# CANYONS & CAVES

## A Newsletter from the Natural Resources Offices
## Carlsbad Caverns National Park

**Issue No. 8** **Spring 1998**

**Edited by Dale L. Pate**

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### RESOURCE NEWS

SAVE OUR CAVE DAY was Friday, February 13th. Over 30 employees of the park and CCGMA helped restore and clean up various portions of Carlsbad Cavern. Participants acquired a better appreciation for Cavern resources, got a break from their normal duties, and had fun in the process. More days like this are planned for employees. The cave appreciated all the work also.

Takanobu Kajiki (TK) meticulously picks up trail debris from the Big Room in Carlsbad Cavern (NPS Photo by Dale Pate)

THE TITANIC AND LECHUGUILLA – Donald Davis has been corresponding with Dr. D. Roy Cullimore who is studying "rusticles" found growing on the Titanic, the famous ship that sank in extremely deep, cold waters of the North Atlantic many years ago. Evidently, the "rusticles" found in Lechuguilla Cave appear to be very similar to those growing on the Titanic.

BAT FLIGHT TALKS – With Bat Flight talks beginning soon, please remember to turn off the microphone as the bats begin to fly. Only use the microphone during the bat flight to effect crowd control. The bats thank you in advance.

FLASH PHOTOGRAPHY AT BAT FLIGHT – It is a thankless job to prevent flash photography during the bat flights. Nevertheless, it is important that we continue our efforts in this regard. We recently received a letter from Dr. Ken Geluso concerning the bat flights and flash photography. He states, ***"Because we do not know how much flashing lights from the amphitheater affect the bats and because we do not know that some types of artificial lights do affect bats, I recommend that flashes not be used during the evening exit flights of Mexican Free-tailed bats from Carlsbad Cavern. This was not my recommendation many years ago, when relatively few visitors were using electronic flash units."*** In other correspondence, Dr. Geluso has agreed to consider the problem and try to devise a way to scientifically determine if the bats are significantly bothered by the hundreds, if not thousands, of flashes the bats will be subjected to on a daily basis if we allow flash photography at the bat flight.

TWO RINGTAILS have been removed from the lunchroom/pumproom area of Carlsbad Cavern during the last two weeks in April.

THANKS to Lynn Carranza and Lance Mattson for removing a lot of unneeded tools and other assorted stuff from Slaughter Canyon Cave.

CONGRATULATIONS and welcome to Stan Allison. Stan has accepted the position vacated by Harry Burgess in our Cave Resources Office. Stan EOD's the week of May 10 and comes to us from Wind Cave National Park.

WELCOME to Lisa McWilliams and Mike Mulheisen, from Auburn University, who will be in the park through September studying the ecology of Mexican Free-tailed bats. Also welcome to Hannah Sproul who will be doing bird research at Rattlesnake Springs and Chris Roche, an SCA in the Surface Resources Office who will be helping with various biological studies.

THANKS to Rebecca Lee, Tom Kaler, and Paula Alexander for their volunteer efforts in the Cave Resources Office.

WELCOME to Gosia Roemer who will be volunteering in the Cave Resources Office from May through July. Gosia is from Poland and living in Germany.

## AGES OF CARLSBAD CAVERN AND LECHUGUILLA CAVE DETERMINED

*by Victor Polyak*

For the first time, the age of formation of dissolution-type caves has been determined by radioisotopic dating of the mineral alunite. Alunite occurs in several of the caves in the Guadalupe Mountains. This mineral formed as a by-product of speleogenesis. As the larger caves of the Guadalupe Mountains, such as Carlsbad Cavern and Lechuguilla Cave, were forming from waters containing significant amounts of sulfuric acid, the acidic reaction with clay minerals such as montmorillonite produced alunite and hydrated halloysite (endellite). Alunite is a potassium aluminum sulfate mineral. One of the isotopes of potassium (K), K-40 is radioactive and has a very long half-life of 1.25 billion years. K-40 decays mostly to the daughter isotopes of Ar-40 and Ca-40. After the alunite crystals formed in the caves, the K-40 atoms began to decay, and therefore, the daughter isotopes began to accumulate in the crystals. The concentrations of daughter isotopes relative to the concentration of K-40 are directly related to the elapsed time period since the formation of the alunite crystals. We used the Ar-40/Ar-39 method of dating to determine the age of the alunite samples collected from these caves. By measuring the age of the alunite, we have measured the age of formation of the caves.

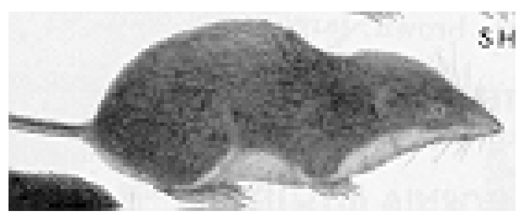
Our first dates show that Carlsbad Cavern and Lechuguilla Cave have formed during the late Miocene from approximately **6 million years ago to about 4 million years ago**. The ages of three levels have been determined so far. Glacier Bay alunite has yielded an age of **5.7-6.0 million years**. At a lower elevation in Lechuguilla Cave, alunite from Lake LeBarge yielded an age of **5.2 million years**. In Carlsbad Cavern, several samples along the Big Room level have ages of **3.9-4.0 million years**. Two caves (Cottonwood and Virgin) at higher elevations in Lincoln National Forest have yielded alunite ages of **11.3-12.3 million years**, and Endless Cave on Bureau of Land Management property (at the same elevation as Glacier Bay) were found to have an age of **6.0 million years**. These ages correlate very strongly with elevation of the alunite occurrences in these caves. The ages and elevations show how the water table has declined 1100 meters from the late Miocene to the present. The water table drop is most likely linked to uplift of the carbonate rocks that formed the Guadalupe Mountains. Our ages for these alunite samples indicate that the caves of the Guadalupe Mountains are much older than previously thought.

