Carlsbad Caverns National Park

CANYONS & CAVES

A Newsletter from the Resources Stewardship & Science Division

Issue No. 29 **Summer 2003**

In the midst of a flowering Texas Madrone (*Arbutus xalapensis var. texana)* in Rattlesnake Canyon. (NPS Photo by Dale L. Pate)

TABLE OF CONTENTS

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Park Address: 3225 National Parks Highway, Carlsbad, New Mexico 88220

RESOURCE NEWS

CARLSBAD CAVERN RESOURCE PROTECTION PLAN – This long awaited Implementation Plan and Environmental Assessment was finally released in February 2003. As stated in Alternative B:

> *"The Park Preferred Action and Environmentally Preferred Alternative would remove the most threatening sources of contamination from above Carlsbad Cavern and follow the same proposals as Alternative A to alleviate contamination from remaining facilities. This alternative also involves modification of land-use policies, including pavement removal and reconfiguration of the Bat Cave Draw parking lot, relocation of some maintenance functions, and removal of the Mission 66 housing area and the tennis court. The actions in this alternative also restore natural drainage and infiltration to areas where pavement is removed. The sewer collection system would be replaced and the outfall system relocated."*

A Finding of No Significant Impact (FONSI) describing the selected alternative with stated reasons why it was chosen is expected to be released soon.

MISSON 66 UPDATE – The following is a Superintendent's update that was published in our weekly park newsletter, *Cavern News*, concerning the west pod of Mission 66 housing.

> *Many of you are wondering why we are using the Mission 66 complex for limited housing this season. As you know, these structures were deemed excess to our needs and are slated for demolition in FY-06. Due to our hiring freeze for permanent positions that was instituted in January, pending completion of the workload analysis and position management planning, we have had to rely more heavily on seasonals and volunteers this year. Once we complete the planning, we will rely less on seasonal positions. During the rehab of the visitor center, which is scheduled to occur late CY-04 through early summer CY-05, we will need these structures for office space and storage, since we will completely move out of the Visitor Center in order to achieve a compressed construction schedule. We will occupy modular units in the parking lot, and use structures in the Mission 66 complex during that construction period. Once the construction is complete, we will move to demolish the Mission 66 complex.*

CAVE PEARLS RETURN TO LOWER CAVE – The following note and 42 cave pearls along with a couple of pieces of cave popcorn were recently returned to the park. The note read as follows:

> *Enclosed are the cave pearls that were removed from Carlsbad Caverns back in the 30's. The young man who took them as souvenirs was possibly working there under the CCC program. Anyway, they came into my possession after my Mother went to the nursing home. I put them up and recently ran across them in a drawer.*
>
> *Best Regards, Bob Phillips*

While we will never know exactly where they came from in Carlsbad Cavern, we can make an educated guess that they came from the Rookery in Lower Cave. Over the recent Cave Research Foundation (CRF) Restoration week, Tom Bemis with several other CRF volunteers placed the pearls in a recently restored area. Thanks to Mr. Phillips for returning these long lost cave pearls.

Tom Bemis carefully places cave pearls in recently restored "nests" in the Rookery, Lower Cave, Carlsbad Cavern. (NPS Photo by Bill Sawyer)

ONE MORE CAVE – Another small cave has been documented in the backcountry bringing the total number of known caves in the park to 106.

EMPLOYEE DEATH – It is with great sadness that we report the death of Myra Barnes, park wildlife biologist. Myra had recently accepted a promotion and transfer to Organ Pipe Cactus National Monument as the Team Leader for the Ecological Monitoring Program and was in the process of moving to her new job. She will be greatly missed.

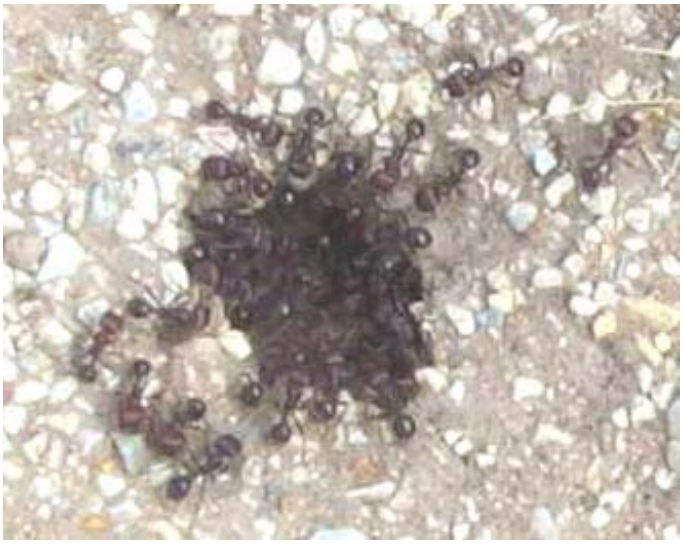
HARVESTER ANTS AND HORNED LIZARDS

by Renée West

They don't have shovels and buckets… Have you ever wondered how those ground-nesting insects actually carry the soil out of the holes they dig? Well, harvester ants have incorporated a remarkable solution: they carry the soil out in their beards. The scientific genus name for most of our harvester ants is *Pogonomyrmex*, which means 'bearded ant'. They have sets of hairs under their chins, kind of like beards -- and stiff and long enough to act as tiny buckets.[1]

Harvester ants live mostly in the semi-arid West, and many occur in Carlsbad Caverns National Park. They live in large underground nests. When weather is between 80 and 95 degrees, worker ants spend the active part of their days foraging for seeds and other foods (such as insects) that they carry back into the nest. You can see long lines of these ants headed to or from nests throughout the park this time of year.

These worker ants, exposed to weather, predation, and trampling, have life expectancies of a few weeks to a few months. The queen ant, protected deep inside the nest, can live much longer. According to researcher Stephen Welton Taber, "We have reliable figures for queen western harvester ants of 40 years or more, perhaps the greatest life expectancy of any rangeland animal… It wasn't all that long ago that our own life expectancy and the maximum age of this insect were about equal."[1]



Red harvester ants (*Pogonomyrmex barbatus*) at their nest near the Biology offices. (NPS photo by Sara Swann)

Despite all the studies on harvester ants, many of the approximately 60 species of the Western Hemisphere are still described with "biology largely unknown".[1] What we *do* know makes harvester ants fascinating creatures as well as important links in the food webs of the ecosystem. Belonging to the same insect order as bees and wasps (Hymenoptera), ants are entirely social, with large community nests and social castes that include worker ants (sterile females), a queen ant (fertile female), and fertile males. Oddly, a couple of harvester species do not have worker ants. These are called 'social parasites' because they must live in another species' nest to benefit from the work of *their* worker ants.

