

INSIDE EARTH

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A Newsletter of the National Park Service Cave & Karst Programs

Edited by Dale L. Pate



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Website Address:

<http://www.aqd.nps.gov/grd/geology/index.htm>

Cover Photo – The spectacular shaft-of-light at Carlsbad Cavern's entrance. (NPS photo by Dale Pate)

KARST AND CAVES

by Ronal Kerbo

The *National Park Service Management Policies (1988)* contain the following statements regarding cave management:

Section 4:20: *Caves will be managed to perpetuate their atmospheric, geologic, biological, ecological, and cultural resources in accordance with approved cave management plans (action plans appended to approved resource management plans). Natural drainage patterns, air flows, and plant and animal communities will be protected. Developments, such as artificial entrances, enlarged natural entrances, pathways, lighting, interpretive devices, ventilation systems, and elevator shafts, will be*

permitted only where necessary for general public use and when such development will not significantly alter any conditions perpetuating the natural cave environment or harm cultural resources. No potentially harmful development or use will be undertaken in, above, or adjacent to caves until it can be demonstrated that it will not significantly affect natural cave conditions, including subsurface water movements. Developments already in place above caves will be removed if they are significantly altering natural conditions.

Caves or portions of caves will be closed to public use, or use will be controlled, when such actions are required for human safety or the protection of cave resources. Some caves or portions of caves may be managed exclusively for research, with access limited to approved research personnel.

Section 6:3: *Caves with all entrances in wilderness will be managed as wilderness.*

It is interesting to note that the cave management policies do not mention karst or karst processes! For those caves that form in soluble rock, to omit karst from the discussion is akin to leaving out flour, milk and eggs when talking about how to manage the making of a cake. While there are many very significant non-karst caves within the National Park System such as littoral caves, lava tube systems, "earth cracks", and talus caves, the most widely dispersed and by far the greatest number of caves are karst features.

For far too many years, those of us who are cave managers and cave users, from recreational cavers, to research scientists have been focused almost exclusively on the hollow components of karstic systems. It seems to me that we have not been aggressive enough in developing strategies, guidelines or policies to manage, protect, conserve or interpret the overall cave/karst system. Based on the almost total destruction of the

contents of some caves (both natural and cultural), it has been and remains important to conserve and protect the contents of caves. But it is now also imperative that we foster a better understanding in our managers of the important role of karst in the eco-system and develop policies to prevent the possibility of catastrophic impacts to these important systems. We can no longer afford to ignore karst processes.

We must understand that leaking sewage lines, leaks from oil or gas wells, toxic waste dumps, and other impact sources too numerous to mention can do irreparable damage to cave biotic communities and other resources in a very short period of time. Recently in NPS areas we have had caves threatened by diesel spills, the possibility of long term production of gas wells near premier caves, raw sewage leaking into the aquifer, and parking lot run-off going into world class caves.

Most of these impacts could have been mitigated from the beginning if we had factored in the importance of karst, and had developed policies to mitigate impacts to all the features associated with karst. I have visited park areas (not just U.S. National Parks), where major roadways overlie cave passage with less than one meter of rock between the bottom side of the roadway and the ceiling of the cave and where pit toilets are built directly in draws that drain into cave entrances! I have seen other areas where dams prevent water from entering a cave entrance, where agricultural developments overlie cave passages and where pipelines moving oil and gas are within 20 meters of known cave passage!

With this latest revision to the *NPS Management Policies* we have an opportunity to assure that karst management is factored into cave management policy in the future. A draft for review of the Management Policies will include the suggested revisions to the *Cave Management* section, a suggested new section titled *Karst Management*, and thanks to recent work with **Jim Walters** (NPS, Santa Fe) we have new suggested language regarding caves and wilderness.

When the new in-house draft of the management policies is circulated please comment on its contents. Too many times, too few people comment during the review process. You will soon be presented with an opportunity to have an impact on how we approach cave and karst management in the future. Please do not let this opportunity to review and comment on the cave/karst management policies slip by.

The timeline for getting the official Draft copy of the policies out to the field is scheduled for the early fall of 1998. This will be the final opportunity before the public comment period begins. In the meantime anyone with comments on this article are welcome to send them to me at Ron_Kerbo@nps.gov

CAVE PARK UPDATES

Carlsbad Caverns National Park (CAVE)

by Dale Pate

Thanks to Harry Burgess for a job well done. Harry has left the NPS to pursue other interests. We welcome Stan Allison to the Cave Resources Office to fill the Physical Science technician position vacated by Harry. Stan comes to us from Wind Cave National Park where he has worked with Jim Nepstad for a number of years.

There are three separate Mexican free-tailed bat research projects ongoing in the park this summer. The first is a long-term project by the park to photo-document the bats while in the roost of Carlsbad Cavern. This project is to determine trends in population size over a period of years. Jim and Val Werker are the primary photographers in this effort. They have been instrumental in the development of a method to shoot infrared photos of the roost without disturbing the bats. A second project is the collection of fresh guano on a daily basis to determine species of insects the bats are consuming. Lisa Williams is working on this project for a Master's thesis from Auburn University. The third project is another Master's thesis by Mike Mulheisen, also from Auburn University. His thesis is utilizing listening devices in the bat roost to transmit audible sounds into electronic form and recording this over a 6-month period. Tom Bemis, an employee of the park, first proposed this study.

