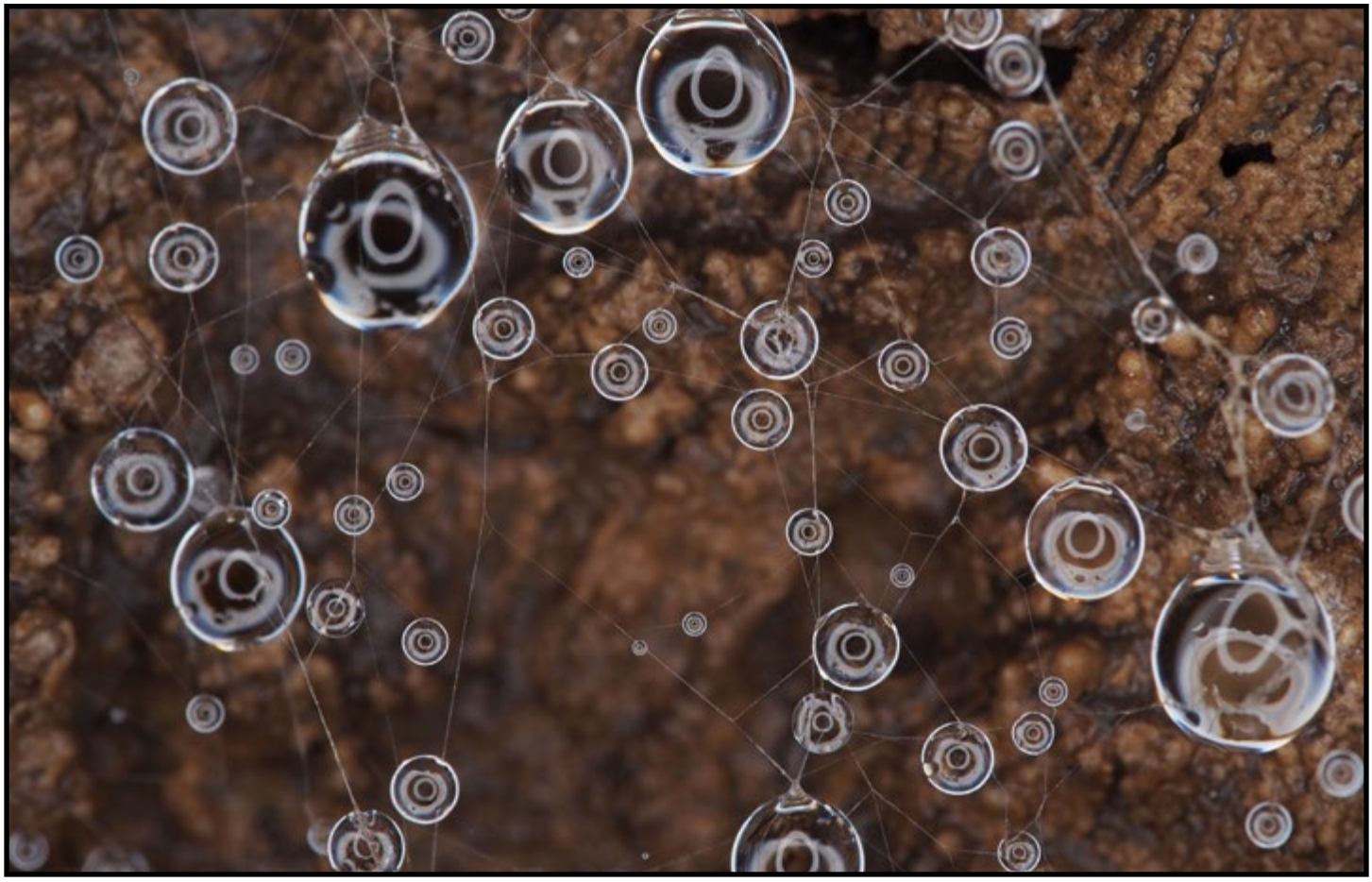
Cave and Karst Programs

Geologic Resources Division
National Park Service
U.S. Department of the Interior

Inside Earth



Fungus Gnat Larvae Web and Mucus in Valentine Cave, Lava Beds National Monument. NPS photo by Katrina Smith.

Contents

Calendar

Bat Survey Techniques Workshop
July 8-14, 2015
Tulelake, California
www.batmanagement.com

NSS Convention
July 13-17, 2015
Waynesville, Missouri
http://nss2015.caves.org/

14th Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts on Karst
October 5-9, 2015
Rochester, Minnesota
www.sinkholeconference.com

Timpanogos Cave National Monument Restoration Camp
October 15-17, 2015
American Fork, Utah
andy_armstrong@nps.gov

Geological Society of America Annual Meeting
November 1-4, 2015
Baltimore, Maryland
http://www.geosociety.org/meetings/2015/

NSS 75th Anniversary Convention
July 17-23, 2016
Ely, Nevada
https://www.facebook.com/nss75th

Submit entries for the Calendar to bonny_armstrong@nps.gov

To receive this newsletter and pertinent updates and announcements, join the NPS Cave and Karst listserve here:
http://nature.nps.gov/geology/caves/email_info.cfm

A Word from WASO

Submitted by Dale Pate

HIGHLIGHTS OF THE NATIONAL CAVE AND KARST PROGRAM

Junior Cave Scientist Program Up & Running

With the printing of the 24-page Jr. Cave Scientist booklet in early April, the program is officially off to a good start. Developed in the summer of 2014 by a team consisting of Jim Wood, Joe Camacho, Limaris Soto, and myself, the Jr. Cave Scientist program has initiated a lot of early interest. This fun and fact-filled booklet includes photos, learning activities, cave information, and a look at the key scientific disciplines that study cave resources. This booklet also discusses karst landscapes and White-Nose Syndrome in bats, a deadly disease that has killed millions of hibernating bats in the eastern United States.

