Carlsbad Caverns National Park
Carlsbad, New Mexico

National Park Service
U.S. Department of the Interior

CANYONS & CAVES

A Newsletter from the Resources Stewardship & Science Division

Issue No. 39 **Spring 2009**

Aragonite bushes off the Western Borehole in Lechuguilla Cave. Photo © Jennifer Foote 2006.

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All issues can be downloaded as a PDF file from the park website
http://www.nps.gov/cave/planyourvisit/brochures.htm
Address: 3225 National Parks Highway, Carlsbad, New Mexico 88220

RESOURCE NEWS

WELCOME to Kent Schwarzkopf, the new Chief for the Resources Stewardship & Science Division. Before coming to CAVE, Kent was the Natural Resource Program Manager for the Appalachian National Scenic Trail, where he worked with inventories, monitoring, and management of rare, threatened, and endangered species, exotic plants, and insect pests in the 14 states through which the trail passes. Kent has strong interests in botany, caves, and travel and has visited numerous caves in the U.S. and in a few other countries.

WELCOME to Steve Ross, recently hired as a biological

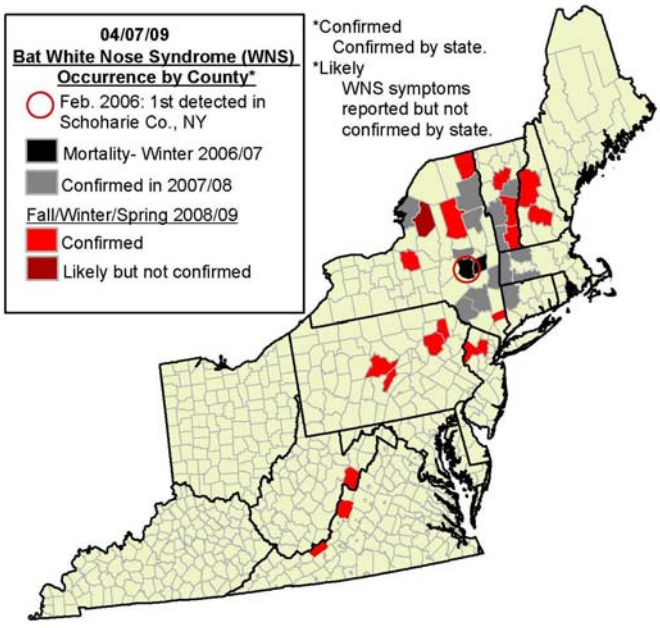
technician in the Biology Branch. Steve has joined the revegetation crew and is excited to be here at CAVE. Steve and his wife and two cats come to us from Indiana where they have been involved in various conservation efforts over the years. Both Steve and Jennifer worked at the Randall Davey Audubon Center in Santa Fe in July 2008 and fell in love with New Mexico - which is why they are back!

NEW CAVES – Three new caves have been documented in the backcountry bringing the total number of caves in the park to 116.

WHITE-NOSE SYNDROME (WNS) – Over the last couple of years, it has been noted that up to 90% of some hibernating bat colonies in the Northeast have developed a white fungus growing on their skin. This fungus appears to be associated with significant bat die-offs in some of those colonies. The fungus has been identified as part of a family of fungi that live in extremely cold climates. There is much that is still not known about this fungus, but it appears to be rapidly moving into other hibernaculums, with at least 60 different caves in 9 different states now known to harbor WNS. It is estimated that over 400,000 bats have died from this disease so far.

There is no indication that this cold-loving fungus will affect bat species that do not hibernate or how many total bat species will be affected. The news so far is very dire for bats. Because of this, the U.S. Fish & Wildlife Service has issued an advisory recommending cave closures in the eastern United States, and advocating mandatory protocols to follow when entering unaffected caves to help prevent the further spread of WNS. To learn more about this devastating disease and to read the advisory, check out the following websites:

http://www.fws.gov/northeast/white_nose.html
http://www.caves.org/grotto/dcg/white-nose.html



Map courtesy of Cal Butchkoski, Pennsylvania Game Commission.

PAST PARK VOLUNTEER PASSES AWAY - It is with great sadness we report that Tom Madison has passed away. Tom was a great friend to the park and served as Area Manager for the Cave Research Foundation during the mid 1990's.

INTERNATIONAL CONGRESS OF SPELEOLOGY – The 15th International Congress of Speleology will be held in Kerrville, Texas July 19-26, 2009. Held every 4 years, this event is expected to draw 2,000 scientists, managers, and cavers from approximately 100 different countries. The annual National Speleological Society Convention, the National Cave and Karst Management Symposium and a host of other international symposia will be a part of this event. To learn more about this event, please visit the following website: www.ICS2009.us

See you there!

NCKRI BUILDING GOING UP – After several major setbacks, construction on the headquarters building for the National Cave and Karst Research Institute has finally begun. Located in the Cascades Project near the Pecos River in Carlsbad, the Institute will finally have a permanent home from which to run its operations.


Construction begins on the headquarters building in Carlsbad. (NCKRI Photo taken on April 18, 2009)

PARK WEATHER - In 2008, Carlsbad Caverns National Park received 13.14 inches of rain, as recorded for the NOAA weather station near Park Headquarters, and a trace of snow. Below are the highest and lowest temperatures recorded each month.

Month	High Temp (ºF)	Low Temp (ºF)
January	73	18
February	80	29
March	82	28
April	88	38
May	97	39
June	103	61
July	95	62
August	95	59
September	95	54
October	86	38
November	82	26
December	82	16

REPLACING PAVEMENT WITH PLANTS – BAT FLIGHT PARKING

Meredith Gosejohan

Hot black asphalt cracks as a parking lot sits empty just hundreds of feet from the natural entrance to Carlsbad Cavern. Contrary to most recent news, it's not because of the current economic predicament.

Since 1996, this parking lot has only been used for overflow and disability parking due to an alarming discovery found in the depths of the cave. Heavy metals and antifreeze were detected in drip waters and pools inside Carlsbad Cavern and traced to surface runoff from the parking lot. Contaminants, mostly from fluid leaks from automobiles, gather on the surface of the parking lot. During rainfall events, these contaminants are washed off the parking lot into Bat Cave Draw and immediately sink into the bedrock. This same contaminated water is then found further down dripping into the cave. These contaminants can have long-lasting effects on the cave and its inhabitants such as harming microbial life and discoloring cave formations.

