

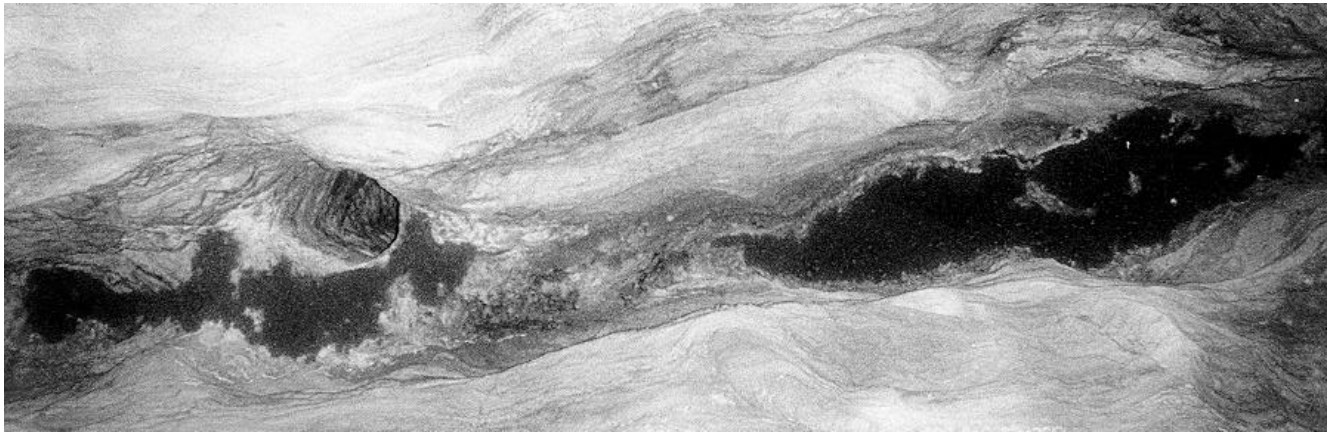
# INSIDE EARTH

## A NEWSLETTER OF THE NATIONAL PARK SERVICE CAVE & KARST PROGRAMS

*Edited by Dale L. Pate*

Vol. 3, No. 2

Summer/Fall 2000



Mexican Free-tailed bats occupy the roost in the bat cave area of Carlsbad Cavern on May 28, 1997. This reflective infrared photo was taken looking straight up from a permanent photo-monitoring point. The dark areas are masses of bats. For more on this photo-monitoring program see Dave Roemer's article on this page. (NPS Photo by Val & Jim Werker)

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#### Website Address:

<http://www2.nature.nps.gov/grd/geology/caves/newsletter.htm>

**Webmaster:** Jim F. Wood: jim\_f\_wood@nps.gov

### PHOTO-MONITORING THE MEXICAN FREE-TAILED BATS IN CARLSBAD CAVERN

*by David Roemer*

The evening flight of Mexican free-tailed bats (*Tadarida brasiliensis mexicana*) from the entrance of Carlsbad Cavern is one of the park's principal visitor attractions, second only to the cavern itself. Free-tailed bats are a migratory, colonial species that feeds entirely on insects. The colony at Carlsbad gives birth and fledges their young from June through September before migrating south to winter in Mexico.

Scientists and resource staff at Carlsbad Caverns National Park have documented a population decline and large-scale die-offs in the bat colony beginning in 1955 (Ahlstrand 1974, Altenbach et al. 1979, Constantine 1967). Similar declines have been noted throughout the southwestern U.S. and Mexico. Residues of organochlorine pesticides (primarily DDT and its metabolite DDE) have probably contributed to the decline of the bat colony at Carlsbad and elsewhere (Geluso et al. 1976, Clark 1988). Despite the ban of DDT in the U.S. in 1972, DDT contamination in the Pecos River Valley and Guadalupe Mountains may still cause harmful effects to wildlife (Clark and Krynitsky 1983). Whether bats are on the road to recovery is uncertain.

