Carlsbad Caverns National Park

CANYONS & CAVES

A Newsletter from the Resources Stewardship & Science Division

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The Billing Doves in the Billing Doves Tunnel off of the Big Room in Carlsbad Cavern. (NPS Photo by Dale Pate)

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Look for Issues of *Canyons & Caves* at the following websites: **http://www.nps.gov/cave/pub-pdf.htm** Thanks to Kelly Thomas and Bridget Eisfeldt all issues can be downloaded as a PDF file from the park website. **http://www.caver.net/** Once there, go to the Canyons & Caves icon. Bill Bentley has placed all issues on his personal website and can also be downloaded as PDF files.

RESOURCE NEWS

PESTICIDE RECORDS – Cultural Resources' Emily Buehler has been extremely helpful to the Biology Branch in searching the park's archives for records of pesticide use since 1947. The results are very interesting, including records of extensive use of DDT by the park. Watch for a summary article in the next *Canyons &Caves*. In the meantime: thanks, Emily!

PARK CAVE COUNT REACHES 100 – Since last reported in *Canyons & Caves* No. 22, three new small caves have been documented in the park.

ROPE SKILLS CLASS – On the first week of March, seven SE&VS rangers attended a basic rope skills course held at Carlsbad Caverns. This 24 hour course provided hands on training, leading the students through the evolution of rappelling and rope climbing techniques. The class started with basic knots and safety training, climbing calls, and belaying, followed by learning basic techniques using only the body for friction while on rappel, and using specialized knots as the only hardware for climbing.

Tom Bemis and a student practicing rope-skills on a cliff. (Photo by Greg Litten)

As the course progressed, students began to learn more advanced rappelling and rope climbing techniques using modern equipment. They then learned self-rescue methods, critical for safe rope climbing. The class concluded with a half day of practice on a seventy-foot cliff, followed by a half day on a rappelling and climbing wall (due to dangerously high winds outside).

BEXAR GROTTO RESTORATION – Members of the Bexar Grotto (San Antonio, Texas), led by Joe Ranzau, have spent several weekends cleaning a flowstone area in Lower Cave, Carlsbad Cavern. Their lastest trip was in January 2002. The park appreciates these volunteer efforts and looks forward to working with the Bexar Grotto on this and other projects in the future.

Beautiful white flowstone is uncovered in Lower Cave by members of the Bexar Grotto. (NPS Photo by Tom Bemis)

MIGRATORY BIRD NEWS

by Renée West

International Migratory Bird Day is May 11

Spring migration is under way. Cave swallows have already returned to the Cavern from their wintering grounds in Central America. Our 'winter residents' are heading up to the mountains or to the north for summer breeding. Others, 'neotropical migrants' (birds that winter in the tropics and breed in North America), are working their way north. Some neotropical migrants spend the summer in our area while others pass through on their way north.

Birds get tired and hungry on their long migrations, and they need stopovers that provide food and water, as well as habitat in which to rest and hide. The upland shrublands of Carlsbad Caverns National Park and its riparian area at Rattlesnake Springs provide important stopover habitats for migrating birds.

International Migratory Bird Day is an annual celebration of the incredible journeys of these birds between their breeding grounds and wintering grounds. The event has taken place the second Saturday in May every year for over a decade. It is designed to encourage bird conservation and increase awareness of birds. This year it will be celebrated on May 11 with a county-wide Spring Bird Count. If you want to participate, as an expert or for the fun of learning, you can contact the compiler of this year's count, Bob Nieman, in Carlsbad at 505-628-3977.

For more information on International Migratory Bird Day, check out: www.BirdDay.org

Shade Coffee Saves Our Migratory Birds

The difficulty in protecting neotropical migratory birds (and all other migratory wildlife, including Mexican free-tailed bats and monarch butterflies) is that they need good habitat for summer, along the migration route, and for winter. It's a tall order, crossing many different kinds of land ownership, jurisdictional and international boundaries, and land uses. There are many threats to migratory habitats, including our morning cups of coffee.

Coffee. An innocent vice. But there is more than one way to grow coffee. Until recently, almost all coffee was grown in the sun, usually by large-scale growers. It involves clear cutting of tropical forests. But this reduces not only plant diversity but also wildlife, because most of the birds, insects, amphibians, and other wildlife are found in the shade of the forest canopy. Sun-grown coffee needs more chemical fertilizers, pesticides, irrigation, and weeding, while contributing heavily to soil erosion, soil acidification, and toxic run-off.

By contrast, shade-grown coffee is planted among the other plants of the forest. It provides a lower yield, but the plants live twice as long. It uses fewer chemicals (or no chemicals, since shade-grown coffee is often organically grown, too). It provides habitat for three times as many birds, at least 24 species of mammals, and more insects and other critters. Another important benefit of shade coffee is that it provides a viable living for small-scale farmers in Mexico, Central, and South America. (Brazil, Colombia, and Mexico are among the top four coffee-producing countries in the world.) Most birds observed in shade coffee plantations do not feed on the coffee fruit. Wilson's warblers, for example, search for insects in the leaves and branches of the coffee plants and other vegetation, particularly the shade trees.

With increased consumer awareness of the damage of sun-grown coffee to the environment, the market for shade coffee is growing rapidly. When you consider that the average North American may consume as many as 56,000 cups of coffee in his or her lifetime, you can see that the benefits of conscientious consuming add up. Many birds will benefit, including many species that use Carlsbad Caverns National Park.

Wilson's warbler is one bird that winters in the tropics and migrates through CCNP. These beautiful yellow birds with black caps can be seen around the Cavern natural entrance area in April and May (and fall). Other species that migrate from the tropics through our park or breed here include: cave swallow, turkey vulture, sharp-shinned hawk, yellow-billed cuckoo, rufous hummingbird, yellow-bellied sapsucker, olive-sided flycatcher, western wood pewee, Hammond's flycatcher, plumbeous vireo, Cassin's vireo, red-eyed vireo, white-eyed vireo, blue-gray gnatcatcher, Swainson's thrush, Tennessee warbler, northern parula, yellow warbler, chestnut-sided warbler, yellow-rumped warbler, black-throated blue warbler, Townsend's warbler, black-throated green warbler, cerulean warbler, black and white warbler, black-chinned warbler, American redstart, prothonotary warbler, ovenbird, northern waterthrush, MacGillvray's warbler, hepatic tanager, summer tanager, scarlet tanager, western tanager, black-headed grosbeak, indigo bunting, painted bunting, Lincoln's sparrow, Bullock's oriole, Scott's oriole and Baltimore oriole.