To help alleviate these problems, Carlsbad Caverns National Park (CAVE) has implemented several construction and revegetation projects including reconfiguration of the Bat Cave Draw parking lot. The project is scheduled to begin in late 2009 with funding from the Federal Lands Highway Program. Removing pavement and revegetating the former parking lot will help prevent additional contamination, improve groundwater infiltration patterns, and provide habitat for wildlife while maintaining accessibility and preserving the integrity of the Caverns Historic District.

Photo of Bat Cave Draw parking lot in the mid-1930's showing the limestone parking terraces and buildings which make up the Caverns Historic District. NPS Photo from the Carlsbad Caverns National Park Archives

Revegetating Bat Cave Draw parking lot will involve replacing 1.2 acres of asphalt with native cacti, succulents, grasses, shrubs, and herbaceous plants. Because the soil has been compacted and deprived of nutrients for 80 years, it will need to be made more hospitable for these new plants. This will involve using equipment to loosen the soil, adding local topsoil to provide nutrients, and bringing in limestone rock to return the area to natural conditions.

In preparation for the parking lot restoration, the Biology Branch is performing many activities around the park including:

- Salvage of native plants, mosses, ferns, biological soil crust, and topsoil in construction disturbance areas
- Seed collection from native plants that are locally adapted to CAVE site conditions to be used for dispersal and propagation
- Weed removal
- Increase of native grass seed in fields at NRCS Plant Materials Center
- Propagation of native ecotype plants with cooperating university partners

Construction of the parking lot at Bat Cave Draw was one of many improvements to visitor services in the decade after the creation of Carlsbad Cave National Monument in 1923. The parking area was originally paved with local white shale in 1928 and re-paved with asphalt within a decade. The same limestone that was uplifted to form the escarpment and dissolved away to form Carlsbad Cavern was used to build these historic terraces, associated walls, and the buildings above them, integrating them with the natural terrain and each other. These parking terraces in Bat Cave Draw parking lot make it an important part of the Caverns Historic District, which was listed in the National Register of Historic Places in 1988. After consultation with the New Mexico State Historic Preservation Office, it was decided that pavement removal and revegetation would have no adverse effect on the historic integrity of the district as long as the terraces are left intact.

The newly constructed parking and drop-off loop for disability access will require the removal of a small portion of the historic limestone terrace, which will be reused in the construction. Runoff water from the new lot will pass through devices called oil/grit separators to remove free oil and other contaminants before they flow into the ground. Although the removal of the parking lot will leave the park with 180 fewer parking spaces, CAVE anticipates needing overflow parking only for the Memorial Day, Independence Day, and Labor Day weekends.

CAVE APPEARS IN LEPIDOPTERA PUBLICATIONS

Renée West

The park's moth survey continues to add new species to the list of moths known for CAVE, as well as for Eddy County. Researcher Eric Metzler submitted 24 new county records from our park to the 2008 Season Summary of the Lepidopterists' Society. The summary contains observations and collections from moth and butterfly experts around the country, focusing especially on new records. Metzler also submitted many records for Otero County from his work at White Sands National Monument. A photo sampling of some of the species newly recorded from CAVE is below. Metzler has many specimens collected from our park and is working on the tedious microscopic task of identifying them all. So far (through last September), he had listed 259 species of moth for CAVE, some of which are new to science and will be published as new species.

And on another Lepidopteran topic, a new book on butterflies of New Mexico is due out this summer. It will be a thorough treatment of the topic, and will include many photos, some taken in CAVE. And author Steve Cary says that it will include CAVE in the list of good places for viewing butterflies.

Pyrausta nexalis, Alfalfa Webworm Moth
© 2006 Joyce Gross
FrinL
www.calphotos.berkeley.edu

Apotolype brevicrista, an aquatic moth with no common name
© 2007 Robert L. Pearson
From: bugguide.net

Cobubatha antonita, Cobubatha Moth
© Jillian Cowles
From: mothphotographersgroup.msstate.edu

UNDERGROUND LUNCHROOM TAKEOVER

Tom Bemis

[Ed's note – The following is the author's story of his experiences during a hostage crisis in the Underground Lunchroom.]

Thirty years ago: July 10, 1979 - 3:10 p.m.

I was working the underground information desk in Carlsbad Cavern and had just checked the clock. Big Room sweep would be starting soon. I glanced into the elevator lobby. An elevator had just come down. Maybe sweep would be on it. A long black object stuck out of the elevator door. It looked like a gun barrel. No way, I thought. It must be a cane. Two men got off of the elevator accompanied by seasonal ranger Linda Philips. The men were both carrying rifles. I first thought that some sort of law enforcement situation was going on. Then I saw Linda's face. The look of terror told me what I needed to know.

Linda came directly to the information desk, followed by the men. She picked up the microphone and announced that the cave was being taken over and everyone needed to leave. No one was allowed to exit by elevator. The men racked rounds into their weapons.

Another seasonal ranger (I think it was Kevin Carson) had been at the back of the Lunchroom setting up for a slide show. He and I quickly cleared everyone out of the Lunchroom and started moving them towards the Main Corridor. By now, as I learned later, a third gunman had joined the other two. As I left the Lunchroom, the feeling I had of knowing that there was most likely a loaded and cocked rifle pointed in my direction, is still unforgettable. Just outside the Lunchroom I met ranger Tom Morton who asked what was going on. I told him that gunmen had taken over the Lunchroom. He answered with "I was afraid it might be something like that." That answer surprised me. I thought I was the only one who was constantly running such bizarre scenarios through my head.

At Big Room Junction we also met up with the elevator operator who had brought the gunmen down. She said that the gunmen had taken Linda and her hostage, but that she had managed to slip out in the confusion in the Lunchroom. She appeared to be very shaken up and on the verge of hysteria. I gathered what people I could that were coming out of the Big Room and Main Corridor and started sending them back up the Main Corridor towards the cave entrance. I had to explain to them that I was a ranger because I had been working for the park service for less than a month and my uniform had not yet come in. I quickly had some allies with the public who kept saying "listen to him! He's a ranger!"

Tom and I started up the Main Corridor, keeping the people moving, and it quickly became apparent that some of them were not in good physical shape. I sent Tom ahead with the majority of the crowd and I stayed behind, shepherding the slow movers. When we got to the Shortcut Phone (where the King's Palace tour now comes out) we found out that ranger Carol Metzger was trapped at the Top of the Cross in the Big Room with about a hundred visitors. They could not leave the Big Room without drawing the attention of the gunmen in the Lunchroom. One from this group was a diabetic and was in need of insulin which had been left inside her car.