Restoration and conservation efforts continue to play a key role in Carlsbad Cavern, Slaughter Canyon Cave, and Lechuguilla Cave. Caves of the park and of the Guadalupe Mountains are very fragile. Impacts from exploration, guano mining, and cave development have taken a great toll. Numerous individuals and caving groups have spent thousands of hours restoring damaged areas and placing flagging tape in areas to delineate trails. The Cave Research Foundation, led by Barbi Barker, has been a leader in this effort in Carlsbad Cavern. Lois Lyles and Jim and Val Werker have led restoration and conservation activities in Lechuguilla Cave and Carlsbad Cavern over the last several years. The Mesilla Valley Grotto led by Kathy and Steve Peerman has worked diligently in Slaughter Canyon Cave over the last year. The Permian Basin Speleological Society led by Walter Fiester, Bill Bentley, and others have broken their backs removing tons of rubble from Carlsbad Cavern. This rubble was debris left in the cave from blasting the elevator shafts back in the 1930's. Pat Jablonsky and her teams have removed many pounds of lint from areas in Carlsbad Cavern over a period of more than 10 years. Dozens of other cavers, too numerous to mention, have donated their time and expertise in these restoration and conservation efforts. We thank everyone who has played a role in restoration and conservation efforts at Carlsbad Caverns National Park.

Grand Canyon National Park (GRCA)

by John Rihs

Grand Canyon National Park is currently in the process of redefining its cave & karst management program. The new plan calls for systematic inventory and mapping as well as developing a classification and permit system. An ARCVIEW/ACCESS database is also being developed. Basically, we are starting from the ground up. Much of this work will be performed by a select group or core team (Speleo-elders) that will in turn recruit their own volunteers on a project-by-project basis. This core team will principally be made up of NPS and university specialists (paleontology, biology, archeology, etc.) as well as known NSS cave surveyors, climbers, etc. A Memorandum of Understanding (MOU) with the local grotto (Northern Arizona Grotto) is also in the works.

As you can imagine, we are walking a very thin line here with regards to sensitive information management and resource protection. I am currently toying with developing a "Non Disclosure Agreement" form for volunteers and researchers to sign prior to performing any work. While I have a good handle on what to include as text, I would like to ask if anyone has any experience with implementing such an agreement. If you have any stories to tell about what pitfalls may arise, please share them with me. Any examples of a form for this type of agreement as well as any other thoughts on the program described above will be welcomed.

Lava Beds National Monument (LBE)

by Kelly Fuhrmann

Lava Beds National Monument was established in 1925. The monument is located on the margin of the Cascade Range and the Great Basin Geologic Provinces in a semi-arid environment. Situated on the lower northern flanks of the Medicine Lake shield volcano in northeastern California, Lava Beds is the site of geologically recent lava flows, cinder and spatter cones, lava tube caves, collapse tubes, rifts and craters. Views of Mount Shasta and Mount McLoughlin from the monument are spectacular. It is the center of the only Indian war fought in California, the Modoc War (1871-1873).

380 lava tube caves have been located within the monument boundaries, with a total of 26 miles of documented passageway. Surveyed passages of single caves range from <100 feet to 7,474 feet in length. The longest lava tube system has been measured at 15,666 feet. Several caves contain multiple levels. A few caves support perennial ice floors that are critical water sources for wildlife in the summer. The ice formations in Crystal Cave are extraordinary. Fern Cave is a significant archeological and Native American spiritual site. Additional caves and cave passages are being discovered every year.

A cave management plan was completed in 1988. Individual action plans for specific Class 4 caves are

being written. Photomonitoring of cave resources has helped assess visitor impact and the extent of cave feature transformation. The Cave Research Foundation and National Speleological Society have played invaluable roles in cave inventory, mapping, gating and research activities in the monument caves.

Lava Beds is home to 13 species of bats. Townsend's big-eared bat (*Corynorhinus townsendii townsendii*) and Brazilian free-tailed bat (*Tadarida brasiliensis mexicana*) colonies are monitored very closely. A foraging study was completed on one of the resident Townsend's big-eared bat colonies during the summer of 1997. A final report is due to be released this summer. The Brazilian free-tailed bat colony is the largest known colony in the northern part of the country. Currently we are investigating the feasibility of implementing an adopt-a-bat program to help support our educational outreach efforts.

A "bat friendly" cave gate was recently installed at Post Office cave. The generous help of CRF and NSS members was appreciated. Cave resource protection was our main concern. An increase in graffiti in the lower levels of the cave and visitation impacts on bats and cave features prompted the action.

The groundwork has begun for establishing a research facility at the monument to be used by research personnel from many fields of study, including cave research. The fund raising campaign has been initiated. Additional sources of funding are being sought.

Mammoth Cave National Park (MACA)

by Rick Olson

There are many projects in progress in and around the park, so with no attempt at being comprehensive here is a Whitman's sampler:

A Paleontological Inventory of Mammoth Cave from Historic entrance to Violet City by Rick Toomey and Mona Colburn of Illinois State Museum has been under way for several months. Though certainly not obvious, the finds have numbered in the hundreds with some real surprises that will be revealed at the NSS Convention.

The Third "Don't Mess with Mammoth Days" cleanup of Pike Spring Basin was again led by Rick Olson, Joyce Hoffmaster, and Janice Tucker (CRF). At a farm just east of the park, 15,000 pounds of rubbish and 9,000 pounds of recyclable metal were removed by over 40 volunteers from seven states.

As part of the Ecological Restoration and Mitigation of Visitor Impact in the Historic Section of Mammoth Cave, John Fry worked with, and supervised a crew that built a boardwalk trail through Broadway to the Church. Structural members were constructed of cypress, which was selected for its natural rot resistance, and decking was made with recycled plastic lumber. Lint curbs have

already trapped visible amounts of the unwanted material since March.

