CANYONS & CAVES

A Newsletter from the Natural Resources Offices
Carlsbad Caverns National Park

Edited by Dale L. Pate

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"*Am I requested to give a word picture of the architectural and sculptural masterpieces of Carlsbad? Respectfully, I decline. Even photographs, which better than words delineate these strange and charming forms fall far short of revealing what you will see.*"

by Freeman Tilden from his book **The National Parks** published in 1976.

REMINDER - When developing programs or projects, whether they be talks, slide shows, videos, or in other forms, please make sure that they conform to park policies. If you don't know whether your project conforms to park policies, please contact your supervisor or one of the Resource Specialists.

RESOURCE NEWS

YATES WELL UPDATE - The drilling of the Diamondback Federal #1 well by Yates Energy Co. began in mid-June, 1996. The site was located about 3000 feet north of the park boundary and the company had decided to drill straight down instead of "kicking out" below the limestone layers to hit their potential gas target at over 10,000 feet down. When drilling through the limestone, a 100 percent loss of circulation occurred at the depth of 120 feet and once again at 1,060 feet. Since no bit drops on the rig occurred, it is thought that no cave passages were intersected, but instead the lost circulation zones were probably high porosity fractured rock. It is estimated that 15,000 barrels of drilling fluids (mostly water with a small amount of bentonite clay added) were lost in the deeper lost circulation zone. The well was drilled to about 10,000 feet in depth and determined to be a "dry hole". The "dry hole" was abandoned and sealed in mid-August. The company still has the option to drill one more well west of the Diamondback Federal #1, but it is hoped that the shortcomings of this well will prevent the drilling of the next.

SUMMER RAINFALL - From June 1 to September 20, the park headquarters area has received 16.98 inches of rain, more than the yearly average. The rain for each month is as follows: May - .08 inches, June - 4.20 inches, July - 2.26 inches, and August - 6.68 inches, Sept. - 3.84 inches.

PAT MULLIGAN will return to the park for a 1 month rehire from October 15th through November 13th. Pat will be doing the annual vegetation monitoring plots. The data he is continuing to collect will help us assess the effects of prescribed fire on the park's vegetation.

ROBIN ANDERSON from Quebec Canada will be joining the Surface Resource Management Team as a Student Conservation Associate. Robin will be here from September 23rd through about mid December. She will work with us on mountain lion transects, monitoring seeps and springs, doing transects for Lee's pincushion cactus, and help with fire monitoring plots.

THE RESOURCE MANAGEMENT DIVISION has submitted the following six project proposals for

potential funding in FY97 through the NPS Intermountain Field Area Special Emphasis Program.

1) Continuation of Free-tailed Bat Population Monitoring
2) Paleo-Demography of Cave Roosting Bats
3) Rattlesnake Springs Management Scoping and Planning
4) Assessment of Brood Parasitism by Cowbirds
5) Archeological Overview and Assessment
6) Historical Structures Report

INTEGRATED PEST MANAGEMENT PLAN TO BE PREPARED - We have acquired funding through our System Support Office to get an Integrated Pest Management (IPM) plan prepared for the park. An IPM specialist will visit the park to evaluate our pest problems such as termites, exotic weeds, mice in buildings, bull frogs at Rattlesnake Springs, cowbirds etc. The contractor will provide on-the-job training and prepare an IPM plan that will provide recommendations for management. Persons interested in the IPM planning process, or if you know of pest problems we should be aware of, please contact Bill Route.

VAMPIRES IN THE U.S. - The only known occurrence of a vampire bat in the U.S. was when a single Hairy-legged Vampire, *Diphylla ecaudata*, was collected on May 24, 1967 twelve miles west of Comstock, Val Verde County, Texas. The individual, a female, was collected from an abandoned railroad tunnel. Its primary food source is the blood of warm-blooded vertebrates, mainly birds.

LECHUGUILLA RESCUE - On July 28, Feldar Hogan became ill from dehydration and heat exhaustion after working in the upper levels of the cave flagging main trails. He was unable to climb out of the entrance pit and was hauled to the surface by Park staff and other cavers on the team.

MANY THANKS to Dale Smith who is continually monitoring pools in the Big Room and reporting problems he sees.

SCIENCE NEWS

CO2 LEVELS IN CARLSBAD CAVERN by Jason Richards

Tuesday, August 20, two visiting Chinese scientists measured the CO2 levels in Carlsbad Cavern. Originally we picked out ten sites for testing, however, due to a time restraint we eliminated Lower Cave and added two additional sites in the Big Room, naturally the Chinese Theater turned out to be one of them. Thang Shouyue, Professor of Geology at the Institute of Geology, Chinese Academy of Sciences, and Jin Yuzhang, Senior Laboratory Engineer, also with the Chinese Academy of Sciences, conducted the tests. The test results were within relatively normal ranges for limestone caves, however, higher in CO2 levels than Chinese caves.

