROCLIMATE AND SPELEOTHEMS. In *Cave Minerals of the World*, second edition, p. 258-261.

Horrocks, Rod, and Ed Petru. 1993. SETTING UP A LONG-TERM MONITORING SYSTEM AT TIMPANOGOS CAVE NATIONAL MONUMENT. *National Cave Management Symposium Proceedings*, p. 29-38.

Ohms, Marc. 2004. TEMPERATURE FLUCTUATIONS CAUSED BY THE LIGHTING SYSTEM IN WIND CAVE, SOUTH DAKOTA. *Inside Earth*, spring.

Pflitsch, Andreas, Piasecki, Jacek, and Martin Kleeburger. 2000. IMPACTS OF TOURISTS ON THE CLIMATE OF STATIC CAVE SYSTEMS. 6p.

Cave Gates and Cave Restoration at Sequoia and Kings Canyon National Parks

Shane Fryer and Joel Despain

The Crystal Cave restoration project has been underway for more than ten years. This year, with funding from the CCI program, we were far more ambitious and held a ten-day restoration with big goals to remove the abandoned cave bathrooms and replace a section of the cave trail with a bridge in the Organ Room. We also hope that this restoration work will expand and improve habitat for Crystal's cave-adapted animals. This year's restoration started October 23 and ended on October 31. The outpour of help from volunteers was tremendous. 57 Volunteers donated a total of 2664 hour of their time to the effort.

The bathroom removal included removing all the fixtures, pipes and walls from the cave restrooms. The

restrooms are just inside a natural entrance to the cave and restoring this area should provide more habitat for twilight zone dwellers, such as *Pimoa* spiders. This first project is going to be a multi year effort, and is now well underway. By the end of the restoration all eight of the bathroom walls were brought down, and ¾ of the spoils were removed to the cave parking lot. This included all the pipes, sinks, doors, toilets and dividers. In order to bring this material to the parking lot, teams of two or three volunteers pushed 200 lbs wheel barrows for 2200ft, gaining nearly 300ft in elevation. Obstacles included steep and narrow trails, inclement weather (snow and rain) and four flights of stairs. On a typical day a volunteer would make five trips, the equivalent of pushing 200 lbs over two miles and up



Wheel barrows were moved in groups by volunteers during the Crystal Cave Restoration. Here a "train" has developed above a set of stairs on the trail.

nearly 1500ft. In total, 22 tons of demolition material was brought out. Rod Neubert really speeded up this process by loaning us the use of his ATV, which was just narrow enough to negotiate the upper half of the trail. In the later half of the week, Rod moved the material from the Organ Room and the abandoned bathrooms, saving everyone a great deal of work.

The completed project will also involve removing the underlying concrete floor, and will leave this part of the Crystal Cave entrance much like Medley and Webster, the cave's discoverers', found it 86 years ago.

Our second objective was to remove a large section of trail from the base of a formation known as the Organ. The Organ consists of a large flowstone with many nice draperies hanging above. Over the years, this formation has been repeatedly vandalized. Our goal was to install a bridge to bring people away from the formation, and remove the trail to uncover its base. This would further protect the formation and restore valuable habitat. This project involved breaking up large sections of concrete trail, and removing the underlying fill. All concrete was brought up to the parking lot, while natural fill was left inside the cave in an area that had been quarried during construction of the cave infrastructure in 1939. At the end of the week, the base of the formation had been cleaned revealing intricate rimstone dams, curtains, stalactites, stalag-

mites, flowstone, and other formations. Sadly the manufactured bridge didn't arrive on time from its manufacturer in Florida, due to the hurricanes there. The companies facilities were badly damaged during two of the storms. In addition, a switch back in the trail near the Organ was removed, and steps were installed to further restore habitat and reduce the human footprint in the cave. We plan to finish this project by installing the bridge in the spring before the cave opens. Further trail removal will extend into next fall.

All participants camped in the Crystal Cave parking lot and were treated to a food plan organized by Mary and Bill Roberts. Mary did a huge amount of work before, during, and after the restoration to keep everyone fed. The campers endured a major winter storm during the week and generally cool, damp weather throughout the period. We concluded the week with a party to celebrate our accomplishments and thank our volunteers.