Western Kentucky University's Karst Field Studies are under way in the park, coordinated by Joe Meiman (NPS) and Chris Groves (Western Kentucky University). Classes include: Karst Geomorphology, Exploration of Mammoth Cave (History), Speleology, and Karst Hydrology.

The park is developing plans for replacement of an aging cave lighting system. To avoid locating transformers underground, surface sites will be connected via borings, and the estimated cost of the project is more than two million dollars; on another expensive front, Interstate 65, which runs through the park's watershed, will be widened to six lanes in coming years. Rick Olson is working with federal and state highway designers to insure that retention basins will be included to treat routine runoff, and contain spills from tanker trucks.

Sequoia & Kings Canyon National Parks (SEKI) *by Joel Despain*

The Cave Management Program at Sequoia and Kings Canyon National Parks continues to move forward on several fronts. We have a busy summer planned with cave mapping, biological inventories, photo documentation and an expansion of the program into abandoned mine lands assessment in the Parks' backcountry. The following are descriptions of our 1998 and some 1997 activities and news about the Cave Management Program:

- **WHITE CHIEF BECOMES PART OF THE PARK**
Following extensive negotiations between the owner, the National Park Trust, and the National Park Service, the White Chief patented mining claim was added to Sequoia and Kings Canyon on March 25. This 21.62-acre parcel contains at least 12 caves and nearly that many small mines and prospecting digs. The parcel included all but one entrance to White Chief, the largest cave in Mineral King and one of the finest alpine caves in California.

The caves in this area have become very popular with "flashlight" cavers in recent years and park staff are examining the management implications of this use and its potential impacts on the caves. Many ideas are under consideration including re-routing the trail away from both the caves and the mines, and placing signs within the cave entrances to encourage safe and responsible caving.

- **CRYSTAL CAVE MANAGEMENT PLAN**
After years of planning, the Park is moving ahead with plans to produce a Crystal Cave Management Plan in 1998. This will be a complicated plan to accommodate the commercial operation of the tour route area, the wild tours, cavers and grotto trips, as well as the unique and amazing mineralogy and biology of the cave. Some areas

will be closed to protect the cave's wildlife and unique features. The Crystal Cave trustees (trip leaders) will be involved in discussions on the proposed plan and will be making suggestions on how to manage the cave.

- **CLOUGH CAVE GATING**

A large effort by members of Southern California Grotto and the Desert Dog Troglolites resulted in repairs to the existing Clough Cave gate, and the installation of an additional gate ten feet deeper into the cave. The project was coordinated by John Woods. Months of preparatory measuring, planning and welding led up to the installation weekend, which was September 6 and 7. Many cavers spent long uncomfortable hours welding, bolting, and concreting the old and new gates. A generator too small to properly power the welders complicated the entire effort. A backup generator, which was to have been provided by the Park, was also not available.

Two trips entered the cave since the gate construction and repair. Both entered at night to diminish disturbance to the bats. The first trip involved a court case, while the second trip focused on the cave's unique biology. An exit count of bats was made at the entrance at dusk, three permanent invertebrate monitoring plots were established, and many of the cave's unique invertebrates were photographed. We are happy to report that small numbers of Townsend's long-eared, Western Pipistrelle, and Little Brown Bats are using the cave. Their guano is beginning to accumulate in several parts of the cave and many of the cave's invertebrates have already begun to take advantage of the new food source.

- **SOLDIER'S CAVE TRUSTEES**

Two meetings of the Soldier's Cave Trustees have taken place in the last six months. The 1997 meeting took place on November 15. Five trustees joined the cave specialist for a re-flagging of trails trip through the cave. Areas where old flagging was removed and new flagging was installed included the Starlight Passage and Room and the Helictite Room and its approach to it. As all of everyone is aware, plastic flagging does not last forever. Replacing the flagging will be an on-going part of proper management in Lost Soldier's. The 1998 meeting was held on April 25 with five trustees attending. The group divided into two teams. One group worked on survey of the Starlight area and another did cleaning in several areas in the cave's upper level. A good discussion of the management of the cave was held that evening. It was suggested, and park staff agreed, that small rescue caches, focused on keeping people warm, be placed in the cave. We expect this to be a project this summer.

- **SOLDIER'S CAVE SURVEY**

The resurvey of Soldier's Cave has begun in earnest. As is typical of earlier versions of cave maps across California, the original Soldier's Cave maps lacked floor detail, mineralogical information and documented no aspects of the cave's biology. The data from this survey is not available to the Park Service. A more recent

version completed by John Tinsley includes interesting profiles and cross-sections but still has the previously mentioned short comings. The survey work is progressing steadily, but slowly. At this time, five survey trips have documented 1,225 feet of passage. We plan on at least four trips to the cave for survey work this summer. The park has also applied for a grant from the National Park Service's Geologic Resources Division for next summer to further the survey and inventory work in the cave.

- **HURRICANE CRAWL PHOTO DOCUMENTATION**

Two trips entered Hurricane Crawl for photo documentation in 1997. The photographers were Dave Bunnell and Peter Bosted. Both photographed in the Pumpkin Palace area and documented outstanding calcite lily-pads and lion's tails as well as stalactites, stalagmites, helictites and sparkling black, orange and white flowstone in Sequin Balcony. This year we are expecting trips by Dick LaForge, Bill Frantz and Dave Bunnell. A single survey trip entered Hurricane Crawl on November 17. The Pleiades area, found in 1995, was the focus of this work, which documented several side passages and well-decorated rooms.