In the first month after publication, we have mailed 6,500 booklets to 17 parks, a NPS WASO group, the National Speleological Society, and several families.

To find out more about the program and to download an electronic copy, visit http://nature.nps.gov/geology/caves/jrcavesci.cfm

To obtain hard-copy booklets for parks, classrooms, or other educational uses, please contact dale_pate@nps.gov or by phone at 303-969-2635.

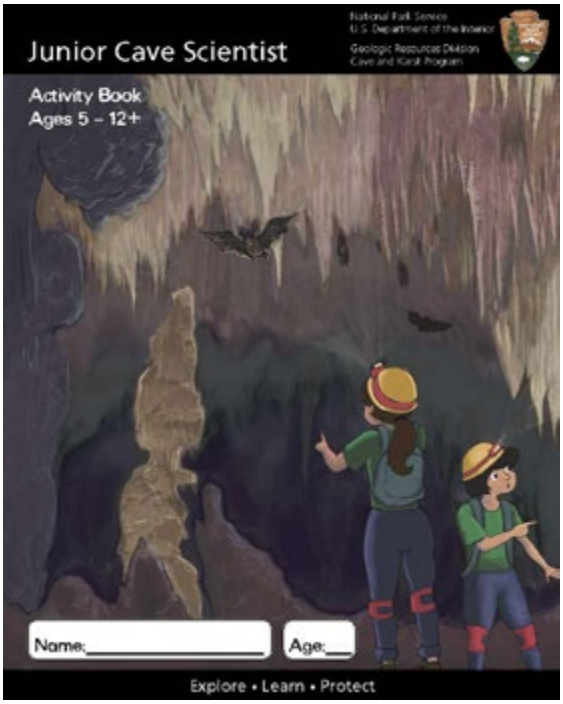
NPS MOUs with the NSS & CRF

The National Park Service presently has two Memorandums of Understanding with caving organizations. One is with the National Speleological Society and the other one is with the Cave Research Foundation. The objectives of

Dale Pate, NPS National Cave and Karst Coordinator. Photo by Johanna Kovarik.

these agreements are to cooperatively engage the members of these organizations ". . . in the inventory, scientific study, management, and protection of caves and cave resources located on lands administered by the NPS." As stated in the NPS/NSS MOU, these projects "may include but are not limited to cave exploration, research, monitoring, and the development of cave management documents."

Basically, these agreements serve as an overarching umbrella that can be used to establish an official working relationship by encouraging the NPS and these two organizations to work cooperatively together for mutual benefit. However, these MOUs do not authorize activities in any park unit. For individuals, Internal Organizations, or other factions of these organizations to work in park units, the individual park unit will develop project and site-specific operating procedures, issue scientific research and collecting permits, or issue special-use permits as appropriate. Nothing in these MOUs gives parks or organizations the ability to go-around or ignore various laws, policies, and guidelines developed to protect park resources.



The front and back covers of the Junior Cave Scientist booklet.

The two MOUs can be viewed at the following links: http://nature.nps.gov/geology/caves/publications/Final%20Signed%20NSS-NPS%20MOU.pdf and, http://nature.nps.gov/geology/caves/publications/2013-02-12%20Final%20Signed%20CRF-NPS%20MOU.pdf

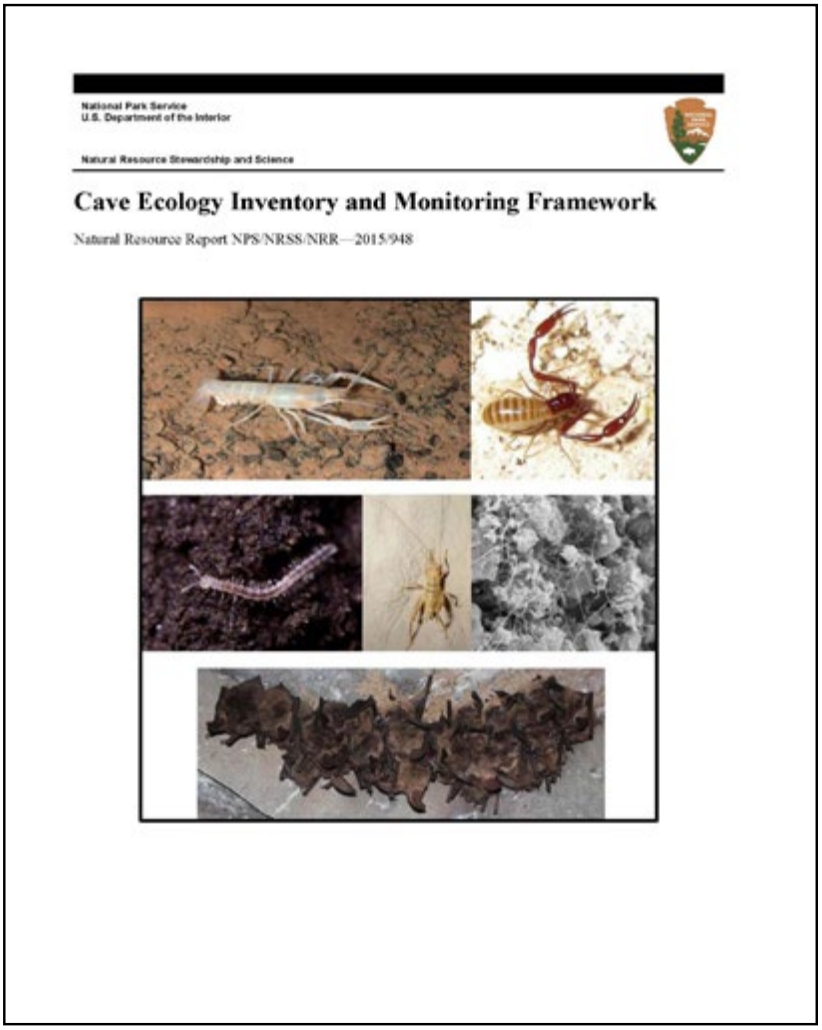
Cave Ecology Monitoring & Inventory Framework
Natural Resources Report NPS/NRSS/NRR - 2015/948