I continued my slow trek up the Main Corridor. One of the people in my group had emphysema and was having a lot of difficulty. His son, supposedly with no health problems, was with him and appeared to be having as much trouble as his father. When we got to the Iceberg Rock phone, I called the surface once again. I let them know that I had given a talk on caving in the Big Room earlier in the day and that all my vertical gear, including a three hundred foot length of rope, could be found on Texas Trail and was available for use if

needed. I also filled them in on the health problems in my group.

Communication via the cave phones was tricky. All the phones in the cave were connected in a party line. If any phone was picked up, it would ring on the surface and at the Underground Desk. The gunmen were occasionally on the phone and were not yet aware that they had an additional one hundred hostages in the Big Room.
As we continued the slow climb out of the cave I looked back and saw a lone figure climbing off-trail through the rocks. He was wearing something on his hip. My first thought was that it was one of the gunmen wearing a pistol. As the lone figure got closer, I realized it was Harold West, one of our elevator mechanics. The object on his hip was the battery pack for his headlamp. What a relief!

Harold said he had been watching the gunmen from the rock pile above the Lunchroom. He said they had been doing quite a bit of shooting. At what, he didn't know. I'm surprised it wasn't at him. I later found out that they heard noises and thought there were rangers in Left Hand Tunnel and had opened fire. I suspect that they had heard Harold and had misjudged the direction. Either that, or had heard the raccoons that lived in the Lunchroom area at that time. I do know that no trash cans in the Big Room were tipped over by raccoons for at least two days after the incident.

Shotgun pellets riddle the door to the wooden barrier that keeps visitors from straying into Left-Hand Tunnel from the Underground Concessions area. (NPS Photo by Dale Pate)

We finally got to the cave entrance three hours after leaving the Lunchroom. Park staff were there waiting with oxygen. It turned out that the oxygen was used on the son of the man with emphysema. His father was doing fine. When I got out of the cave, I called home and told everyone I was ok. I then went back to the visitor center to see if I could help. By this time the gunmen had surrendered and the FBI were preparing to enter the cave to begin their investigation. They needed a photographer, so I was drafted.

When we entered the Lunchroom, we found an arsenal sitting on the underground information desk. I recall there being at least two 30-30 rifles, a twelve gauge shotgun and enough ammunition to supply a small army. There were also whiskey bottles. How they managed to smuggle all that onto the elevator is beyond me. I do know that the rifles were broken down and shoved down their pants legs and the men entered the elevator on crutches, but there was still a lot of stuff to be carried.

The wooden handrail in the food serving line had been heavily peppered with pellets from the shotgun (and remained that way for several years after the incident). The slide projector case and screen in the back of the lunchroom also had quite a few pellet holes in them. I later saw that the wooden gate in Left Hand Tunnel had also been heavily riddled with pellets.

There are many other stories to tell about this day, especially from the viewpoints of Linda Philips, who remained a hostage during the entire incident; Carol Metzger, who sat in the Big Room with a hundred stranded visitors; Ron Kerbo, who was preparing to lead in S.W.A.T. and rescue teams; the newspaper publisher who entered the cave and interviewed the gunmen; Hal Cottingham, who was the sole person waiting in the elevator lobby to greet the gunmen when they surrendered; and the gunmen themselves who, due to terms of the negotiated surrender and the lack of state jurisdiction at the time, got off with misdemeanor charges.

As for me, the day after the incident, I called the uniform supplier and thanked them for taking a long time to fill my order. Otherwise I also would have been taken hostage and would have had a very different story to tell.

SHORT HISTORY OF THE CAVERNS HISTORIC DISTRICT BUILDINGS

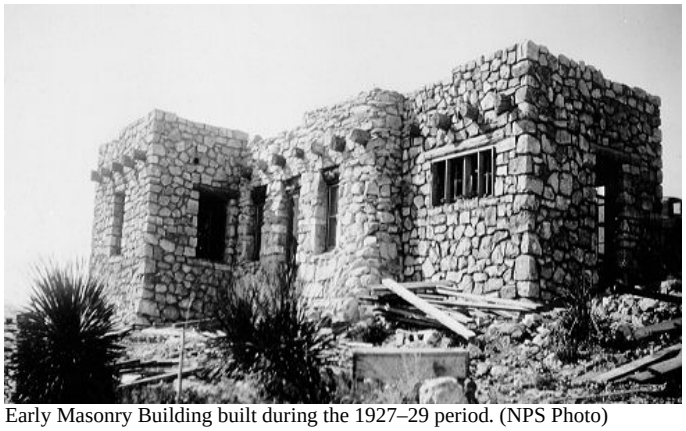
David W. Kayser

The Caverns Historic District consists of 13 administrative, residential, and maintenance buildings and various associated landscaped constructions in the Carlsbad Caverns National Park Headquarters Area. The buildings are architecturally significant as good examples of architecture and landscape designs of the "rustic" theme for facility development used during the formative years of the National Park System. The Caverns examples combine the regional historic building types and styles of the Pueblo Revival and New Mexican Territorial Revivals, which utilized traditional building materials and techniques, with the "rustic" ideal of harmony with the natural setting and the historic past. The assemblage of buildings, terraces, trails, and roads is significant as a group of interrelated features of a landscaped setting which reshaped and incorporated the natural terrain.

The earliest buildings used the native limestone to harmonize with the rugged environs. The architectural style, the Pueblo Revival Style, has historical and regional qualities. The buildings with broken masonry lines suggest a ruined prehistoric Indian pueblo. The same broken masonry motif appears in the terrace parapets of the parking lot and other landscaped features executed in limestone during the 1920s and 1930s.

The earliest buildings 6, 7, 8, 9 10 and part of 16, began being built in 1927 and were completed by 1930. Thomas Boles, the

new Superintendent, directed the work on stone cabins for the guides. He claimed to have prepared plans for these cabins himself. The guides erected their stone cabins when not guiding tourists through the cavern as they were living in tents or tar paper shacks. When the cotton picking season was over that winter, other labor became available to assist the construction work. The guides' cabins were small, square, flat roofed, random rubble structures. Most of these cabins received later additions. NPS Building #6 is the only unaltered example that remains. The rough random cobble, unshaped stone work identifies these structures.