- **1997 BAT SURVEY**

Through special funding from the Biological Resources Division of the U. S. Geological Survey, two bat biologists visited the park for approximately 10 days in August. The biologists, accompanied by Assistant Cave Specialist, Greg Stock visited a number of caves on the South Fork, including Clough. They also inventoried for bats in Crystal Cave, Kaweah Cave and at a bridge in the town of Three Rivers, which has large colonies of three bat species.

- **THE CAVE RESEARCH FOUNDATION, REDWOOD CANYON AND LILBURN CAVE**

It was another active summer and fall season for the Cave Research Foundation in Redwood Canyon with more than 11 expeditions involving 42 people in 1997. Here are highlights of the year's activities:

Lilburn's total length after 1997 is 16.4 miles or 26.4 kilometers with 2,280 feet of new survey last year. Ten survey trips worked in the dry sections of the cave and completed surveys near the Kleinbottle Complex, the Crystal Crawl, in the Angel's Perch area, parallel to the Curl Passage, and in the Mud Club where 500 feet of passage that still continues was found. The crawl into the Mousetrack area was found to be wet and breezy on one trip possibly indicating the presence of a new entrance. Minor sand and cobble moving on the same trip turned up a canyon passage leading to a pit with air that will be dropped in 1998. Approximately 61 quadrangle maps have been completed, with progress on several maps from the north end of the cave.

Bill Farr and Jim Brown worked diligently to survey and explore the submerged sections of Lilburn in 1997. They made 11 trips into the canyon in 1997 to either dive or to

prepare for dive trips. Extensive work took place in Big Springs, and at the Upstream Rise where Redwood Creek enters the dry portions of Lilburn. These passages had been choked with sediment during previous years. Approximately 900 feet was surveyed in Big Springs, while 1,200 feet was found in the Upstream Rise. Big Springs continued to descend to a depth of 248 feet where a slight constriction exists. Upstream Rise initially went horizontal, then down to a low point at -163 feet and from there has climbed upward. All of this was in passage 15 feet in diameter and with no side leads.

The hydrologists led by Jack Hess completed work on a monitoring station along Redwood Creek just above the beginning of the karst. Bill Howcroft put this in place as a component of dissertation work. Water samples from springs, streams and cave drips were also gathered and analyzed.

Three restoration trips led by Bill Frantz entered the cave in 1997. Two trips worked to clean flowstone below the Jefferson Memorial. The other trip returned to previously cleaned areas to assess their condition.

It was a dramatic year in Redwood Canyon for the movement of sediments. Early January floods caused a tremendous movement of water through the karst system. This resulted in the clearing of sediments in Big Spring and the Upstream Rise, the near filling of the Pebble Pile Creek sinkhole (nine years after the sink opened) and the inundation of the cave to a level 130-140 feet above the cave's lowest point in the Z Room. Sediments in the lower sections of the cave were moved and redistributed.

Another busy year is planned for Redwood Canyon in 1998. Expeditions will enter the Canyon on the weekends of Memorial Day, June 20th, July 4th, October 24th, and November 21st. The survey, sediment, and hydrology projects will be in high gear and special emphasis this year will be on dives by Bill Farr and Jim Brown in Big Springs and the Upstream Rise. The Park has two projects planned, both of which will begin on Memorial Day. These are the movement of two bear boxes into the canyon to protect caver's food and the Cave Research Foundation's research infrastructure. We also plan to begin flagging routes through this very complicated cave to facilitate travel during emergencies.

- **1998 CAVE BIOLOGICAL INVENTORY**

With good quality maps for many park caves now available, biological inventories tied to survey stations can begin, and that is just what we are planning for 1998. Hopefully, biological-monitoring trips will visit, Hurricane, Soldier's, Crystal, Kaweah, Carmoe Crevice, Cirque and Panorama caves this year. The primary focus will be the establishment of permanent 0.3 meter square plots that can be checked through time to monitor long-term population trends. The data will be stored in dBASE and may be imported into ArcView and CorelDraw! for map making.

- **1998 MINE INVENTORY AND ASSESSMENT**

Dozens of small mines are found throughout Sequoia and Kings Canyon. Mineral King has more than half of these sites. The effects of mine tailings on nearby watersheds and stream courses can be severe. Tailings often contain heavy metals and compounds that become very acidic in water, thereby destroying the ecology and wildlife in such streams. Mines can also pose a serious risk to unwary park visitors. The Abandoned Mineral Lands (AML) program of the Park Service's Geologic Resources Division (GRD) provides funding for parks attempting to either inventory or mitigate mine problems. Sequoia and Kings Canyon received a small grant this year to begin inventorying the mine sites and tailings found in the Park. At the end of July, geologists from GRD will travel to Sequoia to spend two weeks training the Cave Specialist and Assistant Cave Specialist in the details of mine site inventory. Subsequent trips in August and September to areas with mines will be made. Overall the project will focus on Mineral King, Upper Deadman Canyon, and Cedar Grove.

- **OTHER WORK FOR 1998**

The Cave Management Program will undertake a diverse group of tasks in 1998. Radon readings will be taken in several Park caves in conjunction with the Park Safety Office. The program hopes to accomplish survey work in Soldier's, Carmoe Crevice, and Clough Caves and possibly two newly discovered Park caves on Rimstone and Marble Creeks. We hope to create and put in place two small emergency caches each in Soldier's and Hurricane Crawl Caves. The kits will be focused on keeping cavers warm while they await rescue and will include space blankets, candles, and heat packs.

