Park News

Great Basin National Park
National Park Service
U.S. Department of the Interior

The Midden

The Resource Management Newsletter of Great Basin National Park

The Legacy of John Tilford and the Bonita Mine

By Greg Seymour, Great Basin Institute – Research Associate Program and Eva Jensen, Cultural Resource Program Manager, Great Basin National Park

Late this summer, Great Basin National Park and the Great Basin Institute (GBI) teamed up to research the history of the Tilford family and the Bonita Mine in Snake Creek Canyon and to restore the Tilford Spring Stone Cabin.

In 1912, John Tilford lived with his wife and family up Snake Creek at about 8,000 feet elevation. In that year, he and his partners discovered tungsten downstream, about three miles west of the current Park boundary.

Upon the tungsten discovery, Tilford moved his family down to the new mine site and built a cabin, which was used as a commissary by the family, the miners, and the cook, Toy Fong. John also built a house, a small school, and perhaps barracks and tent platforms for miners he employed. He named the mine Bonita after his newest daughter, Bonnie, who had been born at the house near the upstream saw mill.

Apparently he did well for himself until the end of World War I, when the demand for tungsten dropped and the price plummeted. Then the Tilford family left the Bonita Mine. The mine and other buildings fell into disrepair. Occasional upswings in metal prices brought prospectors back but the boom of building never returned.

Photos by Greg Seymour, Great Basin Institute

The restored Tilford Spring Stone Cabing (above) and the cabin before restoration (below).

Restoring the cabin was the ultimate goal of the project. Understanding the building materials and techniques and keeping as much of the original construction as possible was essential to convey the historical feeling. The first step of the Tilford Cabin restoration was to gather old photos and talk to living descendants of John Tilford. With this information, Greg Seymour of GBI and the Cultural Resource staff of the Park began the process of

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The Legacy of John Tilford and the Bonita Mine (continued)

collecting clay for the mortar, rock, and other materials necessary for the job. Some walls had fallen and others had bulged. The walls were repaired with the help of historic photos in order to give the building the original look and feel of the one that John had built 102 years earlier. The Park purchased rough cut lumber from a custom sawmill. Boards were cut especially for the job to duplicate what had been there originally. With the help of the maintenance staff at the park, the ridge beam was placed on top of the now completed walls. Rafters were put in place and the roof, with its cover of dirt, was completed. Doors, based on the originals from a photograph, were built and installed.

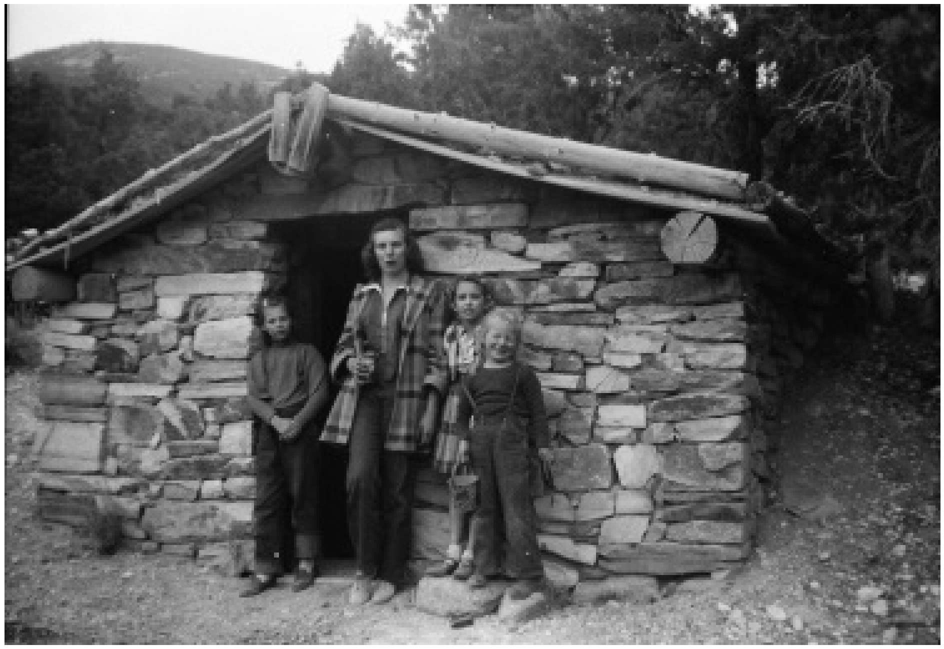

Photo courtesy of the Tilford Family

Photo of the Tilford family visiting the cabin in 1952 or 1953.