Wilson's warbler uses CCNP during migration.

For more information about shade-grown coffee, and where to buy it, see: www.seattleaudubon.org

PRACTICE RESCUE FROM HALL OF THE WHITE GIANT

by Tom Bemis

The Cave Resources Office at Carlsbad Caverns National Park is in the process of reviewing its rescue pre-plans for frequently used off-trail areas in Carlsbad Cavern, permitted backcountry caves, and main routes in Lechuguilla Cave. On March 6, 2002 seven employees of Carlsbad Caverns and Guadalupe Mountains National Parks participated in a practice rescue from the passage leading to the Hall of the White Giant in Carlsbad Cavern. The primary goal of this session was to give rescue staff practice with the extrication of an injured person from the area and acquainting them with the obstacles along the route.

A quick trip to the Hall of the White Giant determined that there would be no major obstacles to negotiate for the latter portion of the route, so the starting point for the practice was located at the first major obstacle on the way back to the paved trail. The rescue route started at the top of the last slick area before the silt-filled room and included transporting a litter over several steep, slick drop offs, and through chimneys as well as low, tight passages.

The practice demonstrated that one 200-foot rope, anchored at the start of the route, could be used to belay the litter over all vertical obstacles on the far side of Matlock's Pinch. As during a past rescue practice, it was evident that a patient in a litter could not fit through Matlock's Pinch. In the event of an actual rescue from this area, the pinch would have to be enlarged. Fortunately, due to the shape, size, and materials in the pinch, it appears that it could be easily and quickly enlarged, should the need arise. Further practice in this area will be required to determine if other types of litters or immobilization devices might be practical.

A larger problem was found just beyond. After the pinch on the way out, the passage becomes a narrow fissure for several feet. Depending on the nature of the injury, this could pose a much greater problem, because the litter and patient would have to be turned on their side to fit. This section of passage would be more difficult to modify in an emergency.

An additional trouble area was found just before reaching the main trail. The bends in the "corkscrew crawl" are too sharp to negotiate with a litter. It was determined that a rope would be needed to belay the patient through an exit that comes out higher above the paved trail. Fortunately, this could be quickly and easily accomplished.

While the tour to the Hall of the White Giant is fun and very popular to the public, great caution must be exercised on these trips to minimize the risk of injuries and to prevent an extremely difficult rescue, as well as to prevent irreparable damage to the resource.

OUR CHIHUAHUAN DESERT NETWORK

by Bill Reid

These are times of exciting change in the Park Service, and one of these is the Inventory and Monitoring Program that came from the Natural Resource Challenge. Under the program we first will determine just what plants and animals are in our parks, then monitor the condition of their ecosystems to fully carry out our mission. Almost 300 park units have been formed into 32 networks, so far. The networks do not infringe on each park's traditional responsibility, rather, they coordinate efforts for similar ecosystems. One analogy is that the independent park "ships" have formed a convoy and intend to reach new management shores together.

Ours, the Chihuahuan Desert Network, includes White Sands, Guadalupe Mountains, Carlsbad Caverns, Fort Davis, Big Bend, and Amistad. The network has one representative from each park, forming a Steering Committee to guide the efforts of the Coordinator. The Chihuahuan Desert Network's Coordinator is also its database manager, and he has been on board since December.

We are now developing work statements for contracts that will help complete our inventories. We, also, will soon complete the development of a charter to make clear our organization and goals. Along the way, we will put our text and digital data on line in several Park Service databases. In looking ahead, we are developing conceptual models of how each of the major ecosystems works and responds to human and natural stress. These models will be used to develop monitoring programs for the parks.

But success is built from big bricks and small ones. Dave Roemer recently mentioned that the efforts of the program have provided solid, museum-vouchered proof that the Caverns' Ringtails are really there.

We will have more articles as the network progresses, but you can direct any questions to Bill Reid, the network coordinator, stationed at Guadalupe Mountains. Jan Wobbenhorst currently chairs the steering committee, and its members include Dave Roemer, Fred Armstrong, John Heiner, Bill Conrod, Raymond Skiles, and David Larsen. So, if someone speaks of the "I&M Program," they're referring to the Inventory and Monitoring Program under the Natural Resource Challenge. And look proud; we are taking an active, proactive approach to protecting our natural treasures.

HOW PLANTS FIGHT BACK

by Myra Barnes

Are ecosystems controlled 'from the bottom up or from the top down' is a question often posed by ecologists. For example, are the numbers of deer controlled by the number of predators or by the amount of forage available? Most biologists believe that plants, which provide the foundation or 'bottom' of the food pyramid, limit the number of herbivores and then the number of herbivores limits the number of carnivores. Just as animals use speed, camouflage, flight, or dashing down holes to avoid predators, plants have also developed some clever strategies to avoid being eaten by herbivores. Physical defenses are the most conspicuous deterrent in the Chihuahuan Desert at Carlsbad Caverns National Park. The spines on cactus or ocotillo are easy to see compared to the cat claw shaped thorns on the acacias, which subtly grab your clothing as you try to walk by. The bayonet-shaped leaves of the agaves include stiff spines and barbs, especially the Lechuguilla. Thorns and spines don't completely prevent an animal from browsing on a plant but they slow down the rate that leaves or other edible parts can be removed. Research with medium sized ungulates like antelope and deer shows that they can only remove a quarter of the number of leaves from an acacia tree with thorns as can be removed from a tree with the thorns removed, over the same period of time.