The park had long hoped for funding to replace and repair cave gates. When the money came through last year for three new stainless-steel, ACCA-style cave gates we were very pleased. The caves chosen for the gates clearly need greater security. Clough Cave was originally gated in 1965, but no gate has stayed on the cave for more than a year, and several significant reconstruction efforts in the past decade have been for



Joel Despain standing where the trail once lay in the Organ Room of Crystal Cave. The level of the trail can be seen as a faint brown horizontal line across the flowstone. Notice the rimstone pools and other speleothems that had been covered by the trail.

naught. Still, the cave has at least 9 endemic species of invertebrates and an infrequent colony of long-eared bats. Crystal Cave, Sequoia and Kings Canyons' commercial cave, is the best known cave in the parks and was the scene of a major incident of vandalism in the cave entrance in the summer of 2003. The small Red Belly Entrance is very close to the tour trail and had never been gated. Soldiers Cave is near a campground and a trail and like Clough, has seen numerous break-ins. The existing gate on the cave was also a biological problem. It consisted of a concrete wall with only a small opening.

Work on the project began early in 2004 when an account was created for the grant funding and legal environmental and cultural compliance issues were resolved by park staff. Next was the preparation of a contract for the work and a work plan. We received a great deal of help from the SEKI procurement staff during that phase. Out of five companies solicited, only one returned a bid - Zara Environmental of Austin, TX. Closer firms already had too much work, and we were pleased that Zara staff was willing to travel from Texas to build the gates. As part of the contract, the park agreed to recruit and provide volunteers to assist two staff people from Zara who would be coming

to the California. We once again tapped our wonderful Western Region volunteers to come help us again. This time it was only 1 week after the exhausting Crystal Cave Restoration at the end of October. Never-the-less, many showed up to help, and Ben Robinson from the Stanislaus Grotto helped for more than a week through the duration of the project.

Work began at the Red Belly Entrance of Crystal Cave. Crystal is the highest elevation cave to be gated, thus we went here first to stay a step ahead of winter. Many hundreds of pounds of gear were moved down the trail toward the cave. The welder, generator, clamps, bars, cables, grinders, and much more made the trip. Due to long cables, the generator remained on the trail while the work on the entrance went on 40-foot overhead at the cliff-side entrance. Work progressed quickly. Charlie Savas, from Zara, welded, while in radio communication at the parking lot, Peter Sprouse cut bars to size. Volunteers delivered the materials to be added to the growing gate. The gate was in place within two days.

Our next effort was at Soldiers Cave. Following the movement of all of the gear and personnel, we began the hard work of carrying the equipment a kilometer to the cave entrance. This time the generator was perched on the side of steep slope after being lowered in place using a haul system. Much of the first day of work was focused on removing the old gate on the cave. Sledge hammers, chisels, rotor hammers, and drills were all employed to remove the concrete barrier. To everyone's surprise, the concrete had been poured in place around an existing gate of thin bars that clearly would not have protected the cave much. This metal framing was the last component of the gate removed and hauled to the parking lot by Ben. We were all surprised by the size of the entrance, open again for the first time in 30+ years. The new gate quickly took shape 8 feet inside the entrance. Two uprights were used and ten bat-friendly horizontal bars were welded into place. Another smaller entrance to the cave lies immediately to the right of the main entrance and the small grate here was also replaced with stainless, reinforced bars. Rollers in the bars of this small gate proved to be challenging to overcome, but a concerted effort breached the old gate. With a day off for a rainstorm that never really materialized, we were done with Soldiers in three days.

Clough Cave was our final task. This gate was to be the largest of the three with the longest bars and uprights. We again used a hauling system to raise the generator to a ledge below the cave entrance. More volunteers from the Southern California Grotto and students from Cal Poly San Luis Obispo had arrived overnight,

and they set to work removing the two old gates on the cave. Grinders, hack saws, sledge hammers, and a reciprocating saw were put to use to remove the barred gates and the raised concrete footing of the oldest gate, which lay right at the cave entrance. Concrete inside the bars in the newer gate, ten feet inside the cave, proved to be a challenge, but within a few hours both old gates were gone and were being carried to the back of the government pickup for recycling. Late in the day a few generator problems slowed us down, and we ended the day early. We were all back at it first thing the next morning. Charlie welded diligently while Peter cut bars and the volunteers moved the material along a narrow cliff-side trail to the entrance. By early afternoon Charlie was finishing his final welds and we began the process of clean-up.

In just over a week Sequoia and Kings Canyon National Parks had three new, strong and biologically sensitive cave gates. And in just over a month, the cave management program had completed its two largest projects in several years. We were very happy and looking forward to relatively quiet winter.



Charlie Savas of Zara Environmental welds a new gate in place on the main entrance to Soldiers Cave. Park staff hopes this gate is more bat and wildlife friendly, and more secure to help protect this delicate cave.