

CANYONS & CAVES

A Newsletter from the Natural Resources Offices
Carlsbad Caverns National Park

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Edited by Dale L. Pate
Special thanks to Dave Roemer, Celia Gomez, and Paula
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TABLE OF CONTENTS

Resource News	1
Cougars at Carlsbad Caverns	1
Women of Carlsbad Cavern: 1920-1940	3
The First Step in Science	5
Gray-footed Chipmunk	5
Geologic History: The Tobosa Basin and Woodford Sea	6
N.E.P.A. For Poets: A Primer	6
What is GPS?	7
Letters to the Editor	8
Calendar of Events	9
Index for 1997	10

RESOURCE NEWS

GOODBYE AND GOOD LUCK to Harry Burgess. He has resigned from his position in the Cave Resources Office to take a job with Eddy County as an Emergency Services Coordinator/Fire Marshall.

CONGRATULATIONS to Larry and Phyllis Weston. They are the proud new grandparents of granddaughter Anora Astra Weston who weighed in at 7 1/2 pounds.

WELCOME TO RENEE BEYMER, our new surface resources manager. Renee comes to us from Death Valley National Park.

MARTIAN CARBONATES - Penny Boston sends word that the Mars Global Surveyor Mission has obtained high-resolution photographs of Mars showing a 4,000 ft. high escarpment which clearly has bedding planes in the rock face.

THANKS TO BILL GARWOOD for installing easy-to-use light switches in the elevator lobby, pump room, lunch room area of Carlsbad Cavern.

CONGRATULATIONS to Suzie Cadell, Lin Donnelly, and Dale Smith. They received Fast-track awards for helping take care of Carlsbad Cavern. Keep up the good work!

COUGARS AT CARLSBAD CAVERNS

by Michelle Abodeely¹ and David Roemer

While *Felis concolor*, the "cat of one color," is one of the most abundant large predators in America's national parks, it is also one of the most elusive, solitary, and secretive animals anywhere. The cougar is the source of many myths, and has long stirred human imagination, yet reveals few clues to the mysteries of its reticent life.

Just a few centuries ago, the cougar was the most widespread mammal in the Western Hemisphere besides *Homo sapiens*. Continent-wide, 27 subspecies resided in as many different environments as exist in the Americas - from the jungles of Central and South America, to the deserts of the southwestern United States, and up to the icy expanses of Canada's northern territories (Hansen 1992).

With European settlement of the Americas, cougars and other predators threatening to livestock were targeted for eradication. In the 1600s, Spanish missionaries in California awarded a live bull for each dead cougar turned in. Throughout the 1700s, many eastern states paid bounties for cougars, a practice that did not cease until the late 1800s, when there was no longer a population to hunt. Many western states later employed professional hunters to kill what even Theodore Roosevelt, a dedicated conservationist, once called the "big horse-killing cat, destroyer of the deer and lord of stealthy murder with a heart craven and cruel" (Cochran 1984). Like the owner of a mansion who is restricted to just a few rooms, the great cat that once called this entire country its home is now found in just 11 western states. Three subspecies - two in the United States (the eastern cougar and the Florida panther), and one in Costa Rica - are now regarded as endangered. Beginning in the late 1960s, mountain lions began to receive some statutory protection. All states **except Texas** have now reclassified the cougar from a freely hunted "varmint" to a game animal

¹ Michelle was an SCA for Surface Resources in Fall 1997. This article is taken from a paper she wrote during her internship.

subject to some hunting restrictions. California has banned cougar hunting for nearly 20 years, except in specific livestock depredation cases.

Cougar Controversy at Carlsbad Caverns

Cougar management in southeastern New Mexico, heated up in the early fall of 1981. Area ranchers suspected an increase in sheep losses. Unguarded sheep can be easy prey for mountain lions and other predators and the economic losses to ranchers may sometimes be great. The ranchers informed the New Mexico Department of Game and Fish (NMGF) of the problem, reporting that the lions were killing their livestock, then taking refuge in Carlsbad Caverns and Guadalupe Mountains National Parks. As the controversy escalated, rumors and speculation intensified with some ranchers demanding that lions be killed within the parks.²

Assistant Secretary for the Department of the Interior, Ray Arnett, agreed to a proposal from the state to allow state game wardens, in coordination with park rangers, to kill lions if chased under "hot pursuit" (fresh trail - no more than 24 hours old) from a sheep kill. The state would have to get advance approval from the park to chase the suspected cat, at which point the two parties would pursue the cat together. Once found, the cat would be caught and relocated or killed. Arnett and William Huey, Secretary of the New Mexico Natural Resource Department, forged this agreement in early 1982, sparking protests from wildlife and national park advocates.