Congratulations to Gretchen Baker and her 12 co-authors for completing this important report. She writes the following about this report:

The National Park Service manages over 4,700 caves across the country, including solution caves, volcanic caves, sea caves, talus caves, and more. What lives in those caves and how do those plants, animals, and microbes interact with their environment? Cave managers now have a new means to help them answer those questions.

The Cave Ecology Inventory and Monitoring Framework was published in April as a Natural Resource Report. The report will help cave managers prioritize monitoring activities and provide guidance on conducting in-cave monitoring work by promoting safe and sustainable methods. Thirteen co-authors, including those from NPS units and networks, other agencies, non-profits, and universities, wrote the document.

The principal goal of the Cave Ecology Inventory and Monitoring Framework is to encourage cave



managers to understand as much as possible about local cave ecology and threats to cave biota in order to make informed decisions geared towards cave conservation and protection of cave ecological systems. In order to do this, the Framework provides managers with tools to determine variability and long-term trends in cave biota.

The report is available on the NPS Cave and Karst website, http://nature.nps.gov/geology/caves/publications/Final_Cave_Ecology_Inventory_and_Monitoring_Framework_nrssaim2015.pdf and may also be downloaded from the NPS datastore.

TECHNICAL ASSISTANCE SITE VISIT

A critical component of the national program is technical assistance that is provided to requesting park units. On March 11-12, I did a site visit to Russell Cave National Monument to assess an erosion problem within the archeological shelter area of the cave. I met with Mary Shew, Larry Beane, Keena Graham, and Mary Dawson from RUCA along with Michael Seibert from the Southeast Archeological Center (NPS). The site visit included a look at photos and a review of the older archeological digs within the shelter, a look at the erosion area and the layout of the shelter, and discussions on mitigation potential as it relates to undisturbed sediments within the shelter. Observations and recommendations were made to the Monument to help them make important decisions related to the ongoing erosion.

Located in Jackson County, Alabama, Russell Cave is 7.6 miles long and obtains a depth of 400 feet. With Russell Cave National Monument at 320 acres in size, most of the cave is outside the boundaries of the Monument. The entrance shown in the photo below has formed by hillside erosion, breaching a portion of the main cave to form the entrance we see today. The entrance is a single passage that contains both the active stream flowing into the entrance on the left of the photo and the "shelter" portion of the entrance on the right where the archeological site is located. A remnant of the Paleozoic limestone bedrock divides the passage at the entrance creating the "shelter". The shelter portion joins back into the main stream passage several hundred feet into the cave.

Park Updates

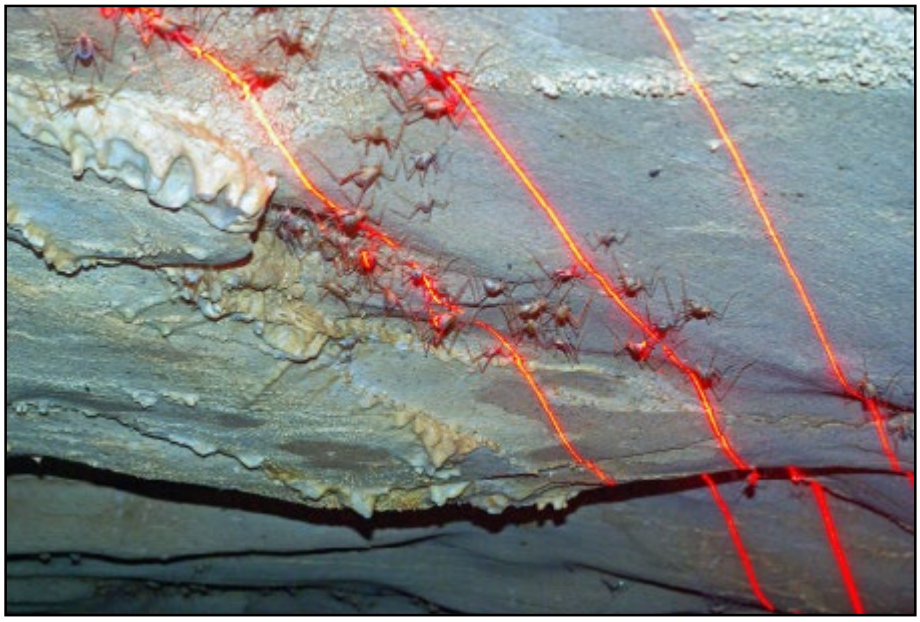
Cumberland Piedmont Network

Submitted by Kurt Helf

Four parks in the Cumberland Piedmont Network (CUPN) selected various vital signs within their cave ecosystems as requiring long-term monitoring. One focal resource selected for long-term monitoring by resource managers at Mammoth Cave National Park (MACA) was cave crickets (Hadenoecus subterraneus). Cave crickets ranked first among proposed cave organism populations for monitoring at MACA because they act as a conduit for the transfer of nutrients between the surface and cave communities dependent upon these nutrients. Natural stressors that affect foraging cave crickets' ability to access primary productivity on the surface, such as contingent climatic conditions (e.g., extremes in maximum temperature and precip-