The ages resulted from a five-year study of the clay minerals of these caves conducted by Victor Polyak as part of his dissertation. Carlsbad Cavern National Park, Lincoln National Forest, and the Bureau of Land Management issued collection permits to Victor for clay samples. The mineralogy and sample processing was done at Texas Tech University in Necip Güven's clay mineralogy laboratory. The New Mexico Bureau of Mines and Mineral Resources in Socorro, New Mexico provided funding for the Ar-40/Ar-39 dating of alunite samples. Dr. Bill McIntosh and the Geochronology Laboratory at the New Mexico Institute of Mining and Technology in Socorro, New Mexico measured the Ar-40/Ar-39 ratios of the samples and provided the dates. Paula Provencio provided the electron microscopy and characterization of samples at Sandia National Laboratories.

## DESERT SHREW (*Notiosorex crawfordi*)

*by Ken Geluso*

In his checklist of mammals from Carlsbad Caverns National Park, Steve West (1985) states that only one desert shrew has been found in the park. This animal was collected at the entrance to Carlsbad Cavern in January of 1943. This information was derived from park files, and the specimen is presently housed in the National Museum of Natural History. Eventually, I will examine this individual and confirm its identification.



I obtained another record of the desert shrew in the park in 1991. On March 16, I placed two pitfall traps near the large natural entrance to Carlsbad Cavern. Both traps were sunk in soil along the base of limestone ledges on the south-facing slope of Bat Cave Draw. Vegetation in this area of rock outcrops included mescal bean, small junipers, sotol, prickly pear, catclaw, oreganillo, skeletonleaf goldeneye, Spanish dagger, and netleaf hackberry. On May 19, nine weeks after the traps were set, a desert shrew was found alive in one of the traps. Pitfall traps were monitored until mid-August before being removed, and the only other vertebrates captured were reptiles.

During my rodent study at the park, thousands of trap nights were employed using Sherman live-traps; however, no shrews were caught in these traps. The difficulty of obtaining shrews in conventional traps is well known among mammalogists. With the use of pitfall traps throughout the park, desert shrews surely will prove to be much more numerous and widely distributed than the present data indicate.

**Editor's note:** A third sighting of the illusive Desert Shrew was made by Lynn Carranza when she found a dead specimen at the entrance to Carlsbad Cavern recently.

*Taken from a report by Ken Geluso titled "Mammals of Carlsbad Caverns National Park: An Annotated Checklist" dated September 17, 1993.*

## THE BATTLE AGAINST WEEDS

*by Renee Beymer*
*Integrated Pest Management Coordinator*

Our battle against weeds leads to a long list of questions: What is a weed? What is a noxious weed? Why do they really matter? How do they get here? How can we get rid of them? Why do we have to use herbicides; can't we just pull them or ignore them? Can we ever stop using the chemical treatments? Can we ever win?

Often the answers vary with the land management philosophy. Within our agency, NPS Director Robert G. Stanton has called invasive species one of the most significant threats facing the natural and cultural resources of the National Park System. NPS Management Policies direct parks to manage exotic plant and animal species "whenever such species threaten park resources or public health".

Invasive non-native plants are now considered by some experts to be the second-most important threat to native species, behind habitat destruction, according to a federal multi-agency committee. In announcing the committee's report, due out this summer, Secretary of the Interior Bruce Babbitt said, "The invasion of noxious weeds has created a level of destruction to America's environment and economy that is matched only by the damage caused by floods, earthquakes, wildfire, hurricanes, and mudslides."

Here is a brief overview of the weed world from a national park perspective.

### *What is a weed?*

In the science of botany, 'weed' is not a technical term. The usual working definition is a plant that's in the wrong place. Of course, this means different things to different people. 'Noxious' is also an imprecise term. In many states, noxious weeds are legally determined by the state legislature. Since New Mexico has no noxious weed law, we are left to find other definitions. The dictionaries define 'noxious' as corrupting, unpleasant, or harmful.

Within the context of a national park, I think a good definition of 'weed' is a non-native plant. Other words that are used include 'exotic' or 'alien' plants. A useful definition of 'noxious' would be the weeds that spread quickly, threaten the ecosystem, and are really hard to get rid of. Plants that show up on other states' noxious weed lists are sometimes good bets, although these lists often include native plants because of their negative impacts on agriculture or livestock. (In California, a native wild iris is declared a noxious weed.) All the weed books included in the Reference section also list native plants. So when you read them, you have to keep in mind the working definition for the piece of land you're interested in. For example, one weed book lists creosotebush and mesquite, both natives in our park.