The strawberry cactus is protected by long, dense spines while the prickly pear cactus pad has smaller, widely spaced spines. (NPS Photo by Dale Pate)

The lechuguilla plant has a combination of spines and a sharp tip. (NPS Photo by Dale Pate)

When we choose leafy vegetables that we might want to eat, the decision is based primarily on taste. We may also consider nutrition and select vegetables that are high in vitamins, minerals or other nutrients. Nutritional value, determined through scientific research, has provided information that our ancestors did not have and that we can't determine by taste. Through trial and error our ancestors sampled plants for taste and to determine if they might have adverse effects when eaten. Plants produce a variety of chemical deterrents that work in different ways. Some chemical toxins may produce an immediate reaction, causing vomiting or pain in the digestive tract. An animal or person will avoid eating a plant associated with an unpleasant reaction. Other chemicals interfere with digestion, preventing the absorption or utilization of nutrients. How animals detect chemicals that disrupt digestion is not well understood. Recent research has detected cells in the digestive tract that appear similar to tastebuds in the mouth. Some of us are aware of the nutritional value of certain vegetables and realize that a bowl of fresh spinach leaves has more nutrition than a bowl of iceberg lettuce. Health reports on TV and in magazines talk about new and ongoing research about combinations of foods that are beneficial or other combinations where one item may interfere with the absorption of nutrients from certain foods. But for most Americans we know we can maintain life and reasonable health by choosing among our favorite foods. Few of us worry about whether we will be able to acquire sufficient calories and nutrients to survive the next week or through the next winter. Life is more precarious for grazing and browsing wildlife. During the winter, grasses have dried and many shrubs and trees have dropped their leaves. Drought can stress animals in other seasons.

Anyone who has watched deer or other ungulates browse on plants notices that they seem to continuously move from plant to plant. If they find a plant that is nutritious, why don't they stay and eat every leaf? You might think that they are good stewards of their resources and don't want to damage or kill plants that are important food sources. However, it seems that the plants are sending signals to the animal to move on. Producing toxins to deter browsing is expensive, as the plant must divert energy to produce chemicals rather than adding more new growth or fruits. Many plants delay producing toxins until they detect browsing damage. It seems they can begin producing chemical deterrents within minutes. What is even more amazing is the ability of plants to send chemical warnings through the air to warn neighbors of impending danger. Soon, all the plants in the area will be producing chemicals to deter browsers and they move on to a new area.

A Mule Deer. (Photo © Dale L. Pate)

Research over the past ten years has confirmed the ability of plants to communicate warnings to neighbors with air-borne chemicals. However, recent research has shown that plants can send out very specific messages. While large animals like deer are the most common browsers that we see, insects may remove more vegetation than the large herbivores. Some insects have developed a resistance to the chemical toxins produced by plants. Since thorns don't deter insects and if they can tolerate chemical toxins, how can the plant get rid of these small but often numerous herbivores? They send out a very specific message to the predators of the specific insect that happens to be chewing on their leaves. For example, chemicals in a caterpillar's saliva can prompt a plant to send out a specific chemical cue to attract a specific parasitic wasp that prefers to lay its eggs on that species of caterpillar. After the egg hatches, the larva feeds on the caterpillar, eventually killing it.

It appears that plants have an impressive arsenal of defenses. Physical defenses like thorns can reduce the rate of browsing to 25% of the amount of leaves or other plant parts of the same species with the thorns removed. Thorns are usually a permanent investment but some trees may reduce the number of thorns above the level that the tallest herbivore can reach. Plants may produce chemicals that are toxic or that interfere with digestion, reducing browsing by 90%. Since these chemicals require energy to produce, some plants only produce the chemicals in response to an herbivore browsing on the plant or in response to a chemical signal from a neighbor. Plants of other species may even detect these air-borne signals. The production of specific chemicals to attract a specific predator to kill an herbivore is certainly the most amazing adaptation.

Cougars reduce the number of deer and other large herbivores. Hawks, foxes, snakes and other carnivores eat rodents, and birds, bats, lizards and predatory insects forage on insects. However, plants seem to be as well armed as the predators. The animals in the middle of the food chain need to be vigilant for predators while trying to find enough nutritious food to survive and reproduce. It is important to maintain all parts of the ecosystem. Without predators, animals may increase beyond the carrying capacity of the ecosystem, resulting in starvation. It is also important to realize that the plants at Carlsbad Caverns are not passive components of the ecosystem. Using a variety of impressive tactics, they can fight back when attacked by an herbivore.

FIXING SURVEY BLUNDERS IN CAVE SURVEY DATA

by Stan Allison

Currently Carlsbad Caverns National Park has 142.5 miles of surveyed passages in multiple caves. The survey data is of varying quality based upon the skills of the surveyors and the equipment they used. Most cave survey data was obtained using Suunto brand hand-held compasses and clinometers along with 100-foot fiberglass tapes. As many caves in the Guadalupe Mountains are exceptionally mazy there are many loops made by the surveys. For example, Lechuguilla Cave has over 1,737 loops in the survey data. Whenever a loop is made in a cave survey it is possible to calculate the error in the loop. Loops serve as an excellent way to check the quality of survey data.

There are three basic types of survey errors that can lead to loop closure problems:

1. Random errors are typically small errors that occur in the survey process. These errors are predictable and their effects are generally small. They can be dealt with using standard statistical techniques.

2. Systematic errors occur whenever an error is made repeatedly. An example of a systematic error would be someone's steel glasses frames pulling the compass over by several degrees each shot. Another example would be a magnetic anomaly that would systematically change all compass readings such as trying to read a compass near the stainless steel handrails in Carlsbad Cavern. In some cases these errors can be corrected by changing a constant within the survey data, such as changing the compass readings by the amount they were pulled off by the glasses.

3. Blunders are fundamental errors in the survey process. Usually they are human errors. Examples of blunders include incorrectly reading the survey instruments, incorrectly recording data in the survey book or tying the survey into the wrong station. Blunders can produce very large and unpredictable errors and are the focus of this article.

All of the survey data for Carlsbad Caverns National Park is managed using a computer program called COMPASS written by Larry Fish. Along with a number of other features, this survey program stores and manipulates cave survey data and can provide a plot of survey stations that represents cave passages and rooms. Compass also has a feature that will analyze the loop errors of a cave survey and categorize them into three categories based on their standard deviation from the expected error of the surveying equipment. The expected error is 2 degrees for compasses and clinometers and .1 feet for the survey tape. "Good" loops are defined as loops with less than one standard deviation from the expected error. "OK" loops are loops that are between 1 and 2 standard deviation from the expected error. "Bad" loops are loops that are greater than 2 standard deviations from the expected error. The goal is to have as few bad loops in the survey data as possible.