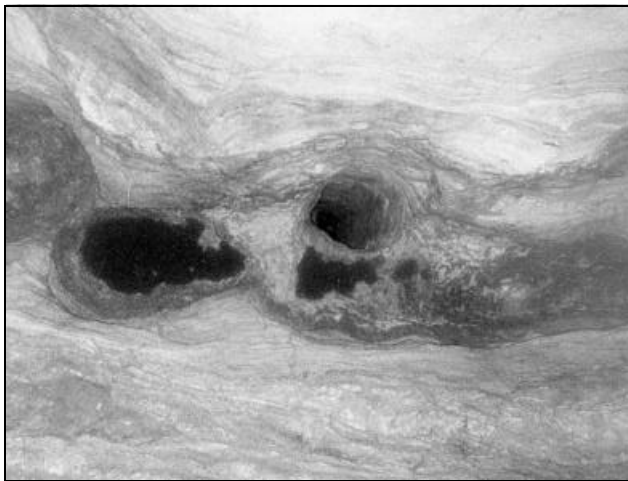
The health of the free-tailed bat colony at Carlsbad is therefore an important concern of park visitors, ecologists, and resource managers. What are the population trends of the colony? Has the bat population recovered following the plugging of the guano shafts in 1980? How has the population responded to a decrease in the use of DDT and other organochlorine pesticides? Are bat numbers as high as they may have been in the early 1900s? And what degree of fluctuation in the colony can be considered to be a "normal" response to changing environmental conditions, such as drought?

Attempts to answer these questions have been hampered by the problems inherent in sampling the bat colony (i.e., roost geography and inaccessibility, nocturnal behavior of

bats, large numbers of bats, etc.). The size of the free-tailed bat colony at Carlsbad has been estimated using a variety of techniques since the 1920s, providing estimates ranging from 8.7 million to 200,000 bats. These estimates have included visual observations of activity (Bailey 1928, Allison 1937), capture-recapture studies (Constantine 1967), still photography (Altenbach et al. 1979) and computer-assisted video analysis of outflights. These methods have been generally limited by cost and labor intensiveness, sources of error (i.e., observer bias), and a lack of statistical precision, thereby limiting their usefulness as a method for assessing long-term trends in the colony.

### Infrared Photomonitoring

One promising methodology for monitoring the bat population involves the use of reflective infrared photography to document the location and size of the bat colony within the Bat Cave portion of Carlsbad Cavern. This method, funded in part by the Adopt-a-Bat program, has been in use since 1996 (Route et al. in prep). Black and white infrared photographs are taken from permanent photo-points in Bat Cave to document the extent of roosting bats. These photographs, taken during five days in early summer, ten days in mid-summer (when pups are present), and five days in late summer, are then overlaid with a grid that measures square feet of ceiling space. Colony size can be estimated by taking the area and multiplying by 200 bats per square foot (2,153/m<sup>2</sup>), a conservative estimate of roosting density (McCracken 1984).



Mexican free-tailed bats (black patches) roosting in natural domes and near an old mine shaft (center right) on cave ceiling in Carlsbad Cavern, New Mexico. Image taken June 2, 2000 using reflective infrared photography. This image contains all of the bats present in Bat Cave on this day, occupying approximately 8.25 square meters of ceiling.  
(NPS Photo by Val & Jim Werker)

### June 2000 Results

The results from this year's count are presented below. The photographs were taken and developed by Val Hildreth-Werker and Jim Werker of Southwestern Composites and Photography. The ceiling area was independently calculated by Jim Werker, Ben Laws, and David Roemer. Applying a conservative roost density of 200 bats per square foot (2,153/m<sup>2</sup>), the population for the 5-day period was 42,000 +/- 16,000 (95% confidence interval) with daily fluctuations between 18,000 on June 2 and 64,000 on June 5.

### Discussion

High daily variability was noted during the photoperiod, with an overall increasing trend evident. This is possibly due to bats immigrating to the roost. The first rains of the season, which usually correlate with increases in bat numbers at the cavern, occurred during the photo-session. The differences in ceiling area observed could also be due to changes in roosting density, or variable utilization of roosting surfaces that are not visible to the camera (i.e., domes and cracks). In other words, there *could* be the exact same number of bats in the cave each day, only they are spaced and aligned rather differently as to appear greater on some days than on others. While this probably does occur to some extent, I feel that bat immigration in response to the drought-ending rains better explains the observed increase in ceiling area.