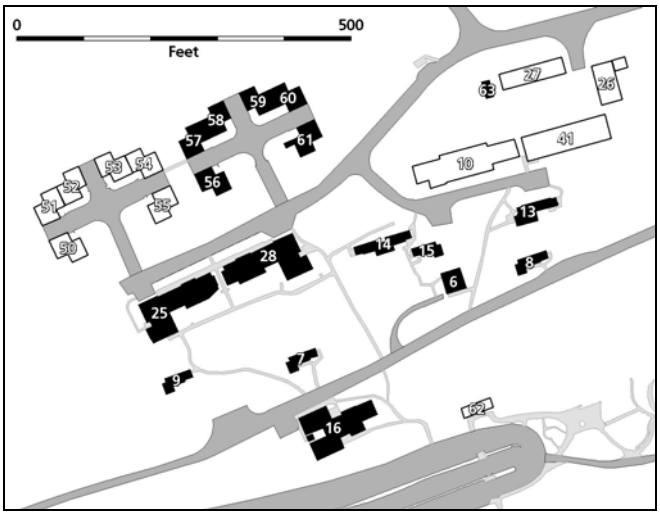

Early Masonry Building built during the 1927–29 period. (NPS Photo)


Late Masonry Building built during the 1930-35 period. (NPS Photo)


Adobe Building built during 1940-41 period. (NPS Photo by Stan Allison)

The assemblage of limestone buildings was completed between 1930 and 1935 when a large "Bunk House and Mess Hall (Building 16), Elevator Building (now encased in the VC structure) ", additional residences of Buildings 13, 14, & 15, and additions to existing residences were built. Funding limitations necessitated that the work be done in phases. The building contracting firm of Armstrong and Armstrong of Roswell, New Mexico built most of the structures with some help by day labor supervised by NPS engineers. A more finished cut and shaped stonework identifies these structures. An example is the Superintendent's Complex Bldg, #16 which is a Pueblo Revival Style structure designed in 1932 by Thomas C. Vint, Chief Landscape Architect, Western Field Office and San Francisco; and built in 1932 by Armstrong and Armstrong. The eastern portion of this building (Building 16) incorporates a residence structure designed by Superintendent Thomas Boles in 1927 and erected between 1927-9. The building was completed with the addition of the Pueblo Revival Style structure in 1932. Used first as a bunk house and mess hall, part of that building was adapted for use as an administration building in 1944 and presently used solely for administrative purposes.

A third phase of major construction began in 1940, with Civilian Conservation Corps (CCC) labor and funds. Buildings 25, 26, 27, and 28 were entirely built of adobe bricks covered with stucco in the New Mexican Territorial Revival Style, another regional historical style. Instead of being scattered at random over the slope of the draw, as are the rock structures, the adobe buildings are in two complexes. One complex consists of two multiple dwelling units and the other complex contains maintenance structures. The residential complex remains largely unchanged. Ken Saunders of the NPS Regional Office in Santa Fe was the principal architect for the adobe buildings. The architects of the Regional Office influenced by the popularity of the New Mexican Territorial Revival Style in Santa Fe utilized this style for the new structures at the park.



General layout of park buildings. (Map provided by Peter Lindstrom, GIS Office)

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DO MICROBES EAT PLASTIC?

Paul Burger

In 2004, Carlsbad Caverns National Park funded a study to look at microbial communities in Carlsbad Cavern to determine what effect commercial development has had on native microbes. Dr. Hazel Barton of Northern Kentucky University conducted the research at numerous sites throughout the cave, including both developed and undeveloped areas.

The primary results of the study showed that the large input of organic materials was having a measurable effect on microbial communities and has contributed to the red to black patina found on the bedrock in places such as the Underground Lunchroom. These patinas are primarily made up of clay particles that are a byproduct of microbial activity.

Patina in Secondary Stream Passage near the Underground Rest Area. Photo by Hazel Barton.

While these results were not entirely unexpected, one side result was. Some of the microbes were placed in a media that contained no nutrients. This is done as a control to evaluate the growth of microbes in various media that contain different nutrients.

Much to the surprise of the researchers, some microbes were able to thrive in the starved environment. When they examined the cultures, they discovered that the microbes were actually breaking down the plasticizers in the Petri dishes and using them as a food source.

The reason this is so important is that one of the biggest problems with the disposal of plastics is that they do not break down easily in the environment and contain some very nasty chemicals. Some of the toxic ingredients are plasticizers that are used to increase the flexibility of plastics, including benzenthiazole and benzenesulfonic acid.

Now does that mean you just spray your landfills with these microbes and all the plastic goes away? No. While removal of the plasticizers will only embrittle the plastic, it does give hope that there may be microbes that could eventually lead to an effective treatment for breaking down plastics in the environment. We are still a long way from a solution or a treatment, but microbes from Carlsbad Cavern may someday lead researchers to a solution to a major environmental problem.

MYTH BUSTERS

Dale Pate

MYTH – Bats living near Lake of the Clouds (LOC) in Left-Hand Tunnel (LHT) of Carlsbad Cavern during the warm months use an unknown passage and entrance to enter and exit the cave.

FACT – A study done in the Summer of 1995 by Dr. Ken Geluso of the University of Nebraska and Dr. Troy Best of Auburn University showed conclusively that bats living in the deepest part of Left-Hand Tunnel fly in and out along known passages to enter and exit the known cave entrances.

These researchers and their students captured thirteen Fringed Myotis bats (*Myotis thysonodes)* as they left their roost at Lake of the Clouds, placed small transmitters onto the back of their shoulder blades, and tracked these individual's movements over several nights as they moved through the cave on their way in or out for their nightly feeding. This has been known as a maternity colony for many years. So it was not surprising to find that eleven of the thirteen captured bats were pregnant or lactating females.

A Fringed Myotis bat with small transmitter attached is ready for release during the July 1995 project to track the bats movements through Carlsbad Cavern. (NPS Photo)

The researchers found that the bats as they left their roost at LOC would fly along the same route we use through LHT to the Underground Concessions Area. From there they would fly behind the concessions area up through the large passage

above the Grape Arbor coming out at the Wooden Staircase in the Main Corridor. From there, the bats followed the Main Corridor to the two natural entrances. About 75% exited the cave through the main, large natural entrance while the other 25% utilized the smaller, vertical natural entrance located about 1300 feet east of the main entrance. The average flight time from roost to outside the cave was 5½ minutes.