A good example of the improvement that has been made in the park cave survey data in the past decade is the resurvey of Carlsbad Cavern begun in 1993. The old Carlsbad Cavern survey data had 16% bad loops, whereas the resurvey only has 3.6% bad loops (See Table 1). I attribute the data improvement in the resurvey largely to the Carlsbad Caverns National Park Survey Standards which were instituted in the early 1990's. The survey standards require backsights for all compass and clinometer readings. Backsights reduce the number of blunders due to incorrect instrument readings. Another improvement in the resurvey was careful use of survey designations that reduced the number of blunders due to bad tie-ins. Both the original Carlsbad Survey and the Resurvey incorporate a network of survey stations set by Tom Roher in the 1960's using a Transit. The transit is a very precise and accurate surveying instrument and these surveys greatly improve the accuracy of the Carlsbad Caverns data.

During the early days of survey and exploration in Lechuguilla Cave (1986-1992), the unfortunate result of little park oversight of the survey meant that much of the cave was surveyed in haste. Teams were trying to "explore" as much as possible with the end result of a higher quantity of survey but of less quality. This activity led to many survey errors. In 1993 the NPS became more actively involved in directing the survey and required that all surveys be done in accordance with the Carlsbad Caverns National Park Survey Standards. Furthermore in 1997 a reduction in the number of survey trips allowed into Lechuguilla Cave better allowed the NPS to manage the survey data in a meticulous fashion. Both of these actions have greatly improved the more recent survey data coming out of Lechuguilla Cave.

In the past four years, much effort has gone into fixing bad loops in the Lechuguilla survey data. Thanks to these efforts Lechuguilla Cave has gone from 32% bad loops in 1999 to 23.1% bad loops in 2002 (see Table 1). This improvement has come mainly through volunteers and employees working on fixing survey errors both in the office and in the cave. The cave survey data software COMPASS has some tools that can be used to fix survey loops without entering the cave. The program looks for typical errors such as a compass reading being read 180 degrees opposite of what it should be. Using COMPASS to solve loop errors can be tedious but rewarding when the error is fixed, much like solving a puzzle. Not all loops are solvable from the office, so many of the loop fixes have been made in-cave by field checking likely stations for errors from lists generated using COMPASS and other software. Obviously there is much work yet to be done to improve the Lechuguilla survey data, but progress is being made.

Spider Cave was resurveyed in the late 80's and early 90's. The old survey (done in the 60's and 70's) is not in COMPASS format but the new survey is. Although the loops are not as good as the Carlsbad Cavern resurvey the loops close much better than those in Lechuguilla (see Table 1).

To see how the cave surveys of Carlsbad Cavern National park fit compare to other caves in the U.S. and in Mexico, I borrowed a table made by Larry Fish and modified it slightly. See Table 2. Both Carlsbad and Spider are in fairly respectable locations on the list. Lechuguilla Cave has the most loops of any cave on the list and probably has more loops than most other caves in the world. Progress has been made in improving the Lechuguilla survey data, but much work remains to reduce the total number of blunders.

Much of the information for this article was obtained from "How Common are Blunders in Cave Survey Data?" written by Larry Fish and published in Compass & Tape Volume 14, Issue 2, No. 46.

TABLE 1 – Statistics for CCNP Caves

Cave	length miles	# loops	% bad >2STD	% ok 1-2STD	% good <1STD
Carlsbad Cavern Old Survey	30.9	829	16	20	64
Carlsbad Cavern Resurvey	21.33	478	3.6	14	82.4
Lechuguilla Cave 1999	100.5	1142	32	not available	not available
Lechuguilla Cave 2002	106.97	1737	23.1	30.7	46.2
Spider Cave	3.54	149	11.4	27.5	61.1

TABLE 2 – Statistics Comparing CCNP Caves (in bold) with Other Non-Park Caves

Cave	length miles	# loops	% bad >2STD
Jewel Cave	127	366	3.3
Lechuguilla Cave	**106.97**	**1737**	**23.1**
Wind Cave	100	900	25
Roppel Cave	69.1	333	2
Kazamura Cave	38.5	83	19
Blue Cave	28.0	46	28
Carlsbad Cavern Resurvey	**21.33**	**478**	**3.6**
Sistema Cheve	16.0	36	30
Lilburn Cave	16.4	238	14
San Augustin	10.0	20	25
Groaning Cave	9.1	70	49
Spider Cave	**3.54**	**149**	**11**
Cave of the Winds	2.0	17	13
Alexander's Cave	2.0	17	65
Fairy Cave	1.5	29	12
Fixin' To Die Cave	1.5	7	57
Fulford Cave	1.0	14	14

INVERTEBRATE NEWS

by Renée West

Velvet Ants – "The Thieves And Murderers Are Already Out And About"

Last summer's aggregations of ground-nesting bees in the park are still there (see *Canyons and Caves*, Summer 2001). The bee larvae have spent the winter in the holes, growing on the pollen their mothers stashed there and waiting for prime weather to come out. That is, those larvae that haven't been eaten by predators and parasites. Last summer it appeared that skunks had dug up some of the larvae in the ground (tasty morsels, I'm sure). And now, velvet ants are appearing on the sites – evidence that their parasitic parents laid their eggs in some of the bee nests last year.

"So, the thieves and murderers are already out and about," was the e-mail comment from Dr. Terry Griswold, research entomologist and bee enthusiast at the Logan Bee Lab at Utah State University, when he heard about our velvet ants. "It actually is not uncommon for parasites to emerge before their hosts. The velvet ants would be newly emerged."