During this process, Dave Tilford, the nephew of John Tilford, and lifetime White Pine County resident, helped with photographs and information about the family. He visited several times to view the work and is happy to see its completion. The Tilford Cabin, besides being important to the family, is representative of an important period in our history as a country. It was small mine operators such as John Tilford that supplied minerals for the development and advancement of high strength steel in the tool and die industry and the war efforts of the United States.

This small building is over a century old and will live on for many more years. As we approach the Centennial of the Organic Act and the National Park Service in 1916, this and other historical treasures provide opportunities to visit the past. Men and women such as the Tilford family endured and flourished on lands that are now Great Basin National Park. Through this cooperative effort of the Tilford family, Great Basin National Park, and Great Basin Institute, this building and all it represents, remains in its place in the history of the Great Basin.

Researchers in Great Basin National Park

By Gretchen Baker, Ecologist

In 2014, Great Basin National Park issued 15 new scientific research and collecting permits and renewed or continued 16 research permits. Since the park establishment in 1986, 145 different research studies have been completed in the park, many lasting multiple years. This is a high number for the size of the park and its distance from institutions of higher learning. In fact, the Park ranks 43rd of 287 parks that support research studies.

In 2014, over fifteen peer-reviewed articles have been published about work done in the park. These articles show an amazing variety of research. This issue of *The Midden* includes summaries of many of these articles to highlight the fascinating discoveries researchers are making. In addition, see the Recent Publications on page 13 for a list of the latest publications about the park.

Scientific research and collecting permits are required for collecting specimens or information in the park that will result in a report. Permits can be applied for on the National Park Service online permitting system: https://irma.nps.gov/rprs/Home. This is also the place where the public can find annual investigator's reports, which summarize work being done in the park.

Many thanks to all the researchers who contribute knowledge about the Park!

Cave Harvestmen of Great Basin National Park

By Shahan Derkarabetian and Marshal Hedin, San Diego State University

Great Basin National Park is home to numerous caves and cave systems. Many interesting animals are known to inhabit these caves, including *Cyptobunus ungulatus ungulatus* Briggs 1971, or more commonly referred to as the Model Cave Harvestman. This species was first described from Model Cave, but since its original discovery has been found in several other caves within the park.

Cyptobunus is comprised of two species: *Cyptobunus cavicolens* from Lewis and Clark Caverns, Montana, and *C. ungulatus*, with two subspecies, the aforementioned *C. u. ungulatus* and *C. u. madhousensis* from caves near Provo, Utah. They all display the typical adaptive characteristics associated with prolonged cave habitation (termed troglomorphy), including loss of pigment and elongation of legs.

The distinctiveness of this genus has been called into question several times throughout its existence. Some have argued that *Cyptobunus* should not be a distinct genus, having evolved from within the related genus *Sclerobunus* and merely representing a cave-adapted form.

Over the past several years, we have been studying these two genera using modern molecular systematic techniques in order to understand their relationships, biogeographic history, and the evolution of troglomorphy. Our previous research resulted in several interesting findings: 1) the discovery of many previously unknown populations of cave-dwelling *Sclerobunus*; 2) there have been at least five independent cave invasions, resulting in convergent morphology; 3) the degree of troglomorphy is correlated with time since cave invasion; and 4) the actual species level diversity in these two genera is greatly underestimated.

Photo by Marshal Hedin, San Diego State University

***Sclerobunus ungulatus*, or Model Cave Harvestman, collected from Model Cave and newly reclassified as its own species based on genetic work.**

Our latest research set out to document and describe this underestimated diversity and determine the relationships among all the species in these genera. Over the past few years, we conducted fieldwork in surface and cave habitats throughout western North America, including two caves from Great Basin National Park. Using the specimens collected, we explored morphological and genetic variation within this group using an integrative approach. These data identified many distinct groups, which corresponded to currently recognized species/subspecies and several potentially new species. Using nuclear genetic data, the genetic distinctiveness of each of these potential species was then validated, and the relationships among all species were reconstructed.

Based on the results, several important discoveries were made. Genetic data showed that *Cyptobunus* was derived within *Sclerobunus*, indicating that all *Cyptobunus* represent highly modified cave-adapted forms of surface *Sclerobunus*. This results in the taxonomic synonymy of these two genera; all *Cyptobunus* are now included within *Sclerobunus*. Additionally, genetic data support all currently recognized subspecies as distinct species. Therefore, the Model Cave Harvestmen, only found in caves in Great Basin National Park, is now a distinct species and should be called *Sclerobunus ungulatus*.

This study is freely available through PLoS ONE.

Temperature/Humidity Micro Logger Sensor Network

By Nathan Patrick, Department of Geography, Ohio State University

Beginning in 2006, Ohio State University researchers have installed and maintained a temperature/humidity micro logger sensor network to characterize climate within Great Basin National Park. This network offers some advantages over traditional weather station locations.