A panoramic view of Russell Cave. Photo by Dale Pate.

itation events across the Southeast predicted by mid-century), can alter the amount of nutrient subsidies they transfer to dependent subsurface communities. Stressors foreign to the cave ecosystem (e.g., natural cave entrance configuration altered by management actions) can also affect the flow of organic matter subsidies into caves due to their effects on cave cricket foraging behavior and population structure. Given the importance of cave crickets to subsurface ecosystems monitoring of their entrance populations will provide park managers with an early warning of potential trouble with cave ecosystem health and contribute significantly toward managing and protecting their populations.



Laser projected strip intersecting cluster of roosting cave crickets to determine entrance population size. Photo by Kurt Helf.

In early April, the cave cricket monitoring protocol developed for MACA by Inventory & Monitoring personnel Kurt Helf, Bill Moore, Lillian Scoggins (CUPN) and Tom Philippi (I & M Division Support Office) was published on the IRMA Portal and can be found at https://irma.nps.gov/App/Reference/Profile/2220998/. This protocol is focused on monitoring cave cricket entrance populations at selected cave entrances within MACA. The sampling method employed in the protocol, strip adaptive cluster sampling, takes advantage of cave crickets' tendency to roost in clusters, and consists of digital images of clusters intersected by randomly located 10cm wide laser-projected strips (see photo below) perpendicular to a transect extending the length of the cave entrance. Analysis of the annotated digital images yields count data which permits estimation of total cave cricket entrance population size at a given cave entrance. The sampling design automatically partitions cave cricket entrance population size into components of cluster size and numbers of clusters which will be used to assess temporal changes in population size and habitat use within and between developed and undeveloped cave entrances. Meteorological data will be collected from local subsurface and surface habitats. Cave meteorological data will be collected using two methods. Opportunistic grab sampling uses handheld sensors to measure cave air temperature, relative humidity, and air flow at roosting clusters. Continuous sampling uses automated dataloggers to continuously collect cave air temperature and relative humidity measurements for a period of time in all sampled cave entrances. Finally, surface temperature, relative humidity, and precipitation are continuously collected by a local automated weather station. These meteorological data will be used to assess whether correlations exist between trends in surface or subsurface meteorological conditions and cave cricket entrance population characteristics (i.e., sex, instar, cluster size and number) and habitat use (i.e., shifts in roosting distance from the caves entrance).

Grand Canyon National Park

Submitted by Ben Tobin

Staff Changes

Over the last year, Grand Canyon has had significant change over in park staff focused on cave and karst resources. Benjamin Tobin began in July 2014 as park hydrologist and cave specialist. Edward Schenk began in March 2015 as the park physical science program manager.

Cave Exploration

Multiple researchers have been working on mapping and inventorying park caves. From July 2014 through April 2015, 9.5 miles of newly discovered passage were surveyed and inventoried in numerous park caves.

Resurvey Projects

Two resurvey projects were started during 2014: Cave of the Domes and Roaring Springs Cave. Cave of the Domes has almost been completely resurveyed, with over 1.25 miles of passage surveyed and inventoried with only a few leads

remaining. The Roaring Springs Cave resurvey was started in November 2014. Currently over a mile of passage has been resurveyed with trips planned for this summer and fall.

Dye Trace Work
The park has started a project to delineate the groundwater basin for Roaring Springs. Dye receptors were placed in February and the initial dye injections occurred in April. With the assistance of park fire staff, we injected dye at 2 locations using water supplied by the park fire engines to flush the dye into the system. These dyes were injected along the assumed groundwater divide between Roaring Springs and surrounding basins. We will continue to collect dye receptors throughout the summer with the hope of conducting additional dye injections as weather allows.

Park staff injecting Rhodamine WT into a sinkhole above the North Rim using park fire equipment to flush the dye. NPS photo.

Great Basin National Park

Submitted by Gretchen Baker

Lint Camp
Due to high interest in the Lehman Cave Lint and Restoration Camp last year, the park planned two camps for the winter of 2015: February 6-8 and March 3-4. During these five days, 46 volunteers spent nearly 500 hours cleaning numerous sections of Lehman Cave. Teams worked in different parts of the cave, some picking lint off of formations, others removing hairballs and trash from staircases and along the edges of trail. Teams uncovered rimstone dams and flowstone that have been buried by old debris for decades. They removed over 3,000 pounds of debris and sand originally brought in for old trails and trail-making activities. Volunteers of all ages participated and were able to meet the centennial goal to connect with and create the next generation of park visitors, supporters, and advocates. Superintendent Steve Mietz, who participated in the lint camp, said, "Lint camp is making life-long stewards of the cave and park. I was especially impressed with the dedication and persistence of the kids and parents who spent hours carefully cleaning the formations, asking questions, and at the end of the camp, inquiring when they could return to "their spot" to finish their work." Mietz added, "Extensive media interest in the camp also helps raise awareness across the nation about the impacts of long-term lint and dirt build-up on cave formations from cave visitors." Stories appeared in National Parks Magazine and in the Los Angeles Times. The interpretive division of the park is planning to hold mini-lint camps on Friday evenings during the summer.