In the "eat and be eaten" natural world, harvester ants are important as the primary food of horned lizards. Important, because when they decline, so do horned lizards. Harvester ants have largely died out of central Texas, and the Texas horned lizard—the Texas state reptile—is listed as threatened there. So is the mountain short-horned lizard.

Here in CCNP, we have two confirmed species of horned lizards—Texas horned lizard (*Phrynosoma cornutum*) and roundtail horned lizard (*P. modestum*). The mountain short-horned lizard (*P. douglasii*) is listed as 'possible', and that may be confirmed by the current herpetological inventory. The Texas horned lizard is also listed by various federal agencies as a species of concern and a sensitive species.[2]

A Texas horned lizard (*Phrynosoma cornutum*) near CCNP. (Photo © Mike Woolman)

Other ant species have played a role in the Texas decline of harvester ants and horned lizards: non-native (exotic, imported) fire ants. Local biology instructor Rick Wiedenmann (New Mexico State University at Carlsbad) saw the decline first-hand: "When I first moved to Central Texas I would find Texas horned lizards in my yard. Then imported fire ants came through. And with the ants came the use of ant poisons. Between the poisons, and probably direct predation, the harvester ants disappeared. And so did the lizards. Now fire ants are entering Eddy County. Who knows how bad it will be? But I would hate to see the harvester ants and horned lizards disappear here also."[3]

The Horned Lizard Conservation Society is working to protect remaining wild populations of horned lizards. According HLCS, "Populations of the Texas horned lizard have disappeared in East and Central Texas, and are decreasing in North Texas as well. A decline and disappearance of them in Oklahoma and New Mexico has been noted… The primary cause for population decline is the loss of habitat by agricultural and urban conversion. Other causes also have led to declining populations, including overharvesting for the pet trade and curio trade and the invasion of exotic species, particularly exotic ants which the lizards cannot survive on and outcompete their preferred ant."[4]

Those "spine-covered, squat-bodied horned lizards"[5] are capable of sitting very still for long periods of time, making themselves look like rocks to their predators (which include Harris hawks, roadrunners, and coachwhip snakes).[5] They will sit near trails leading to harvester ant nests and pick off large portions of a population in one feeding. Their heavily armored skin helps stop some of the stings of the ants, and they also have a chemical in their blood that neutralizes the ant venom.

We don't know exactly how many species of harvester ants we have because we lack an inventory of the park's invertebrate wildlife. But some are known to occur in our area:

Pogonomyrmex barbatus--red harvester (identified in the park by Dr. Taber)
P. desertorum—desert harvester
P. Maricopa—Maricopa harvester
P. rugosus—ough harvester

Several other species are possible residents in our park:

Pogonomyrmex apache—Apache harvester
P. californicus—California harvester

P. occidentalis—western harvester
P. texanus—Texas harvester
Ephebomyrmex imberbiculus—no common name

Besides providing a food source for rare lizards, harvester ants provide other services that humans find useful. Their primary food is seeds, but various species also eat insects, some of which we consider pests. Several harvester ant species kill and eat termites, crop pests, screwworms, cattle ear ticks, grubs, and… fire ants![1] (But, apparently, not enough fire ants.)

Harvester ants benefit the ecosystem in other ways, according to Taber. "Large nests modify the surrounding soil by aerating it via the system of tunnels, an alteration that also increases water penetration. Nitrogen and potassium are concentrated in the soil by the remains of thousands of stored seeds and insects."

When we set about to preserve our own populations of horned lizards, or to try to keep the species off endangered species lists, we can't just think about saving the animals. We must look at the whole of the system—especially who eats whom. And we must continue to strive to keep non-native species out.

REFERENCES

[1]Stephen Welton Taber. 1998. *The World of the Harvester Ants*. Texas A&M University Press; and personal communication.
[2]Roemer, David M. 2002. Amphibians and reptiles list for Carlsbad Caverns National Park, Eddy Co., New Mexico. Park files, in Biology office.
[3]Rick Wiedenmann, personal communication.
[4]Horned Lizard Conservation Society website: www.hornedlizards.org
[5]Degenhardt, William G., Charles W. Painter, and Andrew H. Price. 1996. *Amphibians and Reptiles of New Mexico*. University of New Mexico Press.

CAVE CLIMATE MONITORING

by Paul Burger

How does the weather in Carlsbad Cavern change and what effect does it have on the cave? A microclimate study was done in the late 1960s by John McLean from the U.S. Geological Survey that showed that airflow up the elevator shafts were causing the cave to dry out. The resulting report dated May 1971 and titled "The Microclimate in Carlsbad Caverns, New Mexico" led to the installation of airlock and revolving doors. But what have the long-term trends been and how has the current drought affected the cave? Thanks to a generous donation by Carlsbad Cavern-Guadalupe Mountains Association (CCGMA) and the National Park Service Challenge Cost Share program, we are now beginning to collect long-term environmental data in Carlsbad Cavern and Lechuguilla Cave.

The park has installed temperature and humidity loggers to monitor seasonal and long-term variations in cave climate. In Carlsbad, loggers have been installed in fifteen locations from Devils Spring in the Main Corridor to Lake of the Clouds (figure 1). To date, we have been concentrating on the areas most affected by the cold air that sinks into the cave from the Natural Entrance and in the areas around the elevator shafts. The loggers collect temperature and humidity readings every hour and appear to work well in the cave environment.

In Lechuguilla Cave, we have loggers placed from the entrance pit to the top of Boulder Falls, the first major drop about 1,000 feet into the cave (figure 2). These loggers will be used to monitor the long-term trends in cave climate as well as checking the effectiveness of the recently-installed air-lock gate. The airlock isn't designed to stop all airflow into and out of the cave, but to force the air to move in and out of the rubble at the bottom of the entrance pit, the conditions that existed prior to digging open the cave.

In Carlsbad, the preliminary data show some basic trends of cooling during December-January-February and beginning to warm up into the spring (figure 3). The data also show that the average humidity levels above and below the popcorn line in the cave match what has been theorized for years. In the places where we have loggers above and below this line at roughly the same location, the humidity levels are higher at the upper logger by several percent. This phenomenon causes corrosion of the ceilings and deposition of popcorn below the line.