First, the network instruments are simple, robust, and can be maintained easily. Second, unlike weather stations which demand space and are visually obtrusive, the micro loggers blend into the environment and can be located anywhere someone can hike. Lastly, the network micro loggers are affordable and allow a dense deployment which helps when studying climate at small spatial scales. In fact, based on available literature, Great Basin National Park's micro logger network contains the densest deployment of sensors above 3000 meters in North America.

Although it is too early to begin using the network to identify climate trends for Great Basin National Park, early results suggest the Great Basin region behaves much differently than other mountainous regions. Lapse rates are useful tools in comparing climate between different regions or different times. A lapse rate is defined as the rate of change in a parameter with respect to an elevation change. For example, it is common knowledge that typically the higher you climb in the mountains, the colder it becomes.

Photos by Nathan Patrick, OSU

Top: One of many micro loggers placed in the Park to measure temperature and humidity differences at various elevations
Bottom: Housing to protect datalogger

This is an example of the physical process and the temperature lapse rate is the actual value. A common global temperature lapse rate value is -6.5°C km^{-1}, or the temperature decreasing 6.5°C for every 1 km increase in elevation. This common lapse rate value is calculated for the free air (think directly up from the ground) and does not account for terrain impacts. Therefore in mountainous regions, we calculate terrain following lapse rates which incorporate the effects of the terrain itself.

Lapse rates for Great Basin were calculated for three different time scales (annual, seasonal and monthly) and while the annual temperature lapse rate compared favorably (-6.0°C km^{-1}) to the common global lapse rate, the monthly lapse rates varied from -3.8°C km^{-1} in January to -7.3°C km^{-1} in June. When temperature lapse rates were further divided into different elevation segments, the lapse rates during certain times of the year became quite steep (in excess of -9.0°C km^{-1}). Great Basin's temperature lapse results suggest greater seasonal amplitudes (difference between minimum and maximum) compared to other selected mountainous regions throughout North America and the world. This may suggest Great Basin's terrain plays a larger role in modifying near surface air temperature. What this might mean for climate trends is unknown, but lapse rates calculated for other mountainous regions with longer climate data records provide insight to how mountain climatic regimes may be changing.

Despite the lack of vegetation at the highest elevations, temperature data from 2006-2012 suggest the park could support additional vegetation on peaks such as Bald and Buck. This data supports the GLORIA project findings of new vegetation species on these peaks. This raises the question: is vegetation being limited by wind and precipitation rather than temperature? Or is Great Basin at higher elevations indeed warming, allowing temperatures which support vegetation? These are just some of the questions the micro loggers may help to answer when additional years of data are recovered.

Find more about this topic in Nathan Patrick's thesis.

Lehman Cave
Lint and Restoration Camps,
February 6-8, and March 3-4, 2015

Contact Gretchen_Baker@nps.gov for more info.

Ancient Packrat Middens Provide Clues about Climate Change

By Katie M. Becklin, University of Kansas

The Earth's climate is rapidly changing, which raises the important question of how these changes will affect plants and animals in the future. Scientists can begin answering this question by first determining how organisms responded to climate change events in the past.

Our lab at the University of Kansas is searching for answers to this question by looking at how plants from the Snake Range functioned during the last glacial period 21,000 years ago. During that time, the Snake Range was both colder and wetter than it is today. Perhaps more importantly for plants, the concentration of carbon dioxide in the atmosphere was less than half of what it is today. In fact, glacial carbon dioxide concentrations were among the lowest levels experienced during the evolution of land plants.

Because plants use carbon dioxide to make sugars during photosynthesis, many scientists think that low carbon dioxide levels during the last glacial period may have greatly reduced plant growth, a phenomenon known as carbon starvation. One of the questions that we have to consider is whether or not glacial plants were adapted to low carbon dioxide concentrations. If so, those adaptations could affect how plants function under current conditions, and how they will respond to future changes in carbon dioxide and climate.

The late Dr. Phillip Wells, a researcher at the University of Kansas, collected numerous middens from locations throughout the Snake Range, some of which are more than 35,000 years old. These middens are a powerful resource for studying climate change effects on plants because they contain leaves from plants that were alive during the last glacial period. Our lab used measurements of stable carbon isotopes to determine if the physiology of these ancient plants changed from glacial to modern times.


Photo courtesy of University of Kansas

Ages of packrat middens collected from the Snake Range were determined using radiocarbon dating. Some middens were more than 35,000 years old. They showed that bristlecone pine was the most common glacial conifer in the Snake Range.

Our results show that most of the Snake Range conifers altered their physiologies in response to changes in the environment since the last glacial period. Interestingly, plant species that are closely related — from the same plant family — showed very similar physiological responses. This indicates that plant evolutionary history is an important factor in driving plant responses to climate change.

