Park News

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

The Midden

Our 20th Year
of Publication!

The Resource Management Newsletter of Great Basin National Park

Creating a Refugium of Bonneville Cutthroat Trout

By Jonathan Reynolds, Fish Biologist

In March 2020, a project was initiated to create two new Bonneville cutthroat trout (*Oncorhynchus clarkii utah*, BCT) conservation populations in Baker and Johnson Lakes. Great Basin National Park hopes that these two high elevation lakes will act as a refugia for BCT as our climate continues to change.

The three most serious threats facing the Park's BCT populations (beside the invasion of nonnative fishes) are drought, increasing temperatures, and catastrophic wildfires. Located over 10,500 feet above sea level, Johnson and Baker Lakes experience cooler air temperatures and more precipitation than the streams located thousands of feet below. Also, since the lakes are located near the edge of the tree line, the probability of a wildfire negatively affecting the lake populations is much lower than that of a fire negatively affecting any one of the BCT streams.

One of the main objectives during the first year of the project was to introduce BCT to Johnson Lake. Several steps needed to be completed before the introduction could occur. First, a YSI SONDE was installed, which measured water temperature, pH, and conductivity every hour for several months. Next, gill nets were deployed in Johnson Lake to ensure that the lake was, in fact, fishless. Lastly, gravel from Snake Creek was hauled to Johnson Lake and placed at the mouth of a small spring channel located on the southwest shoreline. Cool, high oxygenated water flowing through clean gravel is imperative for the survival of trout eggs. The hope is that the spring will provide enough flowing water through these gravels to allow the BCT to spawn and reproduce successfully.

NPS Photo by Julie Long

The Fish Crew at GRBA teamed up with the Back Country Horsemen to successfully release 55 BCT into Johnson Lake during September 2020.

Once everything was ready and the summertime temperatures began to decrease, Great Basin National Park partnered with Nevada Department of Wildlife (NDOW) to collect BCT from Hendry's Creek, a stream located in the nearby North Snake Range.

The Back Country Horsemen of Nevada - High Desert Chapter volunteered to provide the horses, mules, and personnel necessary to transport up to 6 containers of BCT to Johnson Lake. On September 23rd, nine volunteers, nine horses, and three pack mules safely escorted 55 BCT the 3.8 miles and 2,500 feet of elevation gain from the Snake Creek Trailhead to their new home in Johnson Lake.

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In This Issue

Creating a Refugium for Bonneville Cutthroat Trout (continued)

Great Basin National Park would like to thank everyone that helped make the first year of this project a success. BCT could not have been collected and transported to Johnson Lake without collaborating with NDOW and the Back Country Horsemen of Nevada. Not only was the Johnson Lake fish move a huge success, but a new partnership was made and the Park looks forward to working with both NDOW and the Back Country Horsemen more closely in the future.

The Back Country Horsemen put together a video of the event.

NPS Photo by Joey Danielson

NPS fish crew collecting BCT at Hendry's Creek.

NPS Photo by Meg Horner

A Back Country Horsemen's mule packed with 2 aerated containers of BCT.

A Season of Change at Baker Lake

By Leslie Twiner, Biological Science Technician

Sitting at 10,620 feet and surrounded by a breathtaking cirque, Baker Lake remains a popular attraction for backpackers and day hikers visiting the park. From June through October, I was fortunate enough to be able to spend time working and camping at Baker Lake. I got to know the intricacies of this lake and the ecosystem it supports. Throughout the season we collected a wide variety of data to give us a better understanding of Baker Lake and the population of trout it currently supports.

NPS Photo by Jonathan Reynolds

Using the pack raft to take a water quality profile of Baker Lake.

Baker Lake is currently home to a healthy population of Brook Trout and Lahontan Cutthroat Trout. These fish are not native to the park and were stocked in the lake before the area became a national park. In September, we introduced native Bonneville Cutthroat Trout (BCT) into neighboring Johnson Lake. In the years to come, we hope to also introduce BCT into Baker Lake and create a new, thriving population of

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A Season of Change at Baker Lake (continued)

native trout for future generations to enjoy. A large part of our work this season has been preparing Baker Lake to be treated with the piscicide rotenone in the summer of 2021. Treating the lake with rotenone will allow the park to remove all nonnative fish before BCT are introduced.

Due to changing climate, habitat for BCT is quickly disappearing. BCT rely on cold mountain streams that run year-round in order to survive and reproduce. With increasing droughts and warmer temperatures becoming the norm, it is becoming increasingly difficult for BCT to survive in their native range. Our hope is that by creating two new populations at high elevations in historically fishless lakes, we will create refugia populations that can survive changing climate.

