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

Resurvey of GLORIA Peaks in Great Basin National Park

By Gretchen Baker, Ecologist, Meg Horner, Supervisory Biologcal Science Technician, and Adelia Barber, GLORIA Coordinator

Where might you be able to easily see climate change impacts? Mountain tops are one place, due to their restricted area, extreme climate, and short growing season. This combination of factors can make plants and animals more vulnerable to changes. To better study this habitat, Great Basin National Park (GRBA) joined a worldwide coalition called the Global Observation Research Initiative in Alpine Environments (GLORIA) in 2008.

The GLORIA protocol uses a standardized approach to collect quantitative data on species richness and composition, vegetation cover, soil temperature, and length of snow cover period. It also assesses the potential for loss of biodiversity due to climate change by comparing the current distribution patterns of species, vegetation, and environmental factors along vertical and horizontal gradients.

Fifty-six target regions have been established in mountain ranges around the world, with 11 in the western United States. Great Basin National Park, located in east-central Nevada, contains four of the ten highest peaks in Nevada and is the only target region located in the state. The initial survey was completed in 2008, with a resurvey scheduled every five years thereafter.

Photo by Adelia Barber

Figure 1. The 2013 GLORIA resurvey crew on Buck Mountain, with Jeff Davis and Wheeler peaks in the background. The survey found 13 additional species in 2013.

Primary resurvey methods included: 1) Documenting plant species and abundance in 1 x 1 m grids, 10m x 10m quadrats, and section area summits; 2) Installing dataloggers to record soil temperature on each aspect of the peaks and downloading past dataloggers; and 3) Photo documentation of all grid points and datalogger locations. The sampling design followed the GLORIA field manual (Pauli et al. 2011). Some changes were made to allow for sampling trees on Buck Mountain and to shift quadrats to include measureable vegetation.

The 2013 resurvey was completed in six days with a large crew (Figure 1). All four of the GLORIA peaks (Wheeler, Pyramid, Bald, and Buck) were resampled. Seventy-five plant species from 23 families were found within the plots, an increase of 13 species and one family from the 2008 survey. The most common species were in the Grass and Rose families. Only one species was endemic to the Snake Range, Holgrem's buckwheat (*Eriogonum holmgrenii*).

Of the four peaks, Bald Mountain had the highest plant diversity, with 54 species, while Wheeler Peak had the lowest, with just 15 species.

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GLORIA Resurvey (continued)

Peak	Elevation	Number of Species 2008	2013	Change	Additions	Subtractions	# unique	Notes
Buck	3344	26	28	2	3	1	8	most woody species
Bald	3525	42	54	12	15	4	19	most diversity
Pyramid	3635	30	35	5	6	1	7	endemic Eriogonum holmgrenii
Wheeler	3981	11	15	4	4	0	4	fewest species

Table 1. Summary of plant species found on GLORIA peaks in Great Basin National Park in 2008 and 2013, with number of changes including species added and not found, as well as number of species found only on that peak.

All the peaks showed an increase in number of species from 2008 (Table 1). Six plant species were found on all the mountain peaks.

The four Great Basin peaks were compared to other peaks in the GLORIA program in California (Figure 2). Wheeler Peak has among the lowest species richness of the 21 peaks, but Bald Mountain is the second highest.

Dataloggers were downloaded during the 2013 resurvey. Analyzing temperature data only for complete years, Buck Mountain (3347 m) was the warmest peak, while Wheeler Peak (3981 m) was coolest.

Some of the species documented in 2013 appear to be new species to the target region or summit, as they would have been difficult to overlook in 2008, especially *Solidago multiradiata* (Figure 3). These appearances indicate that these species may be shifting upward in elevation to cooler, moister locales.

The park thanks all those that assisted with the GLORIA resurvey. GLORIA monitoring is long-term commitment, requiring people who are familiar with sampling protocols and who have excellent botanical skills. Partnerships are essential to find the expertise needed to accurately sample sites and help foster a wider appreciation of the GLORIA site so the project will continue long into the future.