In September of that year, a coalition of environmental groups, including the Sierra Club and Defenders of Wildlife, filed suit at the U.S. District Court in Albuquerque. Public opposition to the agreement between the federal and state departments was expressed in public meetings, editorial articles, and hundreds of letters to the departments from all over the country. Many worried of the legal precedent the agreement could set for national park management of wildlife, and argued strongly for the protection of lions in national parks.

In March of 1983 the National Park Service was still promoting a "good neighbor" policy with ranchers concerning mountain lions, but the state of New Mexico was no longer interested. In April, Dr. Shirley Hill Witt, newly appointed successor to William Huey, retracted the state's original request to conduct hot pursuit lion control in the parks. The park subsequently withdrew the agreement.

² During the late 1970s, Guadalupe Mountains National Park authorized several "hot pursuits" and the trapping and relocation of lions to a private ranch in Texas. Seven lions were moved during 1975-1981, causing the death of an adult female lion. There were several instances of lion poaching in the park as well. The escalation of the lion issue coincides with the decision by the private rancher in Texas (who had been accepting the lions) to no longer accept relocated lions.

Ecological Study of Cougars at Carlsbad

The ongoing lion controversy drew attention to the lack of knowledge concerning cougars, particularly in the southwest where tracking the elusive cat is difficult. In listening to the opposing sides debate the issue, it was sometimes hard to believe that they were discussing the same animal. So in the summer of 1982, the National Park Service initiated a three-year research project to collect data on four aspects of cougar ecology: (1) population density, (2) population characteristics (age and sex ratios), (3) home ranges and distributions, and (4) food habits of the local lion population. The research, which involved trapping lions and outfitting them with radio-collars for telemetry tracking, was conducted under the leadership of Tom Smith with Harvey and Stanley Associates, Inc.

The final report (Smith and others 1986) makes for some interesting reading (it's in the park library). Major findings of the study were:

- **Density.** The maximum population density within the 400 mi² study area during the three-year study was 58 lions (24 adults, 12 juveniles, and 22 kittens). Density was 1 lion / 7 mi².
- **Home Range.** Average home ranges for adult males were 80 mi². Adult females were 23 mi².
- **Food Habits.** Mule deer remains occurred in 82% of all scats (feces) analyzed during the three-year research effort and, therefore, constitute the main prey item for the regional population. Porcupines were the second (15%) most abundant food item encountered followed by rabbits (7%), domestic sheep (6%), rodents (3%), cattle (2%), and goats (1%). Traces of raccoon, gray fox, aoudad, and elk were found in individual scat samples and are probably not a significant part of the diet.
- **Mortality.** 65 lions were killed during the study (21.6 / yr) of which 9 (14%) were unreported and would not have been discovered except through telemetry. Mortality was particularly high along the northern boundary of the park.

Cougar Monitoring in the Guadalupes

A cougar management plan and environmental assessment was subsequently prepared for both parks, recommending that the parks maintain the protection of mountain lions (as would be afforded to all native wildlife in national parks), and initiate population monitoring. Harvey and Stanley Associates, Inc. prepared a protocol for population monitoring (Smith and others 1988) that outlined the methodology we use today. We now have over 10 years of survey data, suggesting that population trends have been constant at Carlsbad Caverns (Harveson and others in press). The data does suggest a declining trend at Guadalupe Mountains during 1987-1992.

With unregulated lion harvests in Texas, and special allowances for harvests in southeastern New Mexico permitted by NMGF, Carlsbad Caverns National Park must remain vigilant in the protection of this magnificent cat. The park has an awesome responsibility to obtain the best scientific information on cougar population trends, and to

provoke the intellect and imagination of our visitors through the telling of the cougar's story. Mountain lions are an important part of our natural heritage and a key indicator of the health of our ecosystems. Their continued presence in the Guadalupe Mountains provides a measure of our ability to act responsibly as enlightened land stewards.

Next issue: *The San Andres Mountains Cougar Study (1985-1995) and Cougar Management in New Mexico.*

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THE WOMEN OF CARLSBAD CAVERNS: 1920-1940

by *Rebecca R. Lee*

Every visitor to Carlsbad Caverns National Park hears the name Jim White, Abijah Long, or Robert Nymeyer at some point during his visit. The stories of these men are widely publicized throughout the park. Although these men and others were instrumental in the development and success of Carlsbad Cavern, there was another group of pioneers who have been overshadowed by the legends of these men.

The women of Carlsbad Cavern have for years been overlooked as participants of the cavern's glorious history. The role of the cave woman has advanced far beyond being knocked over the head with a club and dragged in to a cave. However, historical references still show women entering caves with parasols and frilly skirts as if they are on a picnic. So, what have these adventurous women done?

In 1923 while in the Carlsbad area checking out an irrigation dam site, Willis T. Lee, a geologist, came to the cavern to see the great wonder about which people had been talking. His eyes widened, his heart opened, and he knew he was in a place like no other. He pushed for the cavern to become a national monument and it soon did. Lee took leave from the U.S. Geological Survey and took a position as temporary custodian of Carlsbad Cave National Monument bringing his family with him. Lee's wife showed little interest in the big cavern and stepped inside only once. But Lee's

daughter Elizabeth took to cave exploration like her father and found herself being one of the premiere female cavers of Carlsbad Cavern.