In Lechuguilla, the humidity levels appear to cycle with changes in barometric pressure (figure 4). During low pressure, the cave exhales and the warm, moist cave air moves out of the cave, increasing the humidity in the entrance area. The data also show virtually no change in readings at Boulder Falls which means that even dry air coming into the cave when the cave inhales does not cause significant drying even 1,000 feet into the cave. This suggests that the airlock is being successful at forcing the wind to travel through the loose rubble of the cave and may be limiting the drying effects deeper in the cave.

The data from Carlsbad and Lechuguilla show that these loggers are capable of collecting long-term data and will be useful in documenting changes in cave climate throughout the years. We hope to expand the monitoring program into backcountry caves like Spider and Slaughter Canyon Caves to see what the seasonal and long-term changes are in other, smaller caves at different elevations and locations.

Figure 1. Carlsbad Cavern Monitoring Stations

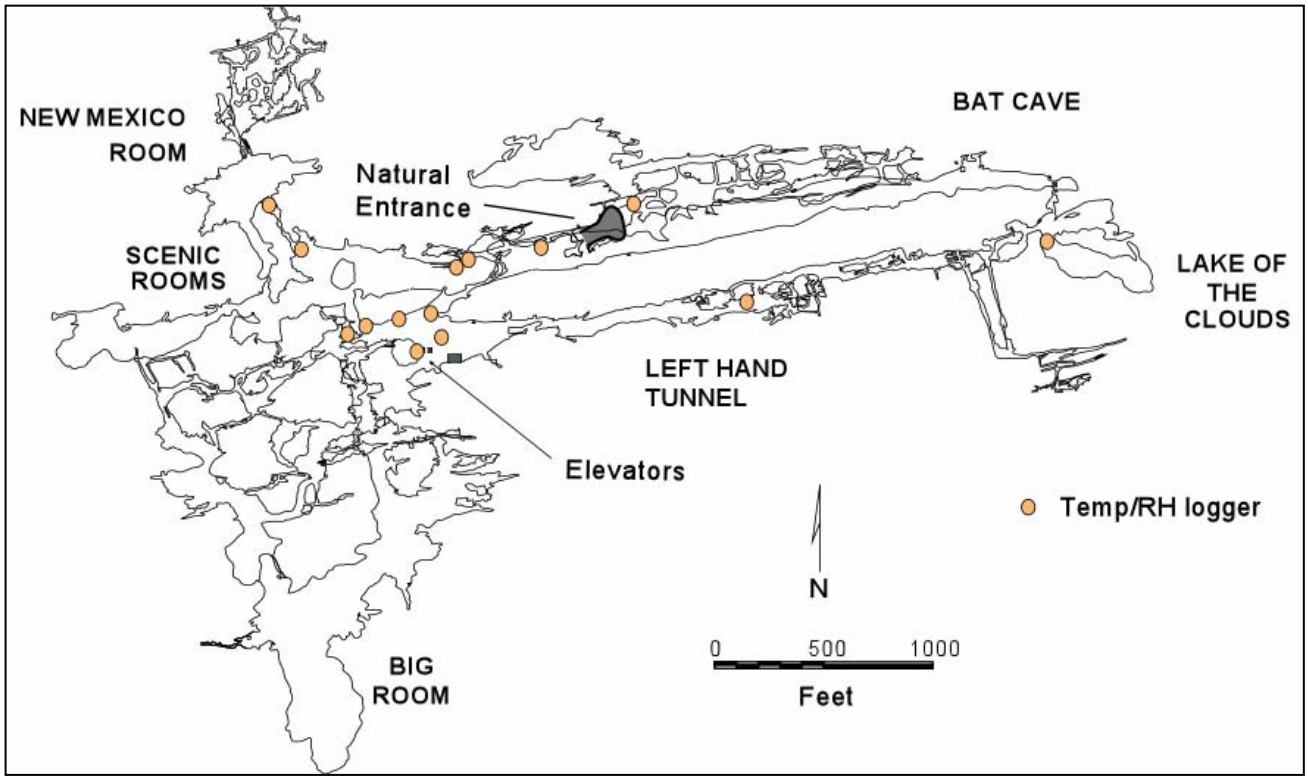


Figure 2. Lechuguilla Cave Monitoring Stations

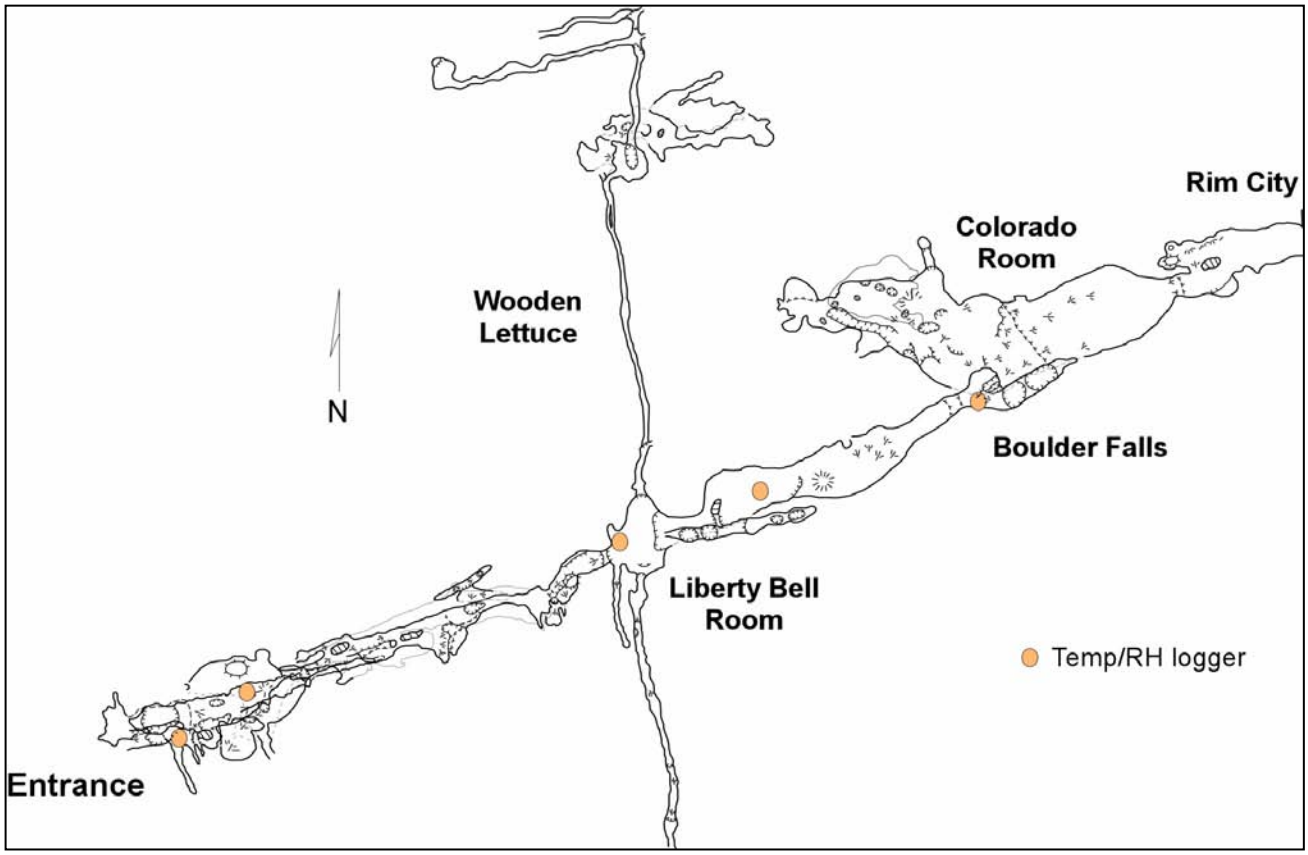


Figure 3. Temperature and Relative Humidity Graph for Devil's Den, Carlsbad Cavern.

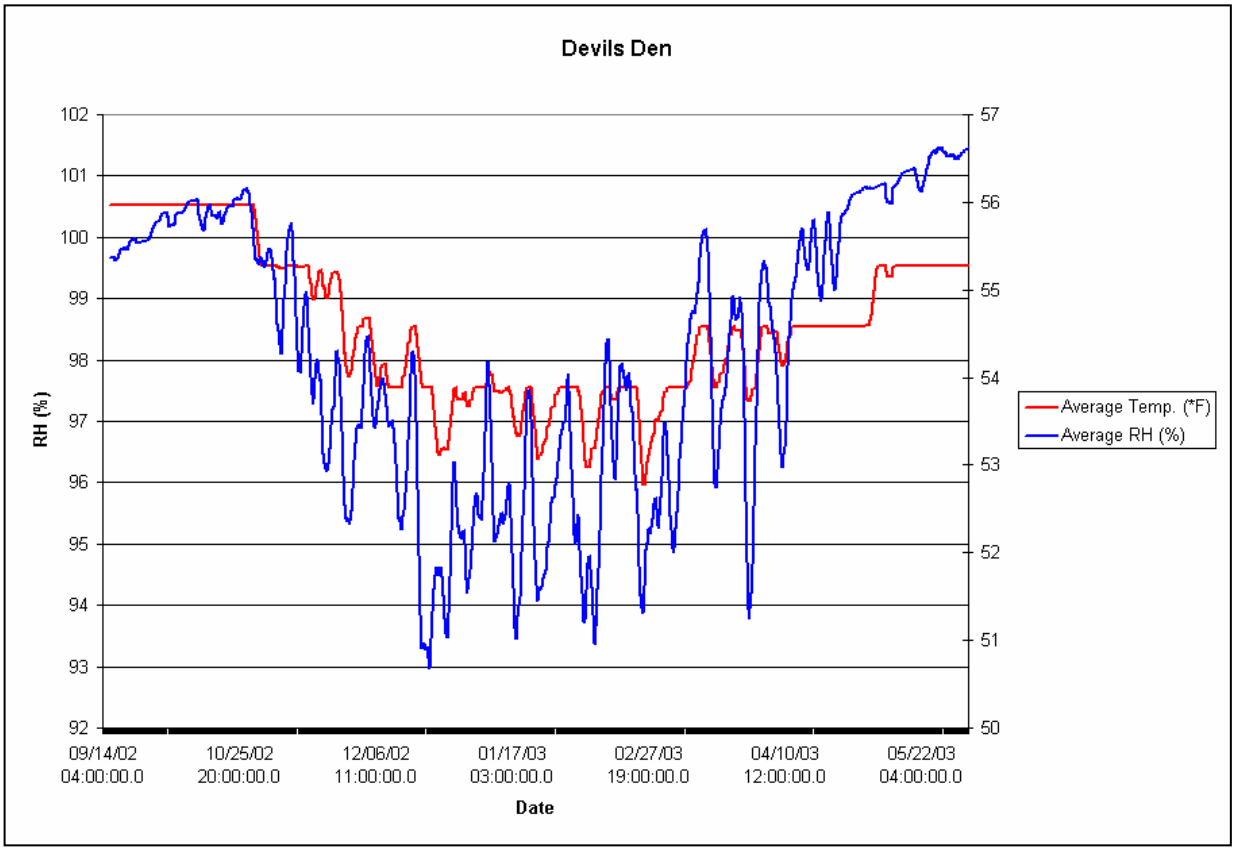
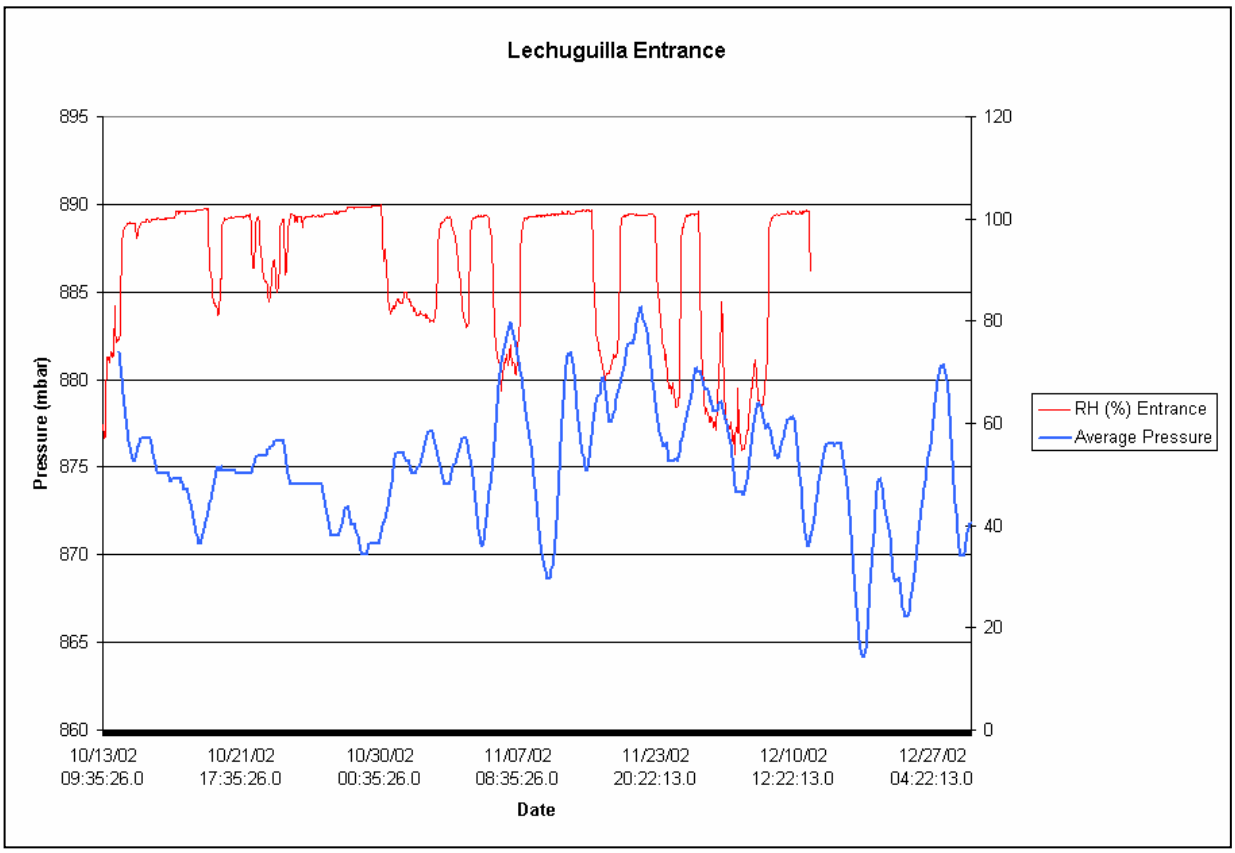