Literature cited

Pauli, H., M. Gottfried, D. Hohenwallner, K. Reiter, R. Casale, and G. Grabherr, eds. 2011. The GLORIA field manual-multi-summit approach. European Commission. http://www.gloria.ac.at/

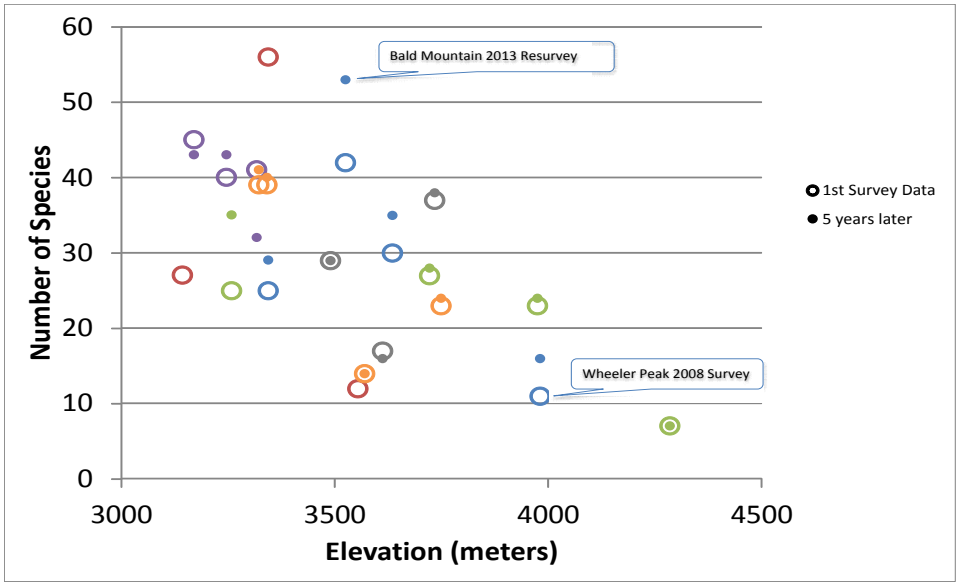
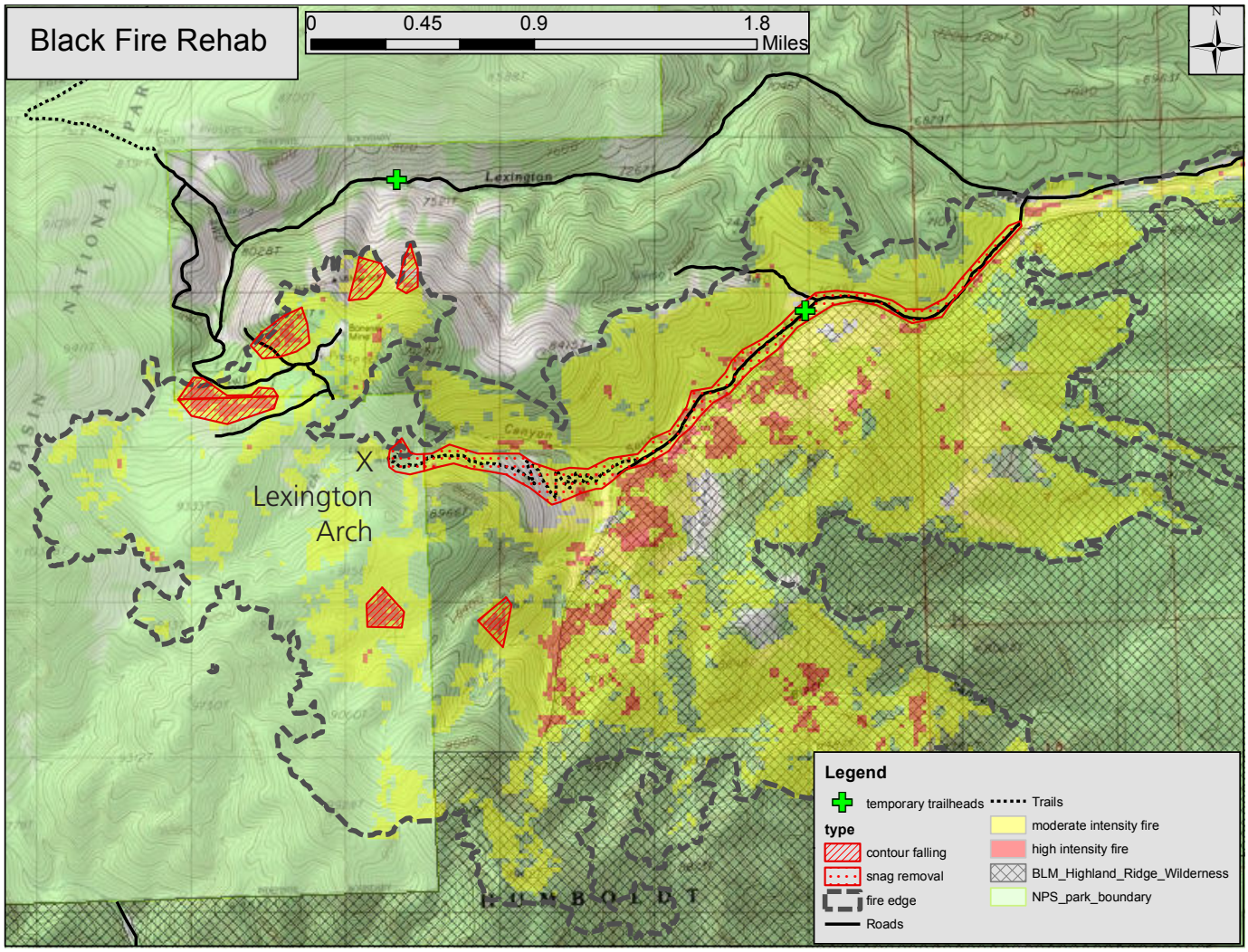


Figure 2. Comparison of species richness among GLORIA peaks in California and Nevada. Peaks in Great Basin National Park are shown in blue.

NPS Photo by Gretchen Baker

Figure 3. *Solidago multiradiata* is one species detected in 2013 that was not found in 2008.

Black Fire Rehabilitation and New Trailheads



Map of Black Fire perimeter, temporary trailheads, and rehabilitation areas. The Black Fire burned in the Lexington Arch area in 2013.

By Ben Roberts, Chief of Natural Resource Management

On July 1, 2013 a lightning strike in the Black Canyon drainage, located outside the park in the BLM-managed Highland Ridge Wilderness, caused an ignition in piñon-juniper vegetation. The fire was initially monitored for resource benefit but then suppressed when it crossed pre-determined management decision lines. The fire was declared contained on September 3, 2013 after burning 96 acres of private land, 1,081 acres managed by the park, and 3,724 acres managed by the BLM. Park and BLM staff submitted a restoration plan on September 24, which was partially funded this spring, to carry out seeding, weed surveys and treatment, and minor facilities repair, including erosion control.

The BLM and NPS have established temporary road and trail closures for visitor safety and resource concerns. After safety considerations are met, and road and trail maintenance occur, the roads and trails will be reopened at temporary trailheads on both the North and South Forks of Lexington Canyon. The South Fork trailhead to Lexington Arch will be approximately one mile below the original trailhead. Please ask at either visitor center for the most recent information.

The fire on NPS lands was a mosaic of low, medium, and high intensity fire. Most of the fire was in high elevation areas consisting of mixed conifer and aspen forest types. Fires like the Black Fire are natural events and are very beneficial to natural ecosystems. Multiple fires over multiple years allow for increased patch heterogeneity, reduced forest pest outbreaks, reduced fuel loads, and increased vegetation and wildlife diversity.

Abundant Fish near Park Campgrounds

By Jonathan Reynolds, Biological Science Technician

In the summer of 2013, the Great Basin National Park fish crew conducted extensive fish population surveys on Baker and Lehman creeks. Using a Smith-Root LR-24 backpack electrofisher, NPS staff performed 50 meter (164 feet), three pass depletion surveys at five sites on Baker Creek and six sites on Lehman Creek.

Surveys sites were located on Baker Creek between 6,825 and 9,000 feet elevation. Only a single brown trout was captured at the lowest site on Baker Creek. This is because the section of Baker Creek below 6,975 feet temporarily went dry in 2011, and fish are still slowly recolonizing the area. The next two sites were located at 7,175 and 7,650 feet, near Grey Cliffs and Baker Creek campgrounds, respectively. A mix of brook, brown, and rainbow trout were caught over these two sites, with the fish density estimates ranging from 2,800 to 3,765 fish per mile. The fourth site was located upstream of the Baker Creek trailhead at 8,350 feet. Only brook trout were caught and the estimated density for the site was 1,867 fish per mile. The fifth and final site on Baker Creek was located at 9,000 feet. A single brook trout was captured and the fish density was estimated to be 32 fish per mile. When all five sites on Baker Creek are averaged, the fish density is estimated at 1,925 fish per mile.

The survey sites on Lehman Creek were located between 6,600 and 9,000 feet elevation. Brown trout dominated the two lowest sites

NPS Photo by Jonathan Reynolds

A brook trout captured between Upper and Lower Lehman campgrounds.

NPS Photo by Jonathan Reynolds

A brown trout captured near Lower Lehman Campground.

located at 6,600 and 6,975 feet. The population density estimates for these sites ranged from 2,293 to 3,347 fish per mile. The third site was located at 7,400 feet between Upper and Lower Lehman campgrounds. Brook, brown, and rainbow trout were all captured at this site, producing a population estimate of 2,478 fish per mile. The fourth, fifth, and sixth sites were located above Upper Lehman Campground at elevations of 7,900, 8,475, and 9,000 feet, respectively. With the exception of one rainbow trout, only brook trout were caught and the population densities were estimated as follows: 3,283 fish per mile at site four, 2,317 fish per mile at site five, and 2,382 fish per mile at site six. Using the estimates from all six sites, the average fish per mile for Lehman Creek was 2,684.
Both Baker and Lehman creeks contain healthy populations of non-native, naturally reproducing trout. Brown trout are the dominant species below 7,000 feet, brook trout dominate above 8,000 feet, and a mix of the two species can be found between 7,000 and 8,000 feet. Rainbow trout were dispersed between the elevations of 6,600 and 7,900 in substantially lower numbers than brook or brown trout.

These surveys showed that even without supplemental stocking, Great Basin National Park offers exceptional recreational fishing opportunities in and around its most heavily used campgrounds. The park is also home to native Bonneville cutthroat trout in five streams.

Lehman Creek streamflow is now available online at: http://waterdata.usgs.gov/nv/nwis/uv?site_no=10243260

Park Geology Report Released

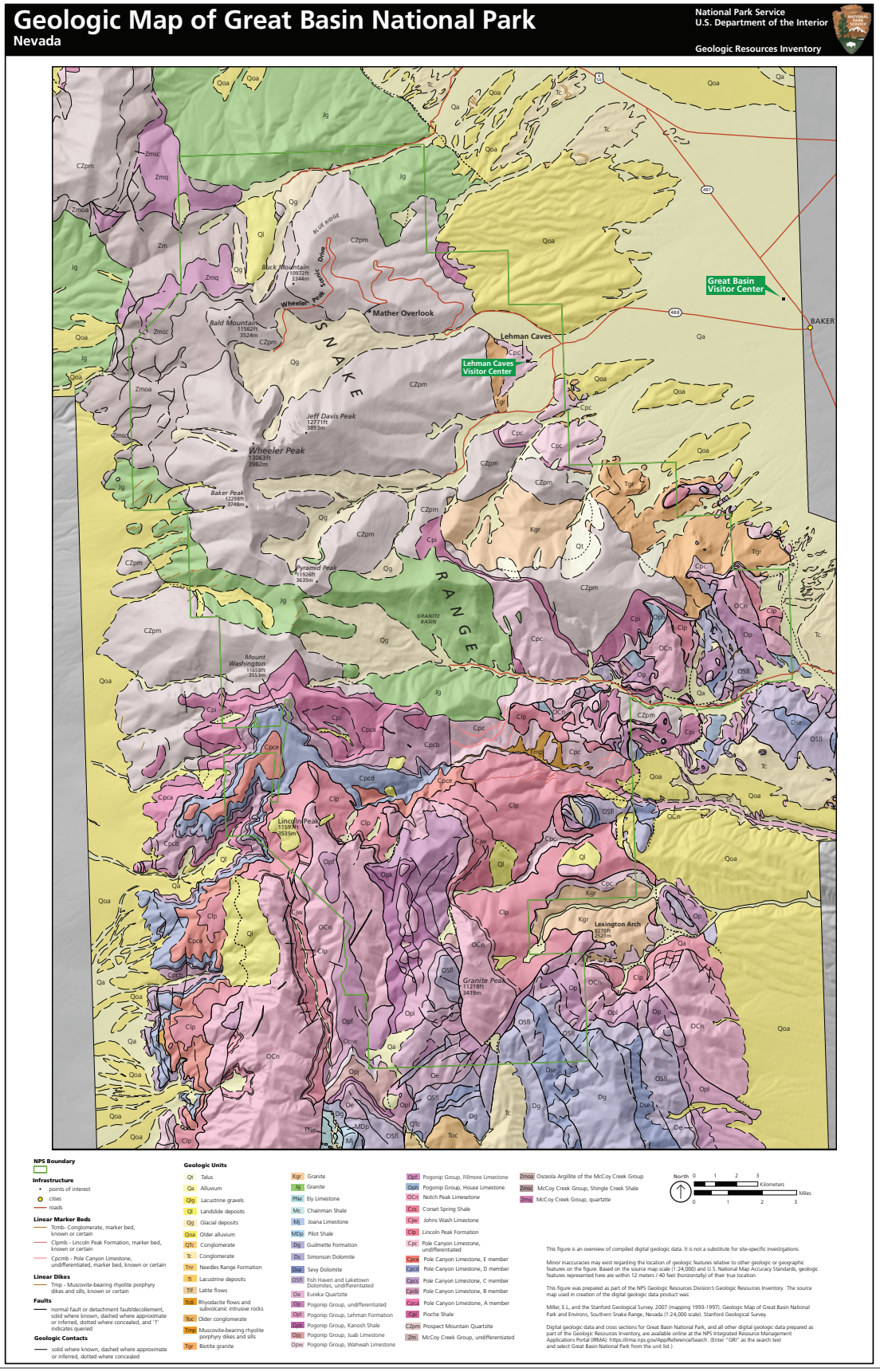
By Ben Roberts, Chief of Natural Resource Management

The park is pleased to announce that the Geologic Resource Division of the National Park Service (NPS) has completed the Geologic Resources Inventory (GRI) for the park.

The GRI is one of 12 inventories funded by the NPS Inventory and Monitoring Program. This report synthesizes ten years of work beginning with a scoping meeting held in September 2003 to determine geologic resources, the status of geologic mapping, and geologic resource management issues and needs.

The GRI is a companion document to the previously completed digital geologic map. The report, the initial scoping document, a printable map, map properties table, GIS data, and a Google Earth file can be accessed and downloaded at the following location:

http://www.nature.nps.gov/geology/inventory/gre_publications.cfm



Ecosystem Restoration Effects on Small Mammals

By Bryan Hamilton, Wildlife Biologist

Sagebrush communities have declined dramatically across the Great Basin, while the extent of piñon-juniper woodlands has increased by an order of magnitude. Piñon-juniper encroachment is a major driver of sagebrush habitat loss. Therefore, sagebrush restoration efforts have focused primarily on reducing tree encroachment by thinning encroaching conifers.

Small mammals are important components of biodiversity and ecological function in the Great Basin. Seed caching by small mammals enhances plant germination, and burrowing aerates soils, cycles nutrients, and maintains early seral state plant communities. As the prey base for many predators, small mammals are important links in food webs. Despite their importance to ecosystems, the effects of sagebrush restoration on small mammals has received very little attention relative to other taxa such as birds and big game.

To restore sagebrush habitat, Great Basin National Park treated over 100 acres between 2004 and 2007. Treatments involved cutting trees, chipping or pile burning slash, and reseeding native vegetation. To evaluate the effects of sagebrush restoration on small mammal diversity, a Before, After, Control, Impact (BACI) design was used. This design can establish casual relationships between thinning, annual grasses, small mammal diversity, and tree encroachment.

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NPS Photos by Bryan Hamilton

Figure 1. Tree encroachment (top photo) is reduced immediately after thinning treatments (bottom photo). Reduced tree cover leads to increased herbaceous vegetation and small mammal abundance.

Ecosystem Restoration Effects on Small Mammals (cont.)

As expected, thinning significantly reduced tree cover ($P = 0.0010$; Figure 1). Shrub cover remained unchanged on both treated and untreated sites ($P = 0.086$). Herbaceous cover significantly increased on treated plots and was unchanged on untreated plots ($P < 0.0001$). This increase in herbaceous cover was driven primarily by invasive annual grasses (44%). Even when annual grasses were removed from the analysis, the increase in herbaceous cover remained significant, but at a reduced magnitude ($P = 0.0002$).

Prior to treatments, small mammals were more abundant on sites with minimal tree encroachment. Nearly twice as many small mammals were found on less encroached sites than sites with high tree encroachment (15 versus 8 per hectare). Treatments had no effects on small mammal abundance, richness, evenness, or biomass ($P > 0.05$). Sagebrush-dependent small mammals (harvest mice and sagebrush voles) increased on treated sites, while piñon mice decreased. However these results were statistically significant only for harvest mice.While past studies on tree thinning in shrub habitat have similarly shown minimal effects of thinning on small mammals, these studies did not employ a BACI design, limiting their ability to assert causal relationships. Our results support the conclusion that restoration treatments do not negatively impact small mammals, with a caveat that treatments were small in scale relative to some restoration efforts.

Ultimately, by decreasing tree cover and increasing shrub and herbaceous cover, restoration should eventually increase small mammal abundance. Higher small mammal abundance may have trophic consequences. Small mammal abundance could cascade upward to benefit predators such as Great Basin rattlesnakes, raptors, and mesocarnivores, and cascade downward to impact plants, soils, and ecosystem processes.

Recent Publications about Great Basin National Park

Eagles-Smith, C. A., J. J. Willacker, and C. M. Flanagan-Pritz. 2014. Mercury in fishes from 21 national parks in the Western United States—Inter and intra-park variation in concentrations and ecological risk: U.S. Geological Open-File Report 2014-1051, 54 p. http://pubs.er.usgs.gov/publication/ofr20141051

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Hollenhorst, J. 2014. Lehman Caves: Time capsule of nature etched in stone and bone. KSL News, Salt Lake City, Utah. http://www.ksl.com/?nid=148&sid=29376634

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Natural Resource Report on Aspen Stand Condition and Health

by Meg Horner, Supervisory Biological Science Technician and Bryan Hamilton, Wildlife Biologist

NPS Photo by Meg Horner

View of aspen stands in the fall from the Mather Overlook.

Quaking aspen (*Populus tremuloides*) is the most widely distributed tree species in North America and is regarded as a keystone species because it supports a high diversity of flora and fauna. Nevertheless, aspen are declining throughout the West, including within Great Basin National Park. To determine the status of park aspen, assess stand condition, and develop management strategies for restoration, the park partnered with The Nature Conservancy to perform Landscape Conservation Forecasting™.

Aspen systems represent the largest vegetation type in the park covering 27.3% of park lands; but as a result of fire suppression, aspen stands have converted to conifer on over 1,200 acres. Under current management practices, park aspen condition will continue to deteriorate. Within 50 years, the conversion of aspen to conifer is predicted to result in a permanent loss of aspen from approximately 10,000 acres. Restoration strategies include prescribed fire to correct ecological departure and prevent conversion of aspen to conifer. Ecological restoration using prescribed fire is recommended for nine park watersheds, totaling 14,174 acres.

The park has published a Natural Resources Report outlining potential restoration areas and applicable restoration strategies. You can find the report, *Great Basin National Park Aspen Stand Condition and Health Assessment,* at http://www.nature.nps.gov/publications/nrpm/nrr.cfm.

2014 Lint Camp Removes over Two Tons of Sand and Debris

By Gretchen Baker, Ecologist

Thirty-seven volunteers from Nevada, Utah, California, Idaho, Canada, and Australia gathered the weekend of March 21-23, 2014 in Great Basin National Park to help clean Lehman Cave during the annual lint camp. Participants picked lint from cave formations and walls along 600 feet of passage and treated algae accumulations near lights. In addition, volunteers carried out over 4,000 pounds of old trail debris, particularly sand, that had covered formations. They used brushes and dust pans to collect sand into five-gallon buckets, which were then carried or wheeled out of the cave one or two buckets at a time.

The park is planning to hold another lint and restoration camp next year, continuing to engage park visitors in innovative ways to celebrate the upcoming NPS Centennial in 2016.

NPS Photo by Gretchen Baker

One of the many young volunteers at the 2014 lint camp. This participant was able to remove a great deal of lint from one of the seven staircases in the cave.

Species of Management Concern Update

By Meg Horner, Supervisory Biological Science Technician

Resource Management staff at Great Basin National Park are updating the park's list of species of management concern. The list includes species of mammals, birds, reptiles, amphibians, invertebrates, and plants that meet one of the following criteria: local rarity, endemism, importance to the park, vulnerability to local population declines, usefulness as an indicator species, sensitivity to human disturbance during critical portions of its life cycle, and/or the focus of unusual public interest or political concern.

The last update was in 2006, and since then, surveys have shed light on the presence, distribution, and status of several species. A variety of survey and monitoring methods have been used to sample local wildlife and plants: small mammal trapping; remote camera surveys; visual encounter surveys for reptiles (Figure 1), pygmy rabbits, and yellow-bellied marmots; acoustic and mist-net surveys for bats; monitoring bighorn sheep with satellite-linked GPS collars; fish population surveys; broadcast surveys for Northern goshawk; breeding bird surveys; cave invertebrate surveys; and rare plant surveys.

Wildlife observations made by park staff and visitors from in and around the park have also added to the known distribution for some species and helped inform several changes to the list. Over 41,000 geo-referenced locations have been recorded for 207 species of wildlife (Figure 2).

Check out the park website to view the updated sensitive species list and find out more about the species of wildlife and plants found in the park – http://www.nps.gov/grba/naturescience/index.htm.

And if you encounter wildlife during your visit, please fill out a Wildlife Observation Form located at one of the park's visitor centers.

NPS Photo by Bryan Hamilton

Figure 1. A Sonoran mountain kingsnake, one species of management concern at Great Basin National Park.

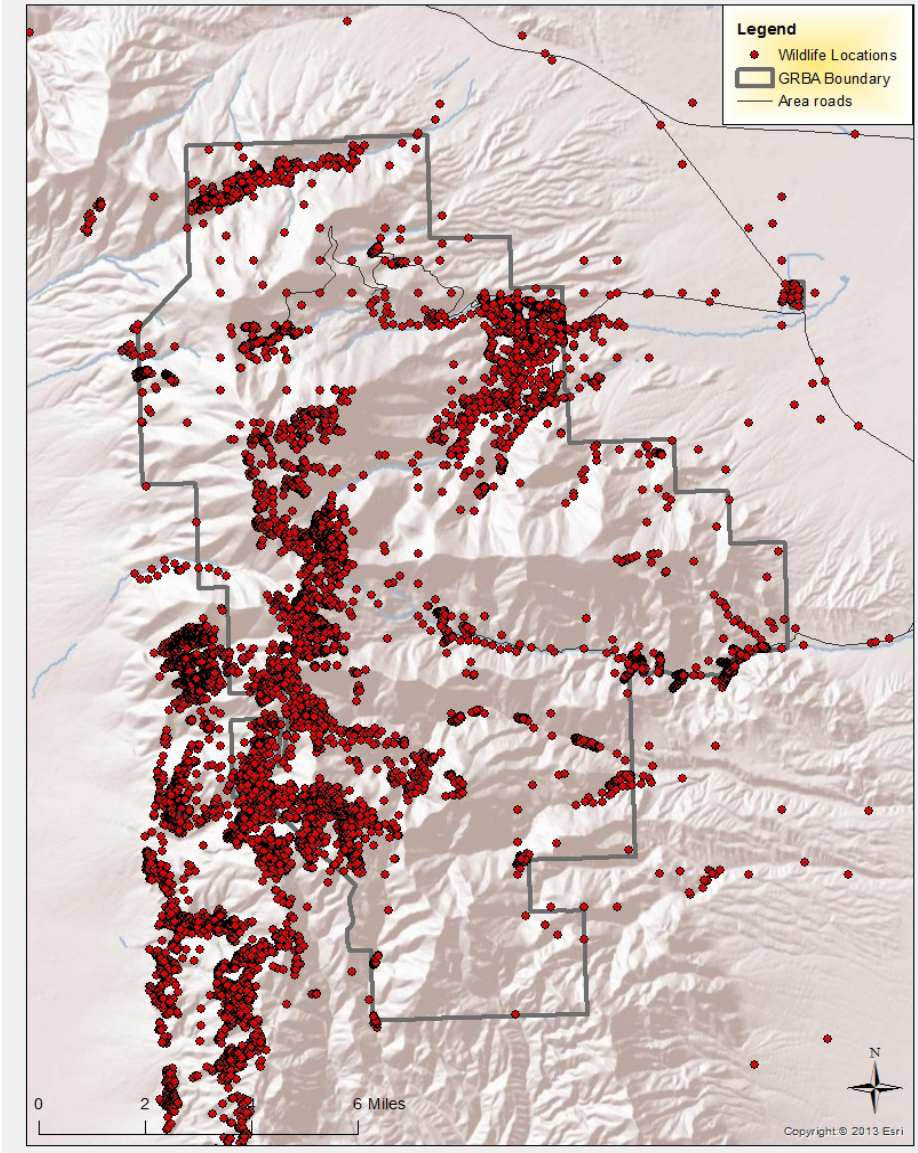

Figure 2. Map of wildlife observations in Great Basin National Park.

National Park Service
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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 numerous middens.

Great Basin National Park

Stalagmites Reveal Past Climate History

By Matthew Lachniet, University of Nevada, Las Vegas

Three stalagmites from Lehman Cave, along with two others from Pinnacle and Leviathan caves in Nevada, have been age dated with uranium series and oxygen isotopes to help determine the past climate history in the Great Basin.

Stalagmites grow in air-filled caves from dripping water and act as ancient rain gauges to help researchers form a more precise chronological record of climate history. Calcite minerals from tiny drops of water accumulate over thousands of years and, much like tree rings, accurately record the precipitation history of an area.

The record produced in this study is the first long-term and continuous record that shows unambiguously that the Great Basin climate was paced by the Earth's orbit around the sun. Our team was able to show that sea surface temperatures off the coast of California did not control Great Basin climate as was suggested by the prevailing hypothesis, based on work at Devil's Hole in California. Instead, this new research shows that the controls on Great Basin climate are instead related to snow and ice cover on land.

NPS Photo by Gretchen Baker

Cave formations store past climate history. Only previously broken stalagmites in Lehman Cave were used for this research.

In addition, the new research shows that the growth of the iconic pluvial lakes in the Great Basin were controlled by the metronomic pulsing of climate changes linked to Earth's orbit. The pluvial lakes were huge lakes that covered a large portion of northern Nevada and Utah during the last ice age when climate was much wetter than today. The Great Salt Lake of Utah is a tiny remnant of Lake Bonneville, one of the past lakes in this area.

Based on this relationship of the variations in the Earth's orbit and Nevada's climate, our team suggests that the region won't see the re-appearance of these pluvial lakes for at least another 55,000 years.

These findings are presented in more detail in the journal Nature Communications.

Upcoming Events:

June 12, July 12, August 10, September 8 Full moon hikes: Call 775-234-7331 for details

July 13-15 Lepidoptera BioBlitz: Look for butterflies and moths during the sixth annual BioBlitz open to professionals and citizen scientists. Contact Gretchen_Baker@nps.gov.

August 12 Perseids Meteor Shower: Watch the year's most active meteor shower with Great Basin's Dark Sky Rangers

September 18-20 Astronomy Festival: Peer though many telescopes at some of the darkest night skies in the nation. Check the park website for details.

October 31 Sesquicentennial of Nevada: Nevada's 150th birthday