Wind Cave National Park (WICA)

by Jim Nepstad

In the last issue, it was reported that Wind Cave staff had discovered a drip site in the cave that had received traces of a dye injected near the main parking lot after more than 18 months. In April, an even more intriguing site was discovered. In June of 1993, Rhodamine WT was injected above the cave to the west of the park headquarters area. Despite valiant efforts, no dye was ever detected at any of the sites monitored. After two years of monitoring, we eventually gave up. It was assumed that the Minnelusa formation, which lies above most of the cave, somehow prevented the dye from infiltrating down into the cave.

In April of this year, an effort was made to clean up all the monitoring sites from the 1993 trace. We decided it would be good to grab one last sample from each site so that we could have some background information on these sites with a new fluorometer we recently acquired. One site, just to the south of the Club Room and nearly beneath the 1993 injection site, was found to be slightly positive. A return trip in June found the site to be rapidly picking up steam. In an unbelievable stroke of luck, we not only discovered dye showing up, but we discovered

it just as it was *beginning* to show up. We now know there are at least some sites in Wind Cave that require almost five years for water to finish its journey to the cave.

Wind Cave NP, together with Jewel Cave NM, hosted a week-long cave restoration camp in early May this year. Once again, 20 volunteers from across the US and Canada assisted with various on-going cave restoration projects at both caves. Several hundred feet of passage in both caves was meticulously cleaned of lint, litter, candle wax, and trail construction debris. The parks have had excellent luck in recruiting a core group of very dedicated, loyal volunteers who return year after year. This has been accomplished by providing free housing to volunteers, paying stipends through the NPS VIP program to offset travel costs, and working side-by-side with the volunteers.

Long-time Wind Cave employee Stan Allison, who served as an assistant to the park's Cave Management Specialist, has left Wind Cave for more arid pastures. Stan accepted a permanent position at Carlsbad Caverns NP, and will be working with Dale Pate and the rest of the cave management staff there. The entire staff at Wind Cave wishes Stan the best, and thank him again for his efforts on the behalf of park caves.

OFF-SITE HOUSING AT JEWEL CAVE

by Mike Wiles

Runoff is one of the many results of surface development. Even if the water remained perfectly clean, changes to surface drainage could alter the natural processes that occur within underlying cave passages. At Jewel Cave we have observed that houses, sod, and parking lots do significantly change the natural drainage patterns, causing overland flow in drainages that would not normally carry water, and changing the distribution and quantity of water infiltrating into the cave. Because of this we have decided, where and when possible, to reduce the amount of surface development above the known cave.

An ideal opportunity presented itself with the scheduled replacement of three aging trailer houses, used for seasonal housing. Rather than replace these trailers with permanent on-site buildings, we opted to build an apartment complex in the town of Custer, 13 miles from the cave and completely removed from the limestone escarpment in which the cave is found. NPS funds were used for the 14-bedroom apartment which is currently being built on USFS land. Housing will be shared with Black Hills National Forest (BHNF) employees, with the understanding that nine bedrooms will be reserved for Jewel Cave -- replacing the nine bedrooms currently provided by the trailers. Jewel Cave and BHNF will share responsibilities for maintenance and upkeep of the new facility, which will be occupied next spring.

As part of our 1999 GPRA goals, we will remove the asphalt from the parking lot adjacent to the former trailer sites and reclaim the excavated hillside with material from the trailer pads. The hillside will then be shaped to near-original contours and revegetated with native seed to prevent erosion and reduce unnatural runoff.

Though this is a relatively small effort, it is a good first step toward ensuring that “natural drainage patterns, air flows, and plant and animals communities will be protected,” and that “developments already in place above caves will be removed if they are significantly altering natural conditions.” (NPS Management Policies, Chapter 4:20, Cave Management, Dec 88.)

CARLSBAD CAVERN: LOOKING TO THE FUTURE

by Dale L. Pate

An Infiltration Study to investigate pathways for contaminated waters and how they may enter Carlsbad Cavern has been completed. Researchers from the Colorado School of Mines have prepared a final report from this study. As reported in the April 1995 *NSS News*, an infiltration study for Carlsbad Cavern was initiated to investigate (1) infiltration routes and pathways, (2) contaminant levels and sources, and (3) worst-case scenarios for major disasters and how they may affect the cave. This study suggested measures to eliminate or reduce possible impacts to Carlsbad Cavern.

When development of Carlsbad Cavern began in the early 1900's, the area was remote and difficult to get to. Getting to the cave was a major undertaking requiring a long drive over rough roads. The trip into the cave was an all-day affair. In those early days it was convenient and practical to build structures near the cave entrance. By the early 1930's, the new road through Walnut Canyon was completed and numerous structures, which included parking lots and a maintenance yard were constructed to provide for park operations and to accommodate the visitor. Sewer lines from the Visitor Center and other buildings ran to septic tanks, while excess liquids were sprayed over the open ground directly above Left-Hand Tunnel. The last major building phase occurred during the 1960's as part of a nationwide program to upgrade Park housing. This program added 12 three-bedroom apartments directly above the Guadalupe Room.