While there could still be unknown passages and even another unknown entrance to Carlsbad Cavern, the bats living in the deepest part of the cave use the large, well-known passages and entrances to enter and exit the cave.

This study did help the park better understand the dynamics of the bat species living in this part of Carlsbad Cavern. This in turn led to management actions that help protect these bats while still allowing over 400,000 people each year to visit one of the world's most spectacular cave systems.

Management actions implemented when the bats are in residence include the following: (1) Turning off all lights along their travel route by 7pm each evening. This study also showed that when lights were accidently left on along their route, the bats would return to the roost rather than fly through the lit area. For pregnant or lactating female bats, even a few disruptions like this could prove serious and even fatal. This is why it is important when anyone is in the cave after closing hours, all lights be left off along the bats entire flight path including, the Main Corridor, the elevators, the Concessions area, and the pump room area. With the Big Room lights on a separate circuit, approved after-hours tours can still take place without interfering with the bats flight path as long as the lights in and around the elevator are not turned on. (2) Lake of the Clouds is closed to orientation and other management-related trips when the bats are in residence. This is especially true during June and July during and immediately following the birthing season. (3) Any repair or maintenance work in the Underground Concessions Area including the elevator and pump room must be done during normal working hours or during the off-season when bats are not present. (4) The fence around the smaller, vertical natural entrance initially was very close to the pit edge and was moved further away from the edge to give bats utilizing this entrance more room to maneuver away from the chain-link fence.

HIGH-ANGLE & CAVE RESCUE TRAINING 2009

Tom Bemis

There were twelve participants in the Carlsbad Caverns National Park's annual High-Angle and Cave Rescue training this year. The 40-hour course included sessions on rescue rigging and cave search and patient transport, as well as underground communications. Participant safety and resource protection were strongly stressed throughout the course.

Due to the highly mobile nature of NPS employees, maintaining a well trained rescue team is very difficult to do within the park. Therefore it was decided several years ago that rescue training should be made available not only to park staff, but also to the much more established populace of the surrounding communities.

For this reason, this free training not only included employees of Carlsbad Caverns and Guadalupe Mountains National Parks, but also members of the Carlsbad Fire Department, Otis Volunteer Fire Department, the Waste Isolation Pilot Plant, and Eddy County Search and Rescue. Teams, comprised of both park and non-park staff, have responded to several SAR incidents on and off the park within the past several years and have worked well together due to their joint training. An additional advantage of the interagency training is the development of an appreciation for resource protection by non-NPS responders, resulting in fewer impacts to cave and surface resources during missions.

The final day of training featured a search for a patient in a cave and then the rescue through a constricted entrance, followed by demonstrations and practice of small party vertical rescue techniques that can be accomplished with minimal gear.

Rescue techniques were practiced in tight quarters in a BLM cave named Park's Ranch Cave. (Photo courtesy Pat Seiser)

BAT POPULATION FLUCTUATIONS (*Tadarida brasiliensis)*

Renée West

A few years ago our park cooperated with researchers at Boston University to census our colony of Brazilian free-tailed bats (*Tadarida brasiliensis*). We wanted to know how many bats use Carlsbad Cavern and whether we really had lost a large portion of the former population as has been suggested.

Dr. Thomas Kunz of BU's Center for Ecology and Conservation Biology (CECB) and his Kunz Bat Lab studied

our colony from 2004-07. The primary researcher on site was Dr. Nick Hristov, now at Brown University. The final technical report was submitted to the park last December. This article contains several excerpted quotes (with underlining added to emphasize certain points). The report highlights even more variability than expected:

"During this three-year study we recorded large fluctuation in the size of the colony on a daily, seasonal, and yearly basis indicating that colony composition is considerably more dynamic than previously thought. Our estimates range from 10,621 to 1,045,913 [1.05 million] bats, values that are orders of magnitude lower than historical estimates. These results, combined with a quantitative analysis of emergence behavior, question the validity of historic estimates that millions of bats once roosted in this cave, and suggest that the long-term pattern of decline reported for this species might not be as severe as had been originally proposed."

NEW THERMAL INFRARED METHOD

Kunz and Hristov censused the bats using thermal infrared imaging and adaptive computer vision processing. "Unlike traditional census methods, thermal infrared imaging records the emission of heat energy from objects in the environment. Temperature-sensitive cameras detect differences in thermal values in their fields of view and represent that information visually as different brightness values. In thermal video, flying bats appear as bright, relatively warm objects, silhouetted against the dark, relatively cooler sky (Fig. 1). Computer vision algorithms use the thermal signature of bats to recognize and track each individual in flight, ultimately producing a complete census of the emerging colony."

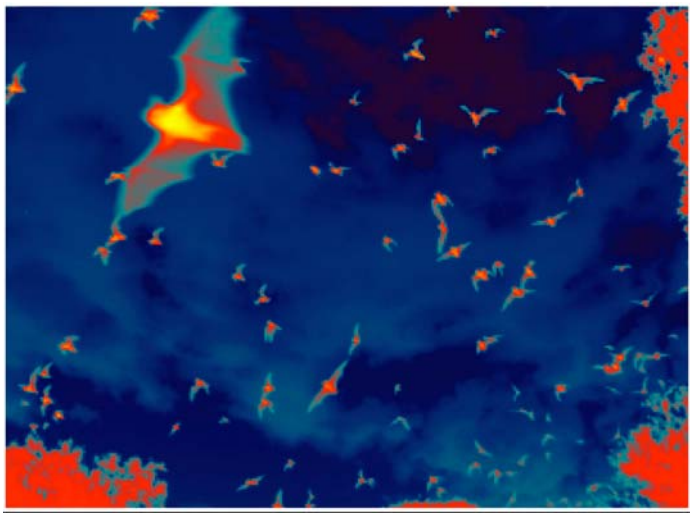

Figure 1. Thermal infrared image of flying Brazilian free-tailed bats (*Tadarida brasiliensis*) (image by Thomas H. Kunz, Nickolay I. Hristov, and Margrit Betke).

"Together, thermal imaging and computer vision processing solve two of the most challenging caveats of traditional census methods – the dependency on ambient or introduced light and the need for long and tedious data processing. As a result, the thermal imaging method is completely non-invasive, repeatable, and fast. Our estimates are more frequent, accurate and reliable than methods that have been previously used to census bats and for the first time provide reliable estimates of seasonal emergence behavior and colony size for this species."