The NPS Natural Resources Management Guideline (NPS-77) has a chapter on exotic species management. Its term 'disruptive species' includes noxious weeds. Disruptive species are defined as exotic species that "have species-, community-, or ecosystem-level effects, significantly altering natural processes" or that "affect localized resources such as archeological features or scenic qualities on a broad scale".

By any of these definitions, Carlsbad Caverns National Park has many weeds and several noxious weeds. Worse yet, the park is surrounded by seed sources of other noxious weeds such as saltcedar (currently flowering in the landscaping at White's City). It's only a matter of time before these turn up in our park.

Keep in mind that common names change a lot around the country, so you may know a weed but not recognize its name here. For example, a common noxious weed called klamathweed in the Northwest, is also called St. John's wort (a popular herbal remedy). The plants listed on the attached CAVE weed list are all vascular plants, the so-called 'higher' plants. But there are other plants that can be weeds in our unique park environment: the subsurface. A report in our library titled "Control of Exotic Plants in Carlsbad Caverns" (Aley and Aley 1984) is all about algae and mosses down in the caves. They are photosynthetic organisms growing in an unnatural place. Where and what a weed is all depends on your context.

### *What weeds are in our park, and where are they?*

The park weed list at the end of this article is by no means complete. It includes only plants that we know are not native, and are listed either by the park or have matured enough by mid-April so they could be identified. More plants, newly started, will flower later. These include all the thistles, at least some of which are native.

You can see by the variety of plant families represented that we have high biological diversity when it comes to weeds. This also means that there is diversity in the reproductive, survival, and dispersal strategies of these plants, requiring a variety of approaches for control or eradication.

Most weeds grow in disturbed areas--soil or gravel surfaces that have been dug up or disturbed by trampling, driving, or even burning. These include trampled areas around the visitor center parking lots, roadsides and trails, houses, and even backcountry areas with histories of horse, cattle, and sheep use. In this park, some weeds seem to have arrived in seed form in fill material or gravel, perhaps even during last year's road project. Many weeds get picked up along the highway in vehicle tires (<u>including</u> employees' tires) and deposited here. They may be carried in inside horses and get deposited in the manure. Some blow in on the wind, some stick to clothes or wildlife, and some arrive in beautiful--but noxious--dried flower arrangements. Some of our noxious weeds were even deliberately planted as landscape plants by the park or by residents.

### *What should be, can be, will be done?*

*"There is no weed known which cannot be eradicated by constant attention, if the nature of its growth*

*be understood"* (Principle 1 of General Principles for Weed Control, quoted in Jaques 1959).

The ideal approach is a program, as outlined in the park's Resource Management Plan, that starts with a thorough inventory and map of the weeds and future threats. Then, strategies and methods are selected and carried out, based on the best way to handle each species. Plans for preventing future infestations follow. Few parks have a luxury of time and money, so we do what we can to tackle the worst weeds with the best methods we can, using any volunteer assistance and money that becomes available.

We continue to participate in the Noxious Plant Interagency Team, being led locally by the Bureau of Land Management in Carlsbad. BLM has published an insert section in the April 29 Carlsbad newspaper, including an article contributed by park staff. Nationally, BLM is working on education with an excellent brochure called, "Noxious Weeds--A Growing Concern". U.S. Forest Service brochures use slogans like, "Spread the Word--Not the Weeds!" and, for the attractive exotics, "the damage they do is not worth the view".

**Step 1: Inventory Weeds.** A thorough parkwide inventory could be fairly expensive. Until the money arrives, we are starting the process by collecting preliminary information about species and locations. The best place to start is near ourselves--around our buildings and roads--since these are the sites of most disturbances and seed depositions. You will probably see our staff and volunteers out looking at weeds, making notes, and collecting and pressing specimens to send off for identification. We will also keep a binder of pressed weeds for all park staff to use for identification.

**Step 2: Choose Strategies.** Once we know the number and location of each weed, we can begin to plan strategies for each species (or population), whether containment and control, or eradication. Total removal from the park (eradication) seems most desirable, but is not always possible or practical. If the plant has already become well established, has taken over a huge area, or is in an area where effective methods cannot be used, we may choose to leave it, but limit it from encroaching on uninfested land.

**Step 3: Choose and Implement Methods.** It's also important to know the strategies for dispersal, survival, and reproduction for each weed species. To work against weeds, you must construct strategies to get around their strategies. The reason that weeds are 'weeds' is that they have adapted clever ways to survive and spread. Some weed plants, like the *Melaleuca* tree in south Florida, produce billions of seeds per year. Some, like starthistles, have seeds that can remain in the soil for many years before they germinate. Others, such as field bindweed and tree of heaven, can grow back from their deep root systems even after herbicide treatments. Some weeds have hormones that trigger rapid maturation after they are pulled, thus producing live seeds even after the plant is dead.

This diversity requires us to be clever, diverse, and diligent in our approach. Hand pulling and strategically timed mowing can help with some. Some can be or must be dug up roots and all. Sometimes herbicides are the best bet as a practical matter of time and money, and to avoid more soil disturbance. Any strategy used must be well planned, timed properly, and monitored for effectiveness.

Overall, we will be using the best integrated pest management (IPM) methods possible. This means that chemicals (herbicides) will be used minimally, and only when they provide the most effective method. Hand pulling, cutting off flowers before they drop seeds, avoiding new ground disturbances, and revegetating disturbed areas will be used wherever possible. Herbicides will also be used, but we will take care to minimize their effects on native plants and wildlife, the caverns, and people.