Our first step in preparing Baker Lake for next year's treatment was to perform snorkel surveys throughout the lake to document successful spawning of Lahontan Cutthroat Trout. Our first few trips up to Baker Lake, we put as much gear as we could carry on our backs and made our way up the trail to the lake. Once we arrived at the lake, we put on dry suits and snorkels and started the process of observing the fish in the lake. Our hope is that if Lahontan Cutthroat Trout are successfully reproducing, this is a good sign that Bonneville Cutthroat Trout will also be able to reproduce and create a self-sustaining population. When snorkeling in the lake, we were able to document what we believe is spawning behavior.

Photo by Stephanie Greenwood

NCC all women's crew member taking depth measurements at Baker Lake.

NPS Photo by Jonathan Reynolds

Hiking up gear to stash at Baker Lake for the summer.

We also deployed a water quality sonde into the lake. The sonde takes measurements such as pH, dissolved oxygen, conductivity, and temperature. This instrument allows us to get a water quality profile of the lake. This gives us a better idea of how effective the rotenone treatment will be and how much rotenone will need to be used in the lake.

In order to measure the lake and get a profile of the lake depth, we conducted a bathymetric survey with the help of the women's Nevada Conservation Corps (NCC) crew. The survey involved creating a 5m x 5m grid in the lake and taking depth measurements every 5 meters. This tells us how deep the lake is and how much water is in it.

We also picked multiple reference points to measure their distance to the water. Then, when the water levels are higher, we can compare measurements using those reference points and extrapolate that change to the rest of the lake. This information gives us a better idea of how to properly prepare for the rotenone treatment and guarantee its success. Once the nonnative fish have been removed from the lake, Bonneville Cutthroat Trout will be reintroduced in order to create a new population that will hopefully be more resilient to survive a changing climate in years to come.

Temperature Changes across an Elevational Gradient

By Bryan Mark & James DeGrand, Ohio State University; David Porinchu, University of Georgia; & Scott Reinemann, Sinclair Community College

How have temperatures been changing in Great Basin National Park (GBNP) over the past decade? This is an interesting question, especially considering that temperature is highly variable across the diverse terrain of the Park. Globally, the average temperatures of the planet have been rising. Furthermore, studies in other mountain regions suggest temperatures in higher elevations might be increasing at an even faster rate than at lower elevations. How consistent are these patterns of change throughout the various biomes contained within the Park that span from the desert floor to the mountain summits? This article summarizes a study we published this year addressing such questions in a long-term collaboration between universities and National Park staff.