NUMBERS VARY WITHIN AND BETWEEN YEARS

According to Kunz and Hristov, in addition to year-to-year population variations, each season exhibited a different pattern in colony size.

"In 2005 the number of bats in the cave varied between 67,602 and 793,838 bats. The fewest bats (67,602) were recorded in March 2005 before the majority of the colony had arrived. In April, the size of the colony increased sharply to 793,838 bats, the highest that we observed throughout the active season in that year. We attribute this increase to the effect of immigrating bats from overwintering sites in Mexico that presumably used the cave as a stopover en route to other locations further north. After the spring migration period, in May, the colony decreased to 395,168 individuals. In June, the month when female bats typically give birth to their young, there were between 346,756 and 438,551 bats present in the cave. This is the period that we believe represents the resident colony at Carlsbad Caverns in a season. In July the colony remained at its June level until a sharp and unexpected decrease in size occurred in the second half of the month when only 74,202 bats were estimated exiting the cave. By the middle of August, the colony increased to 381,153 bats, similar to its early July level. For the rest of the season, however, the average size of the colony declined as young bats began to fly, and adult females presumably emigrated from the cave. At the beginning of fall migration, fewer bats resided in the cave. By the middle of October, we recorded less than 150,000 bats emerging from the cave."

"In 2006, the size of the colony was significantly lower than in 2005. The number of bats fluctuated between a low of 10,621 on 16 April and a high of 617,000 on 12 October, however, for most of the season the size of the colony remained below the level recorded in 2005. In June and July, during lactation, the average size of the colony was estimated between 41,000 and 145,000 bats, well below the corresponding period in 2005. The overall seasonal pattern showed a general increase in number of bats from spring to fall."

"In 2007, the size of the colony returned to levels similar to 2005. The number of bats in the cave increased steadily from 61,402 on 27 March to an average of 340,000 in June and July during birth and lactation of young bats. In August the colony decreased in size to approximately 150,000 bats but in September and October it increased sharply to 450,000 and 1.05 M respectively. The estimate on 13 October is the largest size of the colony dating back to estimates made in the 1950s by Constantine."

The researchers found large fluctuations in colony size on a day-to-day basis as well. "On several occasions, we recorded changes of 40,000 to as many as 291,000 bats within only a few days."

OLD ESTIMATE OF 8.7 MILLION BATS FOUND TO BE IMPOSSIBLE

They also looked at both the duration of the outflight and numbers of bats in the flight column, in order to assess older estimates of much larger populations. "The emergence rates measured in 2005 to 2007 were orders of magnitude smaller than the maximum historic estimates of emergence rates for this colony [8.7 million bats by Allison in 1936]. Given the numbers and flight pattern of bats during the densest emergences, it seemed unlikely that flights with such historically reported rates were possible."

"To test this hypothesis, we simulated the emergence of the colony through a constricted section of the cave at two emergence rate scenarios. An emergence at 18,210 bats per min, compared favorably to our observations of the flight pattern and density of bats during the highest emergence rates in 2005. At a rate of 546,360 bats per min, however, the assumptions of the simulation were violated: the spheres modeling bats either overlapped extensively with one another or exceeded the volume of the cave. The average distance and resulting overlap between the volumes of the simulated bats was well below the minimum values necessary for powered flight."

"These results indicate that there is not enough space for that many bats to be present in that portion of the cave at the same time and that the emergence rate and thus colony size in June 1936 was likely much lower… a colony size of less than 1 million is likely closer to the actual number of bats in the cave at that time."

CAUSES OF POPULATION FLUCTUATIONS

Though it was beyond the original scope of the study, Kunz and Hristov provided some thoughts on the causes of the population variations: "In light of the pronounced changes in colony size that we show, we hypothesize that fluctuations represent natural responses of the colony to factors such as food availability and local and large-scale weather patterns. Thus, a small number of bats emerging on a given day does not necessarily indicate a long-term decline any more than a large number suggests a population increase. Rather, both are likely manifestations of short-term responses to changing environmental conditions."

"Weather appears to have a profound effect on the number of bats in the colony through its likely effect on insect abundance. Although we did not collect insect abundance data, the effect of weather on insect population dynamics is well documented in the literature. The North American monsoons have a similar strong effect in the south-central and southwestern parts of the United States. Relatively dry conditions reduce insect availability in May through early July. With the increase in precipitation in late July and August, insect abundance increases as well. As indicated by our analysis the amount of precipitation is a significant predictor of colony size."

DANGERS OF INFERRING LONG-TERM POPULATION TRENDS

The researchers concluded that "because of variation in colony size, past single season estimates are not a reliable measure of colony size at Carlsbad Cavern. Moreover, estimates collected during spring and fall migration are likely to produce inaccurate estimates of long-term population trends. As has been suggested previously, estimates collected with valid methods during lactation should give a reasonable approximation for the size of the resident colony, however, the extension of such results to inferences about long-term population trends should be placed in the context of annual local and global climate patterns to avoid potential misinterpretation of the data. Given the complexity of factors involved in the determination of the size of the colony at this location, there is no single tool that allows resource managers to predict or monitor trends."

"Nevertheless the relationship between duration of emergence and colony size as well as the effect of precipitation on colony size can be used cautiously to gauge large-scale trends in the colony."

EXPECTED FUTURE THREATS TO BATS AT CARLSBAD CAVERN

Kunz and Hristov note that as wind has become increasingly important in the renewable energy push, "development of the utility-scale wind energy industry has led to some unexpected environmental costs. In particular, large numbers of bat and bird fatalities have been reported at utility-scale wind energy facilities in both forested and agricultural landscapes. Less is known about adverse effects of wind energy developments in arid regions and offshore sites where wind energy capacity is often high.

"In particular, wind energy facilities have developed rapidly in the southwestern United States, most notably in west Texas, in areas that may be directly located in the nightly dispersal and seasonal migratory routes of Brazilian free-tailed bats. As the world demand for renewable energy increases, we are witnessing a near exponential growth of wind energy facilities. Given the current unregulated development of this industry in many parts of the world—including the United States, especially in Texas--large numbers of bat and bird fatalities can be expected. To date, most of the bat fatalities have been reported from onshore localities in Europe and North America, where several local efforts are being made to monitor operational wind-energy facilities for turbine-related fatalities. Unfortunately, few if any assessments of bat or bird fatalities are being made in most other regions of the world."