It was interesting to note that on the morning test of the underground concession facility, the CO2 level was 1,600 PPM, and by 1:00 PM there was a significant increase in CO2 of 5,000 PPM. It makes you wonder what it would be at the same period of time on July 4th or Labor Day?

THE RUSSIANS ARE COMING!!! by Jason Richards

During the week of August 12th, the cave resource staff spent time with visiting Russian geologists. Vladimir Maltsev, Professor of Geology, University of Moscow and Victor Korshounov, also

with the University of Moscow, came to Carlsbad to compare and investigate corrosion residues and corrosional features in Carlsbad Cavern, Spider Cave and Lechuguilla Cave with Cupp Coutunn Cave in Russia.

Cupp Coutunn Cave in southeast Turkmenistan, formerly a part of the Soviet Union, has many similar speleothems and geologic features as Lechuguilla Cave, in fact, if you asked any cave scientist where pictures taken in Cupp Coutunn came from, they'd all have the same resounding answer.....Lechuguilla. Cupp Coutunn is in the arid mountain range of Kugitangtau where summer temperatures reach 55 degrees Celsius (and we think it's hot here). Besides the usual stalactites, stalagmites, helictites etc. that are found in all Guadalupe mountain caves, Cupp Coutunn has chandeliers, selenite needles, gypsum beards, gypsum stalagmites and many other features that Lechuguilla is noted for.

Saturday, August 17th, Jason Richards with the Cave Resource Office, Chief Ranger Gary Vequist, Peter Bosted, a professor with Stanford University, and Victor Korshounov visited the Chandelier Ballroom in Lechuguilla Cave to compare corrosional features and other similarities with Cupp Coutunn Cave. Victor will be sending us a report on his impressions.

BUTTERFLIES OF THE FALL by Diane Dobos-Bubno

Although the major viewing time for butterflies in the park has passed, many opportunities to find these beauties still exist. A slow meander down Slaughter Canyon trail will provide a few chances and even pulling out your lawn chair across from the residences may satisfy you. By far the best place to do a little butterfly watching is down at Rattlesnake Springs. In early summer, the multitude of these winged wildflowers is awesome and many of these species still flutter among the cottonwoods and composites. In late August 1986, Steve Cary (noted New Mexico lepidopterist), and Dick Holland, inventoried 42 butterfly species at Rattlesnake Springs, approximately 1/3 of the current park listing of 130 species. The habitat elements of Rattlesnake Springs are so important that 16 of these species are not found elsewhere in the park.

Some of the small to medium species you may see are: Pearl Crescents, Phaons, whites, sulfurs (both yellow and orange) and a fritillary or two. There are still many of the large butterflies that always produce the “oh, LOOK” response. Recent sightings include Desert Queens, Monarchs, Two-tailed Tiger Swallowtail and Pipevine Swallowtails. The latter is a dark butterfly with scales on the upper hind wing that throw a shimmering turquoise blue. This specie is distinguished from other dark swallowtails by its relative absence of top markings and by the magnificent arc of very large orange spots on the under hind wing.

Two of the most prolific species observed in Rattlesnake Springs are the milkweed family butterflies: the Desert Queen and the Monarch. Both these butterflies subsist on a strict milkweed diet during the larval (caterpillar) stage, thus concentrating a cardiac glycoside toxin in their system. The toxin concentrations make both the Queen and the Monarch unappetizing for most potential predators.

The next few paragraphs will focus on the Monarch since this butterfly participates in a most unusual activity, that of a migration and remigration movement unknown elsewhere in the insect world.

THE MONARCH MIGRATION

The study of monarchs is probably the most extensive of any other invertebrate. It’s migrational movements, equaled only in the bird world, coupled with the incredible fragility of its over-wintering sites, brought this showy butterfly into public attention. As a result, it has become a symbol of the natural history conservation movement and has incited involvement from school children to retirees in tagging and monitoring efforts.

Current interpretation of data from tagging recoveries indicates there are two migratory

populations of monarchs in North America. These are aptly titled *western* and *eastern* populations. Monarchs found in this park are probably part of the much larger eastern population that summers east of the Rockies across the United States and up to the southern boundary of Canada. Though the true "summer range" is in the north, reports of monarchs do occur in Carlsbad Caverns National Park between March and October. At this point, there is not enough local information to determine either the extent of the migration or the breeding occurrences in this area. However, in other states with similar agriculture and factors, the monarch's range has expanded over the last 150 years. This is primarily due to the increase of an especially weedy milkweed, *Asclepias syriaca,* which provides great fodder for growing baby caterpillars, particularly the fall generations. Observations document monarch larvae feeding on 27 of the 108 known North American *Asclepias* species. Though the plant list of Carlsbad Caverns does not include *Asclepias syriaca,* at least three of the ten *Asclepias* found in the park support monarchs.

This time of year, monarchs begin a fall migration to the south. The butterflies seen throughout the park might follow a flight path that converges with other eastern flight paths somewhere near Del Rio in southern Texas. From there, migration continues south to the final destination: twelve over-wintering sites high in the peaks of the Transverse Neo-volcanic Belt, south of the Tropic of Cancer in central Mexico. Entomologist Fred and Norah Urquhart, a married couple who started tracing monarch migration via tagging in 1940 discovered these sites only 20 years ago. This incredible discovery, published in an August 1976 *National Geographic* article, ended the controversy that existed regarding monarch migration.

AN ENDANGERED BIOLOGICAL PHENOMENON?

Despite the extraordinary abundance in some fall seasons, today we know that the eastern monarch migration is in trouble, threatened by human activities. In North America, the milkweed plant is now being identified as an unwelcome "weed." Eradication efforts on farmlands and elsewhere pose a severe threat to the monarch's breeding grounds by eliminating necessary food sources for the butterfly larva. Herbicide and pesticide use, as well as ozone damage, affect *Asclepias* populations in the United States. Protected areas throughout the southwestern and gulf states, such as riparian and marshlands, disappear at an alarming rate. These wet areas provide refuge for migrating butterflies by providing various types of nectar species as well as meeting water, shade and wind protection needs. Lastly, yet most importantly, monarch populations are particularly vulnerable in their overwintering sites. Only two of known wintering areas in Mexico are protected from logging and habitat destruction. The oyamel trees in these areas are a valuable lumber and economic source for a growing Mexican population.

WHAT'S LEFT TO LEARN?

There is an absence of good literature on flyways through New Mexico and there are many unanswered questions. The migrational paths and basic life history of monarchs are undocumented. What happens to butterflies flying through New Mexico, particularly through this area, in the fall? Are these butterflies migrating on a particular flyway directly through New Mexico? Are they on the farthest fringes of the central Texas flyway or a yet undiscovered one that passes through the park? Do these butterflies go on to Mexico? Do any butterflies breed in the park?

This season, the park will join in the nationwide tagging program that, over time, may be able to give us better information on this tremendous phenomenon. In the meantime, if anyone has any information on monarch clusters either here or around Carlsbad, or has observed monarch caterpillars on milkweed in the park, please notify the Surface Resources Division.

If you have access to the World Wide Web, you can also broaden your knowledge by visiting a great web site by the University of Kansas. Their research program also has an educational arm known as Monarch Watch. The web site address is http://monarch.bio.ukans.edu or search for "Monarch

Watch" on a web search engine.

GO'N BATTY

By Bill Route, Tom Bemis, Dale Pate, Jason Richards, and David Roemer

The Resource Management Division is well into a two-year project aimed at developing a consistent way of monitoring the Mexican free-tailed bat colony that roosts in Bat Cave. As previously reported in "CANYONS & CAVES" (Issue No. 1, Spring 1996), we anticipate that our primary method of monitoring trends will be infrared still-photographs. In this article we provide an up-date on our progress with photo monitoring and then introduce a second method which entails monitoring bat sound levels at night.

UPDATE ON PHOTO MONITORING

Photos are being taken from permanent points each spring and fall to document the area of cave ceiling covered by bats. Eventually the area covered by bats can be converted to an estimate of the bat population, but several problems must be dealt with first. We don't know, for example, how many bats there are in a square foot of cave ceiling at Carlsbad Cavern. While estimates have been made elsewhere, it's unknown whether these estimates hold true at Carlsbad and how much it depends on season or weather.

We now have **very preliminary** estimates of ceiling area covered by bats for this past spring and fall, but refinements are still necessary. Before we come out with final numbers we need to accurately map the cave ceiling. This winter we hope to use laser survey instruments to create a contoured map of the ceiling. Contours would correspond to varying ceiling heights thereby providing accurate estimates of ceiling area. Each year the photos will be scanned into a computer and displayed as an overlay on this contour map. Using GIS software we can sum up the area of bats within contours for a reasonably precise and unbiased estimate of total area covered by bats. Finally, we need to verify the average number of bats packed into a square foot of cave ceiling. This all takes time, but we are optimistic that the time and effort will result in a statistically defensible estimate.

All abundance estimates for wildlife are subject to errors and limitations of course. For the photo method, we will always under estimate the population since there are ceiling fissures and other features that hide bats from the camera's eye. For this reason we are looking into a second method to verify trends. We are excited about the use of sound recordings as this second method.

SOUND RECORDINGS

We are experimenting with using a remote microphone to record the sounds made by bats flying in and out of the cave. A data-logger allows us to record the sound, measured in decibels, once every second all night. This huge data set is then downloaded to a computer in the morning and graphically displayed for a permanent "signature" of the nights activities. The figure below shows a 100 minute recording of the bat flight on September 7th. The area under this curve, apply dubbed "bat units", is, theoretically, proportional to the number of bats that fly. Correlating this sound signature with actual numbers of bats may be possible in time, however, this type of correlation analysis requires many estimates over a broad range of population levels. Several paired photo sessions with simultaneous sound recordings will be necessary, but it is feasible that this could eventually be the most efficient method of monitoring population trends.

Additionally, sound recordings can provide us with insights on the behavior of bats at night when they are most active. As can be seen from the graph, on this particular night the major exodus took

approximately 30 minutes, followed by a 10 minute lull, and then a second more drawn-out exodus. Recordings taken throughout the night can help us better understand bat behavior during various seasons, weather patterns, or disturbances.

To sum up, the bat monitoring project is going well, but definitive numbers are going to take some time. A Technical Report on our progress should be completed this spring and the Final Report is slated for the fall of 1997. This project is being funded by the NPS Intermountain Field Area Science Fund and the Adopt-A-Bat Program at Carlsbad Caverns.

BAT RABIES - FACT VS. FICTION by Harry Burgess

Test yourself with the following true/false quiz:

1. Rabies is a virus which is found throughout the world.
2. Bats are responsible for the majority of human rabies infection.
3. Rabies is a curable disease.
4. Bats are asymptommatic carriers of rabies.
5. Insectivorious bats are not rabies transmitters.

How did you do? Read on to find the answers...

Rabies is a viral infection of the central nervous system. It can affect any warm blooded animal exposed to the virus, and results in disorientation, paralysis, and ultimately death of the affected individual. Exposure to the virus usually results from the bite of an infected animal, as the virus is secreted through the salivary glands of those infected. In order to infect a new host, the rabies virus must come into contact with the mucosa or bloodstream of an individual, and the virus does not survive well outside of a host. Usually this infection comes from a bite which breaks the skin, but in two demonstrated cases, inhaled viruses suspended in the air of a heavily populated, humid, bat maternity cave transmitted the disease to humans. Sunlight, alcohol, soap and water are all effective means of killing the virus outside of a host.

Rabies was first described in written history around 2000 BC, in reference to liability for a dog bite. Throughout recorded history, domesticated animals have been the most significant threat to humans for the transmission of rabies. In fact, during the last four decades, only 10 people in the U.S. and Canada have acquired rabies from bats, much less than the number that die annually from food poisoning.

That's not to say that bats don't serve as hosts for the disease, they do. In the earlier part of this century, vampire bats in Brazil were responsible for spreading rabies throughout the cattle in that country, virtually destroying that growing industry. Many ranchers further north attempted to prevent such a problem by destroying any bat roost they encountered, a practice which still occurs today in areas unfamiliar with the benefits associated with other species of bats.

It wasn't until 1953 that rabies was identified in insectivorous bat species in the United States. Most likely, the disease was already present, yet the risk of bat-introduced rabies was very low. Today, with the removal of many natural bat habitats and the bat's increasing dependency on man-made structures for roosts (such as attics, barns, and eaves) the potential for contact with a sick bat has increased dramatically.

Many people consider bats to be carriers of the rabies virus that don't themselves become infected, thus allowing the bats to infect many other animals during their considerably long lifetime. This belief was supported for many years by research that showed laboratory mice dying after being bitten by "infected" bats, yet the bats never developed any symptoms of rabies. It was later discovered that the mice were dying from Rio Bravo virus, a virus with similar symptoms yet which does not affect bats or humans. Bats do succumb to rabies, and as symptoms develop they are more likely to come into

contact with humans, generally when a person picks up a dying bat found under a roost. For that reason, do not attempt to handle any bat without proper protection (heavy gloves, pre-exposure vaccinations for rabies) since any bat that allows itself to be handled is most likely sick.

Rabies has been eradicated in Great Britain through tough controls placed on pet owners and required quarantines of animals entering that country, and in some remote parts of the world (Hawaii, Australia) the disease has never established itself. With modern medicine, and early detection, rabies can be treated. It is a progressive disease, travelling along the nerve fibers, debilitating the nerve cells encountered. Although pre-exposure vaccinations consist of three painless injections in the arm, post-exposure treatment still requires a series of injections into the stomach lining, and the amount of damage to the infected individual depends on the stage at which the disease is identified.

A small percentage of the bats collected in Carlsbad Cavern have tested positive for rabies, as would be expected for any large group of mammals, and so precautions should be taken by any person who comes in contact with a bat. For those entering Bat Cave, the additional requirement of a respirator (and pre-exposure shots if there is a need to be in Bat Cave during the summer months) is designed to remove the potential for airborne infection in an area known to be heavily populated. In general, bats are not a common vector for the infection of humans with rabies, and when certain steps are taken to prevent bites from obviously sick animals (and healthy ones for that matter) the risk of rabies transmission is very low.

For more information: The material presented here was collected from various vertical files (Constantine,D.G., Brass,D.A., Murnane,T.G., Lewis,W.C.) as well as America's Neighborhood Bats, by Merlin Tuttle, and Bats, A Natural History, by John Hill and James Smith. All of these materials can be found in the Park library.

ANSWERS: 1. f, 2. f, 3. t, 4. f, 5. f

EXTIRPATED WILDLIFE OF CARLSBAD (PART II) by Gary Vequist

Park Natural Resource scientists are engaged in completing resource inventories that contribute to the understanding of park ecological conditions. We are overwhelmed by the amount of resource data collected over the years. When you look far enough back, say 1890, you realize biological diversity declined in Guadalupe Mountain forests and grasslands. In the last issue of Canyons & Caves we revisited the demise of bison, Desert bighorn sheep, and prairie dogs. This time we will turn the pages of Vernon Bailey's 70 year old book "Animal Life of Carlsbad Caverns" to examine four more extirpated species.

GRAY WOLF; "These big gray wolves, or lobos, were once numerous in the Pecos Valley, and were still very destructive to stock when I was there in 1901. Now they are practically gone, and the stockmen could give me no recent record of their occurrence in the Carlsbad region..... The large gray wolf or lobo of the Mexicans is a heavy animal, often weighing over one hundred pounds, with long, light gray fur, and a well marked cape or mane of long hairs."

MERRIAM ELK; "The Merriam elk are gone from the Guadalupe and Sacramento mountains, where they were once abundant and from which area they may well have moved in winter down to the Mescalero Cave level. At any rate they were within an easy day's hunting trip from the cave and undoubtedly afforded one of the important sources of game and food supply for the local aborigines..... The Merriam elk is a large form with very heavy antlers, and in coloration and general appearance differs little from the Rocky Mountain elk."

MEXICAN BEAVER; "A few beavers are said to have been taken a few years ago in Black River on the Washington ranch, four miles south of the Carlsbad Cavern, but the foreman of the ranch thinks that none is found there now. During high water the Black River runs to the Pecos below Carlsbad, but for most of the year it is dry except in pools and sections where the water rises over rocky dykes. On the Washington ranch there are large permanent pools and ponds, fed by flowing springs, so the beavers need only to swim up Black River from the Pecos in high water to find a paradise of deep water, high banks, abundance of food, and ideal homes. Evidently the Pecos River is used as a highway of travel by beavers, but the section below Carlsbad is very strongly alkaline and not enjoyed by them."

TEXAS GRIZZLY: "That grizzly bears once inhabited the Sacramento and Guadalupe mountain ranges is well known, but as early as 1900 they were extremely scarce, and now are probably all gone. Not a specimen remains to show what the species was..... Apparently the species is now extinct, but any old skulls from the Guadalupe or Sacramento mountains would be of great interest in showing which of the several species of grizzly bears once inhabiting New Mexico was represented in this range."

In the next issue we will discuss invading plants and wildlife; both natural range expansions and exotic introductions.

RADON IN CARLSBAD CAVERN by Dale Pate

Radon 222 is a radioactive gas found in varying concentrations in many caves, including Carlsbad Cavern. This gas is found in many caves because minute traces of Radium, which give off Radon 222 as a gas, are found in most rocks and soils throughout the world. This includes the limestone of the Permian Reef that Carlsbad Cavern is formed in. Radon 222 decays relatively fast through four intermediate isotopes or phases termed radon daughters. Radon daughters give off a type of radiation known as ALPHA particles. Studies on uranium miners have shown a correlation between the increase in number of lung cancer cases and long-term exposure to ALPHA particles.

The terms "Working Level Months" (WLM) and "Working Level Hours" (WLH) are used to describe cumulative exposure to radon-daughter environments. The exposure level is a value obtained from the amount of radon daughters in a certain volume of air and the time one spends in an area exposed to that air.

NPS-14 titled Cave Radiation Safety and Occupational Health Management Guidelines (which are still in draft form) states that the annual cumulative radiation exposure for any employee shall not exceed 4.00 WLM's. Radon sampling in Carlsbad Cavern, Slaughter Canyon Cave, and Spider Cave began in 1973 and continued through the mid to late 1980's. In 1986 the average exposure values for employees in the Cavern was about 1.2 WLM's, well below the maximum permissible in NPS-14. The highest value was 1.5 WLM's. At that time, the average time per day per employee spent in the cave was approximately 4 hours.

Due to air circulation patterns in Carlsbad Cavern, radon daughter levels are higher in the summer months. In winter cold air sinks into the cave at the main entrance and forces the warmer air to flow up and out of the top of the main entrance as well as the Bat Cave entrance. This results in the radon present in the air being literally flushed out of the cave. In the summer, this overturning of air occurs less frequently, so that radon builds up to higher levels. Remember, the average **annual** cumulative exposure is still well below the maximum permissible of 4.00 WLM's.

There is no direct evidence that exposure to ALPHA radiation levels present at Carlsbad Caverns National Park presents a hazard to human health. However, several studies have indicated that those who smoke cigarettes are at a much higher risk when they are also exposed to radon daughters. It was because of these studies that all smoking within Carlsbad Cavern was prohibited starting in the late 1970's. Not only were the smokers putting themselves at higher risks, but the non-smokers breathing passive smoke

in the cave were at risk also. It is well documented that smoking is very hazardous to your health. When combined with long-term exposure to radon daughters, the risks appear to increase a great deal.

Due to the large amount of sampling for radon levels over an extended period at Carlsbad Cavern and the relatively small amounts of radon measured, the park at this time only keeps records of employee hours spent in the cave.

COUNTING BATS AT CARLSBAD CAVERN: THE 8.7 MILLION NUMBER

by David Roemer

Counting the bats at Carlsbad Cavern has never been an easy task. The inaccessibility of the roost site and the irregularity of the roost surface has led investigators from Bailey (1928) to Altenbach, Geluso, and Wilson (1973) to decide against roost estimates, and attempt counts of flying bats. Early attempts at making a population estimate were based on personal observations of the flight column, unaided by the technology of today. In the late 1920's Vernon Bailey of the U.S. Biological Survey determined that there were 3,000,000 bats in the population in this manner. This number was posted on a placard at the entrance to bat cave for park visitors to see (Allison 1937).

8.7 MILLION BATS

The highest estimate of the bat population at Carlsbad Cavern comes from an observation by Vernon Allison on the evening of June 16, 1936. This oft-quoted number of 8.7 million bats was published in the Journal of Mammology in 1937. The method used by Allison to count the bats involved estimations of the area of the flight column, the density of bats within the column, and the rate of speed at which the bats traveled.

From a vantage point 75 feet from the cavern entrance, Allison observed a cylindrical column of bats approximately 20 feet in diameter. Allison estimated that the density of the column was one bat per cubic foot, therefore each linear foot of the column contained 314 bats (there is an area of 314.16 square feet in a 20-foot diameter circle). Allison further estimated that the bats traveled at 20 miles per hour, or roughly 29 feet per second. At this rate of speed, 9,106 bats would pass through a 20-foot diameter hula-hoop every second.

Having determined that 9,106 bats flew past his vantage point every second, all that remained for Allison was to observe the flight and his pocketwatch. The flight began at 7:03 PM and continued at full force until 7:17 PM (14 minutes or 840 seconds). During that time, Allison saw 7,649,040 bats (840 times 9,106). From 7:17 until 7:21 PM (4 minutes or 240 seconds) the flight tapered off at approximately half-strength, giving Allison 1,092,720 more bats (240 times 4,553). The grand total for the night came to 8,741,760 bats, which Allison rounded off to a tidy 8.7 million.

A CLOSER LOOK

There are several assumptions built into Allison's equation that might be challenged. Basically, Allison has treated the bat flight as one might consider water flowing through a pipe, assuming constant rate of speed, constant direction, constant density, and an unchanging diameter of the flight column. Allison's model does not consider variability in these matters, such as bats returning to the cave, wind scattering bats within the column or changing the shape of the column, etc. Allison's approximations could also significantly affect his calculations. For example, Allison measured time in minutes, although the unit of calculation in his formula is seconds. By counting whole minutes and multiplying by 60, Allison introduced a source of error.

One might particularly question the rate of speed that Allison plugged into his equation. The species account published by the American Society of Mammalogists cites flight speed for *Tadarida brasiliensis* as 30.5 meters in 7.2 to 10.2 seconds (Hayward and Davis 1964) or 9.8 to 13.9 feet per second. If one slows Allison's bats down to 12 feet per second, then instead of seeing 8,741,760 bats, he

would have seen only 3,617,280.

THE 8.7 MILLION DOLLAR QUESTION

Regardless of how many bats Allison saw on June 16, 1936 - 8.7 million or 3.6 million or none at all - can we reliably base our historic population estimate on an observation from a single evening? Nope. During the summer of 1936 rangers at Carlsbad Caverns classified every bat flight as being either good, fair, poor, or none (no flight). Most of them were poor. As it happens, Allison was here on a good night, following two days of rain. On the whole, the summer of 1936 (May 15 to October 22) contained 42 good flights, 36 fair flights, 81 poor flights, and 1 flight that never happened. According to ranger records, the flights in August of that year were "unusually poor" and there were "several nights when not over 100 bats came out." What if Allison had visited us then?

Reliable population estimates of the Mexican free-tailed bat colony at Carlsbad Cavern require a methodology that is repeatable, inexpensive, fairly easy to use, and statistically robust (see Mexican free-tailed bat monitoring in *Canyons & Caves No. 1*). The information that we gather and present concerning our popular furry friends should be based on much more than a shot in the dark.

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CONSTANTINE'S FREETAIL by Dale Pate

On May 7, 1958 Denny Constantine, a famous bat biologist, collected skulls of a new species of bat from New Cave (now called Slaughter Canyon Cave). This new species was described by Barbara Lawrence in the August 1960 issue of Journal of Mammalogy and given the name of *Tadarida constantinei* in honor of Dr. Constantine. This species is extinct and is only known to have occurred in Slaughter Canyon Cave. The upper layers of guano in the cave have been age-dated by the Carbon 14 method and found to be older than 28,150 years. It is not known at this time when *Tadarida constantinei* actually was using the cave for a roost. This extinct species was approximately 10% larger than the Mexican freetail bat that forms the large colony in Bat Cave.

MOONMILK by Harry Burgess

One intriguing speloethem found in the caves of the Guadalupe Mountains is Moonmilk. The name refers to the appearance of the deposit, and not to its mineral content. Moonmilk is a term that commonly describes any soft, white, pasty deposit found in caves. The texture of the deposit is the defining test, as moonmilk has often been described as having the consistency of cottage cheese yet ranges from a more fluid deposit to a dry powder, depending on each cave's environment.

In Carlsbad Cavern the most identifiable deposit of moonmilk is in Left Hand Tunnel. There the mineral content is hydromagnesite, $Mg5(CO3)4(OH)2$. Moonmilk can consist of hydromagnesite, dolomite, huntite, calcite, aragonite, or a variety of other minerals, yet these five are most commonly found in the Guadalupes. Often moonmilk is deposited at or near the intersection of the reef and either the forereef or backreef, as these are zones of varying magnesium content in the bedrock, and magnesium

content is believed to control deposition of the material. The five minerals mentioned above are all deposited according to the relative amounts of magnesium present in solution. Magnesium further prevents the formation of large crystals, and thus when the magnesium content is high, the formation of small particles in the deposit account for the characteristic smooth texture of moonmilk.

For more information, including historic medicinal uses of moonmilk, see Cave Minerals of the World, by Carol Hill and Paolo Forti, and Geology of Carlsbad Cavern and other caves in the Guadalupe Mountains, New Mexico and Texas, by Carol Hill.

RAFTING WALNUT CANYON by Tom Bemis

I have been asked repeatedly to detail my dealings in the Whitewater affair. Since I have been offered immunity from prosecution, I am offering this testimony. In October of 1979, Walnut Canyon, a normally dry and cactus strewn wash, flooded and set into motion a case of simultaneous insanity in both Ron Kerbo and me. "Wouldn't that be fun in a raft?" I casually said. Ron agreed, knowing that (1) the canyon only very rarely floods, and (2) neither of us owned a raft.

During the next year however, 6 man rafts went on sale at Surplus City. Being an overpaid government employee, I bought one, naming it the "Hodag I". At about this time, Ron added several more gray hairs to his already ample supply. As the year wore on, I inflated and deflated the raft countless times, fine tuning my rapid deployment skills. I knew that when the canyon ran, it wouldn't be for long. The purchase of a high volume, low pressure 12 volt pump eased my worries.

Summer ended uneventfully and I gave up hope for the year, stuffed the raft and pump into a box, and put them away. Ron didn't shy away from me quite as much now. October approached and the clouds returned. Day after day, it drizzled. I told Ron to be ready, because the canyon was primed. He humored me and secretly hoped that I would catch a cold out there watching the weather. At that time, I was living in the men's dorm, which was in the superintendent's building. My room was where the fire management
office is now, and what is now the weight room was then the restroom. To save time, I had inflated the raft and stored it on top of the restroom stalls.

One year to the week after we had first watched the canyon flood, it rained again- hard and all night. I was up early, and as soon as the patrol ranger announced that the entrance road was flooded, I let some air out of the raft to get it out of the restroom (not an easy trick), shoved it into the back of my Datsun wagon (not an easy trick), and was on my way to Kerbo's house. Ron greeted my news with something less than enthusiasm, and more akin to the attitude of a condemned man. He did grab his hard hat and wet suit however, and then excused himself to put on his pantyhose.
(Note: This is an odd little quirk about divers. They claim the hose makes it easier to pull on the wetsuit. Many other people have other theories about this practice, rarely said to the diver's face.)

Anyhow, we were soon on our way. Other hilltoppers watched through their windows as we departed, whispering among themselves, and shaking their heads sadly. At the bottom of the big hill, the water was flowing well several inches over the road. We pulled on our wetsuits, which was a major improvement in Ron's case because he does not look especially smashing in pantyhose, and started the raft inflating. Ron then startled me by leaping into the water and body-surfing around the bend. I heard no screams for help, so I followed. Almost immediately, the word "stupid" came to mind. The water was moving far too fast for me to maintain any control, so I started reaching for branches so that I could pull myself to shore. It is amazing how many dead, dry branches are in the
bottom of Walnut Canyon.

I finally met with success however, and joined Ron in trudging back to the raft, which was by now well inflated. We then inflated the seats, which only wedge into position, and which provide some rigidity to the boat. We pulled on our cave helmets, cinched up our live vests, grabbed our paddles, and set out. All that was missing was a funny looking kid with a banjo.

We knelt in the bottom of the raft, preferring the security offered there, over the seats. The lower placement also offered more protection from the branches that zoomed overhead. I found myself worrying about how little protection an eighth of an inch of wetsuit material offers from the rocks passing under the raft. I should have been worrying instead about the large rocks ahead. Approximately 200 yards from where we launched, two boulders jutted out of the water offering just enough space for the raft to pass between. With a great deal of last minute frantic over-controlling, we managed to perfectly align ourselves with the slot- sideways. We slammed into the rocks, the water slammed into us, and the raft collapsed and was forced down by the tremendous pressure. The seats popped free and launched downstream. We climbed the rocks and fought the raft free, emptied the water, relaunched, and collected the seats downstream. The water level was going down now, and the ride was becoming a little more sane.

At the next crossing, although the water was still over the road, we had to carry the raft over the pavement. We then launched and continued to the next crossing, which we once again had to portage. We were now starting to have trouble finding enough water to navigate even away from the crossings, so we pulled out at the archaeological site, which was a DEEP lake with a natural water slide emptying into it. We played on the slide and in the pond while discussing how we were going to get out of there. The original plan was to raft to White City, stash the boat, and hike the guano trail back. At about that time, Jack Linahan, the area manager, pulled up in his Suburban and threatened to cite us for rafting without a permit.

So now you know the full extent of my involvement in the Whitewater affair. How do I plead? Insanity.

WHO'S WHO by Jason Richards

Everybody knows J. Michael Queen, but did you know what the J stands for in front of his name? Well your just going to have to keep wondering because he didn't tell me, however, he did share some other interesting facts that tell who Mike Queen really is. Mike Queen was born in Oakland, California January 10, 1948. Being a California boy near the Sierra foothills in 1966, he started exploring and found he had an interest in mines and caves. Mike pursued his interest and in 1969 joined the National Speleological Society.

Mike attended State University of New York at Stoneybrook where he received a bachelors in earth and space sciences, a master in sedimentology, and a doctorate in paleobiology. Mike is known for being one of the leading carbonate geologists of the Capitan Reef, and his knowledge of Carlsbad Cavern is astounding.

With a mother that lives in California and sometimes in New York, and a brother that lives in New York and sometimes in Florida, it's no wonder that Mike comes and goes with the wind.

For Michael, real life entertainment really does include caving, however, Mike is also an accomplished impressionist painter, enjoys cooking, an antique dealer and plays the penney whistle.

CALENDAR OF EVENTS

Sept. 23-Oct. 30	Coryphantha Cactus Monitoring
Sept. 30-Oct. 4	Lint Camp
Oct. 1-30	Lion Transects
Oct. 10-14	Restoration in SW Branch, Lechuguilla
Oct. 12	Old Lunch Room Rubble Removal - Permian Basin Spe. Society
Oct. 15-Nov. 15	Fire Effects Plots
Oct. 16-18	Vertical Rescue Techniques Training
Oct. 19- 26	Seiser Exploration and Survey Exp. - Carlsbad Cavern
Nov. 2-9	Mallory Science Exp. - Lechuguilla
Nov. 16-24	LEARN Restoration Exp. - Lechuguilla
Nov. 24-28	DuChene Mineral Inventory - Lechuguilla
Nov. 28-Dec. 1	CRF Survey Exp. - Carlsbad Cavern
Dec. 7-15	LEARN Restoration Exp. - Lechuguilla