Female (wingless) red velvet ant. (Borrowed from: www.calacademy.org)

Velvet ants are not ants at all, but parasitic wasps. 'Parasitic' because they lay their eggs in nests of other wasps and bees. The velvet ant larvae then hatch and eat the host insects, hence the 'thieves and murderers' label. Female velvet ants are the wingless, fuzzy red-and-black crawling creatures we commonly see in the desert. Males are much more difficult to find (and identify): they are larger, winged, look very different, and don't hang around in groups. Adult velvet ants feed mostly on nectar, but also eat larvae and adults of many other insect species. They have very hard exoskeletons that protect them from insect stings.

Velvet ants of North America are not well studied. There are possibly hundreds of species – some of which are very beautiful – and we don't know exactly which are in our park. Griswold, who studies biodiversity and conservation of native bees, is interested in positively identify our velvet ants and ground-nesting bees. It would provide valuable information on potential parasite-host relationship.

(Note: Like all the other solitary bees and wasps, velvet ant females have stingers and will use them if harassed. But they are not aggressive and they won't chase you. So the moral of this story is: Look, admire, but don't touch.)

[Further reading: www.desertusa.com; A Field Guide to the Insects, America north of Mexico, Borror and White, 1970.]

Monarch Butterflies Devastated By Winter Storms

This winter's severe winter storms in the mountains of central Mexico have caused the "worst die-off on record," says monarch expert Dr. Lincoln P. Brower. Brower estimated that as many as 270 million butterflies may have frozen to death in an unusual combination of freezing temperatures, rains, and clear night skies in January and February in central and western Mexico. Roberto Solis, butterfly reserve manager for the Mexican government, estimated a lower death toll at 30 to 35 million, but agreed with Brower that about 80 percent of the butterflies have died at one of five official mountain sanctuaries and about 40 percent at another. Three other sites remained largely unaffected in mid-February. Both agreed that the monarch's survival as a species is not at risk.

Brower said of the scene in January, "The only butterflies that remained dry (in the freezing rain) were the ones deep inside the clusters." Once they were wet, they froze to death during the cold night. He described reaching into piles of dead monarchs a foot deep.

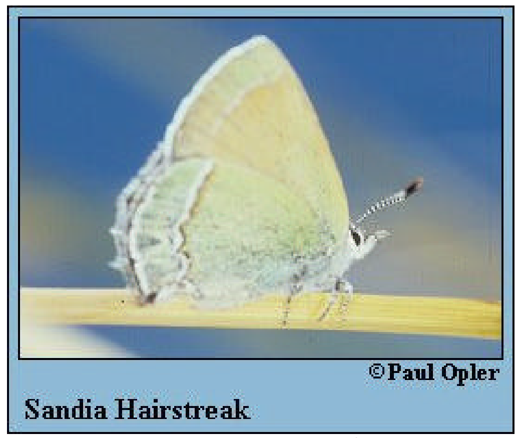
Monarchs migrate northward in spring, stopping to lay eggs in the southern United States, including in Eddy County, NM. The butterflies that develop from those eggs continue the journey and, by summer, butterflies reach as far north as Canada, a 3,000-mile total migration. Then the monarchs reverse the amazing trip every fall. There, they winter in massive clusters that "hang like Spanish moss from the boughs of Michoacan fir forests," according to the *Guardian Unlimited*. The epic migration is so exceptional that scientists have called it an 'endangered biological phenomenon.' Such a long migration is subject to all kinds of habitat threats. It is important to protect all the bits of habitat along the way, like the milkweeds right here in Eddy County and CCNP. Milkweeds are the all-important 'host plants' for monarchs, where eggs are laid and caterpillars feed.

According to the *National Post Online:* "Scientists will know in coming weeks how precarious the situation of the devastated populations has become, as they get a better sense of how many millions survived and what shape the butterflies are in as they begin to move north." Said Dr. Karen Oberhauser, a monarch ecologist at the University of Minnesota, "A bad winter followed by a bad spring could be catastrophic."

[Further reading: www.nationalpost.com for February 12, and www.guardian.co.uk for February 13.]

New Mexico Names Official State Butterfly

Our state now has a state butterfly to go along with its many other state symbols, such as the state flower (soaptree yucca), state bird (roadrunner), and the state question ("Red or green?") During the 2002 New Mexico legislative session, the legislature passed a joint memorial giving the honors to the Sandia hairstreak.



New Mexico state butterfly.

Though its name suggests northern New Mexico, the Sandia hairstreak does live and breed throughout much of New Mexico, including Eddy County, west Texas and northern Chihuahua. Its all-important 'host plant' (where eggs are laid and caterpillars feed) is beargrass, *Nolina* sp. [Of course, beargrass isn't a grass but a relative of the yuccas and sotol.] CCNP harbors lots of beargrass, providing prime habitat for the state butterfly.

The bill, known as HJM1, is titled, "A joint memorial recommending that New Mexico consider naming the Sandia hairstreak the official New Mexico butterfly." Some of the HJM1 language is below:

> *WHEREAS, butterflies enhance the beauty of the environment, and naming a butterfly symbol would benefit tourism and the economy of New Mexico by bringing attention to a New Mexico butterfly, by adding credibility to New Mexico among entomologists, which may encourage scientific research in the state, and by providing educational opportunities for study and appreciation of the butterfly and its habitat; and*
>
> *WHEREAS, naming a New Mexico butterfly would enhance awareness of the importance of butterflies, in ecosystems as important pollinators for*

wildflowers and agricultural crops and promote the conservation of our natural wildlife heritage; and

WHEREAS, the Sandia hairstreak symbolizes the ability of New Mexican residents to thrive year-round in a semiarid climate where different years bring floods and droughts and where the terrain is beautiful but rugged; and

WHEREAS, the Sandia hairstreak is one of about twenty-five different species of hairstreaks in the gossamer-wing family residing in New Mexico, and it is small and gold and green in color and it lives in and among beargrass plants, where its pink, lavender and white caterpillars eat beargrass flowers, making the butterfly and its caterpillar easy to identify; and

WHEREAS, the Sandia hairstreak, a New Mexico native, does not migrate, but stays in the New Mexico landscape year-round and has not been designated as the state butterfly for any other state;…

With 318 species, New Mexico is the state with the third-highest butterfly diversity, after its neighbors Texas and Arizona. The list of butterflies known for Eddy County contains 127 species. So far, biotech Gavin Emmons has documented at least 104 butterfly species in our park (see *Canyons and Caves*, Winter 2000-01).