"The wind energy industry is developing at such a rapid rate, projected cumulative impacts of fatalities are staggering—affecting both cave-dwelling and tree-roosting species. Recent research has shown that adverse impacts of existing wind energy facilities on bats can be mitigated by operationally feathering (turbine blades are pitched parallel to the wind and thus hardly move) turbine rotors at low wind speeds, when bats are more often killed, and during high seasonal periods of

bat activity (e.g., during fall migration). Preliminary research suggests that this type of mitigation can reduce fatalities by up to 92%. Thus, the wind energy industry—to retain its "green" image—should be required… to implement such measures during designated times of the year and at low wind speeds to reduce adverse impacts on bat populations."

The Center for Ecology and Conservation Biology website contains a wealth of information about bats, current issues, and research. Click on the Kunz Bat Lab link to access all their publications at: http://www.bu.edu/cecb/.

CLIMBING CAPITOL DOME IN LECHUGUILLA CAVE

Stan Allison

On January 23, 2008 John Lyles led his survey team of Brian Kendrick, Andy Armstrong and Scott Linn up a narrow, 9 to 12 inch wide fissure at a 45 degree angle. This steep, narrow passage was difficult to move through and even more challenging to survey. Noticeable airflow motivated them to survey up through this obstacle they named Mount Vernon. On the other side of Mount Vernon, they were rewarded with over a thousand feet of walking passage containing large gypsum flower masses on the floor and the first selenite chandeliers in the Eastern Branch of Lechuguilla Cave. This new discovery extended the northeastern limits of the cave and had good airflow, so they named the area the Northeast Corridor. On their final day of exploration, Andy Armstrong led a sixty foot climb up a steep gypsum slope and rigged a rope so that the team could follow him up into a large room they named Mount Washington. Mount Washington was about 100 feet by 120 feet at floor level and it had a high dome that was measured with a laser rangefinder at 170 feet tall. Even in this huge chamber the team felt airflow and it appeared that there may have been passage at the top of the dome. They were already dreaming about returning to this promising lead in 2009.

In December 2008, John Lyles submitted a proposal to lead a team of eight people to return to the Far East section of Lechuguilla Cave with gear to climb the dome above Mount Washington and to pursue other leads in the Far East. A total of 11 excellent proposals were submitted to Carlsbad Caverns National Park for Lechuguilla Cave survey, inventory and exploration in 2009. Due to several factors including time constraints on the Cave Resources Office, the park was only able to approve 6 proposals for 2009 with a total number of people on these trips being 51. John's proposal was one of the 6 that were approved.

John scheduled his expedition for March 14-21, 2009. He invited Brian Kendrick, Andy and Bonny Armstrong and Mark (Elvis) Andrich to be part of the team. The climbing team that John assembled consisted of Larry Shaffer, James Hunter and myself. The night before the trip, all of the climbing gear was divided up into equal loads and each member of the team carried a portion of the equipment. Our packs weighed between 32 to 52 pounds, with an average weight of 40 pounds per pack. Not only did we need to carry the normal equipment for eight days of cave camping, but we also had a large amount of climbing equipment including a 200-foot dynamic rope and a 200-foot static rope.

FROM ENTRANCE TO CAMP

Our trip from the entrance of Lechuguilla Cave to the Grand Guadalupe Junction Camp in the Far East was along the most difficult and lengthy of all of the travel routes to the four camp sites in the cave. We traveled through the entrance series, which involves a 50 foot entrance drop, a 10 foot drop, a 50 foot drop at the Liberty Bell and a 30 foot drop above Lake Lechuguilla. We rappelled 140 feet down the mostly free-hanging Boulder Falls. From Boulder Falls, we descended steeply without rope down to the Rift Overpass at 650 feet below the entrance. The Rift Overpass involved four traverse lines to get to the top of Apricot Pit.

James Hunter at the top of Capitol Dome. (Photo courtesy Larry Shaffer)

Apricot Pit is where the fun of the Eastern Branch of Lechuguilla began. Apricot Pit is a jungle gym of ropes, rebelays, redirects and traverses in a steeply sloping fissure that is coated with slick, greasy corrosion residue. A series of six drops and one traverse drops a total distance of 350 vertical feet to reach the bottom at -1,000 feet. From the bottom of Apricot, our travel was a little bit easier through the well-decorated Nirvana, although it posed the challenge of

moving with a large camp pack through passages well decorated with delicate calcite formations including long soda straws. Soon the pool located at survey station GA7 was reached and everyone rehydrated. We carefully used a clean pitcher to collect water from this pool and pour it into our drinking bottles without contaminating the pitcher or pool. Moving past GA7, we soon arrived at the Rusticles Camp. Past the Rusticles camp are a series of awkward passages that were difficult with a large pack. The culmination of these challenges was moving up the calcite-coated breakdown maze of the aptly named Giant Chiclets. From there it was a short distance to the Moby Dick Room, with its great white, whale-shaped rock.

We then climbed up the 200 foot high Aragonightmare rigged with four separate rebelays to keep our lifeline away from the beautiful, yet sharp aragonite crystals that lined this pit. At the top of the Aragonightmare, we were about 700 feet below the entrance and finally in the section of cave known as the Far East. We travelled through the extremely delicate and beautiful China Shop, which had large 8-10 foot high aragonite coated stalagmites and required slow and careful movement with our large packs. The almost gaudy beauty of the China Shop reminded us of why Lechuguilla Cave is so special. Beyond the China Shop we traversed the Don't Fall Here Pit, the Land of Fire and Ice and climbed up a rope into the Silver Bullet Passage. Here, we negotiated the annoying Tilt-a-Whirl and did a belly crawl that required us to pass our camp packs over a rough and sharp floor. Soon after, we arrived in the Grand Guadalupe Junction Camp after about 8 hours to travel from the entrance.

FROM CAMP TO THE CLIMBING LEAD

After a good night of sleep despite the snoring chorus in camp, we all got up and headed to Mount Washington with the climbing gear. Our travel from camp involved descending on rope via fissures coated with thick corrosion residue to the top of the 65-foot Gorilla Falls drop into the Ruby Chamber. We then traveled down the massive Wild Black Yonder passage to our low point of about 400 feet below camp and about -1,100 feet below the entrance in the Outback section. From the Wild Black Yonder, we stopped at Elbow Pad Junction to put our elbow pads on and prepare for the nasty crawls of the Mount Vernon area. Past Mount Vernon, we were able to remove our pads and walk up the steeply climbing passage. At one point we had to carefully crawl next to some extremely delicate gypsum flowers and selenite needles. Soon, we were ogling the 4-foot long selenite chandeliers of the Northern Lights and climbing up the two ropes to Mount Washington. This area was to become the staging area for working on the climb up Capitol Dome and was at about the same level as the Grand Guadalupe Junction Camp.