Elizabeth Lee was only twenty-one when she began getting paid \$100 a month to work in the cavern. Her duties included photographic assistance from holding flares to artistic input, guiding tours, exploring the cave, and doing anything else she could physically do. Her mastery of the cavern had her leading geology students through the depths that would help ignite even more interest in the cavern. Her brother Dana worked along side her and the two were said to be able to do most of what Jim White had done.

With photography as one of his many talents, Willis T. Lee quickly learned the art of cave photography but it was his reliance on Elizabeth's keen artistic eye that helped him improve the photos that are so revered today. Elizabeth was included in many of his photos and even aided Willis T. in his 1923 and 1924 "National Geographic" expeditions.

A photo from 1924 shows Elizabeth in pants wedged in a guano bucket with Dana and another explorer as they were being lowered into the cavern. She would ride the bucket elevator so much that it became part of her regular day. The 173-foot entrance ladders and shaky bridge failed to scare her anymore. One photo shows Elizabeth holding a lantern and tiptoeing on a ledge from a wire ladder while another photo shows her climbing a trail made of bagged guano called the "Golden Stairs." This was an unusual living for a woman in those days but it seemed made for Elizabeth.

During a Lower Cave project in April of 1924, Elizabeth found herself tottering on the edge of a 90-foot drop off after slipping when trying to get to the ladder that descended into the lower section. It was a maneuver that at least one of the men of the project refused to try. Surefooted enough, Elizabeth kept on caving undaunted by her experience. On June 1 she became the first woman to enter Lower Cave by climbing down a ladder that hung precariously from the Jumping Off Place. A strong explorer and significant to Carlsbad Cavern, Elizabeth Lee could be called the female equivalent to Jim White though her notoriety is unfortunately lost within the pages of history.

If notoriety in caving was all that is important then **Amelia Earhart**, Trans-Atlantic pilot, brought that to the cavern on September 9, 1928. When Earhart visited the cavern, she had exploration on her mind. Superintendent Boles led her to Lower Cave, put a lantern in her hand, pointed her to a dark, brooding hole, and encouraged her to see what was there. Twenty minutes later she returned with the caving bug and signed up as a cavern guide. Fascinated and excited, Earhart planned future explorations possibly to Bottomless Pit with Jim White and Boles. Even a woman who had tempted fate so many times in an airplane could find the exhilaration of caving. Amelia Earhart never made it back to the cavern having disappeared on a flight across the Pacific Ocean. Had history not made a fateful turn for Earhart, she could have been one of the cavern's exceptional female explorers.

Exploration was not the only role women played at the cavern. During the 1920's, **Fannie White**, Jim White's hospitable wife found herself catering to the visitors. Feeding them and offering a bed to them in their cabins, she created an

unofficial bed and breakfast at the cavern and was occasionally paid two dollars per visitor. With the terrain so hard, visitors were overjoyed to find good food and a warm bed and this in turn increased visitation to the cavern. She even cooked for Willis T. Lee and others during his 1924 "National Geographic" expedition. In 1927, Fannie bragged about her cooking and attempted to contract the lunch concessions in the cavern only to lose out to the Cavern Supply Company co-created by Ray V. Davis.

Other notable women include **Blanche Grant** who in 1927 wrote the "Cavern Guide Book" which chronicled the cavern's history. She enjoyed visiting the cavern often. In 1927 the Secretary of State for New Mexico, **Jennie Fortune**, worked as a Park Ranger during her stay which was rare for a sophisticated woman of the day. In 1929, **Helen Kennicott** became the Voucher Clerk in charge of accounting at the cavern. Her duties were more like the Chief Clerk as she took on more work when the acting Chief Clerks' persistent illnesses kept him out of the office. She did this for many years. Also in 1929, **Isabelle Story**, Editor for the National Park Service, inspected the cavern visiting Left Hand Tunnel and Lower Cave and was touted by Superintendent Boles as, "A real hiker on our underground trails." Later in 1936, she also wrote a cavern guide book.

In the 1930's, the jobs women took at the cavern went in the direction of babysitters and nurses dealing primarily with the softer side of the cavern. A nursery was opened in 1930 for parents to place their children in while they toured the cavern. And in 1932, Ranger Nurses Julia Dean and Nora Hemler were hired seasonally to treat sprains, bruises, and cuts. There was some ambiguity in the official title of these nurses. The uncertainty of their exact role suggested that they were extremely versatile. They were described as ranger nurses, guide nurses, and lady guides. Superintendent Boles commented that accidents and illnesses, usually by female visitors, and the fact that the nearest doctor was thirty miles away warranted having trained nurses at the cavern. He consistently noted his appreciation for the ranger nurses in the "Superintendent's Monthly Reports." But when funds were not available to keep the ranger nurses employed, some were promptly released despite the usual praise and hardwork. This was the case with **Ranger Nurse Willis**.