[Further reading: www.npwrc.usgs.gov/resource/ for NM butterflies and http://legis.state.nm.us for NM legislature. Renée West still has a few free posters from NM Game and Fish and NM State Parks called "New Mexico, Butterfly Haven." They are for educational purposes. Call ext. 364.]

CAVE SCIENCE AT CARLSBAD CAVERNS NATIONAL PARK: 2000-2001 REVIEW

by Paul Burger

Summary

There has been a great deal of active research going on in the backcountry caves of Carlsbad Caverns National Park. Due to a culvert replacement project Lechuguilla Cave was closed for most of 2000 and part of 2001, so much of the research was centered in Spider Cave. This report is intended to update cave scientists, cave surveyors, and the interested public on what has been going on in the past two-years and to provide some very preliminary results of these studies. The following summary has been compiled from trip reports and communication with the investigators. Some of the information has been reported at conferences this year and can be found in the references listed at the end of this report. If any researchers have conducted trips or presented papers not shown below, please let me know.

Some of the long-term projects that continued this year, include a study of life in extreme environments headed by Diana Northup and Penny Boston, a study that could provide analogs to Martian life by Mike Spilde, and a water tracing study by Jake Turin.

Microclimate and mineral geochemistry of Spider Cave

<u>Rick Hazlett, Michael Queen, Garrett Miller, Alexandra Plank</u>

The purpose of this study is to derive a microclimate model of Spider Cave using humidity, CO_2, and radon. The investigators also hope to interpret the speleogenesis of the cave based on mineral chemistry.

August 20-21, 2000-Spider Cave

The team placed four Hobo data loggers in several places in the cave to record temperature and relative humidity data. They also collected twenty-one rock and small mineral samples from many locations throughout the cave.

January 9, 2001-Spider Cave

The team removed the Hobo loggers to download the data. No additional rock samples were taken.

Environmental Disturbance of Oligotrophic Bacteria and Water Quality

<u>Andrea Hunter, Penny Boston, Diana Northup, Cliff Dahm</u>

The three main goals of this study are to 1) determine the exact strain and source of *Hyphomicrobium* in Lechuguilla, 2) determine where the nutrient sources of *E. coli* and Hyphomicrobium are coming from and why the coliforms are thriving in the cave, 3) consider the symbiotic relationship between *Hyphomicrobium* and *E. coli*, and 4) determine the tubing type that will have the least impact on cave pools.

November 17-19, 2000-Lechuguilla Cave

Water samples were collected from Deep Secrets Pool and brought back to the UNM lab for use in the tubing experiment. Seven different types of tubing were used including tygon, teflon, polypro, rubber latex, vinyl, silicon, and Nalgene.

Microscope slides left in Deep Secrets, Lake Louise, and Red Lake were examined for slime growth. No obvious slime was apparent, so they were left to grow for an additional 2-3 months (or until the next trip). Two slides from Deep Secrets were collected aseptically for microscopic AOINT analysis.

Positive/negative coliform tests were performed on site by collecting small amounts of water in whirl-packs. These tests were run at Red Lake, Lake Louise, and Deep Secrets Pools. Coliform quantification was also performed on site collecting samples from Deep Secrets and Lake Louise. Additional water samples were collected for lab analysis at UNM.

January 25, 2001-Lechuguilla Cave

They collected the slides from Red Lake, Lake Louise, and Deep Secrets that were left on the January 2000 trip. They also collected small water samples from the Liberty Bell, Snow White Passage, and Oasis pools, and from the Deep Secrets, Lake Louise, Red Lakes, Pearlsian Gulf, Lake Chandelar, and Big Sky drinking sources to test for coliform. They also removed the slime-covered tubing from Red Lakes.

Andrea's study makes the following general recommendations:

1. Long-term monitoring of coliform levels at all the drinking water sources in the cave.
2. Replacing the tubing in the cave with special silicon or teflon tubing.
3. Using boot covers at urine dumps and drinking water sites.
4. Using sterile gloves and tyvek suits for approaching drinking water pools.
5. Using iodine tablets or water purification systems before drinking water from cave pools.

Terrestrial Biomarkers in Caves
Mike Spilde
The purpose of this study is to identify geologic material that may serve as indicators (biomarkers) of microbiological activity that will aid in the search for microbiological life in meteorites and eventual geologic samples from Mars.

January 14, 2000-Lechuguilla Cave
The team went into the cave to collect a DNA sample near the Void Overlook area. They carried dry ice in a thermos to preserve the samples for the trip out of the cave. Six culture inoculations were also done using corrosion residue from the same area.

July 22, 2000-Spider Cave
The team drilled a 1? diameter core hole into the wall of a side passage of the Third Joint Passage. Samples of rock and corrosion residue were also taken.

June 9, 2001-Spider Cave
Team collected rock and core samples from around the Grand Canyon.

Geomicrobiology of Lechuguilla Cave
Penny Boston, Diana Northup, Mike Spilde
The purpose of this study is to determine the nature of microbiological communities within corrosion residue in Lechuguilla Cave and to discover the interactions between microbial communities and the rocks, minerals, and air of the cave.

January 11, 2001-Lechuguilla Cave
Set up enrichment cultures at EA Junction to be left in the cave for a few weeks.

July 18, 2001-Lechuguilla Cave
Team ran the AO/INT process for Diana on corrosion residue samples in Sanctuary off the Western Borehole. This process helps determine the ratio of total cells to total respiring cells in order to see how "alive" a sample is.

July 27, 2001-Lechuguilla Cave
Team collected samples of corrosion residue in Northwest Passage and the PHD Room off the Western Borehole.

Geomicrobial Investigations of a Cave Deep Substrate Environment
Diana Northup, Penny Boston
The purpose of this study is to investigate the possibility that the corrosion residues in Lechuguilla and Spider Caves are produced through the actions of microorganisms.

March 11, 2000-Spider Cave
The team performed AO/INT analysis on corrosion residue near the Rabbit Ears.