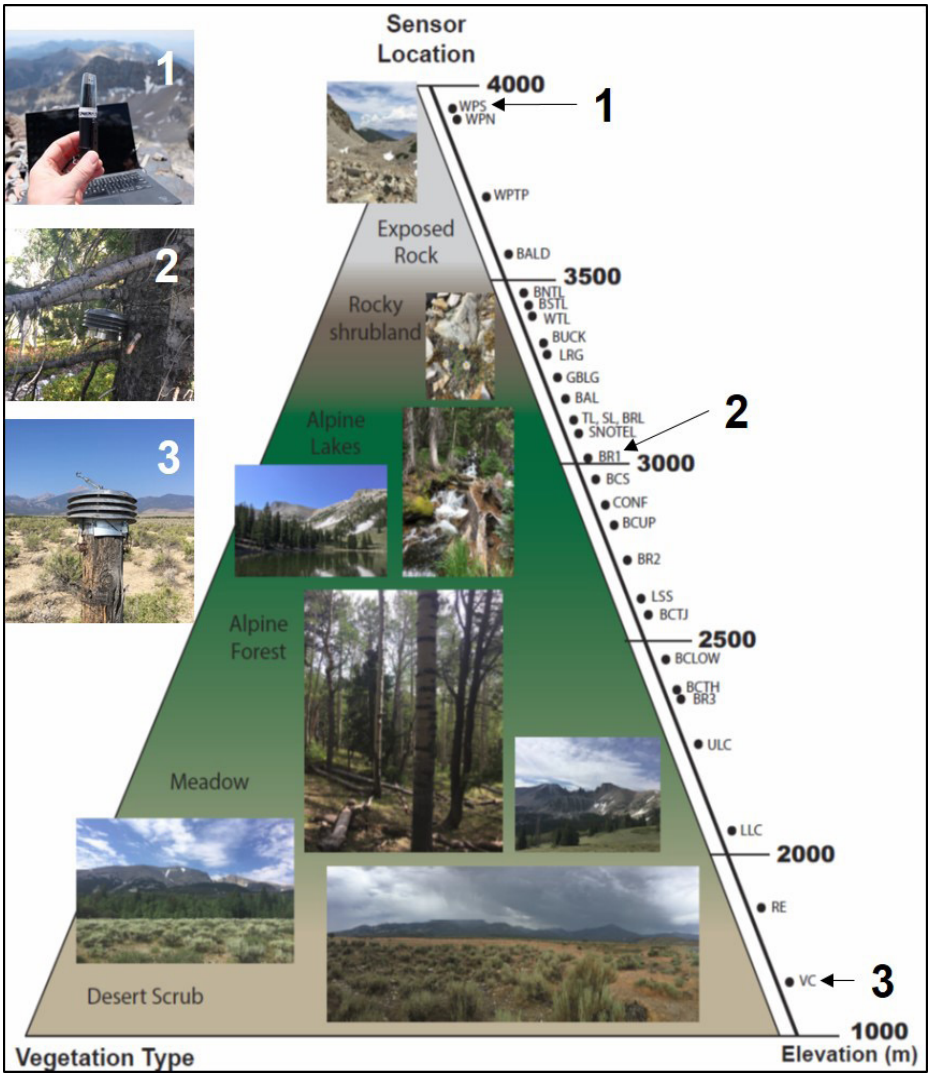

Figure 1. Vertical schematic representing the ESN sensor location by elevation and ecosystem. Numbered panels show examples of thee specific Lascars dataloggers in locations with radiation shields, also identified by number and elevation: (1) Wheeler Peak Summit (WPS), 3976 m a.s.l.; (2) Buck Ridge 1 (BR1), 3034 m a.s.l; and (3) Great Basin Visitor Center (VC), 1639 m a.s.l.

To investigate patterns of ongoing temperature changes throughout the Park, we set up a network of "embedded" sensors in different locations, usually in trees, distributed across the 2,300 m (7,800 feet) elevation range in the Park (Fig. 1). These sensors have provided a unique collection of hourly readings of near-surface air temperature and humidity, shaded from direct sunlight, at about the height of a person above the landscape. The expansive nature of the network, i.e. multiple sensors located at varying elevations, gives us a way to consider trends in temperature change over time and for different landcover. We installed the embedded sensor network (ESN) in 2006, and it now comprises 29 sensors. From a maximum elevation near the summits of Wheeler, Bald and Buck mountains, the sensor locations are distributed along ridgelines and streams in adjoining eastern-draining watersheds all the way down to the Great Basin Visitor Center. The network spans multiple ecological zones including tundra, sub-alpine forest, sub-alpine lakes, sagebrush meadows, and a rock glacier. We have maintained this network in partnership with NPS staff during annual visits to GBNP with undergraduate and graduate students as part of an educational research experience we have entitled, "GBEx (Great Basin Expedition)" (Fig. 2).

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Temperature Changes across an Elevational Gradient (continued)