Corresponding with the rise of women's rights, women slowly began to penetrate the male dominated ranger staff at the cavern. **Ranger Nurse Alvey** is the only female pictured in the 1936 ranger staff photo and **Ranger Nurses Lucille White and Rita Walker** are the only ladies in the 1937 picture. But when the 1940's arrived, women began to obtain Seasonal Park Ranger positions having generally been promoted from ranger nurse. A 1940 ranger staff photo picturing **Myra Appell, Neta Armstrong, Alva Daniels, and Rita Walker** shows an increase from two female rangers to four over the years and the numbers would continue to escalate.

The women of Carlsbad Cavern have come a long way since Elizabeth Lee stepped her booted foot on a dusty cavern floor. Every job a woman at the cavern held was another opportunity for women to be included in the cavern's history. The diligence and persistence of these pioneering

women has placed them in a category all their own as the women of Carlsbad Cavern. So, what have these adventurous women done? It could be said that they have done nothing more than help create one of America's most outstanding national parks.

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Special thanks are given to Robert Hoff for starting me in the right direction and Tom Kaler for the research help.

THE FIRST STEP IN SCIENCE by Jason M. Richards

It is not debatable, it is an undeniable fact, survey is a science discipline in itself, and should be thought as, and treated as a science. Afterall, where would scientists of other

disciplines be, if not for the dedication and perseverance of the surveyors. In the past ten years, Lechuguilla Cave has seen progress associated with turmoil. The us, against them attitude should never be, or have been..... **it's we the explorers.** That's right, we the explorers, surely all scientists are explorers, delving into and exploring the unknown, whether it be exploring and surveying virgin passage, or exploring the unknown habitat of a subterranean microbial ecosystem.

Today's cave surveyors not only use the instruments of their skill; compass, inclinometer and tape. They are also versed in the recognition of potential science study areas. It is also desirable for at least one person on a team of three to be skilled in geological and mineralogical inventories. A typical survey team usually consists of three people, the sketcher, the instrument person and the tape person, however, a fourth person may be on the team to take inventory.

The sketcher, a highly skilled member of the survey team is usually the leader and controls the pace of the survey. As the sketcher draws the passage, adds floor detail, draws formations etc., he or she is also taking data relayed by the instrument persons. Sketching is the most important position of a survey team, and besides being highly skilled, it is helpful if the sketcher is artistic as well.

Usually there are two instrument people on a team, one to do foresites and the other to do backsites. The instrument person takes readings with a compass for the azimuth, and a clinometer for determining the angle of the passage. When taking the azimuth reading, the recipicle (a 180 degree plus or minus difference) of the foresite and the backsite readings must compliment each other by a margin of error of not more than two degrees. An example would be as follows: foresight, 90 degrees and backsite, 270 degrees. Data from the clinometer is given in either plus, or minus 90-degree readings, from 0 (level).

The lead tape person carries the responsibility of not only determining where the survey stations should be placed and measuring distances between survey stations, but must be able to choose the path of least impact to the cave. Many times the lead tape person will also do the important task of inventorying mineralogical, geological, and biological features of the cave.

All good science depends upon good technique. The very first attempts of prominent microbiologists to bring cave microbes back to laboratories for study, failed miserably. Their techniques were fine, and proven for collecting microbes in a known environment, the surface. However, recently, a whole new resource of interesting microbes has been found in caves, and collection techniques have been modified to successfully obtain live microbes for study.

The same can be said for today's survey/explorers. Although efforts have been successful in obtaining data for line-plots and cartography, collection techniques, like those of the microbiologists, have been modified. Although the problem is not bringing survey data out of the cave alive, the problem is bringing good, usable data, out of the cave with absolute minimum impact to the resource. Survey crews

now recognize the fact that no matter how careful you are, your mere presence has an impact, and consequently survey techniques and attitudes have been adapted. Today, survey/explorers and scientists work together, share ideas, and recognize each others contributions to the understanding of caves.

GRAY-FOOTED CHIPMUNK (*Tamias canipes*)

by Ken Geluso

In the southeastern mountains of New Mexico, gray-footed chipmunks primarily inhabit conifeous forests; therefore, Carlsbad Caverns National Park provides only marginal habitats for this species. Chipmunks are limited to the higher elevations of the reef where isolated patches of pines exist. All captures and sightings of this species in the park were above 5,480 feet in elevation.