Infiltration Studies

Two reports came from this initial study. The first by Mark Brooke as a master's thesis titled *Infiltration Pathways at Carlsbad Caverns National Park Determined by Hydrogeologic and Hydrochemical Characterization and Analysis*. Mark's thesis focused on the infiltration pathways, the hydrologic system domains, and the basic water chemistry of the entire karst system. 92 water samples were analyzed demonstrating that aluminum, zinc, total organic carbon, and nitrate found in the subsurface can be traced from surface input areas. Analysis also

shows that there are five distinct hydrologic domains within the cavern system that are defined by topography, hydrogeology, hydrostructure, and hydrochemistry.

The final report, *Determining Water Infiltration Routes from Structures Located Above Carlsbad Cavern, Carlsbad Caverns National Park, Carlsbad, New Mexico*, was completed by Paul K.M. van der Heijde, Kenneth Kolm, Helen Dawson, and Mark Brooke. This report focused on determining the potential pollution from man-made structures and human activities on the cave and determining cave areas most vulnerable to contamination from the surface. This study concluded that although Carlsbad Cavern is highly vulnerable to contamination from infiltration, there are few indications that serious contamination is occurring now. Identified in the report, the most threatened areas in the cave are Quintessential Right, Left-Hand Tunnel, New Section, Main Corridor, Chocolate High, the New Mexico Room, the Scenic Rooms, and the Big Room.

Potential and Known Impacts

To varying degrees, all structures located above the cave have the potential to degrade the cavern system below. A few of the structures that present some of the most serious threats for contamination are the maintenance yard, Bat Flight Parking Lot, and the aging sewer lines. It is conceivable that a major contamination event could take place if no preventative measures are taken. Measures need to be taken to remove potential sources of contamination, to implement accident mitigation procedures, and to re-engineer infra-structural components.

The maintenance yard supports heavy equipment and hazardous materials storage. In addition buried gasoline storage tanks are located there. Any type of catastrophic event such as a fire or major fuel spill could have devastating effects on Carlsbad Cavern. With a fire, thousands of gallons of water would be used to put out the flames. This could easily carry hazardous materials or fuels directly into the cave. The ultimate solution is to remove the entire maintenance yard off the escarpment.

The Bat Flight Parking Lot is in a very strategic location to funnel contaminated surface water runoff directly into the cave. Though convenient parking for the evening bat flights, the lot is situated directly over a major fracture system that is one of the hydrologic domains mentioned in the above paragraphs. This lot collects oil, gas, and radiator fluid spills from parked vehicles. During rainstorm events, contaminated water is funneled directly into Bat Cave Draw where it immediately sinks, directly over the Main Corridor. The location and configuration of the lot limits the installation of water filtering devices. Removal of the Bat Cave Parking Lot and the return of the area covered by pavement to bio-retention plant communities would provide maximum protection to the cave. A shuttle service for handicapped visitors from the upper parking lots down to the cave entrance and back would need to be provided.



Aerial view of Carlsbad Cavern area with the NPS infrastructure built directly over the cave. The entrance is in the lower, central part of the photo. (NPS Photo)

The aging sewer lines are a continual problem. Just within the past month, a major leak was discovered in which thousands of gallons of raw sewage was lost. The main sewer line to the sewage lagoons runs directly over Left-Hand Tunnel. Throughout its length, water seepage into Left-Hand Tunnel has high nitrate values compared to the rest of the cave. The sewer system is an antiquated system that must be totally replaced by using state-of-the-art equipment and technology.



Main sewer line leak discovered in early June, 1998. Sewage is flowing from left of photo. Note sewage lagoons in the background. (NPS Photo by Dale Pate)

Summary

Carlsbad Cavern is one of the world's most magnificent caves. Millions of visitors have marveled at this spectacular cavern system. Since its discovery around the turn of the century, we have learned from many of the mistakes that have been made over the years. We have learned that the infrastructure over the cave threatens the very resource this park was created to protect. It is time that we plan for the future and begin the long process of relocating buildings and other man-made structures off the

escarpment to an area that cannot effect the cave. The goals outlined below are a good start in this process. Many of these projects will be funded through the Fee Demonstration Program, which allows the park to retain 80% of all fees collected and stipulates how these fees can be used.

INFILTRATION ACTION PLAN

The General Management Plan for the park states that once the Infiltration Study for the park has been completed, a Development Concept Plan (DCP) must be prepared. The DCP will "specify what actions will be taken to protect Carlsbad Cavern from the effects of surface activities and developments and will analyze the specific impacts of those actions in accordance with the National Environmental Policy Act." The GMP further states that the range of possible actions could include: (1) the use of technology to mitigate the impacts of some human activities and developments, (2) a partial relocation of facilities and possibly, (3) the removal of all facilities except historic structures and the existing Visitor Center off the escarpment. In the meantime, the park is developing an Infiltration Action Plan that will include short-, medium-, and long-term goals to protect Carlsbad Cavern. The goals listed below are not in prioritized order.

Anyone wanting a copy of the General Management Plan developed in 1996 can obtain one by writing the Superintendent, Carlsbad Caverns National Park, 3225 National Parks Highway, Carlsbad, New Mexico 88220.

Short Term Goals

1. Educate and involve the public concerning the risks to Carlsbad Cavern through press releases, meetings, and other mechanisms.
2. Close the Bat Flight (BF) Parking Lot to most parking. Allow limited parking for handicapped individuals and

the unloading and loading of buses during bat flights. Also, overflow parking on the three busy holiday weekends (Memorial Day, Independence Day, and Labor Day) will be permitted.