Other important strategies that should go along with the program: prevention, education, and long-term commitment. **Prevention** means being on the alert for new weeds and removing the small infestations before they become established. Also important is to avoid disturbing new ground and to revegetate bare ground with native species wherever possible. **Education** includes making people more aware of their roles in the process. Whether or not we can claim victory in the battle depends partly on how well we define our goals, design our programs, carry out the work, and follow through. No weed infestation will be defeated without **long-term commitment**.

If you have any interest or questions, please contact me (x 364) or come by my office in Resource Management. If you are wondering about a possible weed in your yard or near your office, bring in a sample for identification.

***References*** (available in Surface Resources office or park library)


Agricultural Research Service (USDA). 1971. Common Weeds of the United States. Dover Publications Inc., New York.

Aley, Thomas, and Catherine Aley. 1984. Control of Exotic Plants in Carlsbad Caverns. Contract report to NPS Southwest Region.

Jaques, H.E. 1959. How to Know The Weeds. Wm. C. Brown Co., Dubuque, IA.

Martin, Alexander C. 1987. Weeds. Golden Press, New York.

Taylor, Ronald J. 1990. Northwest Weeds: The Ugly and Beautiful Villains of Fields, Gardens, and Roadsides. Mountain Press Publishing, Missoula, MT.

Whitson, Tom D., editor. 1992. Weeds of the West. Western Society of Weed Science, Newark, CA.

**PRELIMINARY LIST OF WEEDS OF CARLSBAD CAVERNS NATIONAL PARK**

| Common name | Scientific name | Family |
|---|---|---|
| woolly mullein | *Verbascum thapsus* | snapdragon |
| Malta starthistle | *Centaurea melitensis* | sunflower |
| other starthistle or knapweed | *Centaurea* sp. | sunflower |
| tree of heaven | *Ailanthus altissima* | quassia |
| bermuda grass | *Cynodon dactylon* | grass |
| Siberian elm | *Ulmus pumila* | elm |
| rabbitsfoot grass | *Polypogon monspeliensis* | grass |
| wild oat | *Avena fatua* | grass |
| Lehmann's lovegrass | *Eragrostis lehmanniana* | grass |
| field morning-glory (bindweed) | *Convolvulus arvensis* | morning-glory |
| horsenettle | *Solanum carolinense* | nightshade |
| white horehound | *Marrubium vulgare* | mint |
| henbit (dead nettle) | *Lamium amplexicaule* | mint |
| Dalmatian toadflax | *Linaria dalmatica* | snapdragon |
| common dead nettle | *Lamium amplexicaule* | mint |
| blue vervain | *Verbena hastata* | verbena |
| various clovers | (various) | legume (pea) |
| various thistles | (various) | sunflower |
| filaree (crane's bill) | *Erodium cicutarium* | geranium |
| curly dock | *Rumex crispus* | buckwheat |
| various sowthistles | *Sonchus* sp. | sunflower |
| various pepperweeds | *Lepidium* sp. | mustard |
| flixweed | *Descurainia sophia* | mustard |
| field pennycress | *Thlaspi arvense* | mustard |
| spurge | *Euphorbia* sp. | poinsettia |
| Russian thistle | *Salsola* sp. | goosefoot |
| Mediterranean barley | *Hordeum hystrix* | grass |
| Johnson grass | *Sorghum halepense* | grass |
| sandbur | *Cenchrus incertus* | grass |
| crabgrass | *Digitaria sanguinalis* | grass |
| Russian olive | *Elaeagnus angustifolia* | oleaster |
| dandelion | *Taraxacum officinale* | sunflower |
| woodsorrel | *Oxalis corniculata* | woodsorrel |
| tumble mustard | *Sisymbrium altissimum* | mustard |
| London rocket | *Sisymbrium irio* | mustard |
| kochia | *Kochia scoparia* | goosefoot |
| black medic | *Medicago lupulina* | legume |
| white sweetclover | *Melilotus alba* | legume |
| yellow sweetclover | *Melilotus officinalis* | legume |
| buckhorn plantain | *Plantago lanceolata* | plantain |
| wild oat | *Avena fatua* | grass |
| rescuegrass | *Bromus catharticus* | grass |
| Japanese brome | *Bromus japonicus* | grass |
| barnyardgrass | *Echinochloa crus-galli* | grass |
| goosegrass | *Eleusine indica* | grass |
| stinkgrass | *Eragrostis cilianensis* | grass |
| annual bluegrass | *Poa annua* | grass |
| rabbitfoot grass | *Polypogon monspeliensis* | grass |
| common purslane | *Portulaca oleracea* | purslane |
| African rue | *Peganum harmala* | caltrop |
| puncturevine | *Tribulus terrestris* | caltrop |
| Scotch thistle | *Onopordum acanthium* | sunflower |

## DATELINE LECHUGUILLA

*by Jason M. Richards*

LECH CRITTERS

During the NASA expedition in November, Serban Sarbu, a well known Romanian speleologist, discovered collembola (spring-tails) on a small pool in Snow White's Passage in the Southwest Branch of Lechuguilla. Until Serban's discovery, Diana Northup's documentation of cave invertebrates in Glacier Bay was the furthest extent into the cave of known invertebrates. The collembola were positively identified and found to be one of the most commonly known species found in many caves throughout the United States.