The Bristlecone pine tree (*Pinus longaeva*), which is one of the longest living organisms on Earth, is an especially interesting species in the Snake Range. Based on the presence of leaves from this species in ancient packrat middens, we know that Bristlecone pine was the most abundant conifer species in the Snake Range during the last glacial period. Our stable isotope results further suggest that this species' physiology contributed to its ability to survive under glacial conditions.

So what do these findings mean for the future as climate conditions continue to change and atmospheric carbon dioxide concentrations increase to levels that have not been seen for millions of years?

Our results suggest that plant species that have different evolutionary histories may respond differently to changes in their environment. Some species may be more likely to change their physiology than others, and for those that do respond, we may see differences in how quickly those species can adjust to new conditions. These differences make it challenging to predict the overall effects of climate change since communities and ecosystems are made up of many different species that interact with each other.

Ultimately, plants are key indicators of climate change effects because plants form the foundation for the rest of the ecosystem. Thus, a more complete understanding of plant responses to climate change, both past and present, is vital to making good choices about managing ecosystems and natural resources in the future. *See the entire article here.*

Historical Lake Sediment Records of Climate & Pollution

By Scott Reinemann, Department of Geography, Ohio State University-Lima

Paleolimnology focuses on extracting information preserved in lake sediment records. These records provide a broad time perspective on changes in aquatic ecosystem structure and composition that can help to identify the direct and indirect effects of climate change and pollutant loading on aquatic ecosystems. It is important to note that the changes in biota, nutrients, and geochemical cycles that have been identified in western North America are linked to both natural and anthropogenic climate change.

To examine these environmental changes in Great Basin National Park (GBNP), a group from Ohio State University (OSU) has made multiple expeditions over the past few years to extract lake sediments from the sub-alpine lakes in the park. Here I describe results from our laboratory analyses of lake sediments extracted from Stella, Dead, and Teresa Lakes during August of 2010 and 2011 that reveal changes in the aquatic ecosystems over the past 100 to 150 years.

Although different indicators preserved in the lake sediments record distinct environmental changes observed in alpine ecosystems, in this study we have focused on two: (1) the remains of sub-fossil aquatic midge communities document changing temperatures; and (2) variations in concentrations of spheroidal carbonaceous particles (SCPs) and Mercury (Hg) to track historical changes in the deposition of pollution.

Photo by Scott Reinemann, OSU

Jim DeGrand (OSU staff) and Christina Zerda (OSU undergraduate) collecting a core from Stella Lake in August 2011.

Our results indicate that the lakes warmed during the last century. Midge-inferred lake temperature estimates were characterized by above average air temperatures during the post-AD 1980 interval and below average temperatures during the early 20th century. Our study adds to the growing body of evidence that sub-alpine and alpine lakes in the Intermountain West of the United States have been and are increasingly being affected by anthropogenic climate change in the early 21st century.

The results of our study also demonstrate that remote aquatic ecosystems in the central Great Basin have been affected by regional and global anthropogenic pollutant loading during the 20th century. SCPs, which varied in absolute concentration between the study lakes, nevertheless provide a consistent signal of increased pollutant loading to the study sites between A.D. 1950 and A.D. 1970, followed by a subsequent decline, which is likely the result of stricter pollution controls implemented within the United States and Europe.

Mercury fluxes exhibit a slightly more complex regional signal. All the lakes exhibit a slight increase in the Hg and SCP flux in the most recently deposited sediment. We have found that atmospheric deposition is the primary source of anthropogenic inputs of Hg and SCPs to these high elevation lakes. Mercury deposition in the Great Basin has most likely been influenced by regional inputs; however, the potential contribution of global sources of Hg should also be considered.

These studies show that aquatic ecosystems within GBNP can be impacted by climate change and atmospheric pollution from sources far outside of the boundaries of the Park. Our data provide evidence that both pollutants (Hg and SCPs) and climate warming derived from human activity are present in the lakes and streams of GBNP. However, we have also determined that the concentration of the pollutants in the sub-alpine lakes present in the Park has decreased in recent decades.

Finally, we acknowledge the constructive and encouraging partnership with the Park scientists and management staff, and hope that our research will further the mission to treasure our National Parks.

Mercury Deposition in Great Basin National Park

By Genine Wright, University of Nevada-Reno

A previous study, the Western Airborne Contaminants Assessment Project (WACAP) found that a number of Western National Parks had fish with mercury (Hg) concentrations of concern. This posed the question as to the source of Hg to some very remote areas; is it local, regional or global? Due to the arid climate of the West, we hypothesized that dry deposition would be an important consideration. We deployed surrogate surface and passive samplers to measure gaseous oxidized mercury deposition and concentration.