Chipmunks in the park are most common on rocky slopes vegetated by fairly dense stands of evergreen and deciduous trees. This habitat occurs most often in deep gullies having northern exposures. Two chipmunks, for example, were captured and observed in a gully near Yucca Cabin. (Ed. Note - This cabin has been removed since this was written) Animals were caught along ledges of rock outcrops high on the sides of the gully. This protected area supported a dense mixture of trees and shrubs including alligator juniper, bigtooth maple, chinkapin oak, scrub oak, mountain mahogany, and Texas madrone. An additional three chipmunks were sighted in wooded habitat near Putman Cabin. Both sites were above 5,800 feet.

Gray-footed chipmunks also can occur in drier habitats of the park. On one occasion, an individual was sighted on the rocky slope of Yucca Canyon. The slope contained small oaks and bushes, but no large trees. This sighting was at 5,480 feet and may represent the lowest elevation that this species has been found in the Guadalupe Mountains. Of 34 gray-footed chipmunks taken in Guadalupe Mountains National Park, the lowest elevation was 5,900 feet (Genoways, et al, 1979).

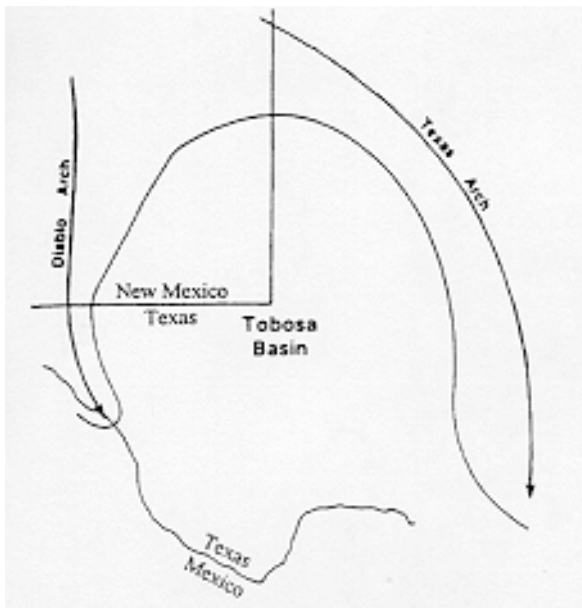
Chipmunks are not active above ground during the winter, but stay in their burrows, become torpid, and awake at intervals to feed on stored food (Nowak and Paradiso, 1983). I observed chipmunks in the park only during spring and summer, but not during winter in prime habitats of the Putman area.

This is from a report by Ken Geluso titled "Rodents of Carlsbad Caverns National Park: An Annotated Checklist" completed in 1993.

GEOLOGIC HISTORY: THE TOBOSA BASIN AND WOODFORD SEA *by Dale Pate*

During the early Ordovician time, 485 to 497 million years ago, the area we know now as the Delaware basin was covered by a vast sea. As a thick sequence of limestone built up, the region experienced crustal downwarping and the continental shelf divided into a series of sags and arches. One of these sags was the 550 kilometer

wide **Tobosa Basin**. To the west was a high area known as the Diablo Arch and to the east was another high area known as the Texas Arch. To the south were deeper waters. This remained a sea environment for the next 60 to 80 million years or so, at times having relatively deep waters where dense limestones and shales were deposited. By the Middle Devonian period, 380 to 390 million years ago, the Tobosa Basin area had been uplifted and widespread karstification of the limestones had occurred. The cave and karst features that formed at this time has contributed substantially to the reservoir capacity of oil and gas fields in the area. By the Late Devonian period, 360 to 370 million years ago, the Tobosa Basin was once again covered by a sea. This sea was relatively deep and had poor water circulation resulting in low oxygenated waters. This sea, called the **Woodford Sea**,



covered part of what is now New Mexico, much of Texas, and Oklahoma. It is thought that the Woodford Sea was similar in conditions to the Black Sea of today. By Late Mississippian to Early Pennsylvanian time, 310 to 320 million years ago, tectonic upheaval in the area divided the Tobosa Basin into three distinct regions, the Delaware Basin, the Central Basin Platform, and the Midland Basin. This marked the end of the Tobosa Basin and the Woodford Sea.

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.

N.E.P.A. FOR POETS: A PRIMER by Diane Dobos-Bobno

Since its passage, NEPA has been a strong tool in protecting public resources and controlling external threats to Interior resources and programs...I view the public trust to carry out our stewardship of Interior's resources and

responsibilities to be the very essence of the policy set forth by NEPA and call upon you to join me in renewed attention to using NEPA effectively in the business of the Department.
--Bruce Babbitt, Secretary of the Interior

Many people believe that NEPA stands for National Environmental Protection Act, when, really, it is the National Environmental Policy Act. NEPA is truly a policy, as well as a planning tool, that mandates federal agencies to analyze the environmental consequences of projects or activities.

NEPA refers to the environment in the broadest sense. It not only mandates that parks consider the impacts to natural and cultural resources as stipulated in the NPS Organic, Endangered Species, Clean Air, Clean Water, and National Historic Preservation Acts, it also requires consideration of the American With Disabilities and Architectural Barriers Acts, as well as socio-economic factors. Think of NEPA as an umbrella, covering all other federal laws.