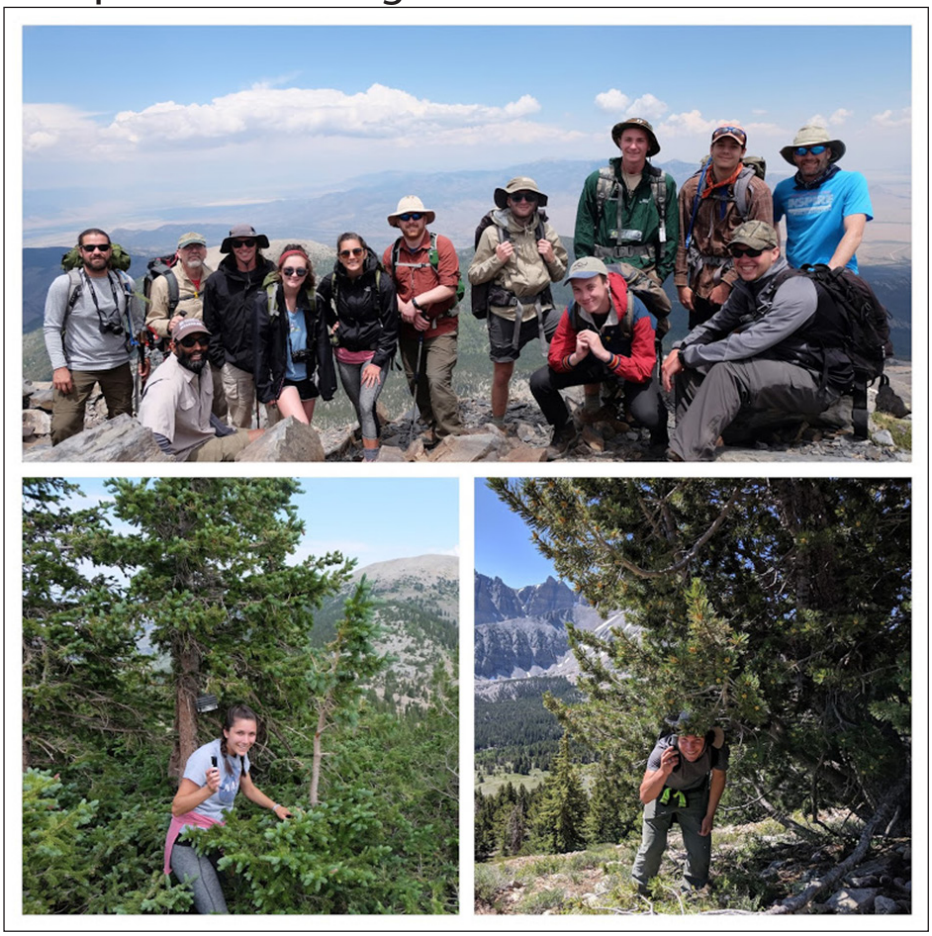


Figure 2. For over 12 years, students, faculty and staff from Ohio State University and University of Georgia have maintained the ESN during annual educational research expeditions to Great Basin National Park (GBNP) called "GBEx." Photos show team atop Wheeler Peak during the 2017 expedition (top), and recovery of Lascar temperature and humidity dataloggers in different locations.

We focused on assessing temperature changes from the GBEX ESN over 12 years, from 2006-2018. We were able to make use of the other weather stations in GBNP and regional climate data to independently verify our results. Specifically, we compared our sensors to the Mather Overlook RAWS and the Wheeler Peak SNOTEL weather stations, as well as the PRISM climate dataset (https://prism.oregonstate.edu/), which provides a gridded interpolation of temperatures distributed across the topography. When we did those validation checks, we find very consistent findings.

Following a robust quality control assessment of all available hourly observations, we were able to analyze the resulting spatially distributed temperature record for GBNP and report on key patterns of variability. From 2006 to 2018, there were significantly increasing trends in daily maximum, minimum, and mean temperatures for all elevations. The average daily minimum temperature increased by 2.1°C (3.8°F). The trend in daily maximum temperatures above 3500 m was significantly greater than the increasing trends at lower elevations, suggesting that daytime forcings may be driving enhanced warming at GBNP's highest elevations.

The results from the ESN indicate that existing weather stations, such as the Wheeler Peak SNOTEL site, are not sufficient to fully capture the small-scale spatial variability in temperature that exists in GBNP. Our study offers an alternative, low-cost methodology for sustaining long-term, distributed observations of conditions in heterogeneous mountainous environments at finer spatial resolutions. In arid mountainous regions with vulnerable water resources and fragile ecosystems, it is imperative to maintain and extend existing sensor networks and observations as climate change continues to alter conditions.

Our full findings are recently published in an open access article:: https://www.frontiersin.org/articles/10.3389/feart.2020.00292/full

Resource Management Videos

During the 2020 field season, resource management and interpretation staff made several in-depth videos about various topics. Get your popcorn and enjoy these short videos.

The Great Basin Rattlesnake
Cave Research in Great Basin National Park
Great Basin National Park Bats
Wetland Restoration
Bonneville Cutthroat Trout Restoration

Highlights of the Hemiptera BioBlitz

By Gretchen Baker, Ecologist

The 2020 BioBlitz focused on True Bugs (Hemiptera). Two experts from Utah State University, Amy Springer and Cody Holthouse, made 12 videos to help people learn more about this often-overlooked order of insects.

"Not all Hemipterans are great... in fact most all of them suck," said Cody Holthouse. That's because Hemiptera are differentiated from other insects by having piercing/sucking mouthparts.