3. Identify substances and practices that employees, residents, and visitors should not be using or performing and develop Standard Operating Procedures (SOP's) as guidelines for allowable practices.
4. Enforce the Commercial Vehicle Prohibition. Because of the winding nature of the road up Walnut Canyon and the potential for a major fuel spill, all large trucks will be required to leave the cargo portion of their vehicles at White's City.
5. Develop a Spill Contingency Plan and maintain the necessary equipment to implement such a plan.
6. Establish housing needs for seasonal employees and VIPs off-site. Also determine which, if any, permanent employees need to live on-site.
7. Develop budget sources to accomplish goals.
8. Begin the process of replacing all sewer lines.

Medium Term Goals

1. Develop and implement strategies for mitigating fluid-runoff from the maintenance yard, visitor center parking lots, roadways, and from the concessionaire loading dock.
2. Remove center paved section of the BF Parking Lot and replace with bio-retention plant communities. *
3. Remove gasoline and diesel fueling capabilities from the Maintenance Yard. *
4. Remove propane heating system and develop alternative heating sources.
5. Remove the "bone yard", a storage area for assorted materials.

Long Term Goals

1. Move the Maintenance Facility off the escarpment. *
2. Remove the Bat Flight Parking lot and provide a shuttle-type system for transporting those with walking difficulties from the upper parking lot. *
3. Explore the possibilities of moving the park generator and associated fuel tank off the escarpment. Replace the fuel storage tank with a smaller one placed above ground. *
4. Remove the non-historic structures. *
5. In conjunction with the construction of a new maintenance facility, build new office spaces for the Resources Management & Visitor Protection Division as well as new dorm-type spaces for use by visiting scientists and short-time volunteers. Convert all historic structures to interpretive sites and storage.

6. Remove water and sewer lines from these structures. *
6. Implement alternative transportation options developed in the General Management Plan. *

* A Development Concept Plan (DCP) will determine if these actions will be implemented.

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CODE OF FEDERAL REGULATIONS
TITLE 43--PUBLIC LANDS: INTERIOR
SUBTITLE A--OFFICE OF THE SECRETARY OF THE INTERIOR
PART 37--CAVE MANAGEMENT

SUBPART A--CAVE MANAGEMENT--GENERAL

s 37.1 Purpose.

The purpose of this part is to provide the basis for identifying and managing significant caves on Federal lands administered by the Secretary of the Interior.

s 37.2 Policy.

It is the policy of the Secretary that Federal lands be managed in a manner which, to the extent practical, protects and maintains significant caves and cave resources. The type and degree of protection will be determined through the agency resource management planning process with full public participation.

s 37.3 Authority.

Section 4 of the Federal Cave Resources Protection Act of 1988 (102 Stat. 4546; 16 U.S.C. 4301) authorizes the Secretary to issue regulations providing for the identification of significant caves. Section 5 authorizes the Secretary to withhold information concerning the location of significant caves under certain circumstances.

s 37.4 Definitions.

(a) Authorized officer means the agency employee delegated the authority to perform the duties described in this part.

(b) Cave means any naturally occurring void, cavity, recess, or system of interconnected passages beneath the surface of the earth or within a cliff or ledge, including any cave resource therein, and which is large enough to permit a person to enter, whether the entrance is excavated or naturally formed. Such term shall include any natural pit, sinkhole, or other feature that is an extension of a cave entrance or which is an integral part of the cave.

(c) Cave resources means any materials or substances occurring in caves on Federal lands, including, but not limited to, biotic, cultural, mineralogic, paleontologic, geologic, and hydrologic resources.

(d) Federal lands, as defined in the Federal Cave Resources Protection Act, means lands the fee title to which is owned by the United States and administered by the Secretary of the Interior.

(e) Secretary means the Secretary of the Interior.

(f) Significant cave means a cave located on Federal lands that has been determined to meet the criteria in s 37.11(c).

s 37.5 Collection of information.

(a) The collections of information contained in this part have been approved by the Office of Management and Budget under 44 U.S.C. 3501 et seq. and assigned clearance numbers 1004-0165 (cave nominations) and 1004-0166 (confidential information). The information provided for the cave nominations will be used to determine which caves will be listed as "significant" and the information in the requests to obtain confidential cave information will be used to decide whether to grant access to this information. Response to the call for cave nominations is voluntary. No action may be taken against a person for refusing to supply the information requested. Response to the information requirements for obtaining confidential cave information is required to obtain a benefit in accordance with Section 5 of the Federal Cave Resources Protection Act of 1988 (102 Stat. 4546; 16 U.S.C. 4301).

(b) The public reporting burden is estimated to average 3 hours per response for the cave nomination and one-half hour per response for the confidential cave information request. The estimated response time for both of the information burdens includes time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Bureau of Land Management Clearance Officer, WO-873, Mail Stop 401 LS, 1849 C Street NW., Washington, DC 20240; and the Office of Management and Budget, Paperwork Reduction Project 1004-016 5/6, Washington, D.C. 20503.

SUBPART B--CAVE DESIGNATION

s 37.11 Nomination, evaluation, and designation of significant caves.

(a) Nominations for initial and subsequent listings. The authorized officer will give governmental agencies and the public, including those who utilize caves for scientific, educational, and recreational purposes, the opportunity to nominate potential significant caves. The authorized officer will give public notice, including a notice published in the Federal Register, calling for nominations for the initial listing, including procedures for preparing and submitting the nominations. Nominations for subsequent listings will be accepted from governmental agencies and the public by the agency that manages the land where the cave is located as new cave discoveries are made or as new information becomes available. Nominations not approved for designation during the listing process may be resubmitted if better documentation or new information becomes available.