Cave Rescue Training
Great Basin National Park co-sponsored training by the National Cave Rescue Commission, along with the Snake Valley Volunteer Fire Department and the Ely District BLM. On April 17, vertical training was held to teach and improve single rope technique skills. An Orientation to Cave Rescue was held April 18 & 19. Sixteen people attended. The mock rescue took place in a nearby BLM cave. The patient was just ten minutes into the cave, but due to the complexity, the carry-out took over three hours.

In addition, new park staff learned about how to conduct a cave rescue out of Lehman Cave and used wheelchairs to access different parts of the cave. The annual Lehman Cave rescue class using litters is scheduled for June 8.

Cave Biomonitoring
Park staff completed nine years of biomonitoring in Lehman Cave at established stations at the end of April. Stations were visited monthly during the first year, then quarterly thereafter. Biomonitoring will continue, but the results of the first nine years will be written and up and submitted for publication so that other parks can learn what has worked and not worked in this cave. In addition, winter bat

surveys were done in several park caves.

Cave Paleontology
Work continues on the fossil fauna from Snake Creek Cave. Additional excavations in the summer of 2013 produced a good diversity of small- to medium-sized vertebrate teeth and bones. We recovered several additional teeth of the extinct rabbit, *Aztlanolagus agilis*, which we had reported earlier, as well as teeth of yet another extinct rabbit, *Brachylagus coloradoensis*. Other interesting finds include teeth and jaws from the pocket gopher, *Thomomys talpoides*, which today occurs to the north and west of the Southern Snake range. Only three single teeth from the porcupine, *Erethizon dorsatum*, suggest that this animal was as uncommon in the area in the past as it is today. Packrats are by far the most common faunal element with more than 1300 loose teeth and 130 jaw pieces recovered so far. It appears that *Neotoma cinereus* and other species were common in the area before the end of the Pleistocene. Now that the materials have been processed and sorted, the next step is to identify all of the remains and hopefully to acquire 14C dates for the accumulation.

Park interpreter Adelia Blis assists with the biomonitoring efforts in Lehman Cave by recording specimens found and microhabitat conditions. NPS photo by Gretchen Baker.

Lava Beds National Monument

Submitted by Katrina Smith

Winter Bat Surveys
Nearly every winter for the past 26 years, bat hibernacula surveys have been conducted in caves throughout the monument to monitor and assess the health of bat populations. Hibernacula are plentiful within Lava Beds; undisturbed caves provide the perfect habitat for hibernating bats during winter months when food is not available.

Record breaking surveys of Townsend's big-eared bats were completed during the last week of January 2015, with totals reaching 1582 *Corynorhinus townsendii* in addition to seven *Myotis sp*., one *Eptesicus fuscus*, and one unidentified bat from surveys of 77 caves. The largest cluster seen contained 30 bats, and the biggest surprise was finding 438 bats in a cave where the average has previously fluctuated between 50 and 250 bats. The number of caves surveyed certainly affects the total count, and varies in any particular year depending on staff availability. Previous years' survey totals from a similar number of caves ranged from 1,250-1,450 bats. It appears that Townsend's big-eared bat populations within Lava Beds continue to be stable and may even be increasing. This is great news, as this species is in decline in other places due to loss of habitat and increased human disturbance. No sign of white-nose syndrome was detected in Lava Beds this year.

Surveyors noticed that the bats seem to be congregating into the deeper, colder caves; there may be a connection between this behavior and the unusually warm, dry winter experienced in

A *Corynorhinus townsendii* hibernates at LABE. NPS photo by K. Smith.

2014-2015. The monument hopes to look more closely at the data and better understand the environmental drivers behind hibernating bat behavior.

Fungal Bloom in Valentine Cave
Conditions inside Valentine Cave produced a unique fungal bloom during the late weeks of March. Plentiful white fungus grew on cave walls, and strange fungal poofballs hung from the ceiling. In relation to this explosion of rotting material, cave invertebrates came out of their crevices to chow down on the wealth of available food.

Ozark National Scenic Riverways

Submitted by Scott House

Working under the guidance of NPS OZAR Division of Resource Management, and operating through a cooperative agreement, Cave Research Foundation does the bulk of the hands-on cave management, monitoring, and inventory work.

White Nose Syndrome continues to spread across Missouri and the Ozarks. Numerous trips were taken over the winter to known major hibernacula plus smaller hibernacula, which are also of importance. One

Too many to count quickly, a newly-discovered gray bat hibernation colony manifests itself. Photo by Scott House.

of the things noted as the disease spreads is that bats are moving from known locales to other caves. Sadly, most of the caves examined showed multiple species with obvious signs of fungus. Species most affected appear to be pipistrelles (*P. subflavus*), northern bats (*M. septentrionalis*), and little browns (*M. lucifugus*). Interestingly, two bat species previously classified as endangered – gray bats (M. *griseescens*) and Indiana bats (*M. sodalist*) appear to be holding their own. However, the number of gray bats in one large hibernaculum dropped dramatically while another one, nearly 16 miles away, showed an extremely large increase; while it might appear that these bats simply moved, the area of the cave where the increase was shown had not been monitored in many years. This at least demonstrates the need to look in places not previously checked; simply checking known locales is not sufficient.