The NEPA Process

What kicks in the NEPA process? Quite simply, any "federal undertaking" does. If you think of the daily running of a park, it would not take long to understand that "any federal undertaking" refers to EVERY action. A "federal undertaking" can be as subtle as washing a trail to as involved as building a new visitor center.

NEPA requires parks and other federal agencies to use a systematic, inter-disciplinary planning approach. Through this planning process, the Act mandates federal agencies include the following six elements:

- * Evaluate unavoidable environmental impacts: short-term, long-term and cumulative
- * Provide reasonable alternatives to a proposed action
- * Include a "no action" alternative to the project
- * Identify mitigation measures to lessen or eliminate any potential impacts
- * Provide for public involvement
- * Document the decision

A systematic approach assures that an understandable planning process is followed that identifies the issues first and then the solutions, not the other way around. Including public review as an element of the Act reminds federal agencies that they are public entities with responsibility to the public-at-large. Providing reasonable alternatives that are public-reviewed forces agencies to look harder for solutions to issues. This, in turn, provides the deciding park official with the means to select the best possible solution. Finally, documenting decisions provides a reason for the decision and retains a record for the future.

Required Environmental Documentation: the CX, the EA, and the EIS

All federal actions require some type of environmental documentation. The three levels of environmental documentation: (1) Categorical Exclusion [CX], (2) Environmental Assessment [EA], or (3) Environmental Impact Statement [EIS].

Congress was thorough in defining every action as a federal undertaking but they also understood the importance of focusing on those actions having environmental impacts. Most of the everyday business of running a park does not warrant full NEPA documentation. The Act allows parks to list smaller projects with little or no environmental impact and exclude them from further NEPA requirements. These undertakings are Categorical Exclusions. This list represents the first step in the NEPA process.

For most projects, appearance on the CX list requires no further action, except perhaps a memo to the file for documentation needs. Samples of CX's include: legal searches or arrests; non-destructive data collection and research; activities which are educational or informational to other agencies, visitors or the general public; land and boundary surveys; or, repair or resurfacing of existing roads (Departmental Manual 516, appendices 1 and 7).

Checking the CX list is not the only step in this part of the NEPA process. Now, this might be confusing so read carefully: There are exceptions to the exclusion list. This needs explaining. Sometimes a small project has elements which impact endangered species or wetlands, potentially violates other existing laws, OR is actually part of a bigger project that must be evaluated with the larger project. If a project appears on the exception list, it is not a Categorical Exclusion.

If the project does not rate as a CX, then it will either require an EA or an EIS. Both of these processes require specified amounts of public review. The difference between an EA and the longer EIS process is often based on the scope of the project, the amount of environmental impact, and the potential for controversy. NPS-12, covering NEPA compliance, provides the following guidance: "An Environmental Assessment shall be prepared for all proposed NPS actions which are not categorically excluded from the NEPA process or adequately covered in a previous NEPA document, unless a decision has been made to prepare an EIS." The Park Service prepares an EIS for any "proposals for legislation and other major Federal actions significantly affecting the human environment (NEPA, Sect. 102)." In addition, large-scale planning proposals with resource use or modifications demand EIS documentation. Many park staff are possibly more familiar with the Dark Canyon EIS for drilling north of the park (BLM, 1993). The scale of this project required consideration of impacts to cave environments, wilderness, and local economics.

An example to clarify each of the three documentations follows:

1. Modifying a trail route in an area where there are no impacts to endangered species or wetlands would qualify as a **Categorical Exclusion**.
2. An example of an action requiring an **Environmental Assessment** would be the Rattlesnake Springs Management Plan, already identified in the more comprehensive, EIS-approved park General Management Plan.

3. The Park's General Management Plan, with the impacts it has on park resources and local economy, requires an **Environmental Impact Statement**.

If you need the NEPA process clarified for your next activity or project, SEEK HELP from your local resource management representative or compliance specialist. Luckily, the National Park Service has people knowledgeable in the NEPA process.

The National Environmental Policy Act is a good tool for managing federal lands. When a park identifies the issues of a problem, NEPA provides a mechanism for creative problem-solving. Through allowing public review, parks can refine their management strategies as needed or be assured that they have at least considered all the stated impacts. With NEPA used in the spirit intended, parks have the opportunity to identify, avoid, or resolve potential conflicts with creative solutions. The policy protects public resources and assists all parties involved with the stewardship of our lands.

WHAT IS GPS? *by David Roemer*

The **Global Positioning System (GPS)** is a method of collecting geographic data using a network of satellites to provide position, time, and velocity information from any location on Earth 24 hours a day. The system has three major components: the space segment (satellites in space), control segment (Department of Defense), and the user segment (that's us).