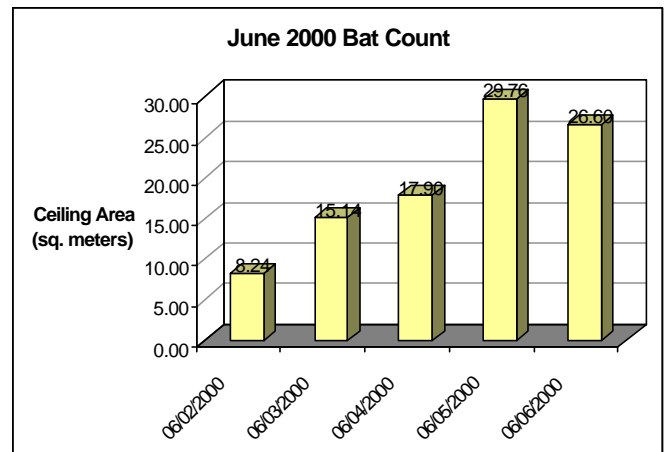
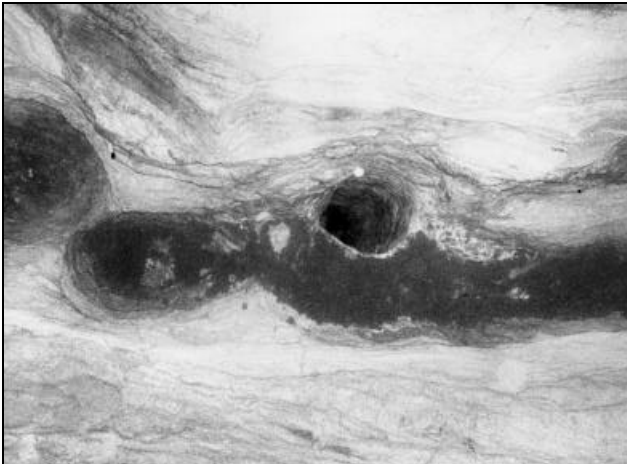


Fig. 1. Ceiling area figures are averaged from 3 independent counts. Rain fell in the area during the photoperiod, ending a period of drought and possibly affecting bat numbers.

Bat immigration and emigration with respect to the roost at Carlsbad Cavern is not a new phenomenon. During 1936 when Allison (1937) calculated a bat population of 8.7 million, there were many disappointing bat flights in August when "not over 100 bats flew out" according to park files. During the summer of 1998 park researchers

noted Mexican free-tailed bats flying into the cavern with baby bats attached to them. Presumably, these bats were born in other nursery locations in the region, and were moved to Carlsbad when conditions became favorable here, or unfavorable elsewhere. While this elasticity in roost habitat is truly fascinating, it greatly complicates our monitoring efforts, stretching the error bars for our five-day bat counts beyond where we would wish them to go.

Despite the sometimes tricky task of arriving at a population figure for the bats, the infrared photographs do shed some light on the changing roost configurations of the colony, and provide adequate data to determine population trends. These photographs serve as a permanent record of the colony, and can help us examine how the colony changes within season and from year to year. For example, a photograph of the same area from four years ago is included below. It appears evident from the photograph that there were more bats in the roost on June 2, 1996. Indeed, the population estimate for the period (May 29 to June 2) was 193,000 +/- 51,000 bats.



Mexican free-tailed bats (black patches) roosting in natural domes and near an old mine shaft (center right) on cave ceiling in Carlsbad Cavern, New Mexico. Image taken June 2, 1996 using reflective infrared photography. This and other photographs taken on June 2, 1996, indicated a total ceiling area of over 130 square meters of bats.

(NPS Photo by Val & Jim Werker)

Evaluating colony size and assessing long-term trends in the Mexican free-tailed bat population at Carlsbad Caverns is a critical need for informed resource stewardship. For this and future bat inventory and monitoring efforts to be successful, methods should:

- Provide a consistent estimate of the minimum population size;
- Provide a measure of statistical precision so that annual trends could be compared;
- Be user-friendly so that revolving park staff can collect consistent data;
- Be relatively inexpensive so that monitoring can be done annually; and

- Have the potential for being comparable with data collected elsewhere so that immigration and emigration, as well as regional trends, can be assessed.