There are three main groups of True Bugs:

1. The Heteroptera ("Different wings"), which include stink bugs, squash bugs, bed bugs, chinch bugs, milkweed bugs, boxelder bugs, backswimmers, water striders, water boatmen, assassin bugs, and more
2. The Auchenorrhyncha (Free-living hemipterans): froghoppers, spittlebugs, cicadas, leafhoppers, planthoppers
3. The Sternorrhnyncha (Plant parasitic hemipterans-some don't even have legs): aphids, scales, and mealy bugs

Each day of the BioBlitz we held a Zoom meeting so that participants had a way to feel some community. Conversations included what people had found and tips on how to find true bugs. Ken Kingsley, a previous volunteer entomologist for the Park, joined in and shared some of his insights from decades out in the field and time at GRBA.

Participants collected in and near their homes (in Texas, Utah, and Nevada) and also in the Park. Overall, we had collections made in Strawberry, Lehman, Baker, Can Young, Snake, and Lexington Canyons.

I was especially excited when I found ants climbing up plants. I took a closer look and found they were farming aphids. The aphids are really tiny Hemiptera, without legs, that put their piercing, sucking mouthparts right into the plant. They then drink lots of plant juices to get the protein, excreting the extra sugar as "honeydew," which the ants gladly eat. In return, the ants protect the aphids. I found aphids on aspens, cottonwoods, and rabbitbrush.

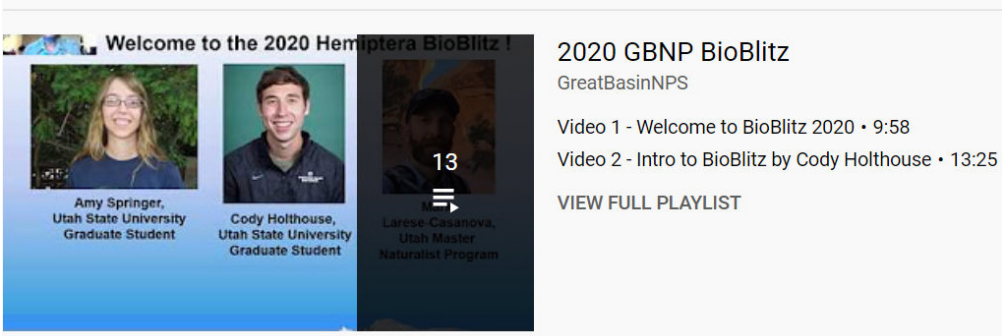
Another cool find was white puffy spots on prickly pear cactus. It turns out this is a protective covering of the cochineal bug, which is harvested in many areas for the red dye it makes. You may be eating it in some of your foods or wearing it in your cosmetics or red-dyed clothes.

Cody and Amy are continuing identifications of the Hemiptera that were collected, and this will provide a baseline for the Park.

NPS Photo by Gretchen Baker

Ants are "farming" aphids on this cottonwood stem. The aphids are sucking plant juices to get protein and execrete extra sugar as "honeyduew", which the ants eat. The ants help protect the aphids.

It was challenging to make the BioBlitz work during Covid, but we did our best. Thanks to all who helped out! Over 80 observations were made on iNaturalist, and you can see those along with the videos by visiting the Park's BioBlitz page: https://www.nps.gov/grba/learn/nature/great-basin-bioblitz.htm



Unique to the 2020 BioBlitz is that all the lectures were delivered online, allowing viewers to choose when they wanted to watch them.

New Virtual Tour of Lehman Caves

By Gretchen Baker, Ecologist

In February 2020, LiDAR scanning and photogrammetry were conducted in Lehman Caves over the course of two weeks, led by Blase Lasala and assisted by participants from Great Basin NP, Zion NP, El Malpais NM, and the Geologic Resources Division. The LiDAR scanning involved placing a high resolution scanner on a tripod and conducting 360-degree scans all along the tour route, approximately a body length apart. In addition, a camera collected color images from the same locations, and these were combined with the LiDAR data.

NPS Photo by Gretchen Baker

LiDAR and color scanning of part of the Lehman Caves tour route. This 3D scanning resulted in a virtual tour of the cave, available on the Park's YouTube

Following the scanning, Blase worked on developing the pointcloud and cleaning up the data, a time-intensive endeavor. Meanwhile, a team from Great Basin NP developed the script and how a virtual cave tour would flow. In addition, descendants of Takeshi Ban and the local Shoshone and Goshute Tribes were consulted on portions of the tour that focus on inscriptions and the entrance area.

During this time, Covid arrived and shut down Lehman Caves. It has been closed ever since. Fortunately, with the development of a virtual cave tour, now more people than ever can experience what the tour route is like via the Lehman Caves Virtual Tour.