LECH UH-OH'S

An interesting phenomenon has been happening to the ropes in Lechuguilla lately. Mold has been growing on all the new ropes as they are replaced in the cave. Jim Werker from Albuquerque has tested these ropes that have had mold growing on them for any strength loss and the results are disturbing. A significant decrease in strength, enough to cause concern, was noted. It is thought at this time that the sizing placed on the fibers when the nylon is actually made may be the food source for the mold. Both DuPont (manufacturer of the nylon fibers) and PMI (manufacturer of the rope we use) are interested in this problem and further research is expected.

CLEAN-UP'S

More and more interest in restoration projects in Lechuguilla is surfacing. Under the leadership of Jim and Val Werker and Lois Lyles, restoration crews have made major accomplishments in the Western and Southwestern branches of the cave. Lois Lyles is planning a restoration project in April to the Near East, which is an area that is hard to get to and often neglected. During the same week, Jim and Val will be in Lechuguilla to set more permanent photo-monitoring points.

LAST EXPEDITION FROM 1997

The Rod Horrocks, Patty Kambesis expedition of March 7th through the 14th was the last expedition for 1997. Unfortunately, the scheduled expedition for '97 had to be rescheduled, and March of '98 was the closest convenient date. Although all the data was "mop-up", the expedition netted over 8,000 feet of new survey bringing the total length of mapped passages in Lechuguilla Cave to 96.24 miles. There are six more survey/exploration expeditions scheduled for 1998. It is possible that the **100-mile** mark may be reached by the end of the year . We're knocking on your door "Jewel Cave", and there's no end in sight!!!!

MURDER IN LECH

A new book is on the stands! *Blind Descent* by Nevada Barr, is a mystery about a murder in Lechuguilla Cave. Although I'm in the process of reading it, I've heard rave reviews from others that have read it. Nevada Barr has written several mysteries that take place in National Parks. *Track of the Cat*, one of her first novels, took place in Guadalupe Mountains National Park.

## LUNAR LECHE *by Paula S. Alexander*

As you begin to walk through the Sherwood Forest area of Left-Hand Tunnel, the texture of the floor becomes somewhat sticky and slick. You have just walked upon a substance that is known as hydromagnesite moonmilk. It is called moonmilk because of its texture and no it did not come from the moon. Moonmilk is a term that describes the soft, pasty substance that looks and feels like cream cheese when it is wet, but when dry is powdery like chalk powder. Moonmilk is popular because of its unique role in history, particularly in medicine. It has been used for reasons such as a dressing for wounds to stop bleeding and to induce mother's milk.

The moonmilk in Left Hand Tunnel is developed along the reef-forereef-facies contact. (Hill, 1987) The best theory on how moonmilk forms is that it precipitates directly from ground water as do other speleothems, but that the crystals in the deposit never grow large. The crystalline nature of the minerals gives the moonmilk its pasty and plastic-like qualities. Another theory is that it is formed as part of the life cycle of microorganisms. Moonmilk is also believed to be formed from the disintegration of rock or speleothems.

Although there seem to be many theories on its formation, moonmilk does make an interesting topic of conversation while walking through the pool areas of Left-Hand Tunnel. Another interesting note is that the orange flagging tape is discoloring the floor in this area! Check it out. Anyone with ideas that would prevent the dyes from the flagging tape from running onto the cave floor are asked to send them to the Cave Resources Office.

For anyone interested in learning more about moonmilk or lots of other minerals, the following books are excellent references.

Hill, Carol, and Forti, Paolo, *Cave Minerals of the World*, 1986, pp. 46-47.

Hill, Carol, *Geology of Carlsbad Caverns, and other caves in the Guadalupe Mountains, New Mexico, and Texas*, Bulletin 117, 1987, pgs. 58, 144, & 125.

Moore, George W., and Sullivan, G. Nicholas, *Speleology The Study of Caves*, Zephyrus Press, Inc.,, 1964, pgs. 79-82.

## WILDLAND FIRE MANAGEMENT IN THE GUADALUPE MOUNTAINS

*by Tim Stubbs*

*"These four bodies are fire, air, water, earth."*
*Aristotle,* Meteorologica

This paper presents some of the available literature that supports the use of wildland fire and prescribed fire in the Guadalupe Mountains and in the adjacent Upper Chihuhuan Desert Biome. It is also a collection of personal observations and communications regarding wildland fire in the Guadalupes. It is hoped that the reader will then understand why the Fire Management Program at Carlsbad Caverns and Guadalupe Mountains

National Parks supports frequent, low intensity wildland fire in the park's wilderness areas. The management of both parks believes that all scientific research and other available evidence supports this management approach as that most close to what nature would be doing were we not present.