(b) Evaluation for initial and subsequent listings. The evaluation of the nominations for significant caves will be carried out in consultation with individuals and organizations interested in the management and use of cave resources, within the limits imposed by the confidentiality provisions of s 37.12 of this part. Nominations will be evaluated using the criteria in s 37.11(c).

(c) Criteria for significant caves. A significant cave on Federal lands shall possess one or more of the following features, characteristics, or values.

(1) Biota. The cave provides seasonal or yearlong habitat for organisms or animals, or contains species or subspecies of flora or fauna that are native to caves, or are sensitive to disturbance, or are found on State or Federal sensitive, threatened, or endangered species lists.

(2) Cultural. The cave contains historic properties or archaeological resources (as described in 36 CFR 60.4 and 43 CFR 7.3) or other features that are included in or eligible for inclusion in the National Register of Historic Places because of their research importance for history or prehistory, historical associations, or other historical or traditional significance.

(3) Geologic/Mineralogic/Paleontologic. The cave possesses one or more of the following features:

(i) Geologic or mineralogic features that are fragile, or that exhibit interesting formation processes, or that are otherwise useful for study.

(ii) Deposits of sediments or features useful for evaluating past events.

(iii) Paleontologic resources with potential to contribute useful educational and scientific information.

(4) Hydrologic. The cave is a part of a hydrologic system or contains water that is important to humans, biota, or development of cave resources.

(5) Recreational. The cave provides or could provide recreational opportunities or scenic values.

(6) Educational or Scientific. The cave offers opportunities for educational or scientific use; or, the cave is virtually in a pristine state, lacking evidence of contemporary human disturbance or impact; or, the length, volume, total depth, pit depth, height, or similar measurements are notable.

(d) National Park Service policy. The policy of the National Park Service, pursuant to its Organic Act of 1916 (16 U.S.C. 1, et seq.) and Management Policies (Chapter 4:20, Dec. 1988), is that all caves are afforded protection and will be managed in compliance with approved resource management plans. Accordingly, all caves on National Park Service-administered lands are deemed to fall within the definition of "significant cave."

(e) Special management areas. Within special management areas that are designated wholly or in part due to cave resources found therein, all caves within the so-designated special management area shall be determined to be significant.

(f) Designation and documentation. If the authorized officer determines that a cave nominated and evaluated under paragraphs (a) and (b) of this section meets one or more of the criteria in paragraph (c), the authorized officer will designate the cave as significant. The authorized officer will designate all caves identified in paragraphs (d) and (e) of this section to be significant. The authorized officer will notify the nominating party of the results of the evaluation and designation. Each agency Field Office will retain appropriate documentation for all significant caves located within its administrative boundaries. At a minimum, documentation shall include a statement of finding signed and dated by the authorized officer, and the information used to make the determination. This documentation will be retained as a permanent record in accordance with the confidentiality provision in s 37.12 of this part.

(g) Decision final. Decisions to designate or not designate a cave as significant are made at the sole discretion of the authorized officer and are not subject to further administrative review or appeal under 43 CFR part 4.

(h) If a cave is determined to be significant, its entire extent, including passages not mapped or discovered at the time of the determination, is deemed significant. This includes caves that extend from lands managed by any Federal agency into lands managed by one or more other bureaus or agencies of the Department of the Interior, as well as caves initially believed to be separate for which interconnecting passages are discovered after significance is determined.

s 37.12 Confidentiality of cave location information.

(a) Information disclosure. No Department of the Interior employee shall disclose information that could be used to determine the location of any significant cave or cave under consideration for determination, unless the authorized officer determines that disclosure will further the purposes of the Act and will not create a substantial risk to cave resources of harm, theft, or destruction.

(b) Requesting confidential information. Notwithstanding paragraph (a) of this section, the authorized officer may make confidential cave information available to a Federal or State governmental agency, bona fide educational or research institute, or individual or organization assisting the land managing agency with cave management activities. To request confidential cave information, such entities shall make a written request to the authorized officer that includes the following:

- (1) Name, address, and telephone number of the individual responsible for the security of the information received.
- (2) A legal description of the area for which the information is sought.
- (3) A statement of the purpose for which the information is sought, and
- (4) Written assurances that the requesting party will maintain the confidentiality of the information and protect the cave and its resources.

(c) Decision final. Decisions to permit or deny access to confidential cave information are made at the sole discretion of the authorized officer and are not subject to further administrative review or appeal under 5 U.S.C. 552 or 43 CFR parts 2 or 4.

A MESSAGE FROM THE EDITOR

Dale L. Pate

*Welcome to the 2nd issue of **Inside Earth**, the newsletter for the National Park Service Cave & Karst Programs. In the 1st issue, we provided a copy of the Federal Cave Resources Protection Act of 1988 (FCRPA). In this issue, we are providing a copy of the relevant section of the Code of Federal Regulations (CFR) that implement the FCRPA for the Department of the Interior. A feature we hope to include in future issues will be summaries of cave and karst management activities from other agencies such as the Bureau of Land Management, U.S. Forest Service, and U.S. Fish & Wildlife.*

*Communication and education are invaluable tools in our efforts to preserve and protect cave and karst resources across the nation. Since April, the 1st issue of **Inside Earth** has been available on the world wide web where it has received 600 visits to the site. This tells us that there is an interest by NPS park units and the general public on how we manage cave and karst resources. We have the opportunity to exchange ideas and to educate each other as well as the interested public. We encourage park units with cave and karst resources to submit summaries or articles concerning cave and karst management activities for publication in future issues.*