In addition, ozone data, meteorological data, and event back trajectories were used to investigate spatial trends in Hg deposition and concentration and the potential sources to western National Parks.

Results varied by location, but overall concluded that local, regional, and global sources

Photo by Genine Wright, UNR

Air monitoring station with mercury deposition equipment on top.

of air pollution, including oxidants, contribute to deposition. Specifically, at Great Basin National Park (GBNP) the air chemistry had influence from regional urban and agricultural emission and free troposphere inputs. The GBNP was the furthest inland site in our study and had the highest concentration and mean deposition during the time of the study. Results from two additional locations (a higher and lower elevation) within GBNP indicate that the source at this location is from the free troposphere but is also influenced by long range transport.

In addition to current trends in Hg deposition we wanted to look at historical trends in these remote locations using tree rings. Tree rings have been used as long term monitors of climate change indicators and we hypothesized that they would be useful for showing local, regional and global air Hg concentrations. We developed and tested a method for using tree rings to measure Hg over time. This ultimately led to a conclusion that multiple other factors such as tree age, tree species, elevation, and the form of Hg need to be more carefully considered for this to become a more valuable proxy for understanding changing global air Hg concentrations.

Despite these considerations, tree cores have good potential as a passive recorder to show atmospheric Hg trends over long periods of time on a resolution of approximately 5 years. This could prove to be extremely helpful for very remote locations where instruments would be difficult to install or transport.

High Elevation Five-Needle Pines Proactive Planning

By Gretchen Baker, Ecologist

Only 5-10% of the whitebark pine trees in Glacier National Park remain today. This is due to the non-native pathogen *Cronartium ribicola,* which causes the lethal disease white pine blister rust (WPBR), and to outbreaks of native mountain pine beetles. WPBR has not yet reached Great Basin National Park, but when it does, limber and bristlecone pine trees in the park may be susceptible.

The park has begun proactive interventions to help prepare the landscape for invasion and to mitigate the severity of future impacts. Working with the U.S. Forest Service, the park has collected seeds from marked trees to be tested for WPBR. Seeds that are resistant can be propigated to help conserve the species and promote self-sustaining five-needle pine ecosystems.

See the entire article here.

NPS Photo by Gretchen Baker

Bristlecone pines (above) and limber pines may soon be at risk due to white pine blister rust; the park is involved in a proactive strategy to protect them.

Lepidoptera BioBlitz Nets Hundreds of Additional Species

By Paul Opler, Colorado State University

NPS Photo by G. Baker

Dr. Paul Opler leads a trip to identify butterflies near Stella Lake.

Great Basin National Park held its sixth annual Bioblitz on July 12-14, focusing on Lepidoptera (butterflies and moths). The purpose of the BioBlitz was to discover as much as possible about the diversity of Lepidoptera in Great Basin National Park and to engage citizen scientists of all ages so that they learn about and foster a relationship with Lepidoptera in Great Basin National Park.

Prior to the BioBlitz, 88 butterfly species were known in the park, based on a study by George Austin. Kelly Richers, who is building a computerized database of the moths of Nevada, showed 200 moth species for the park, 167 of which were Macromoths and 33 of which were Micromoths.

A group of seven expert Lepidopterists was invited to lead the BioBlitz team. The experts were led by Paul Opler, Colorado State University, Fort Collins and included David Bettman and Chris Grinter, both from the Denver Museum of Nature and Science; Evi Buckner-Opler; Judy Gallagher, Virginia; Paul Johnson, Pinnacles National Park; Kelly Richers, California; and David Wikle, California. The Nevada State Entomologist, Jeff Knight, and his experienced crew also assisted with the event. Approximately 50 citizen scientists registered for the 2-day BioBlitz, including familes from Utah and Washington State, past taxonomist-in-the-park Ken Kingsley, members of the Bristlecone Audubon Society and the Toiyabe Chapter of the Sierra Club, a past artist-in-residence, and a professional photographer.

Photo by David Hunter

Some of the many moths collected during the 2014 Lepidoptera BioBlitz.

The BioBlitz began at noon Sunday with an introductory workshop on Lepidoptera led by Paul Opler and Chris Grinter. The workshop included information on Lepidoptera natural history, how to sample and prepare specimens, and how to document butterflies and moths. Then followed a potluck dinner that was enjoyed by all participants.

On Sunday evening there were two demonstration light-sheet set-ups for attracting moths so that participants could view and/or photograph those attracted.

The next day, participants divided into three groups for trips to different habitats in the park to look for butterflies and diurnal moths.

At night, ultra-violet light traps were run at a number of locations in different habitats throughout the park. In all, we had 17 or more trap nights of sampling in the Park for the BioBlitz.