Figure 4. Relative Humidity and Barometric Pressure Graph for Lechuguilla Cave Entrance.



NOT JUST ANOTHER PRETTY FACE (IMPROVING SLAUGHTER CANYON CAVE ACCESS TRAIL)

by Diane M. Dobos-Bubno
with assistance from Jeff Doryland

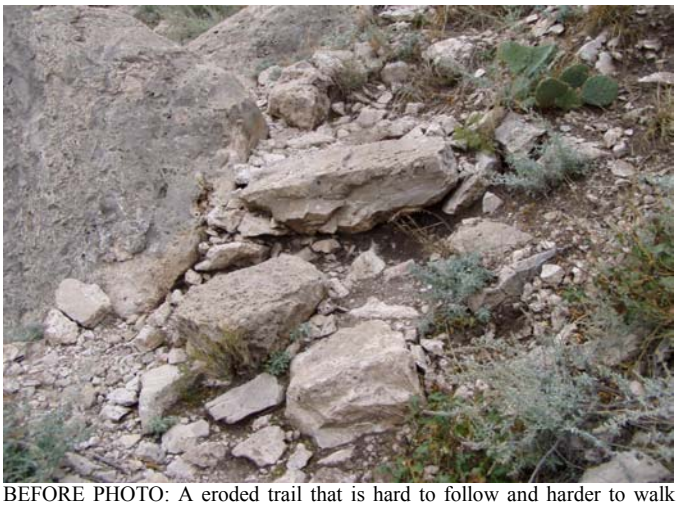
A well-built and maintained trail is one of the most effective ways to protect natural and cultural resources. – Jeff Doryland, Grand Canyon National Park

If you visited Slaughter Canyon Cave prior to February 2003, you might remember the steep trail sections, the high steps suitable only for the Hulk's gait, or the eroded trail sections that drop off into the canyon. That's because over the years, the current path has been subjected to the standard whims of the desert environment. Rock and debris slides, undercutting, and slumping have all affected the trail, testimony to the natural erosion processes constantly in action. As the trail trace became obscured, hikers to the cave created new "social" trails to avoid the resulting uneven footing. This widened the trail to proportions not in the original design and caused additional erosion. High steps and confusion about the route of the trail existed. In places, it even seemed, the trail led straight to the edge of a cliff.

Grand Canyon Trail Crew at Slaughter Cave: (left to right) Chris Kerr, Evonne Ellis, Jason Hughes, Shannon McCloskey, Jeff Doryland, Joseph Moyer. (NPS Photo by Jeff Doryland)

This past February, a diligent trail crew changed that. Carlsbad Caverns NP, lacking regular trail personnel, enlisted a crew from Grand Canyon National Park. The six-person crew included Jeff Doryland (crew leader), Chris Kerr, Joseph Moyer, Shannon McCloskey, Jason Hughes, and Evonne Ellis who spent a wintry four weeks from January 27- February 21, 2003 rebuilding and renovating the trail to Slaughter Canyon Cave.

With the entire trail in need of some degree of repair, the crew focused on the upper third of the trail, where the greatest concentration of safety and resource concerns existed. They constructed retaining walls and hand-built approximately 95 steps, all of stone and indigenous materials, and eliminated two social trails. They used hand-tools, relying on gravity and geometry instead of mortar or rebar. In an especially nasty location, the crew dug down approximately three feet to lay subsurface "checks" that provide support for the overlying steps. In another location, they built a retaining wall approximately 12 feet long and 2-3 feet high. The crew had to be especially careful, as Slaughter Canyon Cave trail traverses through fragile terrain and plant communities. As a result of their attention and care, few plants were even affected.



BEFORE PHOTO: A eroded trail that is hard to follow and harder to walk over. (NPS Photo by Jeff Doryland)

AFTER PHOTO: The trail is now a well-defined path with a stairway in this location. (NPS Photo by Jeff Doryland)

The results from this project are a trail that rivals any of those of other National Parks. Slaughter Canyon Cave, alone, is an experience. Now, a hiker can enjoy the beauty of the trail against the backdrop of Slaughter Canyon.

BEFORE PHOTO: Rubble-strewn pathway on steep portion of Slaughter Canyon Cave trail. (NPS Photo by Jeff Doryland)

AFTER PHOTO: A series of built-in steps and other measures were employed to correct the problems. (NPS Photo by Diane Dobos-Bubno)

INVERTEBRATE NEWS

by Renée West

ENTOMOLOGY: A HOT TOPIC AT RATTLESNAKE SPRINGS

Several researchers are conducting inventories and studies of the insect life at Rattlesnake Springs (RSS) this spring and summer. Last month, Dr. John Abbott brought his University of Texas entomology lab class to RSS to conduct a day-long inventory of the insects. Students were assigned different groups to concentrate on, such as ants, aquatic insects, dragonflies, damselflies, beetles, true bugs, etc. Dr. Abbott allowed some of the park biology staff to tag along, and it was fascinating. You should see what lives in that leaf litter and pond scum! The park will receive a complete species list later this year. [And this is only for insects—it doesn't include spiders, mites, scorpions, centipedes, millipedes, pillbugs, or the thousands of other small wildlife that are not six-legged.]