***FREQUENT FIRE?***

The evidence is very abundant that for centuries prior to settlement, large unrestrained wildland fires burned every few years in the Guadalupe Mountains. Lightning ignitions are frequent, statistically more frequent than in most of the rest of North America. (Komarek, 1967, Schroeder et al, 1977) Tree ring analysis completed by the University of Arizona (Swetnam et al, 1994, Baisan et al, 1995) throughout the region and locally in the Bowl area of Guadalupe Mountains National Park suggests the median frequency of fire between 1700 and 1900 to be less than 10 years. Fire scar analysis also showed these wildland fires to be low intensity surface fires that were rarely damaging to the overstory trees under which they burned. This study and also historic records in the Southwest (Bahre, 1985, suggest that these fires were often very large, in the thousands of acres, and burned for weeks at a time in certain dry years, especially in the lower grasslands (Pyne, 1982).

Ponderosa and pinyon pines in the west end of Carlsbad Caverns National Park similarly show numerous fire scars (Ahlstrand, 1981 & personal observations) and Texas madrone and Torrey yuccas similarly display numerous fire scars throughout the lower elevations. Ahlstrand generalized that, between 1697 and 1922, 30 years appeared to be the maximum interval between major fires in the mixed conifer of the higher Guadalupes.

Studies done by Texas Tech University (Wright, 1974; Bunting & Wright, 1977) have suggested a similar high frequency, low intensity fire regime throughout the Upper Chihuahuan Biome of West Texas and Southeast New Mexico. Other Texas Tech researchers have shown more recently the beneficial effects of fire in the diversity of desert scrub communities adjacent to the Guadalupes. (Monasmith et al, 1996)

***LARGE FIRES?***

It is well documented that the last very large natural, unsuppressed fire in the Guadalupes occurred before 1922 (Ahlstrand, 1980, fire history maps of both parks). After this time a combination of heavy grazing and a full fire suppression policy limited ignitions to generally very small in size. In the Carlsbad Caverns area goats and sheep heavily grazed all available forage beginning in the 1920's and continuing until about 1942. The Guadalupe Mountains National Park was subjected to various amounts of grazing through this period and was know to have three times the calculated carrying capacity of cattle in the few years prior to its protection as a national park (personal communication with Kenneth McCollaum, USFS Fire Management Officer 1968-1992 and lifetime Queen, NM rancher and resident).

The next very large fire after 1922 did not occur until 1974. The Cottonwood Fire in the Upper Slaughter Canyon area was over 15,000 acres despite formidable USFS/NPS efforts to suppress it. The X-Bar fire in 1976 was 12,000 acres in upper Dark Canyon. It was widely agreed that the regime of periodic large fires in the Guadalupes had returned due to the cessation of grazing on NPS lands and the reduction of heavy grazing on USFS lands.

Between 1974 and the present there have been numerous lightning-ignited fires in the area of both national parks that reached several thousand acres despite a continued full suppression policy. Many of these are listed and described in the fire management plans for the two parks (Stubbs, 1995; Sullivan, 1997), and in both parks' fire report files. There similarly occurred many large wildfires and management ignited prescribed fires on the adjacent Lincoln National Forest during this period even while light grazing still continued.

In 1990, in my first year here as Fire Management Officer, I personally witnessed two such large fires. The Big Fire covered over 33, 000 acres of timber, desert shrub, and semi-desert grassland in about a week and the Frijole Fire covered about 6,000 acres of timber in just 4 days, much of that as a crown fire. Both of these fires became as large as they did despite our best efforts to suppress them using all of the modern suppression tools available and despite spending in excess of a million dollars per each effort. I remember looking at the lightning-ignited Frijole Fire in the heart of Guadalupe Mountains National Park from an airplane and thinking that it very easily could burn all the way to White City some 30 miles distant. I have since similarly seen several lightning ignited large fires in 1993 and 1994 that easily could have become many thousands of acres had we not suppressed them with a heavy hand and at great expense.

The current El Nino (ENSO) phase is leading into a similar La Nina situation that occurred during those years of high fuel loadings and dry, windy conditions. I think we can expect to see similarly large and intense fires again soon in the Guadalupes. This notion has been supported by ongoing ENSO/fire occurrence research being conducted at several universities (personal communication with Tom Swetnam, University of Arizona).

***CAN FIRE BE BENEFICIAL?***

With all the evidence of frequent large fires, one wonders how they must effect the ecosystem as a whole and the individual species within that ecosystem. So what do we know about the effects of fire on the parks?

The effects of fire on the ponderosa pine forests such as is found in the high country of Guadalupe Mountains National Park are very well documented and understood (Ahlstrand, 1980, Wright, 1977, Swetnam et al, 1994). High frequency and low intensity fire generally increases vegetation diversity while preventing fuel accumulation and and subsequent overstory consumption. Frequent fires maintain healthier forests. Infrequent fires lead to less healthy forests beset with overstocking, surface fuel accumulations, disease, insects, and dwarf mistletoe. Lack of fire sets the stage for inevitable holocaust.

Similarly, in the lower country of Carlsbad Caverns, Kittams (1973) noted that the aggressively colonizing agavaceous species such as lechuguilla and sotol were generally killed by frequent fire and were replaced by sprouting shrubs and grass/forb species. Bunting and Wright (1977) found that after two years fire had reduced total shrub cover by 43% and total grass cover by 72% while increasing forb and shrub sprouts by 650%.