During the Bioblitz there were 'blizzards' of adults armyworm moths (*Euxoa auxilliaris*); these were especially abundant in the tree groves at higher elevations and

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Photo by Paul Johnson

One of over 40 butterfly species found during the Bioblitz.

Lepidoptera BioBlitz (continued)

probably numbered in the millions!

At noon on the third day, all the participants reconvened for a closing lunch sponsored by the Great Basin National Park Foundation followed by raffle prizes donated by the Western National Parks Association. Preliminary results were shared. During the BioBlitz we found over 40 butterfly species. One species added to the park list was the Great Purple Hairstreak (*Atlides halesus*); this brings the Park butterfly list to 89 species. In addition, an estimated 300+ species of moths were added to the park list.

Identification of moths continues long after the BioBlitz. As of the end of September, the results of the Bioblitz for moths is as follows: We had 31 families of moths, including eight Macrolepidoptera (Macro-moths):

Family	Common name	# species
Erebidae	Tiger moths	22
Eutellidae	Euteliid moths	1
Geometridae	Loopers	55
Lasiocampidae	Tent caterpillars	5
Noctuidae	Owlet moths	96
Notodontidae	Prominents	4
Saturniidae	Wild silk moths	1
Sphingidae	Sphinx/Hawkmoths	6
Total		**190**

The so-called Microlepidoptera comprise the remaining 23 families:

Family	Family
Acrolophidae	Opostegidae
Argyresthiidae	Plutellidae
Blastobasidae	Prodoxidae
Choreutidae	Pterophoridae
Coleophoridae	Pyralidae
Cossidae	Scythrididae
Crambidae	Sesiidae
Depressaridae	Tineidae
Gelechiidae	Tischeriidae
Gracillariidae	Tortricidae
Nepticulidae	Ypsolophidae
Oecophoridae	


Photo by David Hunter

Checking an ultra-violet light trap.


Photo by David Hunter

Moth specialists sort the thousands of moths collected. Three or four may be new or undescribed species.


NPS Photo by Gretchen Baker

Past Artist-in-Residence Kristen Gjerdset sketches an *Arachna picta*.


NPS Photo by G. Baker

The BioBlitz included interpretive programs during the day and evening.

So far, we have identified three or four moth species that may be limited to the Park or to the Snake Range, but it will require several years before scientists can make this definite and describe the species.

Scientists who have intensively studied the butterfly and moth fauna in several North American localities, including parks and reserves, have found that a good way to estimate the total moth fauna is to multiply the number of butterfly species by 15. If we do this for Great Basin National Park, we come up with an estimate in the range of 1275 moth species. Adding in the 89 butterfly species makes 1364 for the entire Lepidoptera fauna!

Work will continue with members of our team and as we build a computerized listing of the species found during the Bioblitz and the cumulative list of butterflies and moths known from the park.


NPS Photo by G. Baker

Two young citizen scientists help document butterflies in the park.

See what stream insects live in the park during the next BioBlitz, May 15-17, 2015!

Contact Gretchen_Baker@nps.gov

Bats Return to Lehman Caves

By Meg Horner, Supervisory Biological Science Technician & Bryan Hamilton, Wildlife Biologist

Bats play a vital role in healthy ecosystems. They provide valuable ecosystem services such as pollination and pest control. Using echolocation and highly sensitive hearing, bats are capable of consuming their own weight in insects each night. Yet these valuable nocturnal predators are threatened by a recently introduced disease.

White-nose syndrome has killed more than 5.7 million bats in the eastern U.S. and Canada. The syndrome is named for the white fungus, *Pseudogymnoascus destructans*, present on the nose and wings of infected bats. White-nose syndrome causes abnormal behavior during winter hibernation such as flying during daylight and congregating outside of hibernacula. These behaviors deplete important energy reserves and ultimately decrease survival, with some hibernacula experiencing 90 to 100 percent mortality. So far, this disease has not been detected in bat populations west of Missouri, but three bat species affected by white-nose syndrome in the eastern U. S. also occur in the park: big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*) and silver-haired bat (*Lasionycteris noctivagans*).

In response to White-nose syndrome, the National Park Service has provided special funding to monitor bat populations; protect valuable habitat such as caves and mines; and provide educational outreach on the disease and its impacts on bats. Bats occur in 18 caves in the park, and this year's monitoring efforts focused on Lehman Caves, Snake Creek Cave and Upper Pictograph Cave. We used three different monitoring techniques to survey bats – direct capture using mist nets, exit counts at cave entrances, and acoustic surveys using bat detectors.

Figure 1. Towsend's big-eared bats were the most common bat captured near Lehman Cave in 2014.