The **Space Segment** is comprised of 26 space vehicles (SVs) that transmit a signal describing their position and the exact time. SVs circle the planet in 12-hour orbits that provide between 5 and 8 usable SVs to users from any position on Earth. Three SVs are needed for a user to calculate a 2-dimensional position such as latitude and longitude. Four SVs are required to calculate altitude.

The **Control Segment** is run from Falcon Air Force Base near Colorado Springs, Colorado. They upload instructions to the SVs to make orbital adjustments and clock corrections. The Department of Defense intentionally degrades the signals from the SVs using selective availability (SA). This is to prevent unauthorized users from calling down precision-missile strikes and things like that. Due to selective availability, accuracy for non-military users is degraded to 100 horizontal meters, 156 vertical meters, and 340 nanoseconds. GPS accuracy may be improved through differential correction (see below).

The **User Segment** is the community of researchers, surveyors, navigators and countless others who access SV signals (free of charge) by using GPS receiving equipment manufactured by a number of private companies. GPS receivers range from relatively inexpensive models commonly seen in outdoor gear catalogs, to sophisticated units that are capable of submeter accuracy (with differential correction). Carlsbad Caverns National Park currently uses a Trimble Pathfinder Pro GPS receiver. The Pathfinder unit consists of a six-channel receiver (it can track 6 SVs at a time), datalogger,

dome-shaped antenna, and software for mission planning and differential correction. After correction, the accuracy of recorded positions with the Pathfinder can be expected to be within five meters. The park will soon be upgrading to a lightweight unit with more powerful software which will be capable of the same accuracy.

So what can you do with GPS?

The GPS is a powerful data collection tool for resource management, especially when used in combination with a **Geographic Information System (GIS)** for the display and analysis of geographic information. For example, information about nests at Rattlesnake Springs was collected in the field using the GPS. Field personnel used the GPS to pinpoint the geographic location of the nests, as well as important attribute information such as the species of bird, kind of tree, date, and nest number. The data was then entered into the park GIS, where ArcView software was used to sort the nests by species, and perform other analyses, such as the identification of nests that are within 20 meters of the park road (see diagram). A future application of GPS and GIS could be to help plan the location of a proposed visitor trail at Rattlesnake Springs away from the nesting habitat of rare birds (i.e., Bell's vireo).

GPS may also be used to navigate to known features, such as archeological sites, endangered cacti, or backcountry seeps and springs. Any previously recorded location may be programmed into the datalogger as a "waypoint" (a set of latitude and longitude or UTM coordinates) and navigated to.

Mission Planning and Differential Correction

When considering a GPS mission, it is important to plan for the best time to use GPS, based on satellite and base station availability. One function of the GPS software is to predict the orbits of the SVs to ensure that there will be a workable constellation for the time period that you want to be out in the field. Frequently there are times of the day when the geometry of the constellation is less than optimal, which will result in poor accuracy. The **Position Dilution Of Precision (PDOP)** is an indicator of data accuracy resulting from poor SV geometry. In the office you can forecast times of high PDOP using the GPS software. In the field you can check it in real time from a menu on the datalogger.

Differential correction is a method of defeating the data errors caused by selective availability. It is done by adjusting the bias error at one location (a nest, a rock shelter, etc.) with the measured bias from a known position somewhere else (a base station). For this to work, the base station must be recording data at the same time, and from the same SVs as we are using in the field. The GPS software sorts all of this out for us once we have our data and the base station data together in the computer. Base station availability requires some planning. When we have a GPS mission to run, we contact the Lincoln National Forest in Alamogordo to ensure that their station is up and running, and ask them to send us a base file for the time period that we will be collecting data. After our mission is complete and the base file arrives in the mail (usually the following week) we can differentially correct our data to remove the errors caused by selective availability. Since Alamogordo is a little far away, we are on the lookout for the possibility that the BLM might set up a base station closer to home.

Feel free to stop by the GIS office if you have any questions, or want to see how any of this stuff works. Volunteers working on resource management projects may find themselves on a GPS mission - step-by-step instructions for collecting field data using the GPS are available.

LETTERS TO THE EDITOR

I enjoyed your recent issue "Canyons and Caves #6". In addressing your item about black bears in CCNP, I would suggest that the park staff pay particular attention to the sotol covered areas of the park especially during early spring when most bears are coming out of their winter sleep. In the Big Bend country and south into Northern Coahuila and Chihuahua, biologists have noted the importance of sotol as a food source at this time of the year. When a black bear feeds on sotol they literally tear the plant apart, much more aggressively than mule deer and javelina. Perhaps a helicopter survey in dense areas of sotol during the spring would turn up a few bears.