The park's largest hibernaculum, a cave with large passages and a pit entrance, showed a constant but nearly uncountable number of gray bats. A priority one gray bat cave, it houses perhaps 150,000 hibernators with no obvious signs of WNS. The counting of these bats is primarily the responsibility of the Missouri Department of Conservation with help from NPS and CRF.

The park's sole interpretive cave, Round Spring Cave, will be open for tours in the summer of 2015. Winter surveys identified one bat in Round Spring with obvious WNS and DNA results show the fungus is on other bats and adjoining substrate. Treatment of visitors' shoes will be done after tours. During the winter census, the cave had over 400 healthy pipistrelles.

Replacement cave interpretive signs are being installed in several locations. Bookmarks featuring bat and WNS facts are being distributed, particularly aimed at younger readers. A series of posters highlighting cave life and WNS issues are also

A healthy Indiana bat displays its band. Photo by Matt Bumgardner.

being prepared. Also in preparation is a virtual tour of Round Spring Cave, utilizing a new technique known as photosynthing, in which a long series of still photographs are stitched together into a movie. The results are superior to standard video technology.

Dr. Michael Sutton of CRF has been working on a funded project to establish baseline biological surveys of a number of relatively wet park caves. Most of these caves have been discovered in recent years and lack adequate bio-surveys. This project is expected to end late this summer.

CRF and NPS personnel are working on a couple of vandalism/misuse issues, including trying to remove illegally-installed climbing hangers from a cave in the park. Personnel also continue to identify and monitor culture resources within caves, both in the park and on adjacent partner lands.

Richard Young examines torch remnants cemented in place by flowstone. Photo by Scott House.

Cartographic surveys of a number of park caves continue, mostly under the direction of CRF member Dan Lamping. Another cave within the boundaries of the park, but on state fee land, surpassed a mile during winter surveys. A cluster of smaller caves within the park were also surveyed.

Law Enforcement District Ranger Lindell Gregory provides ground support for LE District Ranger Chris Figge and CRF member Tony Schmitt during removal of illegal climbing gear at an OZAR cave. NPS photo.

NPS and CRF also worked with a park partner, the L-A-D Foundation in preparing and executing a major prescribed burn; preparatory to that was an inventory and survey of a cave on the edge of the burn unit.

With NPS support, major modifications continue to be made to the Missouri Cave Database, maintained by the Missouri Speleological Survey and Cave Research Foundation. Hundreds of new faunal records were added to the faunal table, instantly linked to locational information elsewhere in the database. The results of this effort will be demonstrated at the National Speleological Society convention in Missouri this summer. Other cooperators in this massive effort include the Mark Twain National Forest, U.S. Fish and Wildlife Service, and the Missouri Department of Natural Resources.

Timpanogos Cave National Monument

Submitted by Andy Armstrong

Timpanogos Cave National Monument has been studying its bats for the last eight years. Each summer, 3-6 bat netting nights are conducted along the American Fork River. These efforts have yielded hundreds of bat captures and identification of 11 species out of 16 expected to be in the area. Despite this diversity and apparent large numbers of bats in the canyon, bat

behavior and roosting locations are poorly understood.

The four species that have not yet been caught in a mist net or harp trap are *Tadarida brasilienses*, the Mexican free-tailed bat; *Nyctinomops macrotis*, the big free-tailed bat; *Euderma maculatum*, the spotted bat; and *Lasiurus blossevillii*, the western red bat. *Tadarida* and *Nyctinomops* are high-flying, fast-flying bats that can be difficult to catch in a river-based mist net. Most of TICA's net sites are too confined and cluttered with tree cover to appeal to these fast but not-so maneuverable bat species. *Euderma* and *Lasiurus b*. are Utah's most rarely captured bats, with only a handful of confirmed captures in the statewide literature.

In an effort to better understand species presence/absence, habitat use, hibernation, and migration, TICA is initiating a new acoustic monitoring program in addtion to its capture efforts. Using WNS funds that became available through congressional action, TICA developed a plan, puchased equipment, and attended much-needed training. The new program will provide a better understanding of local species and their behavior. This data will be valuable in crafting strategies to document and protect vulnerable species should WNS appear in the area.

Myotisoft Inc. was contracted to develop an acoustic monitoring plan for TICA and American Fork Canyon. The plan consists of passive monitoring of the night sky with Pettersson D500x detectors, passive monitoring of cave entrances with Titley Anabat Roostloggers, and driving transects using an AR125 microphone with Sonobat and Myotisoft software.

During the same week as a bat netting night, four D500x detectors will be deployed simultaneously at different elevations in the canyon. One site is at cave level (6,700 feet), two are at approximately 6,000 feet on opposite sides of the canyon, and one near river level (5,500 feet). These detectors will record on bat netting night, and one night before and after. These results can be compared to actual captures from the nets and traps to get a fuller picture of what goes on in the bat world at night in the canyon. Having the detectors deployed along the same elevation profile each time will allow park staff to learn about how bat behavior may change and move throughout the summer season. One additional site at 8,000 feet will be used for a two-week deployment to better understand how bats may use the mesa top/cliff edge at the top of the TICA environment. It is possible that some

A *Myotis velifer* with a temporary LED light tag is released while students attending a Bat Conservation and Management, Inc. workshop record its call. The workshop, held in Portal, Arizona May 20 - 26, was attended by 19 students including six NPS employees: Andy and Bonny Armstrong (TICA), Paul Burger (AKRO), Michael Fuerte (GLCA),Virginia Moyers (CAVE), and Lonnie Plinkington (GLCA). Photo by John Chenger/batmanagement.com.

of the more elusive, high-flying bat species may be encountered here.