Four species were captured during mist net surveys: long-legged myotis (*Myotis volans)*, long-eared myotis (*Myotis evotis)*, Townsend's big-eared bat (*Corynorhinus townsendii)* and pallid bat (*Antrozous pallidus*). Seven additional species were detected during acoustic surveys: little brown bat, California myotis (*Myotis californicus*), western small-footed myotis (*Myotis ciliolabrum*), silver-haired bat, hoary bat (*Lasiurus cinereus*), big brown bat and Mexican free-tailed bat (*Tadarida brasiliensis*). Sixty-eight bats were captured at Upper Pictograph Cave and seven at Snake Creek Cave.

Particularly interesting were the survey results from Lehman Cave. Exit counts documented up to 75 bats exiting the cave through the natural entrance. Thirty-four bats were captured with mist nets – two long-legged myotis and 32 Townsend's big-eared bats (Figure 1). Many of these bats were juveniles and lactating females, suggesting that Lehman Caves is being used as a maternity roost. Acoustic surveys revealed two additional species – hoary bat and Mexican free-tailed bat – foraging near the cave entrance.

In the past, bats have rarely used Lehman Caves. Only three bats were captured during mist net surveys in 1946, and the greatest number recorded during previous visual surveys was 13 individuals. We captured more than twice this number and observed five times as many during exit counts.

This increase in bat abundance is due to changes in access to the cave. Permanent closures of mines and caves are harmful to bats because they prevent these sites from being used for roosting, maternity colonies and hibernacula. The natural entrance of Lehman Caves has been altered several times during the last century (Figures 2 and 3). It was sealed shut in 1959 (Figure 4) and remained closed for almost 40 years. In 1998, a bat gate was installed to allow natural debris, bats and other wildlife to enter the cave (Figure 5). Bats have rediscovered Lehman Caves after nearly a century of exclusion.

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Bats Return to Lehman Cave (continued)

Figure 2. Natural entrance to Lehman Caves in 1920.

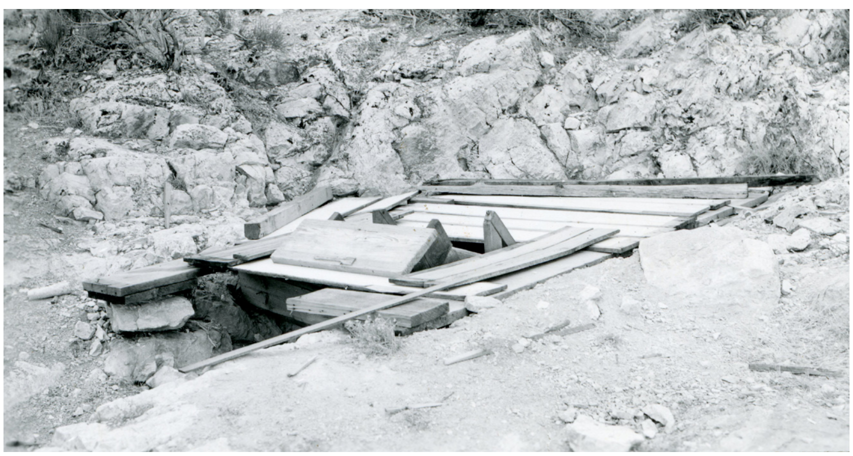

Figure 3. Natural entrance to Lehman Caves in 1940.

The spread of White-nose syndrome is expected to continue, threatening bat populations across North America. The disease is predicted by one study (Maher et al. 2012) to reach eastern Nevada within ten years. By collecting baseline data on bat populations and their dependence on caves and mines, Great Basin National Park is preparing for the arrival of White-nose syndrome and investigating ways to protect these important species.

Citation: Maher, Sean P., et al. 2014. Spread of white-nose syndrome on a network regulated by geography and climate. Nature Communications 3: 1306.

Coming summer 2015: Participate in the park's first-ever BatBlitz! Help study what bats live in the park.

Contact Bryan_Hamilton@nps.gov

Figure 4. Natural entrance to Lehman Caves in 1959, sealed shut with concrete.

Figure 5. Bat gate over the natural entrance of Lehman Caves, which was installed in 1998. This gate allows bats to enter and exit the cave.

A Multiple-Tracer Approach to Understanding Regional Groundwater Flow in the Snake Valley Area

by Philip Gardner, US Geological Survey and Victor Heilweil, U.S. Geological Survey

NPS Photo

Rowland Spring is one of the many water sources sampled in Snake Valley for the USGS study looking at how groundwater flows in the area.

Groundwater in Snake Valley and surrounding basins in the eastern Great Basin province of the western United States is being targeted for large-scale groundwater extraction and export. Concern about declining groundwater levels and spring flows in western Utah as a result of the proposed groundwater withdrawals has led to efforts that have improved the understanding of this regional groundwater flow system.