We will be conducting our next counts during July 17-24 and August 25-29. The ten-day count in mid-July is an interesting time to monitor, as any pups born in Bat Cave this year should still be present and dependent on their moms for feeding. Adult female bats that are lactating are expected to exhibit a strong fidelity to the roost site during this period, and thus be regularly photographed during the photo-session.

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# PARK UPDATES

## Carlsbad Caverns National Park *by Dale Pate*

**FBI Investigation** – The Federal Bureau of Investigation has recently been involved with a case of criminal activity associated with trespass in a park cave and the illegal use of explosives.

**Lechuguilla Cave Culvert Replacement Project** – Though slower than expected, the installation of the new culvert is moving forward. The intense fire season that the nation is experiencing has made it harder to obtain a helicopter to ferry materials to above the cave entrance. With luck, a military helicopter will perform this work in September. Once relocated near the entrance, these materials can be lowered into the cave. Following a couple of days of final rubble removal, the new culvert can then be bolted into place and the airlock box with doors can be constructed. Finally, the rubble that was removed from the hole can be carefully placed back around the new culvert.



Culvert pieces awaiting transport and assembly (Stan Allison for scale).  
(NPS Photo by Dale Pate)

**Carlsbad Cavern Protection Plan** – The long-awaited draft Environmental Assessment (EA) is nearing completion and should be out for public review soon. This document will be a major step forward for the long-term protection of one of the world's most spectacular caves, Carlsbad Cavern. Cavers, scientists and other interested parties are urged to comment on this EA once it is released. To be placed on the list of those to receive a copy of the draft EA, please contact the Superintendent, Mick Holm, 3225 National Parks Hwy, Carlsbad, New Mexico 88220.

**New Caves** – Over the last few months four small caves have been surveyed in the backcountry bringing the total number of caves known in the park to 92.

**New Cave Technician** - Tom Bemis recently accepted a newly created permanent cave technician position in the Cave Resources Office. Tom is from the Carlsbad area and has worked in the Maintenance Division of the park for a number of years.

**New Superintendent** – Welcome to Mick Holm, former Assistant Superintendent at Mammoth Cave National Park.

## Mammoth Cave National Park *by Rick Olson*

Mammoth Cave has secured funding to replace the entire lighting system, which is 7-8 miles of passage depending on decisions made. A team of park staff experienced in lighting concerns for interpretation, maintenance, and resources management began work on detailed recommendations in February, and will complete the roughly 40-page report in mid-September.

On Friday August 11th, the NSS concluded another successful summer restoration camp. Top priority for the camp was the removal of a rotting boardwalk in River Styx. Sixty-one feet of the heavily timbered walkway were dismantled along with several hundred feet of electrical cable removed. Three dump truck loads of materials were removed from the cave.

Mammoth Cave's Eighth Science Conference will be held October 5-6 in the park. The meeting will be jointly sponsored by the Cave Research Foundation. A dinner will be held at the new Hamilton Valley Facility.

A Fire Management Plan for the park is nearing completion, and it is designed as an ecological restoration project within the karst landscape as a whole since both cave aquatic and terrestrial ecosystems are closely tied to forest, savanna, and prairie ecosystems.

A toxicological study on sediments in Green River and selected sites in the Mammoth Cave System is under way to determine if organic or inorganic contaminants pose any likely threat to aquatic and riparian fauna.

Joel Despain, cave specialist at Sequoia Kings Canyon NP is at Western Kentucky University to work on an advanced degree in karst. Joel is the second park service employee (after David Ek) to take advantage of this opportunity.



## **Timpanogos Cave National Monument**

*by Suzanne Flory*

### **SUMMER 2000**

It has been a busy summer at Timpanogos Cave with visitation being up by 6.1% by the end of July. The monument was closed July 30 to August 7th due to a 900-acre fire that came within 400 yards of the park boundary. On average the cave receives over 70,000 visitors between May and end of October.