Five cave and mine entrances at TICA will be outfitted with Titley Anabat Roost Loggers. These are rugged, low-power devices that are housed in a watertight Pelican case. These loggers record bat calls as bats move in and out of the entrances. They turn on each evening and turn off each morning and can be left in place for up to six months at a time before they need to be downloaded. Having these in place year-round will allow TICA a much better understanding of how bats use different cave and mine entrances as the seasons change.

Driving transects with a vehicle-mounted microphone will allow yet another perspective on how bats use different parts of American Fork Canyon. Detections with classifications will appear on a Google Earth view after each transect.

In order to learn how to implement the acoustic plan, TICA Physical Scientist Andy Armstrong and Biological Science Technician Bonny Armstrong attended Bat Conservation and Management (BCM)'s seven-day bat survey and capture techniques workshop in Portal, AZ. This training was also attended by NPS staff from AKRO, CAVE, and GLCA in addition to USFS staff, state biologists, grad students, and bat hobbyists from around the USA. Complementing the classroom sessions, this training featured six nights of bat netting, trapping, and deployment of acoustic equipment. The Chiricahua Mountains are home to the greatest diversity of bat species in the USA with a possible 28 species.

Valuable lessons for setting up nets and traps were learned, but the real value was getting to know the acoustic detectors and the call analyzing software. Working with the skilled instructors (including the developer of Sonobat software) was invaluable in terms of troubleshooting, working through software issues, and getting the benefit of years of experience not only using but developing this equipment.

Particularly helpful was intensive training on how to recognize distinctive patterns on sonograms of recorded bats. Each species has a characteristic call shape and intensity on a graph that shows frequency, time elapsed, and amplitude of each call. It was interesting to learn that some tasks are still better executed by humans rather than computers. Examples are facial recognition software and captcha technology. Humans are still better and faster at recognizing faces than computers. Captcha technology is the little wavy blurry letters and numbers that you sometimes have to type to buy a concert ticket or other online product. You are able to read the letters, but most computer bots are not. Recognizing patterns and the overall feel of a bat call is also one of these tasks. So as powerful as the auto-classifiers are, each call still needs to be manually vetted by a human being that is skilled in recognizing call shapes. Class participants received many hours of training in this area.

Particularly of interest was seeing how reference calls are developed for use in the Sonobat automatic species classifiers. Recording the call of a hand-released bat is usually not effective. A bat that has just been caught in a net, handled, been the subject of flash photos, and had his body parts measured and analyzed does not make typical, characteristic search calls when released. It is likely more similar to "What in the heck just happened to me?" if we could truly translate from bat language.

In order to record more characteristic calls, bats are released with a "light tag" attached. These are lightweight blinking LEDs that are held onto the bat's chest by non-toxic glue. These bats are able to be tracked in the air, and recorded to obtain characteristic calls for the classifier. This was done several nights during the training in order to add a few SE Arizona bats into the classifier. Many bats were seen up to an hour after release, foraging in the sky, roosting in trees, and nearly being recaptured in nets. Not only was this a visually spectacular display, it provided confidence in the auto-classifier that will be used to help identify TICA bats.

Armed with new knowledge and new equipment, TICA staff hope to gain even more understanding of the many bat species that use TICA as a home or an important stop along their migration routes.

Wind Cave National Park

Submitted by Marc Ohms

Caving Incidents in Wind Cave
Since Wind Cave was first discovered people have been entering the cave to explore the unknown, and have occasionally become injured, lost, stuck, or ill. Unfortunately past records of such incidents have been poorly kept. Starting in 1986 the park required all off-trail trips into the cave to fill out a trip report upon exiting. This has provided a better record of what has happened. Even with the reporting system in place, it is believed that a portion of minor incidents still have gone unreported. Regardless, the reports that do exist provide useful information on what, how, when, and where incidents occur within the cave. The park can utilize this information to develop methods to keep cavers safe, and predict what type of incidents will occur in the future so the park can

be better prepared for such events.

The following discussion is based upon the information derived from the off-trail trip reports starting in 1986 to the end of 2014. Since 1986 to the end of 2014 there have been 3,915 reported trips off-trail in Wind Cave. Within this time frame there have been 85 reported incidents. For the purpose of discussion the incidents have been broken into seven categories- rock fall, caver fall, entrapment, pre-existing condition, illness, lost, and miscellaneous.

TYPE OF INCIDENT	NUMBER OF INCIDENTS
Rock Fall	5
Caver Fall	30
Entrapment	3
Pre-Existing Condition	4
Illness	29
Lost	4
Miscellaneous	10
Total	85
Resulted in Injury	26
Required Outside Assistance	5

Rock Fall
Natural occurring rock fall in the cave is extremely rare, at least in the human context of time. Incidents involving rock fall are virtually always caused by a person knocking a rock loose onto themselves or another caver. Generally this occurs on a vertical climb or a slope. Luckily these incidents have only resulted in minor injuries, generally bruises and minor lacerations.

Requiring cavers to wear caving helmets and pads on knees and elbows greatly reduces the chances of a serious injury due to a rock fall. Climbing slopes or climbs with potentially loose rock, one person at a time greatly reduces the odds of someone getting struck by a falling rock.

Caver Fall
Cavers slipping, tripping, or falling is the leading incident in Wind Cave. Being that the cave consists of boulder-strewn uneven floors, contains irregular passages shapes of all sorts and sizes, and the bedrock tends to be soft and friable; it is no surprise that cavers occasionally find themselves involuntarily heading to the ground. While these incidents have mostly resulted only in minor injuries, generally bruises and minor lacerations, there have been a few joint injuries (sprains and strains). Two of the reported thirty incidents, required the patient to be carried out of the cave via a litter due to leg injuries. These are the only two litter evacuations conducted in the cave to date.