In this study, groundwater from more than 140 sites was sampled for chemical constituents that could be used to investigate groundwater recharge and flow-path characteristics (d^{2}H, d^{18}O, ^{3}H, ^{14}C, ^{3}He, ^{4}He, ^{20}Ne, ^{40}Ar, ^{84}Kr, and ^{129}Xe). With few exceptions hydrogen and oxygen isotopes in water samples (d^{2}H and d^{18}O) show that most valley groundwater originated as relatively high-altitude precipitation.

Tritium (an isotope of hydrogen) and isotopes of helium were used to estimate ages of young groundwater. Together they show that modern groundwater (<60 years old) extends from mountain or mountain front recharge areas out into valley aquifers in very few locations.

Pleistocene-age groundwater, common in parts of Snake Valley and Valleys to the east, has minimum adjusted radiocarbon ages of up to 32,000 years old. The combination of noble gas recharge temperatures and helium-4 concentrations shows that the majority of Snake Valley groundwater discharges as springs, evapotranspiration, and well withdrawals within Snake Valley rather than continuing northeastward to discharge at either Fish Springs or the Great Salt Lake Playa.

The refined understanding of groundwater recharge and flow paths acquired from this multi-tracer investigation has broad implications for interbasin subsurface flow estimates and future groundwater development.

Recent Publications about Great Basin National Park

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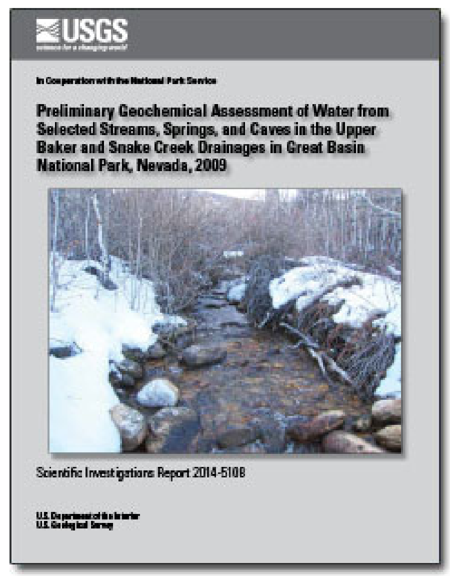

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National Park Service
U.S. Department of the Interior

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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Great Basin National Park,
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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

Climate Regulates Sagebrush Recovery

By Stan Kitchen, Rocky Mountain Research Station, U.S. Forest Service

Wildland fire plays a key role in shaping natural communities on semi-arid landscapes around the world. The composition and structure of plant communities are often tied to specific patterns of fire frequency and size. Knowledge of fire characteristics compatible with sagebrush-dominated communities of the Intermountain West, USA is critical for maintaining habitat critical for sagebrush-dependent wildlife, such as greater sage grouse.

Big sagebrush plants are easily killed by fire but depend on specific climate conditions to reestablish.

Big sagebrush plants are easily killed by fire, thus post-fire recovery must be from seeds that either survive fire or are spread from unburned areas. Recovery rate is dependent upon how fast new sagebrush plants are able to establish after fire.

In recent studies, natural recovery of mountain big sagebrush was investigated for 36 fires in the Great Basin and Colorado Plateau ecoregions, including one in Great Basin National Park. Time-since-fire varied from 1 to 36 years. Sagebrush recovery rate was highly variable with full recovery (when compared to paired unburned areas), estimated to take from 25 to 75+ years. Recovery rate was most influenced by the amount of winter-spring precipitation the year after fire. This rate suggests the importance of sufficient soil moisture for seedling growth and establishment during the first growing season.

Results also suggest that the opportunity for initial post-fire regeneration of mountain big sagebrush is short-lived due to a short-lived soil seed bank, and if missed, the time needed for big sagebrush recovery may be extended by several decades. Thus, conditions that result in short fire-free intervals or more frequent drought are likely to be less compatible with big sagebrush dominance, increasing risk for wildlife species dependent on this habitat type.

See the entire article here.

Upcoming Events:

December 16 Snake Valley Christmas Bird Count: Help count birds in and near the park. Contact Melissa Renfro, 775-234-7154, for more info or visit: http://birds.audubon.org/christmas-bird-count

February 6-8 and March 3-4 Lehman Cave Lint and Restoration Camp: Contact Gretchen_Baker@nps.gov for more info.

May Nevada Archeology Month (date tba): Special activities at Great Basin National Park. Contact Karla_Jageman@nps.gov for more info.

May 15-17 Stream Insects BioBlitz: Join the seventh annual BioBlitz to help learn more about what lives in the Park. Contact Gretchen_Baker@nps.gov for more info.

Summer 2015 BatBlitz (date tba): Help survey bats in the park. Contact Bryan_Hamilton@nps.gov for more info.