Rick Lobello

CALENDAR OF EVENTS

Feb. 14 - 16	Cave Research Foundation (CRF) Restoration and Survey in Carlsbad Cavern
Feb. 21-22	North Texas Speleological Society Restoration in Carlsbad Cavern
Feb. 28 - Mar. 1	Permian Basin Speleological Society Restoration in Carlsbad Cavern
Mar. 7 - 15	Survey in Lechuguilla led by Rod Horrocks and Pat Kambesis
Apr. 12 - 18	Survey in Carlsbad Cavern led by Joe Sumbera
Apr. 18 - 26	LEARN survey in Lechuguilla
May 23 -25	CRF Restoration and Survey in Carlsbad Cavern
June 22 - 26	CRF/NSS Restoration Camp in Carlsbad Cavern

July 25 - Aug. 2
Sept. 5 - 7
Oct. 24 - Nov. 1
Nov. 26 - 29

LEARN survey in Lechuguilla
CRF Restoration and Survey in Carlsbad Cavern
LEARN survey in Lechuguilla
CRF Restoration and Survey in Carlsbad Cavern

Pack it in, Pack it out

1997 INDEX

CANYONS & CAVES

Nos. 5-7

ANIMALS

Black Bears in Carlsbad Caverns National Park	No.6, p.2
Bullfrogs: Friend or Foe	No.5, p.9
Cave Swallows	No.5, p.2
Cougars at CCNP	No.7, p.2
Gray-footed Chipmunk	No.7, p.6
Mountain Lion Sighting	No.6, p.2
Number of Species Found in the Park	No.6, p.2
Rattlesnake Springs Amphibians & Reptiles	No.6, p.6
Rattlesnake Springs Cowbird Study Update	No.5, p.6
Ringtail Removal	No.5, p.1
The Portage Voyage of the SS Munyan on the Black River	No.5, p.11

BATS

Bats Found in Carlsbad Cavern	No.6, p.2
Science Fact or Bat Fiction	No.5, p.5
Studying Bats in the Park	No.5, p.10
Wildlife Observations	No.5, p.13

CALENDAR OF EVENTS

Calendar	No.5, p.13
Calendar	No.6, p.8
Calendar	No.7, p.10

CARLSBAD CAVERN

Dermestid Beetles	No.6, p.1
Infiltration Study	No.5, p.3
Infiltration Study Completed	No.6, p.1
New Discoveries in Carlsbad Cavern	No.5, p.7
New Light Switches	No.7, p.1
Resurvey of Carlsbad Cavern: An Update	No.6, p.5
Restoration in Carlsbad Cavern	No.5, p.2
Surveying in Bat Cave	No.6, p.1
Upcoming Cave Research	No.5, p.2

FIRE

Fire Effects Monitoring	No.5, p.2
Prescribed Fires: Reintroducing Fire in the Desert Ecosystem	No.6, p.3

GEOLOGY & GEOGRAPHY

"Chinese Wall" in Slaughter Canyon Cave	No.5, p.3
Geologic History: The Tobosa Basin and Woodford Sea	No.7, p.6
View of the Permian Equator	No.6, p.8
What is GPS	No.7, p.8

HISTORY

Women of Carlsbad Caverns National Park: 1920-1940	No.7, p.3
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HYDROLOGY

- Infiltration Study No.5, p.3
- Infiltration Study Completed No.6, p.1
- Rattlesnake Springs Hydrology Study No.5, p.1

INSECTS & MICROBES

- Bat Rabies No.5, p.3
- Dermestid Beetles No.6, p.1
- Scorpions at Carlsbad Caverns National Park No.5, p.8

LECHUGUILLA CAVE

- Long Soda Straw In the Western Borehole No.5, p.3
- New Discoveries in Lechuguilla No.6, p.4
- On Underground Wilderness No.6, p.3
- Upcoming Cave Research No.5, p.2

LETTERS TO THE EDITOR

- Letter No.6, p.7
- Letter No.7, p.10

NATIONAL POLICIES

- N.E.P.A. For Poets: A Primer No.7, p.7

PARK INFORMATION

- First Step in Science No.7, p.5
- IPM News No.5, p.1
- Moncrief APD's No.6, p.1
- Rainfall at CCNP No.6, p.7
- Resource Management From the (Under)Ground Up No.5, p.4
- Snowfall at CCNP No.7, p.1
- Working with Disney Film Crew No.6, p.2

RATTLESNAKE SPRINGS

- BullFrogs: Friend or Foe No.5, p.9
- Herpetology at Rattlesnake Springs No.5, p.1
- Rattlesnake Springs Amphibians & Reptiles No.6, p.6
- Rattlesnake Springs Cowbird Study Update No.5, p.6
- Rattlesnake Springs Hydrology Study No.5, p.1
- Updating the Rattlesnake Springs Management Plan No.5, p.4

WORLD & BEYOND

- Martian Carbonates No.7, p.1
- Mexican Wolves No.5, p.3
- More on Mexican Wolves No.6, p.2
- The Portage Voyage of the SS Munyan on the Black River No.5, p.11