Requiring cavers to wear a climbing/caving helmet, boots with good tread, and pads on knees and elbows can reduce the chances of a serious injury due to a caver fall. Traveling at a pace that is comfortable for the whole team and utilizing hand lines, when needed, can reduce the likelihood of a fall occurring.

Entrapment
Even though getting stuck is probably the biggest fear about entering a cave amongst non-cavers, it has rarely happened. However, when it does it can be a very serious situation if the stuck person is not freed quickly. Of the three reported entrapments only one required outside assistance. A visitor took it upon himself to attempt to squeeze in and out of the Natural Entrance. He succeeded in squeezing in, but on the out part he failed. Luckily for him, the kids of a park ranger soon happened by and saw him stuck in the entrance. He was freed in short order by park staff opening the gate from within the cave. If he had not been discovered he would have been in a serious situation. The outside temperatures were below freezing, the cave was inhaling strongly, and of course he took off his jacket prior to squeezing into the opening. He very well may have succumbed to hypothermia before being found.

There is not a lot that the park can do proactively to reduce the chance of someone getting stuck. It seems that most experienced cavers know what they are capable of, and what they are not. Just like Clint Eastwood once said "A man has got to know his limitations".

Pre-Existing Condition
A pre-existing medical condition is anything that had bothered you prior to entering the cave, either recently or in the distant past. Only four cases of this are on record, two of which were formerly injured joints, and the other two were heart conditions. All resulted in the trip being cut short and the cavers exited the cave under their own power.

To a large degree you have to allow people to manage themselves and hope they listen to Clint and know their own limitations of what their body can still do, and what they have no business even trying to do.

Illness
Only second in reports to falls,

reported incidents in this category include reports of cavers being exhausted, dehydrated, or simply feeling ill. Many reports do not specify or go into much detail to determine what was going on. Dehydration is commonly a cause of someone not doing so well. Traveling in Wind Cave is a very physical endeavor and those whom are not familiar with the conditions can over exert themselves and become dehydrated and/or calorie depleted. The body needs water and fuel to run.

Making sure that you and your team are drinking and eating enough is vital. The park has established five water collectors along the travel routes that capture drip water for the purpose of supplying drinking water. There is also an emergency water cache at each of the six in-cave rescue caches.

Over dressing has been an issue for many first time Wind-cavers. The cave temperature is 53 degrees, and many first timers to Wind Cave want to wear insulated layers. However, experience has proven that wearing a short-sleeved shirt while traveling is the best option. You will stay cooler and will not sweat quite as much, and in the long run stay warmer and better hydrated.

Lost

Wind Cave is without question one of most complex caves in the world, which gives merit to the possibility of getting lost - seriously lost. Despite that fact, there have only been four reported incidents of a lost person. Three of the incidents were solved by the lost person(s) eventually finding their own way back. However, one incident that took place in 1986 involved a young female who was lost for 36 hours before rescuers found her. To complicate things for herself she wandered off alone, left her pack behind, and continued to move long after she knew that she was lost (and even after she was out of light). She was lucky to have been found. This incident was the largest rescue event in park history.

The park has flagged the main travel routes within the cave to aid cavers in route finding. Each route is a different color, and the flags are cut on one end to point to the entrance. In addition the park has made it a priority to have up to date accurate maps of the cave available to cavers.

Miscellaneous

This category contains ten incidents including such things as rattlesnake run-ins, two cases of losing a contact resulted in needing assistant to exit the cave, and one reported case of bad-air due to decomposing vegetative matter resulting in high CO2 (not in Wind Cave but another cave within the park). The best thing that the park can do is to educate cavers of the possibilities of some of the situations that they may encounter.

Summary

The park has utilized the data gathered on incidents to create management policies and training that helps reduce further incidents. Developing the Trip Leader program, establishing gear requirements, having up to date accurate maps of the cave, creating drinking water sites within the cave, and creating flagged travel routes throughout the cave has no doubt reduced the number of incidents.

The park believes that the most success has come from developing the Trip Leader program. To lead a trip off-trail in Wind Cave a caver has to be a park-approved Trip Leader. To become a Trip Leader a caver must have done at least ten off-trail trips in Wind Cave, get approval from the park staff, and take a training course hosted by the park. This has created a cadre of experienced leaders who are familiar with the park, cave, and staff. They know the nuances of travel and route finding in the cave, and are good at training new cavers on the rigors of Wind Cave. The park maintains good communication and trusting relations with the trip leaders and the caving community as a whole.

A rescue in a cave not only has the human well-being aspect, but one of resource impact. Regardless of how careful and well-thought out a rescue is conducted, there will be an increase in the impacts to the cave. While it is extremely wise to have a cave rescue plan and have staff and cavers trained in cave rescue, that only deals with something after it has happened. As the saying goes “an ounce of prevention is worth a pound of cure”. Expending effort to prevent accidents from occurring will benefit everyone.

Overall, Wind Cave National Park has an excellent track record of caver safety. With only 85 reported incidents in 3,915 trips (over almost 30 years), that is a 0.02% incident rate (odds 1 in 46), with the injury rate being a mere 0.007% (odds 1 in 150). There have only been 3 cave rescues (defined as requiring assistance outside the immediate caving team) in the park’s history, making the odds of a rescue one in 1,305 trips.

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