The virtual cave tour is split into three main videos, each highlighting different parts of the cave. Each also has special call-out videos, where you can learn additional details about topics such as cave inscriptions, cave biology, and how the cave formed.

Access this cool new way to see the cave at: https://www.nps.gov/grba/learn/photosmultimedia/virtual-cave-tour.htm. It features subtitles in English and Spanish and audio descriptions, making the cave accessible in new ways.

Selected Publications about the Park

Baker, G.M., M. Horner, B. Roberts, J. Long. 2020. Prelimary analysis of biomonitoring and climate data from 13 years of surveys in Lehman Caves, Great Basin National Park, Nevada. *In* Orndorff, W. D., J. J. Lewis, K. Kosič Ficco, M. H. Weberg, and Z. W. Orndorff, editors. 2020. 2019 National Cave and Karst Management Symposium Proceedings, 7- 11 October 2019, Bristol, Virginia. National Speleological Society, Huntsville, Alabama, USA. 160p. Link

Kilpatrick, M. and F. Biondi. 2020. Post-wildfire regeneration in a sky-island mixed-conifer ecosystem of the North American Great Basin. *Forests* 11(9): 900. 17p. Link

Miller, R. F., J. C. Chambers, L. Evers, C. J. Williams, K. A. Snyder, B. A. Roundy, and F. B. Pierson. 2019. The ecology, history, ecohydrology, and management of pinyon and juniper woodlands in the Great Basin and Northern Colorado Plateau of the western United States. 2019. Gen. Tech. Rep. RMRS-GTR-403. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 284p. Link

Sambuco, E., B. G. Mark, N. Patrick, J. Q. DeGrand, D. F. Porinchu, S. A. Reinemann, G.Baker, and J. E. Box. 2020. Mountain temperature changes from embedded sensors spanning 2000m in Great Basin National Park, 2006-2018. Frontiers in Earth Science 8 (292): 18p. Link

Schook, D. M., D. J. Cooper, J. M. Friedman, S. E. Rice, J. D. Hoover, and R. D. Thaxton. 2020. Effects of flow diversion on Snake Creek and its riparian cottonwood forest, Great Basin National Park. No. NPS/GRBA/NRR-2020/2104. National Park Service. 159p. Link

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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:
Resource Management,
Great Basin National Park,
Baker, NV 89311
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 many middens.

Great Basin National Park

Reflections on 20 Years of The Midden

By Gretchen Baker, Editor

It's hard to believe, but you are reading the 40th issue of *The Midden*, the Resource Management Newsletter of Great Basin National Park. The publication started in 2001, published biannually. As the name hints, *The Midden*, just like packrat middens, has become a treasure trove of information for those who want to learn about the past. Reading through the issues, it is apparent how the Resource Management division has grown and evolved over 20 years, taking on more complicated and varied projects.

Photo by Gretchen Baker

While The Midden may not be as old as bristlecones or the Milky Way, it's reached a major milestone with its 20th year.

The Park has benefited by strong partnerships with local agencies, researchers coming from all over the world, and talented seasonal and permanent staff. Although staff in many parks move every few years, over seven resource management staff have been in the park over 10 years, with three of them over 20 years! The institutional knowledge has really benefited the Park, and the strong team values and willingness to help on various projects is obvious.

The Park has also been fortunate to have good funding sources, in particular the Southern Nevada Public Lands Management Act (SNPLMA). Great ideas need funding in order to happen.

Back to *The Midden*, here's an overall breakdown of articles by subject and number of articles:

- Caves - 45
- Wildlife – 36
- Vegetation/Forest Health/ Invasive Plants – 28
- Bonneville cutthroat trout/ Fish – 27
- Other – 23
- Cultural – 21
- Water/Snow/Springs – 20
- Restoration – 16
- Microfauna/Invertebrates – 14
- Weather/Climate – 12
- BioBlitzes - 12
- Physical Science (Geology, Paleontology, Soils) – 10
- Birds – 10
- Reptiles and Amphibians – 9
- Fire - 9

Thanks for reading! Archives are available on *The Midden* webpage.

Upcoming Events:

December 13-14: Geminids Meteor Shower. The dark skies at Great Basin National Park are a great place to observe this meteor shower, just bring plenty of warm clothes!

December 16: Snake Valley Christmas Bird Count. Help with this long-term effort to quantify winter birds! Email Gretchen_Baker@nps.gov for more info.