April 29, 2000-Spider Cave
The team took samples of corrosion residue and punk rock near the Grand Canyon adjacent to the core holes taken by Spilde. They also took samples of the manganese-oxide coating on some white formations. AO/INT analyses were performed on all the samples.

May 22-23, 2000-Spider Cave
The team performed AO/INT analyses of corrosion residue near the Rabbit Ears. They also performed exoenzyme studies of corrosion residue at Rabbit Ears (TN4) and enrichment cultures using Hay extract, *Hyphomicrobium*-manganese, *Hyphomicrobium*-TO, and *Nocardia* media. A sample of the chocolate brown corrosion residue was collected for DNA extraction.

October 13-14, 2000-Spider Cave
The team performed manganese and iron enrichment cultures near the Grand Canyon area. They also set up a dissolution experiment using 24 limestone and dolomite slides inoculated with corrosion residue.

December 9, 2000-Spider Cave
The team performed AO/INT analyses of corrosion residue near the Grand Canyon area. They collected corrosion residue samples for lab testing.

January 9, 2001-Spider Cave
The team collected corrosion residue and punk rock samples from H2X for AO/INT analyses.

August 9, 2001-Spider Cave
The team took samples (corrosion residue and punk rock) from Rabbit Ears, A39X, on the way to the deep point (CY2A), and H1X. They also took some scrapings from the Gnome Dome and a small rock sample with manganese dendrites from Cactus Spring. Samples were also taken of the biofilm at the Grand Canyon.

Tracer Tomography in Unsaturated Fractured Rock
Jake Turin
The purpose of this study is to determine the water flow and solute transport properties of the unsaturated rocks overlying Lechuguilla Cave, using tritium and chlorine-36.

January 7-12, 2000-Lechuguilla Cave
The team collected water samples from Ghost Town, Nirvana, Lake Lechuguilla, Liberty Bell, Sugarlands, EF Junction, and Lake Chandelar.

May 5-7, 2000-Carlsbad Caverns
Several teams collected water samples from Guadalupe Room, Mystery Room, Left-Hand Tunnel, Main Corridor, and the Big Room.

February 11, 2001-Lechuguilla Cave
The team collected water samples from Liberty Bell and Lake Lechuguilla as well as vapor samples from Liberty Bell, Lake Lechuguilla, Boulder Falls, EF Junction, Great White Way, and Little White Bastard. The team also collected vapor samples around Big Sky camp and collected water samples from the water supply and Pearlsian Gulf. All water samples were collected using sterile equipment and Tyvek suits to prevent contamination of cave pools.

The vapor collection is a new experimental method using glass vials to collect small amounts of water vapor for stable-isotope analysis. Before entering the cave, the vials are loaded with a few milligrams of dried calcium chloride. Upon reaching the collection site, the vial is opened and allowed to remain open for a period of hours to days. The hygroscopic chemical absorbs moisture from the air and dissolves into a few drops of water. After an appropriate time period, the vial is resealed and shipped to the laboratory for analysis.

February 12, 2001-Lechuguilla Cave
One team headed to Underground Atlanta and collected water near FLV7, and Tower Place. The second team went to High Hopes to collect water from Vesuvius, Atlantis, and Blue Velvet Lake. On the way back to camp, they collected water samples from Lake Margaret and a very small sample from Briny Pool.

February 13, 2001-Lechuguilla Cave
The team collected samples from Snow Whites Passage on the way out of the cave and closed up all of the vapor-collecting vials.

June 14-16, 2001-Lechuguilla Cave
The team collected water samples from Lake of the Blue Giants, Stud Lake, Lost Pecos River, Lake of the White Roses, Quasimotos Lair, and Kachina Lake.

July 18, 2001-Lechuguilla Cave
The team collected water samples from Oasis Pool while doing some other work for Diana Northup and Andrea Hunter.

August 14, 2001-Carlsbad Cavern
The team collected water from the Rookery Pool, Chocolate Drop, No Name Room, and Devils Hill.

December 5, 2001-Carlsbad Cavern
The team collected water samples from the restoration buckets in Guadalupe Room. They then went to Lake of the Clouds and collected water from the main pool there.

Late Pleistocene and Holocene Paleoclimatology from Speleothems
Victor Polyak, Yemane Asmerom
The purpose of this study is to reconstruct the climate record for the Holocene and late Pleistocene for the southwestern US.

July 20, 2001-Carlsbad Cavern
The team collected a short, already-broken stalagmite from Bat Cave.

Geology of Lechuguilla Cave and Related Caves
Art and Peg Palmer
The purpose of this study is to determine the geologic and geochemical controls on the origin and pattern of Lechuguilla Cave and other Guadalupe Caves.

November 27, 2000-Spider Cave
The team obtained bedrock fragments from 2nd fissure in lower levels beyond Mace Room, between stations CY 4 and CY5. Weathering of the rock has left a thick rind of white paste that has slumped and aggregated to give the appearance of popcorn.

November 14, 2001-Lechuguilla Cave
Visited Rusticles area below Apricot Pit, to investigate origin of rusticles and related features such as rafts, bedrock weathering, water lines, and solution pans. A few loose samples of bedrock and bedrock weathering residue were obtained for later analysis. A short survey was run through the area, to obtain vertical control on geologic features (no stations left in cave, but tied to existing stations). Photos were made to document features and procedures.

November 16, 2001-Carlsbad Cavern
Ran a vertical survey from the Lake of the Clouds to the top of the slope leading to the lake (no stations left in cave), tying in geologic contacts and cave features such as corrosion levels, deposits, folia, spar. A few samples were obtained of loose fragments of bedrock from the ceiling and weathered bedrock paste from the floor.

November 19, 2001-Lechuguilla Cave
Examined bedrock in Yellow Brick Road and paste from weathering of the bedrock. Previous sampling in area showed that rare minerals such as huntite and magnesite had formed in the small hoodoos extending above the water level. It appears that these minerals are formed by evaporative fractionation of weathered bedrock from the ceiling. Photos were made to illustrate relationships. Two loose bedrock samples that had fallen from the ceiling were collected for later analysis.