Ahlstrand (1981) showed that biodiverstiy in the desert shrub/semi-desert grassland communities was greatly increased by burning. He went on to say:

"The practices of suppressing fire and excluding livestock grazing, both in effect for more than 30 years on much of the study area, have permitted grasses, as well as woody and rosette shrubs, to accumulate in quantities sufficient to support fires over extensive areas. With periodic burning of perhaps every 10 to 15 years in this community, grasses can be expected to increase as scrub cover is reduced. In the absence of additional fires, coverage by shrubs can be expected to slowly increase again at the expense of grasses and forbs".

Ahlstrand completed a lengthy literature review in 1981 showing the beneficial effects of fire on 88 selected species of plants. (Ahlstrand, 1981)

The NPS continued Ahlstrand's studies with photopoints in 1988 (Walters, 1988) and augmented in the early 90's by photopoints and line intercept transects (Mulligan, 1996) have consistently shown a postburn increase of biodiversity and grass/forb density coupled with a marked decrease in agavaceous species cover and density. These studies continue.

The New Mexico Game and Fish Department, BLM, and USFS adjacent to the park have cooperated in several large (up to 16,000 acres) prescribed burns for the purpose of enhancing the deer herd. Their subsequent monitoring of these areas consistently shows increased numbers and vigor of deer as a result. I have personally seen the largest deer herds I have seen in the Guadalupes in post burn greenup of our larger prescribed burns and wildfires. I have also seen heavy deer browse cause damage to resprouting shrubs in isolated small burns that drew large numbers of deer to the relatively small amount of browse forage made available by the small burns.

The Fire Effects Information System (FEIS), an Internet accessible free access database maintained by the U. S. Forest Service, (Fischer, Miller et al, 1996) describes fire's effects on very many of the plant and animal species found in the Guadalupes. The contributors were largely from researchers of the various universities of the West Texas and Southern New Mexico area. Almost to the entry, fire's effects on individual species is described as positive both for the individual species as well as for the ecosystem or niche in which it lives.

The Texas madrone, for instance, is known to occur in riparian and seep areas of the Guadalupes. These areas tend to become brushy and quite flammable if not subjected periodically to fire. Texas madrone is killed by high intensity fire and does not resprout (from FEIS). Most large trees show abundant fire scars (personal observation) which shows they have survived past low intensity fires. Could they survive a high intensity wildfire if highly flammable brush was allowed to grow unimpeded underneath them as has occurred in much of McKittrick Canyon?

The NPS has also begun extensive study on fire's effects on a threatened species. Coryphanthus leei, found at Carlsbad Caverns National Park, was subjected to a low intensity prescribed fire during 1993. Preliminary conclusions (Mulligan, Route, 1993) are that this species is quite tolerant of low intensity fire, probably due to its normal habitat of flat, exposed, rocky shelves generally devoid of most other fuels. The 1993 burn showed mortality of about 10% which was likely caused by fire. My personal observations of the effects of high-intensity wildfire on this and other similar cactus species has approached 90% kill in some areas of the 1990 Big Fire!

Similarly, Thomas (1997) has shown that fire can have various effects on succulent species in semi-desert grassland ranging from beneficial in low intensity fires to extremely detrimental in high intensity fires.

There are many other examples of management's need to compromise between the use of prescribed fire and the protection of individual species (LaRosa, 1995). The key is that these compromises have been shown repeatedly in the management of wilderness ecosystems to best protect overall ecosystem health and integrity. An allowable take of individual specimens of rare species is necessary to protect the species and ecosystem as a whole.

***SO WHERE ARE WE GOING?***

Both national parks, the Lincoln National Forest, and the Bureau of Land Management are engaged in discussions to develop an Interagency Fire Management Plan. The draft of this plan defines the Guadalupe Mountains as an fire dependent ecosystem to be managed under consistent fire management policy despite the various jurisdictional authorities.

Wildland fire will only be fully suppressed if it becomes a threat to property or human safety. The "appropriate management response" will be applied to each ignition to ensure that resource management goals are being realized and that fire can continue to be an integral part of the management of the ecosystem.

Management ignited prescribed fire or manual fuel reduction will also be undertaken adjacent to developments, property, and sensitive resources to protect them from unwanted fire. Both national parks have identified large tracts of land for reintroduction of low intensity wildland fire during the next few years through the use of management ignited prescribed fire.

Monitoring of the effects of fire on the flora, fauna, soils, air, and viewshed will continue. Funding has been requested for an exhaustive literature review on fire effects in the Upper Chihuahuan Desert Biome. University involvement in both literature review and data analysis will continue to be encouraged and subsidized to ensure that the suspected benefits of wildland fire continue to be realized.

The reintegration of wildland fire into the Guadalupe Mountains ecosystem will continue well into the next century and beyond. We will strive to restore the ecosystem, the processes, and the common and rare species, including that lately rare species: wildland fire.

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## WHAT IS THAT BLACK STUFF?

*by Jason Richards*

Have you ever gone to Spider Cave and had someone ask you what that black stuff is growing on the white formations that makes a fern pattern.... or .... Why did they try to burn that stalactite with a torch? Have you ever gone to Lower Cave and have someone ask you why some of the formations are black? In all the cases in Spider Cave, and more than likely all the cases in Carlsbad Cavern, ***manganese oxide*** is the culprit.