Nocturnal insect interactions will be the focus next month when Dr. David Gray arrives from California State University-Northridge to study "phonotaxis of parasitoid flies to cricket calling song" at RSS. If you know your word roots, you can guess that 'phonotaxis' has to do with movement (by the flies) toward sound (of the crickets). For more on this intriguing idea, we'll have to stay tuned for Dr. Gray's report!

All of this information will be added to the ever-growing list of known insects for RSS: Shann Stringer's (of NM Environment Department's Surface Water Quality Bureau) ongoing list of RSS aquatic insects so far includes 21 different genera (not identified to species), Robert Larsen's (of Roswell) list of 39 dragonflies and 23 damselfly species for the park [see last issue of *C&C*], and Gavin Emmons's (former biotech) RSS butterfly list of over 105 species.

Inventories of the vast insect populations in the rest of the park are slower going, but Dr. Terry Griswold (USDA Logan Bee Lab, Utah) is identifying some ground-nesting bees and Dr. Stephen Taber (St. Edwards College, Austin) has identified some harvester ants from CCNP.

RARE DAMSELFLY FOUND IN CCNP

While at Rattlesnake Springs in May, Dr. Abbott and his University of Texas class found a single male of a damselfly species not previously documented anywhere in New Mexico: the Leonora's dancer (*Argia leonorae*). This spectacular blue damselfly was previously only known from Texas and Mexico, although Abbott had predicted that, "further collecting will undoubtedly show this species to occur in southeastern New Mexico..." (www.esb.utexas.edu/jcabbott/odonata).

"This species can be locally common but seems to have reasonably specific habitat or possibly oviposition requirements," according to Abbott (personal communication). "Nothing is known of its biology."

The damselfly known as Leonora's dancer. Photo @ John C. Abbott.

According to Larsen, the species is named for Leonora "Dolly" Gloyd, who studied this genus for over 50 years. She originally called the species *Argia balmorhea*, after the springs in west Texas. But Rosser W. Garrison officially described the species in 1994, after Gloyd's death, and named it in her honor. Gloyd did much of her work on the genus in the Big Bend area.

Leonora's dancer became a federally listed "species of concern" by the U.S. Fish and Wildlife Service in 1996. "Its population at Balmorhea State Park in Reeves County, located approximately 100 miles south of the park, is thought to be extirpated due to habitat changes. The larva of this species remains undiscovered," says Roswell dragonfly/damselfly expert Robert R. Larsen. "This species is extremely rare, with only the single New Mexico occurrence at Rattlesnake Springs. And, in using Natural Heritage criteria for a conservation designation in New Mexico would place this species as "Critically Imperiled" (S1) in New Mexico."

Its Natural Heritage Program global ranking is G3 Vulnerable (www.natureserve.org), meaning that it is globally vulnerable to extinction because it is very rare and local throughout its range or because of other factors.

MILLER MOTHS VITAL TO ECOSYSTEM

This spring's swarming visit of miller moths has finally moved on, leaving behind a few moth bodies still in the corners and a few splatters of waste products. But this annual spring annoyance to us turns out to be an important process for the ecosystem. Montana grizzly bears rely heavily on the moths in the summer and fall when they spend days in dark, cool spaces between jumbled rocks in the high Rockies. (Remember the grizzlies eating them in Nevada Barr's book *Blood Lure* which takes place in Glacier NP?)

During the peak season, it is reported that some bears eat 40,000 moths a day, making the insects an important source of calories. The moths are also important food for many species of birds when in the Carlsbad area, where the kingbirds, flycatchers, and phoebes are in obvious frenzy for those few weeks.

While they may startle you flying out of doorjambs, the miller moths are not destructive to household contents. They do not eat fabric, but rely on flower nectar for food, a reliance that probably drives them to the high alpine meadows for summer flowers.

The moths are the adult form of the army cutworm caterpillar from the Plains (in the family of noctuid moths). The eggs are laid on the edges of agricultural fields in fall and the young caterpillars feed in fall and again in spring. In mid-spring they burrow into the ground, pupate, and emerge as adult moths. Then they fly off in great numbers to the high elevations of the West, spending time in mid-elevation areas like Carlsbad Caverns National Park, helping to feed the bats and cave swallows just returning from migration. After a summer of hiding out from grizzlies, the successful moths return to the plains to lay eggs. The name 'miller' comes from the fact that they are covered with a flour-like powder, just like the flour millers from the old days.

THE 70th ANNIVERSARY OF THE CIVILIAN CONSERVATION CORPS (CCC)

by Bob Hoff

The CCC "*was an organization formed as part of Roosevelt's New Deal as an attempt to counter the rampant unemployment and economic despair resulting from the Great Depression. Formed by an act of Congress and upon the request of President Franklin Delano Roosevelt in 1933, the Civilian Conservation Corps was an organization unique in American History. The CCC were a group of men, mostly youths but also World War One Veterans or Skilled Laborers in their own companies, formed across the country and utilized for a wide range of skilled and unskilled labor in the American wilderness. Hundreds of Thousands, and eventually Millions, of these men were gathered under government auspices and paid to perform civil engineering projects in a hitherto unforeseen scale* " (James F. Justin Civilian Conservation Corps Museum at http://members.aol.com/famjustin/ccchis.html)

The Civilian Conservation Corps, created 70 years ago, arrived at Carlsbad Caverns National Park 65 years ago this coming July, setting up camp at Rattlesnake Springs. In February 1938, in his monthly report, Superintendent Tom

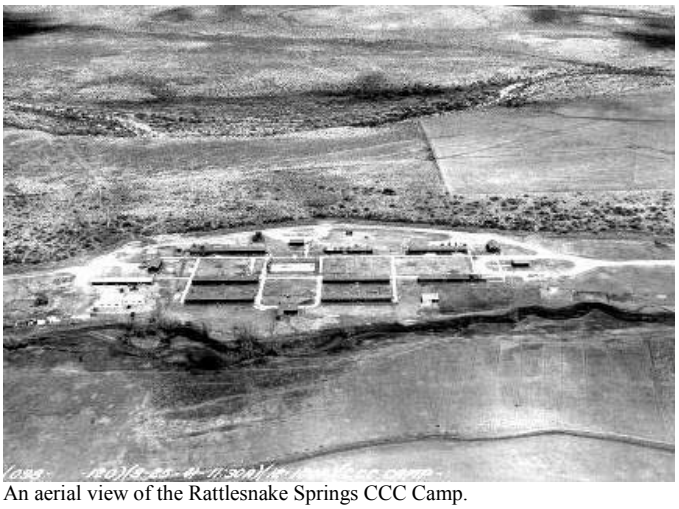
Civilian Conservation Corps Camp (NP-1-N) at Rattlesnake Springs. (NPS Photo)

Boles noted, "*Possible CCC Camp: For some time we have been endeavoring to get a CCC camp located in or near the Carlsbad Caverns National Park, and it now appears that when the camp located near Roswell, New Mexico completes*

its work at the Bottomless Lake State Park that it will be transferred here." The following month a small group of CCC and NPS officials met to select the site at Rattlesnake Springs for the new camp.

In July 1938, Boles wrote that,

> *During the month of July, and first month of occupancy of Camp NP-1-N, located at Rattlesnake Springs, Carlsbad Caverns National Park area, field work consisted entirely of surveying and preparing preliminary plans for final approval of jobs contemplated. Due to uncertainty, in regard to correct details applying on major jobs, it was considered best not to initiate the larger projects until more definite information was received. Low company strength (only 62 enrollees), inclement weather and the need for finishing of camp buildings, etc., also influenced the use of enrollees on the project.*



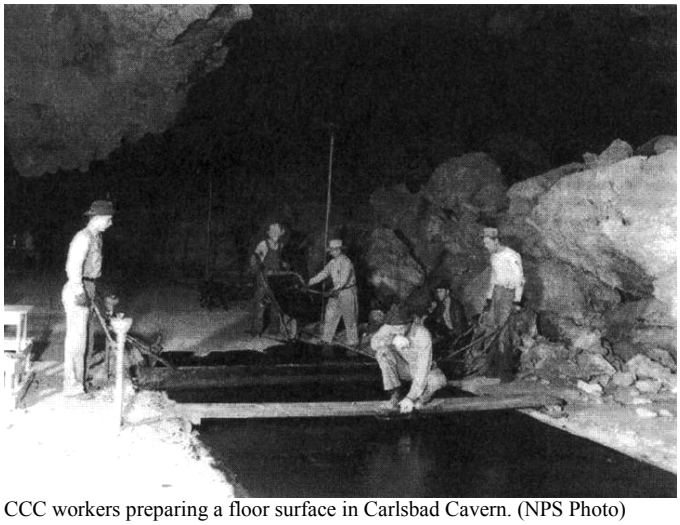
An aerial view of the Rattlesnake Springs CCC Camp.

Over the next four years, the CCC "boys" at Carlsbad Caverns National Park performed an amazingly diverse number of projects. A partial list of projects completed demonstrates this. Consider some of the projects worked on in February 1940:

Civilian Conservation Corps "boys" at Rattlesnake Springs Camp, NP-1-N. (NPS Photo)

Special Improvement Activities: CCC Camp NP-1-N "Rattlesnake Spring," Arthur V. Read, Project Superintendent, reports as follows: for February:

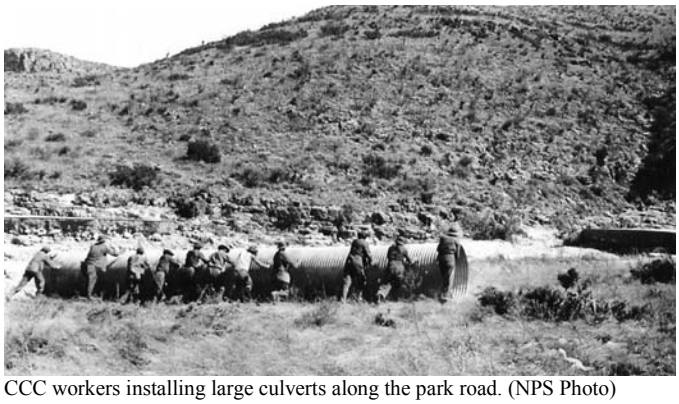
Foot trail maintenance (59 man days labor); hauling cement and asphalt from Carlsbad, taking material into Cavern and distributing to job (101 md.); electric line maintenance (50 md.); building maintenance (13 md.); grading floors in Cavern (129 md.); alterations and addition to Pump House (89 md.); employee's residence, worked on plastering, painting, plumbing, etc. (230 md.); barriers, taking large rock from the talus slope in the Underground Lunchroom and placing them along walk boundaries (225 md.); sewage disposal system, excavating, laying soil pipe and building forms for manhole and septic tank (.28 md.); cavern cleanup, cleaning up as work in Cavern progressed (30 md.); park road maintenance, along Walnut Canyon road (42 md.); tree preservation, pruning, painting and transplanting trees in the Rattlesnake Spring area (128 md.); road obliteration (194 md.); bank sloping (180 md.); new parking area, excavating and building embankment (1016 md.)



CCC workers preparing a floor surface in Carlsbad Cavern. (NPS Photo)

The February 1940 project achievements were but one of the 46 months that the CCC's at Rattlesnake Springs labored here.

Other CCC construction "projects" still used today include the two triplexes and the maintenance office and shed. Originally, the triplexes were to be built with quarried limestone, but after a short period of quarrying the abundant, but difficult-to-quarry rock, CCC workers must have been relieved to see the construction plans shifted to adobe bricks construction. Adobes were made somewhere off the current "loop road," a 9½ mile drive on a gravel road through the Chihuahuan Desert that is open for the enjoyment of today's visitors.



CCC workers installing large culverts along the park road. (NPS Photo)

Throughout New Mexico from 1933 – 1942 the CCC's responded to emergencies: fire fighting, search and rescue,

and flood control work. After the devastating September 1941 flood, they helped to rebuild the flood-damaged Walnut Canyon road. By the time that they left here in May 1942, the CCC had contributed much to the making and the maintaining of facilities at Carlsbad Caverns National Park and in the process left a visual legacy for themselves.

CCC workers repairing the flood-damaged park road in September 1941. (NPS Photo)

All in all, the Civilian Conservation Corps in New Mexico served over 32,000 men from New Mexico and 50,000 men in all. The Bureau of Reclamation, the U.S. Forest Service, and the U.S. Soil Service, among other agencies benefited from the efforts of other CCC camps in the area; in Carlsbad, CCC's lined the irrigation canals, built support for the flume, constructed sidewalks, and constructed facilities at the Carlsbad municipal beach. The CCC's also worked on some projects at the local dams, Avalon etc.

Given responsibility and skills training/experience, along with pay, most of which the CCC administrators sent back home to the enrollees' families every month, many CCC enrollees from New Mexico (and many from the 3,000,000 in the program from throughout the land) matured and went on to serve their nation in industry and the military during WWII.

In 2002 Jeff Bingamin, Senator from New Mexico, along with several other U.S. senators, introduced a resolution proclaiming March 31, 2002, the 69th anniversary of the founding of the CCC's, as National Conservation Corps Day.

During *New Mexico Historic Preservation Week* in 2002, Carlsbad Caverns National Park invited a CCC Alumni chapter from Albuquerque to help us formally dedicate our new CCC wayside exhibit. This exhibit is located on the north side of the trail leading to the natural entrance to Carlsbad Cavern.

Clearly, most CCC veterans I have met rightfully show pride in their accomplishments from six to seven decades ago. As the CCC veterans celebrate the 70th anniversary of their agency this year, many Americans look back at the program and rate it as one of the best programs enacted in the Great Depression. Both America and her young men benefited from the CCC program.

So did Carlsbad Caverns National Park. Here in southeastern New Mexico, the CCC "boys" made a big and long-lasting difference, by building physical facilities on the park and by building their own characters.

Much of the national historical significance of the *Cavern Historic District* and *Rattlesnake Springs Historic District* at the park derives from the work done by the Civilian Conservation Corps (CCC) enrollees from the *Rattlesnake Springs* camp, NP-1-N from July 1938 until May 1942. Here and throughout New Mexico, the CCC's put their strength, labor, and skills into making New Mexico a better place, then and still, seventy years later. At the caverns, we continue to salute the efforts of the CCC "boys."

SOME SMALL-SCALED SOLUTIONAL FEATURES

by Dale L. Pate

Small-scaled solutional features found on the surface are the results of the rock being dissolved from the effects of rainwater and other factors. Majorie M. Sweeting in her book *Karst Landforms* published in 1973 lists six factors that affect the formation of these solutional features. They are as follows:

> *(a) The nature of the chemical reaction involving the limestone, carbon dioxide, and water. (b) The amount and distribution of and nature of the precipitation, whether in the form of rain or snow. (c) The nature and texture of the limestone. (d) The slope or dip of the limestones and their structures. (e) The nature (or absence) of the vegetation cover, soil, peat, etc. and (f) Past climatic phases, since many of the present small-scale features on karst limestones are related to former climatic phases.*

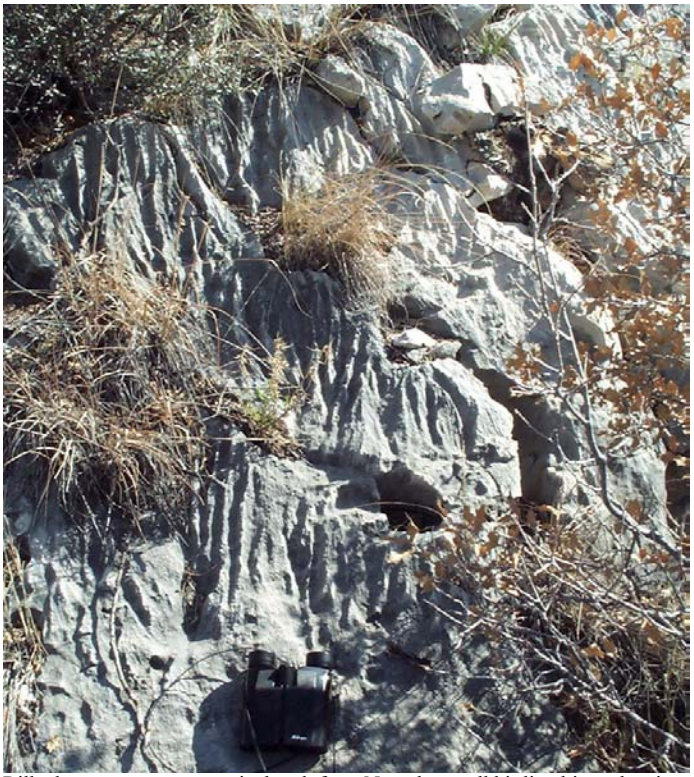
The limestones and dolomites exposed on the surface of Carlsbad Caverns National Park exhibit small-scaled weathering features to a varying degree. Several examples are noted below.

Pitting – Many exposed surfaces exhibit "pitting" where small pits or holes have been dissolved into the rock. This pitting can be on horizontal or steeply dipping rock surfaces.

A pitted surface on exposed bedrock. Note sunglasses in upper, middle of photo.

Some areas exhibit larger, more rounded pitting.

Rillenkarren – Rillenkarren is described by J. N. Jennings in his 1985 *Karst Geomorphology* book as "*solution flutes characteristic of steep to nearly vertical surfaces. These are longitudinal hollows, running in sets straight down the steepest inclination of the rock, with sharp ribs between*." Rillenkarren in the park is not as well developed as found in many other karst areas, but numerous examples can be found of this interesting feature.


Rillenkarren on a steep vertical rock face. Note the small birding binoculars in the lower center of the photo.


Another example of rillenkarren with sunglasses in the middle of the feature for scale.

Solution Cracks – As weathering and other processes produce cracks in larger rock units, these cracks funnel rainwater downward thus widening and deepening them.


Rock cracks are slowly dissolved into larger cracks by the downward movement of rainwater. This photo also shows pitting and rudimentary rillenkarren.

Solution Holes – Found particularly on steeper slopes, holes dissolved entirely through rock faces are fairly typical. These holes can be circular or irregular in shape.

A hole dissolved completely through a large rock.

Solution Pans – These features are shallow depressions in the bedrock that hold water after rains. These are called tinajas in the southwest.

Small, shallow solution pans, such as the one above, are generally found on flat surfaces.

Tom Bemis stands on the edge of a larger, though very shallow, solution pan filled with small rocks and debris.

Small-scaled solutional features are abundant wherever bedrock is exposed at Carlsbad Caverns National Park. The features described and photographed above are only a few found in the limestone and dolomites of the park.

All photos are NPS Photos by Dale Pate.