The season began with Rod Horrocks coming back to assist with seasonal training. The twenty-six seasonal interpreters are doing an outstanding job at interpreting the cave resources while at the same time protecting the cave as best one can do with tours of twenty. It was the first season visitors were not allowed to touch the stalagmites called the "Salt and Pepper Shakers". This very old tradition of touching them was put to an end with little to no complaints by staff and visitors. The resource staff consisted of only one seasonal. We are looking forward to the upcoming arrival of Jon Jasper who will be the monument's new term Resource Management Specialist. Some of the current resource projects include cataloging museum items, cave cleaning and measuring drip rates.

## **Wind Cave National Park**

*by Rod Horrocks*

To guide surface land use management activities within the park, the Cave Management Office recently created a Cave Potential Map for Wind Cave. Based on geology and cave surveys, this model predicts that 98% of the likely maximum extent of Wind Cave lies within the current boundaries of the Park. That maximum extent is 8 times the size of the current cave boundaries. This model also predicts a conservative minimum survey length of 160-180 miles for Wind Cave, that is, if the current boundaries of the cave are not significantly expanded.

Rene Rogers recently joined our cave management staff. She was hired as a seasonal cave management technician. Rene had previously volunteered as the Jewel Cave Intern for Mike Wiles. We also welcomed a new superintendent to the park, Linda Stoll. She comes to us from the regional office in Denver.

Using Illustrator 8.0, we recently drew computer maps of two of the park's small caves. This exercise was in preparation for drawing the Wind Cave quadrangle maps on the computer. Those quadrangle maps will be divided into layers, one for each of the three main levels in the cave, with the option to turn on or off any type (or layer)

of information (such things as survey points, text, interior detail...). These maps should become a valuable tool to cave management, interpretation, maintenance, and especially to cave surveyors.

The new perched lake that sumped the route to the Lakes and the deep point in the cave, rose two tenths of an inch in June and then dropped two tenths of an inch in July. We think this rise was due to a large April snowstorm, while the drop was due to a dry summer. It will be interesting to continue monitoring this lake and see if it drains enough to allow access to the Lakes area in the not too-distant future.

A volunteer recently completed creating a database of all the cave surveyors that have worked in Wind Cave, in preparation for our special edition 100-mile Wind Cave map. This map will probably come out in 2003, during our 100-year park anniversary. As expected, John Scheltens was the most prolific surveyor in Wind Cave, with 154 survey trips. Out of the 822 people that have surveyed in Wind Cave to date, 435 only went on a single survey trip. A total of 83 cavers have gone on more than 10 trips, 40 have gone on more than 20 trips, and only 10 cavers have gone on more than 50 trips.

We recently had a lightning-caused, 1,200-acre fire and a smaller 30-acre fire that burned part of the park where limestone is exposed and where several small caves are located. No impact upon the caves was noticed. We will be taking advantage of this situation to do some ridgewalking in the area.

Recent survey and inventory work at Wind Cave has concentrated in the Historic and Half Mile Hall sections of the cave, with a few trips to other sections of the cave. Since the last issue of Inside Earth, the surveyed length of Wind Cave has been increased by 1.71 miles, raising it to 91.31 miles and moving it up one spot to the position of seventh longest cave in the world.

## CONTRIBUTORS

Suzanne Flory  
Timpanogos Cave National Monument  
R.R.3, Box 200  
American Fork, Utah 84003-5238  
Phone: 801/756-5239  
Email: [suzanne\\_flory@nps.gov](mailto:suzanne_flory@nps.gov)

Rod Horrocks  
Wind Cave National Park  
R.R.1, Box 190  
Hot Springs, South Dakota 57747-9430  
Phone: 605/745-1158  
Email: [rod\\_horrocks@nps.gov](mailto:rod_horrocks@nps.gov)

Rick Olson  
Mammoth Cave National Park  
P.O. Box 7  
Mammoth Cave, Kentucky 42259  
Phone: 270/749-2508  
Email: [rick\\_olson@nps.gov](mailto:rick_olson@nps.gov)

Dale Pate  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, New Mexico 88220  
Phone: 505/785-2232, ext. 368  
Email: [dale\\_pate@nps.gov](mailto:dale_pate@nps.gov)

David Roemer  
Carlsbad Caverns National Park  
3225 National Parks Highway  
Carlsbad, New Mexico 88220  
Phone: 505/785-2232, ext. 373  
Email: [dave\\_roemer@nps.gov](mailto:dave_roemer@nps.gov)