Manganese oxide minerals appear in caves as black coatings on walls, floors or speleothems. Black stains on flowstone or other secondary deposit formations are probably manganese oxide; however, the black coloring occurs between individual calcite grains and are not a part of the crystal structure of the calcite. Although the black coloration of speleothems is usually manganese oxide, this is not always the case. Other factors such as soot from ancient forest fires, tar, organic matter, or even bat guano may cause the black coloration. Specialized bacteria, *Clonothrix fusca* and *Leptothrix discophora*, found in domestic water supply systems are known to precipitate manganese and are also found in caves. These bacteria are thought to be responsible for the black coloration on some flowstone and cave walls.

In some caves, manganese minerals occur as a "fill". This term is used to describe all clastic deposits within a cave. One of the best examples of a manganese fill would be from Jewel Cave in South Dakota. The manganese fills are very powdery when dry and slippery when wet. Whether dry or wet, a caver usually looks as if he or she should have come out of a coal mine rather than a cave.

*References: Cave Minerals of the World, C. Hill, P. Forti; Speleology the Study of Caves, G.W. Moore, G.N. Sullivan*

## LECHUGUILLA TRIVIA
## DID YOU KNOW?
*by Jason Richards*

You must negotiate approximately:

* 475 feet of rope to reach EF junction; (the junction that divides into the major branches of the cave) -665 feet below the surface.
* 585 feet of rope to reach the Chandelier Ballroom in the Southwest branch -890 feet below the surface.
* 730 feet of rope to reach the Western Borehole; -930 feet below the surface.
* 1018 feet of rope to reach the Near East; -1150 feet below the surface.
*1218 feet of rope to reach the Far East (at the top of the Aragonitemare climb) -750 feet below the surface.

Double these values to get back out.

## SECOND VOYAGE OF THE PS MUNYAN
*by Gary Vequist*

On a not so long ago windy day the Paddle Ship Munyan weaved through the overgrown Pecos River jungle. This time Captain SeaQuest and Deckhand Barry Ballast set voyage on a Quest for a floatable whitewater in Eddy. Did we find it? Not exactly! Between Carlsbad and Loving our venture repeatedly grounded on the stream bed, but we were able to pole ourselves free. And, if that was not enough we encountered two dams that required difficult portages.

What we did find was a cool spot for wildlife. Over a dozen species of waterfowl were sighted including the favorite wood ducks and cinnamon teals. Too our surprise there were white pelicans and cormorants on the choppy waters of six mile lake. Also, in great abundance were black-crowned night heron and great blue heron. Scurrying to their hideouts were carp, bass and catfish which had never seen the likes of our surface craft.

This entire waterway although lined with saltcedar showed only slight riparian disturbance along the way. though, I wouldn't exactly call it wilderness. Along the 16 mile route we saw only two locations where cattle could access the river. More common sights were fisherman trails. And, then there was this spectacular waterfall created by the Carlsbad sewage outflow pipe. A diving duck fishing paradise.

Cave exploration doesn't offer the challenges and dangers of finding whitewater in the desert. So our quest will continue to find the southern passage to Red Bluff Lake.

## FROM REEF TO CAVES *by Dale Pate*

From 230 to 280 million years ago, a limestone reef, comprised of algaes, sponges, and a host of other marine animals and plants built up along the edge of an inland sea. To the north, a series of limestones were laid down horizontally during this time in swallow lagoons. This area is considered to be the backreef. To the south, a steep, underwater rubble slope plunged down from the reef itself and fell into open, deep waters. This was known as the forereef.

Slowly, over a long period of time, the ocean receded and the entire area was covered in thick sediments. The uplift of the Guadalupe Mountains began 20 to 40 million years ago. As this uplift proceeded, sediments were eroded from above the reef and fresh water began to infiltrate the fractures in the limestones of the reef and the backreef. From far below these limestone areas, hydrogen sulfide gas moved upward from oil and natural gas deposits. This gas combined with oxygen in the fresh waters to form a mild sulfuric acid that dissolved the main portions of the caves out of the limestone.

As the water receded from the water-filled passages, the ceilings in many places collapsed causing most of the breakdown we see in the caves today. And as the cave passages became air-filled, continued rainfall on the surface filtered down through the fractures dissolving small bits of limestone known as calcite. As this water dropped into rooms and passages, it precipitated the calcite it had picked up on its way down from the surface and formed the many decorations or speleothems we see today. During this time, rainfall was much more abundant on the surface and lots more water found its way into the cave. As the conditions on the surface changed from a wet environment to a much drier one, less water infiltrated to the caves and speleothem growth slowed and stopped in many areas. The cave we see today reflect these drier conditions.

*Material for this article was borrowed from the publication "Geology of the Delaware Basin, Guadalupe, Apache, and Glass Mountains, New Mexico and Texas" by Carol A. Hill published in 1996.*

## CALENDAR OF EVENTS

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| May | Rattlesnake Springs Bird Nest Monitoring |
| May | Mountain Lion Transects |
| May 1-Nov. 1 | Lake Cave closed because of the maternity colony of Fringed Myotis bats found there |
| May 16 | BCI-sponsored Mexican Free-tailed Bat workshop in Fredericksburg, Texas |
| June 6-10 | Restoration in Lechuguilla Cave led by Lois Lyles |
| June 13-21 | Survey in Lechuguilla Cave led by Gerry Petrie |
| June 22-26 | Restoration Camp at Carlsbad Cavern with CRF/NSS |