In the FNH survey leading to Sulfur Shores, they examined the bedrock for evidence of an early rind of dolomite on the limestone. A few loose bedrock samples and weathered material derived from them were sampled for later analysis.

Pool Fingers and Chenille Spar: Investigation of a possible Biological Origin

Diana Northup, Penny Boston, Michael Queen

The purpose of this study is to determine if microorganisms help form pool fingers and chenille spar.

November 23, 2001-Carlsbad Cavern

The team photographed pool fingers in Texas Pool in the New Mexico Room and collected two small pool fingers that were lying on the bottom of Texas Pool. Noted filament-like protrusions from another broken rock piece on floor of pool. Pool fingers line the whole edge of Texas Pool. Collected pool fingers were fixed in a 2% glutaraldehyde solution. Found additional pool fingers behind the Chocolate Drop and photographed them. Right before these pool fingers they noted and photographed moonmilk-like deposits on the wall formations and noted that the outer layers of these formations were peeling away from the main formation. These peeling away parts were covered with moonmilk. Collected approximately 1 cm^2 sample of the moonmilk.

Web Links

Diana Northup (LExEn and other Lechuguilla studies) www.i-pi.com/~diana/

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PARK ELEVATORS: DETAILS CHANGE A FACTOID TO A GOOD STORY

by Bob Hoff

The shaft excavation for the first park elevators began in January 1931 and was finished the following August. Next came the infrastructure installation of the elevators followed by the hanging of the elevators themselves. After several delays and mounting frustrations came final testing and the elevators were put into operation in January 1932.[1]

The Old Elevator Entrance Building Circa 1953. (NPS Photo donated by John Watson)

This description of the elevator story is straight forward, and lacking in the human dimension of conflict, tension and complexity that actually accompanied its achievement. Of course, it is interesting to note that a fully functioning (most of the time) elevator began operating in this remote section of the Chihuahuan Desert over seven decades ago. But what

[1] Superintendent Monthly Reports, January 1931, August 1931, and January 1932

carries this story from a "factoid" level to a broader enriching level is the historical investigation of some of the participants, their thoughts, and their actions. How and why the elevators came about is really one of the richer historical questions to be asked.[2]

Even before geologist W.T. Lee's 1924 expedition and the monument's establishment in September 1924, behind the scenes discussions were taking place about the need for an "artificial entrance" to the cavern. In a letter[3] dated January 1924 from Frederick Coville, chairman of the *National Geographic Society* research committee to the organization's president, Gilbert Grosvenor, Colville said,

> *The present entrance is exceedingly inconvenient, involving a climb of about a thousand feet from the valley bottom and then a descent in a guano bucket through an artificial shaft constructed for the purpose of working the deposits of bat guano and remote from the spectacular and interesting portion of the main cavern. It is highly desirable that a new and convenient artificial entrance be made at the earliest possible date.*

In 1924, Lee suggested that a tunnel could be drilled from the plains outside directly into the Big Room and $5,000 was appropriated for the project. Later, $25,000 was appropriated.[4] Cost estimates for the project grew in a time of restricted budgets for all national monuments. Finally in 1925, wooden stairs, financed by the local chamber of commerce, were built through the natural entrance, making unnecessary the need for the tunnel. But the 200 + stairs made the trip into, and particularly out of the cave, difficult. Consideration for another alternative persisted.

Some stories behind the facts related to the construction of the first park elevators:

- In September 1927 New Mexico Senator Jones asked the NPS to look into the feasibility of providing an elevator or escalator in the cavern.[5]
- Superintendent Tom Boles felt that a better use of elevator or escalator money would be to spend it in revising the grades of trails. Regarding elevators, Boles said, *"Personally I believe that the fewer mechanical devices we have in the Carlsbad Cave, the better off we will be all around."*[6]
- Chief NPS Landscape Architect Thomas C. Vint wrote to NPS Director Horace Albright and said "…*but I believe we should avoid any mechanical assistance to the trip as long as possible because it will give the effect of going down into a mine or a ship, rather than a natural cave."*
- A Wichita Falls, Texas man applied for a lease and permit to install and run elevators at the caverns.[7] The request was denied.
- The local chamber of commerce was against the elevator idea, fearing that it would allow visitors to shorten their stay (and spending) in Carlsbad. Superintendent Boles wanted the chamber to see the park along national, not local, lines.[8]
- Chief Engineer F.A. Kittredge balked at the idea of a three story elevator built on the escarpment and suggested *"that for the psychological effect that it might be attractive to make a 'cave entrance' to the surface elevator."*[9]

This more detailed version of the elevator story is still simplified, but it adds more concrete examples than the factoid at the beginning. It demonstrates the elements of a good story—human beings seeing events, decisions, and choices in their individual perspectives and working them out—or not working them out. But one thing remains clear: how we came to have elevators was not inevitable; it depended on the circumstances and the personalities of the decision makers at the time. And that is what makes it a good story.

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[2] See "Time" on page 4 of *History in the National Park Service Themes and Concepts* at <http://www.cr.nps.gov/history/hisnps/npsthinking/revthem.htm>

[3] January 21, 1924

[4] Lee, unpublished report, 1926

[5] Acting Director A.E. Demaray to Superintendent Tom Boles, September 30, 1927 (Note: Demaray wrote to his superior Director Albright on May 7, 1930, saying "I am so firmly convinced that our plans for the installation of an elevator at Carlsbad Cave…have not been thoroughly studied with a view to solving all the practical problems involved that I urgently recommend installation be deferred until the most careful reconsideration has been given this matter…" and Albright replied on May 10, 1930, saying "I hope that you have not been influenced by Mr. Minter (who was the president of the chamber of commerce—B.H.) who very plainly does not want the elevator used to any extent because he wants to keep people over in Carlsbad, a policy I told him we would never adopt."

[6] Superintendent Tom Boles to Acting NPS Director A.E. Demaray, October 29, 1927

[7] John C. Kay to Secretary of Interior Ray Lyman Wilbur, October 31, 1929

[8] Superintendent Tom Boles to Director Horace Albright, March 31, 1930

[99] Chief Engineer F.A. Kittredge to Superintendent Tom Boles, May 27, 1930