National Park Service
U.S. Department of the Interior

Mojave Desert Network

Mojave Desert Network Science Symposium

October 16–17, 2024

ABSTRACTS



Dead Lake, Great Basin National Park
NPS / Jenn Bailard

Table of Contents

DAY 1: Wednesday, October 16th, 8:30 am–4:30 pm 4

(1) Welcome to Lake Mead National Recreation Area 4

(2) NPS Science-Based Leadership in the Face of Uncertainty 4

(3) Managing Water for Wildlife in Mojave National Preserve 4

(4) An overview of the Ash Meadows Fish Conservation Facility and the ecological monitoring efforts conducted on a 100,000-gallon artificial habitat designed to replicate Devils Hole 5

(5) Post-Wildfire Resprouting and Survival of Eastern Joshua Trees and Banana Yucca After the 2020 Dome Fire, Mojave National Preserve 5

(6) Advances in Paleontological Resources Management within the National Park Service: NPS pilots a Southern Network shared paleontologist 6

(7) Drivers of variability in the population of endangered Devils Hole pupfish (*Cyprinodon diabolis*): a machine learning analysis with management implications 6

(8) Fall 2024 Overview and Update on the Recovery and Sustainment Partnership (RASP), an Interagency Tortoise Recovery Effort in the Western Mojave 7

(9) Evaluating the Use of Tree-Ring Data to Model Pre-Instrumental Water Levels in Devils Hole 7

(10) Exploring Water Quality Trends in Upper Lake Mead 8

(11) Using the NABat Data Portal to Access Your Park's Data! 9

(12) Expanding Diverse Programming with Limited Resources at Red Rock Canyon 9

(13) Geochemistry of Northern Death Valley Springs 10

Poster Session 10

(14) Desert Spring Ecosystems: Biodiversity Hot Spots as Indicators of Anthropogenic Stressors 10

(15) Assessment of Periderm Herbivory by Small Mammals in *Yucca brevifolia* at Death Valley National Park 10

DAY 2: Thursday, October 17th, 8:30 am–12:30 pm 11

(16) Lake Mead Gastropods and Canine Schistosomiasis 11

(17) