National Park Service
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The Midden

The Resource Management Newsletter of Great Basin National Park

Cleaning Lehman Cave: 2008 Lint Camp

By Shawn Thomas, Park Volunteer

In March of 2008 Great Basin National Park hosted a lint camp at Lehman Cave. A total of 10 volunteers from Nevada, California, and Utah participated. This event was organized to address the significant accumulations of lint throughout the cave since the last lint camp in 2000.

Lint is introduced to the cave environment by the approximately 40,000 people who enter the cave each year. Lint is composed of fibers, hairs, skin cells, dust, and other foreign particles. Lint can become cemented into cave formations, causing discoloration or even dissolution of natural cave surfaces. Lint also acts as an artificial food source, potentially causing imbalances in cave biota communities.

In addition to removing lint from the cave, lint camp participants also worked to clean flowstone and ceiling surfaces that had become stained with dirt and mud, and to remove foreign debris such as concrete, rock, and sand that had been introduced during trails and lighting projects. Nearly 50 hours of in-cave volunteer time yielded just over 8 pounds of material that was collected and removed from the cave.

Photo by Shawn Thomas, NPS

Materials removed from Lehman Cave during the 2008 lint camp.

Lint camp participants focused primarily on areas along the tour routes, as these spots have accumulated the greatest amount of lint and other foreign material. Work was performed in the Grand Palace, Inscription Room, Music Room, Tom Tom Room, Rose Trellis Room, Gothic Palace, Exit Tunnel, and Natural Entrance area. Before beginning, park staff led safety, training, and cave biota identification sessions. To remove lint, workers used paintbrushes and tweezers to brush and pluck lint off cave surfaces. Lint was transferred to a collection bag, along with any other trash found. Lint and other debris from each section of the cave was weighed and photographed prior to disposal.

A different kind of restoration activity was conducted near the exit tunnel, where volunteers worked to clean bits of hardened mud and sand off the ceiling. When the floor of this area was blasted in the early 1970s to create a walking passage, the impacts of the explosions were contained by stacking sandbags over the blast area. This resulted in much of the sand and finer sediments being projected onto the ceiling, where some of it has remained to this day. A few hours of work in this area using spray bottles and brushes made a remarkable difference to the appearance of the cave ceiling surface and formations.

The final evening of lint camp was spent using a tall ladder to reach high ceiling areas in the Gothic Palace. This was the site of some of the most concentrated lint accumulations in the entire cave, indicating the presence of air currents that cause lint deposition 20-30 feet off the ground. Some of the soda straws and stalactites in this area were literally shrouded in lint. Unfortunately lint has become cemented onto some of the cave formations in this area, as water has deposited calcite over old lint deposits. This made the removal process extremely difficult and in some cases impossible. Still, the Gothic Palace ceiling looks far better than before we started.

Photo by Justin Gleason

A paintbrush is a useful tool for removing lint from cave formations.

Future lint camps will target areas that were not cleaned in this weekend. Great Basin National Park would like to thank all those who volunteered to help with this important project.

In This Issue

Upcoming Cave Restoration in Talus Room

By Ben Roberts, Natural Resource Program Manager

Work to restore the closed section of Lehman Cave is scheduled to begin this spring. This section was closed in 1981 after park rangers reported that a rock mass above the trail had been showing signs of movement. The rock mass was closely monitored and showed three inches of movement that year. The United States Geological Survey (USGS) evaluated the structural stability of the Talus Room and concluded that the room was unstable.

Photo by Gretchen Baker, NPS

A rusty light switch is an example of outdated cave "improvements" that will be removed as part of the Talus Room restoration.

The USGS presented several options to the National Park Service, including stabilizing the rock mass and constructing a tunnel to bypass the area. Closing the room was chosen as the best option, both for visitor and staff safety and for the protection of cave resources. Though no massive boulders have come crashing down in the years since the closure, rock fall has been documented. With so many stable rooms and passageways, all dense with cave formations, it was determined that it was not worth the risk to visitors and employees to take tours through the Talus Room.

With the Talus Room closed, Great Basin National Park now has the opportunity to restore this large area of the cave to a near natural state. Restoration, however, requires more than just turning out the lights. The restoration process involves removing all foreign materials that were introduced as part of the cave development. Examples of these are wooden staircases (removed in 2003), metal handrails, cement and asphalt trails, and electrical system components. These materials have affected both the cave's chemistry and its food web. For example, the electrical system, which has corroded over time, allowed iron, aluminum, copper, tin, and lead to taint the surrounding cave environment. Iron oxides from rusting metal structures stained the surrounding bedrock and formations. Wooden staircases, exposed to the humid environment for decades, hosted non-native bacteria, fungi, and invertebrates. Restoration will be accomplished by removing approximately 1,800 feet of unused electrical system and 800 feet of paved walkways. Areas will then be restored to natural contours where possible to allow the cave to heal itself over time.

Previous to the Talus Room being closed, there was no major "dark zone" in Lehman Cave. Dark zones are important in developed caves, such as Lehman, because they provide an area for natural cave processes to continue in spite of the altered environment elsewhere in the cave. In the dark zone, the cave maintains its natural temperature and humidity, spared the heating and drying affects of lights. Algae, a common problem in developed caves, cannot grow in constant darkness. Reduced human visitation also benefits the dark zone as even the most careful visitors to a cave bring in elements from the surface including soil from shoes and lint.

The National Park Service is entrusted with the unique responsibility of managing for native species and ecosystem integrity while providing for the enjoyment of these resources by the public. With a restored dark zone established in Lehman Cave, this is possible. Visitors can safely enjoy the highly decorated rooms and passageways of the cave, while sensitive cave species can thrive as part of a native cave ecosystem in the Talus Room.

Photo by Rick Bowersox

Volunteers are an important part of many park programs. Pictured here are volunteers from the 2008 Lint Camp.

More Bonneville Cutthroat Trout Move into Park

By Gretchen Baker, Ecologist

On May 8, 2008, staff from Great Basin National Park, Nevada Department of Wildlife, and Bureau of Land Management (BLM) moved 224 Bonneville cutthroat trout (BCT) to help expand their populations in eastern Nevada. BCT are the only native trout in this part of the state, but in the 1990s only a handful of populations were known. Years of interagency efforts have helped to verify genetically pure BCT in three streams and restore BCT to nine streams in the Snake Range (Table 1).

The fish reintroductions this spring supplemented previous restoration efforts. Hendry's Creek in the North Snake Range was the donor source. After fish were captured using electrofishing equipment, they were transported in aerated fish tanks to two locations in the South Snake Range, Big Wash and Upper Snake Creek. Big

Photo by Gretchen Baker, NPS

A recently released Bonneville cutthroat trout checks out its new habitat.

Wash is located on BLM and private land while Upper Snake Creek is within the park.

Fish population surveys on Upper Snake Creek last year showed that the 104 fish originally reintroduced in 2005 are reproducing well. Many young-of-year and age class 1 fish were found. Nevertheless, Upper Snake Creek contains more than five miles of available stream habitat, and it would take a long time for an initial 104 fish and their progeny to populate this entire area. Therefore, additional fish were reintroduced in other locations within the stream to help the population grow faster.

In 2007, the U.S. Fish and Wildlife Service remanded a decision not to list BCT on their threatened and endangered species list. The Service is currently reconsidering if this fish species should be listed. The Nevada Bonneville Cutthroat Trout Conservation Team is working hard to expand the populations of this beautiful trout with the hope that it will not need to be listed, which would add significant regulatory burdens.

Also in 2007, the Nevada Bonneville Cutthroat Trout Conservation Agreement and Conservation Strategy was signed by all members of the team. This document lays forth activities that will help keep BCT healthy far into the future.

Table 1. EXISTING BONNEVILLE CUTTHROAT TROUT CONSERVATION POPULATIONS IN NEVADA (modified from Nevada BCT Conservation Strategy)

Stream	Kilmeters of habitat currently occupied	Kilometers of BCT Habitat				Source & Year(s) of Reintroduction / Transplant	Mountain Range
		USFS	NPS	BLM	Private		
Within Bonneville Basin							
Big Wash Creek	8.1			1.6	6.5	Hendry's Creek – 2003, 2008	South Snake
Deadman Creek	6.1	6.5				Hendry's Creek - 1997, 1998, 1999	North Snake
Deep Canyon Creek	0.8	5.6				Hendry's Creek - 2003	North Snake
Hampton Creek	5.6	4.8		0.8		Pine/Ridge Creek - 1953	North Snake
Hendry's Creek	11.8	11.8				Core Population	North Snake
Mill Creek	2.6		1.8	0.8		Unknown	South Snake
Smith Creek	4.4	11.3				Hendry's Creek - 1999	North Snake
Snake Creek	5.0		8.5			Hendry's Creek – 2005, 2008	South Snake
South Fork of Big Wash	4.8		4.8			Mill Creek - 2000	South Snake
South Fork of Baker Creek	1.0		3.5			Mill Creek - 2005	South Snake
Strawberry Creek	5.0		6.3	1.8	1.6	Mill Creek - 2002, 2005	South Snake
Outside Bonneville Basin							
Goshute Creek	2.4			6.5		Pine/Ridge Creek - 1960	Cherry Creek
Pine & Ridge Creeks	2.6			2.6		Unknown	South Snake
Deep Creek	2.4 (1.5)	2.4 (1.5)				Goshute Creek	Quinn Canyon

Using Great Basin Cottonwoods to Study Climate Change and Evolution

By Scott Woolbright, Tom Whitham, Gery Allan, Nashelly Meneses, Matt Zinkgraf, and Helen Bothwell, Merriam-Powell Center for Environmental Research, Northern Arizona University

The mountains of Great Basin National Park represent important "natural laboratories" for studying the ecological and evolutionary consequences of past climate change. Pollen data collected from dry lakebeds across Nevada's basin and range geography show that, prior to the last ice age, forest ecosystems occupied the valley floors as opposed to the sagebrush deserts we see today. During this time, streams, rivers, and lakes within the basins likely supported large "gallery" forests of cottonwoods and other riparian species. Climate change at the end of the ice age resulted in the invasion of the Mojave and Great Basin deserts, forcing riparian forests to move up in elevation or face extinction.

Modern populations of cottonwoods now occupy the isolated streams and canyons of the states' numerous mountain ranges. These "sky islands" are surrounded by desert "seas", and support the remnants of the ancient valley populations. These remnants, or "relicts" (Figure 1) as they are often called, provide a unique opportunity for studying the ecological and evolutionary consequences of population fragmentation due to climate change, not only for the cottonwoods, but for their dependent communities as well.

One of the most interesting features of Nevada's sky island cottonwoods is that most populations appear to be dominated by hybrids. Three species of cottonwoods have been identified in Nevada—black (*Populus trichocarpa*), narrowleaf (*P. angustifolia*), and Fremont cottonwood (*P. fremontii*)—and each will hybridize with the other two. Using leaf shape as a guide (Figure 2), our preliminary research shows that populations of these "pure" species are rare in most parts of Nevada, suggesting climate change has favored the survival of hybrid vs. parental genotypes. Because the question of hybrid evolutionary potential has long been debated, these observations represent an important contribution to the field of evolution. Our findings add to other studies demonstrating that hybrids and hybridization can contribute to adaptation, and, potentially, evolution of new species. For example, up to 70 percent of all plant species are thought to have evolved throughout hybrid pathways.

Hybridization among cottonwood species also has important implications for the species that depend upon them for survival. Studies have shown that increased genetic variation due to hybridization influences both the distribution and abundance of associated microbial, arthropod, mammal, and avian species from other river systems. This research has led to a number of important hypotheses about how evolutionary changes in cottonwoods might drive the evolution of other species. For example, the fact that hybrids contain the genetic material from both their parental species has led to the idea that they might act as "bridges," allowing dependent species to switch from one host to the other. If true, hybridization in relict systems might increase the chances that dependent species will adapt to changing climates.

The Cottonwood Ecology group at Northern Arizona University is interested in examining whether genetic changes in Nevada's cottonwood populations have resulted in the adaptation of dependent organisms to new hosts. For example, recent studies have shown that what was thought to be only one species of arthropod on cottonwoods and their hybrids is actually two species, one on the hybrids, and another on the narrowleaf cottonwood (Figure 3).

Our study sites, located on a number of creeks throughout the park and surrounding area, all appear to be

Photo by Northern Arizona University

A "relict population" of cottonwoods Big Creek, Toiyabe Mountains, Nevada.

Great Basin Cottonwoods (continued)

Photo by Northern Arizona University

The range of leaf shapes among Fremont cottonwood (at far left),narrowleaf cottonwood (at far right), and their hybrids (middle).

dominated by hybrid genotypes in which the parental species have died out. We are currently performing DNA analyses in order to verify the hybrid nature of these populations, and to investigate the genetic differences among various populations. If the hybrid status of these trees is verified, it suggests that the conservation of these hybrids is important as they represent the evolutionary potential of hybrids in arid environments (i.e. they are the most drought adapted). Such trees might be especially important with predicted future climate changes and they could be an important source of genotypes that could be used in restoration projects throughout the southwest. Future research will involve identifying and categorizing arthropod, fungal and other community members that occur on these trees in order to look for novel associations not found in other populations. For more information on our groups' research, visit www.poplar.nau.edu.

Photo by Northern Arizona University

Leaf gall from the mite genus Aceria. Galls from narrowleaf and hybrid tree, once thought to represent a single species, consist of two different species. Thus, cottonwood hybridization appears to have resulted in the evolution of a new arthropod species.

Important Bird Areas

By Robin Powell, Nevada Director of Bird Conservation, Audubon Society

The Important Bird Area (IBA) Program is a world-wide effort to identify the most important places for bird populations and to focus conservation efforts. Within Nevada, there are 39 recognized IBAs which are sites that provide essential breeding, migration, or wintering habitat for one or more species of birds. In fact, in order to be an IBA, an area must:

- be important to a Nevada species of concern or a federally listed species under the Endangered Species Act,
- support a species specific to that habitat type,
- support a congregation of many species, and
- have high avian species diversity.

The Nevada IBA Program is focused on the protection, preservation, conservation, and restoration of the habitat which is not only beneficial to the bird species but wildlife in general. Each IBA has varying degrees of resource challenges and issues ranging from invasive plants, habitat degradation, development, and water quantity/quality. The Nevada IBA program is focused on monitoring and conserving the unique habitats that make these sites Important Bird Areas.

Great Basin National Park is an Important Bird Area with 33 of the 51 Nevada Partners in Flight Species of Concern found within or adjacent to the park. The park is also one of the few places in Nevada that contains subalpine and alpine habitats with associated bird species such as Black Rosy-Finch and Three-toed Woodpecker. The Park's spruce forests possess many species of concern such as Olive-sided Flycatcher, Calliope Hummingbird, Prairie Falcon, and Northern Goshawk.

Throughout the park, neotropical migrants are found in many riparian areas. Black-throated Gray Warbler, MacGillivray's Warbler, Wilson's Warbler, Yellow-breasted Chat, and Red-naped Sapsucker are bird species that use the riparian areas for breeding. However, the highest diversity of birds occurs in the mountain big sagebrush and mixed conifer habitats in the Park.

Photo by USGS

Prairie Falcon

Some of the priority species associated with these habitats include Greater Sage-Grouse, Sage Sparrow, Sage Thrasher, Vesper Sparrow, Virginia's Warbler, Orange-crowned Warbler, MacGillivray's Warbler and Olive-sided Flycatcher.

The IBA Program is focused on developing partnerships for the ongoing protection and conservation of the IBA site to mitigate any risks to the IBA habitat and bird populations. If you would like more information regarding the IBA Program, please contact Robin Powell, at rpowell@audubon.org or 775-247-2798.

Stable Isotopes as a Tool in Preserving Park Resources

By Bryan Hamilton, Biologist

How are plants and animals connected to climate, geology and soils? How are animals connected to plants? Is there a relationship between water and biodiversity? How are the myriad of species we see in national parks able to co-exist? Do species compete with each other or are mechanisms in place which allow them to minimize competition? These are important questions for National Park Service scientists to answer. Stable isotopes are a vital tool in answering these questions.

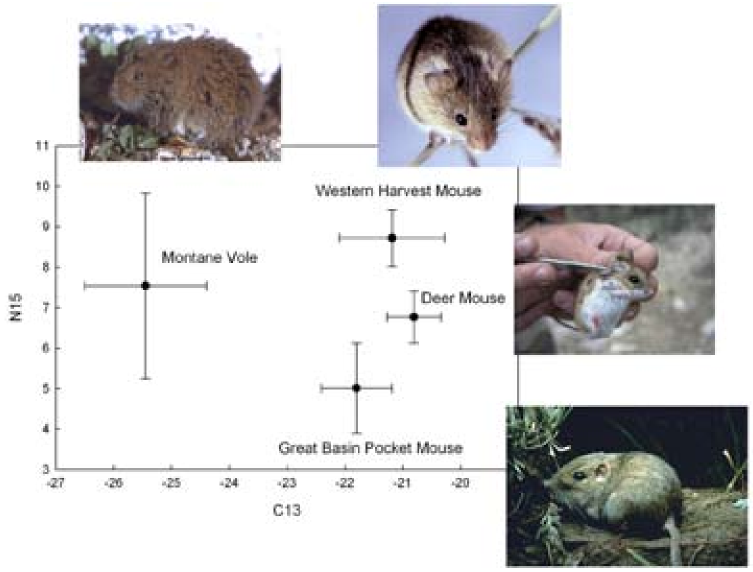


Figure 1. Nitrogen 15 and carbon 13 isotope values for 4 small mammal species in Great Basin National Park. Circles are means and error bars 95% confidence intervals

Isotopes are forms of the same element that differ in the number of neutrons in their nucleus. Stable isotopes are present in the environment (air, water, soil, plants and animals) for long periods of time while radio isotopes are unstable and quickly break down to more stable forms. Stable isotopes are not toxic to life, do not differ in chemical properties, are predictably distributed across the biosphere, and accumulate predictably under certain physiological and biological reactions, such as photosynthesis and protein formation.

By measuring the stable isotopes in plants and animals with a mass spectrometer, park service ecologists can gain valuable insight into the relationships and connections between animals, plants, water, and soils. Two stable isotopes are particularly useful in studying connections between organisms and their environment, carbon 13 and nitrogen 15.

There are two primary categories of plant photosynthesis, C3 and C4. C3 and C4 plants differ slightly in the photosynthetic pathway they utilize to convert atmospheric carbon dioxide into sugar. Carbon-14 is distributed in the atmosphere at approximately 1 part per hundred, usually as part of a carbon dioxide molecule. Plants incorporate carbon from carbon dioxide into sugars and other carbon products through photosynthesis. Because the stable isotope carbon-13 is slightly heavier than elemental carbon-12, plants tend to discriminate against it at the biochemical level, so plants become depleted in carbon-13 relative to the atmosphere. C3 plants are more efficient than C4 plants in discriminating against carbon-13.

Plants primarily incorporate soil nitrogen into their tissues as proteins. Animals feeding on these plants excrete nitrogen-14 at a higher rate than nitrogen-15 and tend to have a greater amount of nitrogen-15 in their tissues than the plants they eat. Similarly, animals that eat other animals (predators) tend to have more nitrogen-15 than their prey.

Knowing the amounts of carbon-13 and nitrogen-15 in plant and animal tissues allows scientists to make inferences about the trophic status (location on the food chain) of animals and the types and locations of the plants that form the base of the food web. This information allows scientists to understand relationships between species, mechanisms that allow coexistence and persistence, and the types of food and habitat they require.

Small mammals in the Great Basin form a diverse community which includes mice, voles, chipmunks, ground squirrels, and shrews. Small mammals in the Great Basin are critical components of functioning ecosystems, forming the prey base for many predators and providing ecosystem services such as plant germination and regeneration and soil aeration and structuring.

Park service scientists used stable isotopes to understand relationships between four species of small mammals: deer mice, pocket mice, montane voles and harvest mice. As part of a dissertation studying sagebrush steppe ecosystems, they trapped and released small mammals using live traps and collected a hair sample from each individual. Hair samples were analyzed using a mass spectrometer at Brigham Young University. Figure 1 depicts the stable isotopes ratios of nitrogen-15 and carbon-13 for these species.

Results suggest that these species coexist through a variety of

Stable Isotopes (continued)

mechanisms. Differences in nitrogen-15 between harvest mice, deer mice and pocket mice suggest that these species feed at different trophic levels. Harvest mice probably include more insects and meat in their diet than deer mice, while pocket mice are probably exclusive herbivores. Carbon-13 values for voles was significantly lower than the other species suggesting that voles feed on different types of plants than the other species, most likely highly productive, riparian C3 plants.

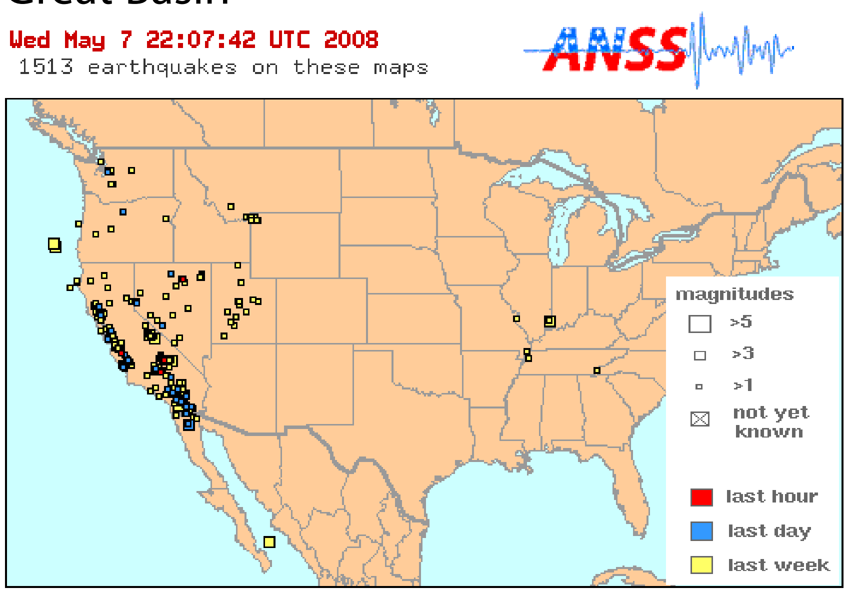
It appears that small mammals avoid competition by partitioning resources spatially but alternatively it may mean that the species are better adapted to certain habitats and are able to exclude other species from those habitats. For example, voles are physiologically adapted to low temperatures and high humidity which they find in riparian areas. They may be simply intolerant of xeric upland conditions. Similarly, pocket mice have cheek pouches, are good diggers in suitable soil, and cache seeds underground. In riparian areas soils may be unsuitable for digging and seeds may not be available, restricting pocket mice to the xeric uplands.

Through the use of stable isotopes, Great Basin National Park scientists better understand mechanisms of coexistence in small mammal communities. Understanding is the first step in preserving park resources, connecting them with present visitors, and protecting them for the future.

Earthquakes in the Great Basin

by Gretchen Baker, Ecologist

Early in the morning of February 21, 2008, some people in and near Great Basin National Park felt a slight shaking, heard dishes rattling, or watched their pets act erratically. The cause for this was a 6.0 earthquake with an epicenter about 150 miles away, near Wells, Nevada. Earthquakes are common in the Great Basin region, but most are too small to be felt and are most frequent along the margins, near the Wasatch Range in Utah and the Sierra Nevada Range in California. The February earthquake caused some surprise because it was relatively strong and located in the middle of the Great Basin area.



The Advanced National Seismic System produces frequently updated maps showing where the latest earthquakes have occurred.

Just by looking at the terrain of the Great Basin region, it is obvious that some strong earth forces have been at play. The Basin and Range physiographic province extends from California to Utah and from Oregon and Idaho to Mexico. Tall mountains have been driven out of the ground so that they lay parallel to each other, forming over 90 mountain ranges in Nevada alone. Some of the mountains within this large area are still getting taller due to earthquakes.

Earthquakes are the result of a sudden release of energy stored in the rocks underground, radiating from a fault along which movement has just taken place. They cause the ground to shake, and if strong enough, are felt by people.

Nevada is the third most active state in the U.S. in the number of large earthquakes over the last 150 years (following Alaska and California) with more than 60 with potentially destructive magnitudes of 5.5 or greater. The strength of an earthquake is measured with the Richter magnitude, which goes from -1 (smallest earthquake detected) to 9 (largest recorded earthquake at 9.5). Both the University of Nevada, Reno and University of Utah have Seismologic Departments to study earthquakes. About 700 earthquakes are detected in the Utah region each year, but of those, very few are felt by humans.

The recent earthquake near Wells shows that even in the middle of the Great Basin, large earthquakes have the potential to cause a lot of damage. The Nevada Bureau of Mines and Geology believes that the probability of an earthquake in the Great Basin National Park area of magnitude greater than 5.0 during the next 50 years to be 20-30 percent, and greater than 6.0 to be 3-4 percent.

To learn more about earthquakes, visit one of the following websites: University of Utah Seismograph Stations http://www.quake.utah.edu, Nevada Seismological Laboratory http://www.seismo.unr.edu/, or USGS Earthquake Information http://earthquake.usgs.gov/.

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The Midden is the Resource Management newsletter for Great Basin National Park.

A spring/summer and fall/winter issue are printed each year. The Midden is also available on the Park's website at www.nps.gov/grba.

We welcome submissions of articles or drawings relating to natural and cultural resource management and research in the park. They can be sent to:
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Or call us at: (775) 234-7331

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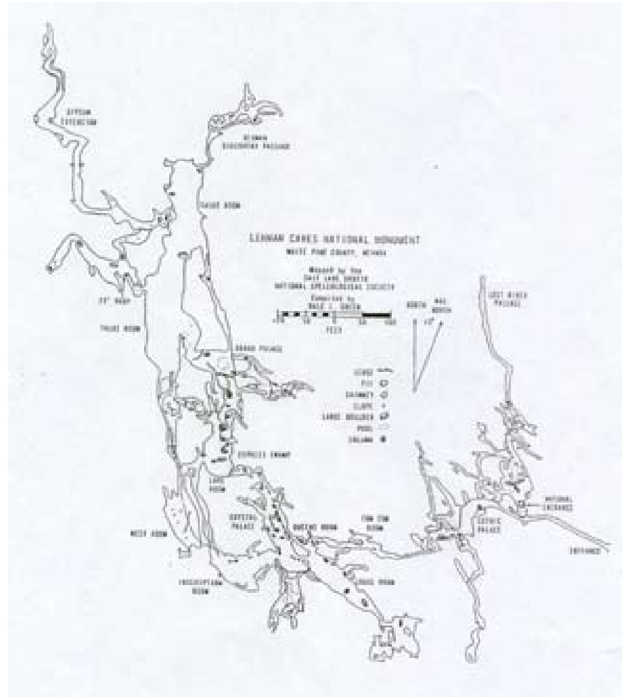
What's a midden?

A midden is a fancy name for a pile of trash, often left by pack rats. Pack rats leave middens near their nests, which may be continuously occupied for hundreds, or even thousands, of years. Each layer of trash contains twigs, seeds, animal bones and other material, which is cemented together by urine. Over time, the midden becomes a treasure trove of information for plant ecologists, climate change scientists and others who want to learn about past climatic conditions and vegetation patterns dating back as far as 25,000 years. Great Basin National Park contains numerous middens.

Great Basin National Park

Lehman Cave Map Turns 50

By Ben Roberts, Natural Resource Program Manager



1958 Map of Lehman Cave by the Salt Lake Grotto

In December 1957, four members of the Salt Lake Grotto, Dale Green, Paul Schettler, Bill Clark and Pete Sanchez, began the first modern survey of Lehman Cave. Dale reduced all the data from the first trip (with a slide rule) and plotted the data on 8-1/2 x 11 inch graph paper, then carried those into the cave on a second trip with Alexis Kelner and Pete Sanchez in January 1958. He then drew in the path and walls. From these surveys, the grotto completed the first modern map of Lehman Cave in the summer of 1958. Since that time, the map has been reproduced in various formats but has remained essentially unchanged over the last 50 years.

A new digital map of Lehman Cave is being drafted based on extensive survey work conducted by the Southern Nevada Grotto, led by Steve Deveny. This new map will allow the park to better manage the cave by providing increased accuracy and the ability to update or modify the location of objects, like lights, quickly and easily. Great Basin National Park is extremely grateful for the thousands of hours of volunteer time that these groups have contributed to the management and mapping of Lehman Cave over the years.

Upcoming Events:

Aug 8 & 9 Night Sky and Meteor Viewing. Learn more about the beautiful night sky in some of the best visibility. Call the park for more information.

Aug 28 Perseid Meteor Shower. One of the most active meteor showers of the year is usually spectacular in the park due to the clear skies.

Aug 30 & 31 Night Sky and New Moon Viewing.

Sept 1 Sun Viewing Party. Check out the sun with the park's special solar telescope.

Oct 27 Great Basin National Park turns 22! The National Park was expanded from the Lehman Caves National Monument on October 27, 1986.

Throughout the Year, Great Basin National Park. Volunteer opportunities with resource management are available to help locate springs, conduct animal surveys, reclaim disturbed lands, and work on other projects. Contact us at 775-234-7331.