Upon arriving at the base of our intended climb, we were all a bit overwhelmed. We had seen pictures of this 170 foot high dome, but the pictures didn't indicate the steepness and overhung nature of the route, nor the lack of features. We knew that we had a lot of work ahead of us.

THE CLIMB

The climbers started sorting the climbing gear that the entire team had brought to the base of the climb while the rest of the team made their way back down to survey near the Mount Vernon area.

To start the climb, we decided to do an 80-foot traverse which I led. We rated this as an easy 5.6 A1 climb. While we hadn't gained much vertical height on the wall, the traverse brought us to a point where we were 100 feet above the floor below Mount Washington. With time running short, we ended the day and made our way back to camp.

We soon settled into a nice routine where each day we would get up, eat breakfast and prepare for our trip from camp. John, Mark, Bonny, Andy and Brian would head out for a day of survey and inventory, thoroughly exploring and surveying sections of cave and bringing back a hard fought for 200-500 feet of survey per day. Larry, James and I soon familiarized ourselves with the route to Mount Washington and were able to reduce our travel time to the base of the climb to about 1.5 hours. We took turns leading and since we would spend hours up on the wall, only one or two of us would get a chance to lead each day. At the end of a lead, the climber would establish a rappel anchor and rappel down off of the wall using our static rope. We were typically spending 12-15 hours away from camp working on the climb and getting about 8 hours of sleep per night. We didn't want to push ourselves too hard, as the climbing was difficult, strenuous and required us to be clear-headed.

As a climbing team, the three of us worked well together. While much of the climb up the Capitol Dome wall was routine, a few areas proved more difficult. Larry ended up with the first difficult lead that involved aiding through an area of large aragonite and calcite blobs that were loosely attached to the bedrock wall. After 20 feet, he was able to place bolts for an anchor in a small patch of solid bedrock. On a separate pitch, James led the climb out 40 feet over weathered bedrock covered with a thin layer of calcite to where he could establish a solid anchor.

I was fortunate to be next in line for the lead that looked like it was going to get us to the top of the dome. A four-foot thick piece of bedrock (named the Chicken Head) stuck out about 20 feet above our heads at what appeared to be a large ledge. I was able to free climb up to this ledge along an easily protectable route with good natural anchors. It was quite exciting to pull up on to the Chicken Head. I regret to say that I didn't stop to enjoy what was probably an amazing view down from my perch to the large void below me. I would have been able to see down the free-hanging drop of 150 feet down to Mount Washington and another 100 feet below that to the pit leading up into Mount Washington.

From the Chicken Head, there was a final traverse into what appeared to be a large alcove. Making my way to the alcove, I thought that the dome might not have any passage at the top. It would not have surprised me, since the climb up the impressive 160 foot high Trepidation Dome in the Prickly Ice

Cube Room in the Southwest Branch of the cave had ended with no passages leading off at the top. But at the Capitol Dome Climb, I belayed Larry up to the top with me. Once there, he noticed that there appeared to be another 20-foot climb up through a large gypsum rim.

On our sixth and last day, Larry led once again up through the gypsum rim. While the lower part of Capitol Dome had all been in the Massive Capitan Formation, the walls in the upper portion of the dome had penetrated into the backreef sediments and were extremely weathered with silt and corrosion residue. Despite the poor bedrock quality, Larry was able to safely pull over the top of the 20-foot climb, stepping over a large, white rim and into a 10-foot wide and 6-foot tall passage. Another 30 feet on, he climbed up an additional 15 feet through two more rims into a room where he tied a rope to a solid natural anchor. James and I were then able to join him at the very top of Capitol Dome. The large rims were a good indication of airflow.

Stan Allison leading the climb up Capitol Dome.
(Photo courtesy James Hunter)

SUCCESS – A ROOM WITH LEADS AT THE TOP

We were elated that after six days of climbing, we had found several horizontal cave passages leading off from the top of the dome. We felt a sense of urgency, since we only had two hours to clean the final climb, rig it for travel, and survey the new area before we headed back to camp. We completed our work for the week by surveying into the room.

The unnamed room at the top of the climb is about 6-8 feet tall and 40 feet in diameter. There are four leads exiting the room. The two larger passages head east and are 10 feet wide and 4 feet high. Another passage going west is about four feet high and wide. The final lead goes up a chimney for at least 20 feet. But we were now out of time and would have to wait until the next trip to see where these intriguing leads would take us.

We had pioneered a 180-foot high route up what we named Capitol Dome. The name came about due to the dome's shape, size and location at the top of Mount Washington. We placed a total of 7 expansion bolts on the climb with a rating of 5.8 A4.

To learn more about how climbs are rated visit the following. http://en.wikipedia.org/wiki/Grade_(climbing).

Larry Shaffer climbs past a large gypsum rim at the top of Capitol Dome.
(NPS Photo by Stan Allison)

We discussed what to name the room with the leads at the top of the climb, but hadn't settled on a name before leaving the cave. After the trip, Larry's wife Sara Booth mentioned that we had been exploring the room at the exact moment of the Vernal Equinox which inspired the name. The leads out of the Vernal Equinox were quite promising with airflow and rims and the fact that the area was on the edge of known cave. We rigged the drop out of Capitol Dome from two bolts making a beautiful free drop of 153 feet.

RETURN TO THE SURFACE

As we prepared to exit the cave on our eighth day, we split up the climbing gear and headed for the entrance. Everyone was back to the surface in 7.5 hours from camp, glad to see the sun and dry out after 8 days in the dark, near 100% humidity cave environment. We were all pleasantly surprised to find that a total of 2,586 feet had been surveyed during the week bringing the total length of Lechuguilla Cave to 126.54 miles (206.25 kilometers.) Additionally, one major survey error had been corrected. Hopefully in 2010, a team will be able to return to the Vernal Equinox at the top of Capitol Dome to continue exploration of this fascinating area.

Lechuguilla Cave

March 14-21, 2009 surveys in red
126.54 miles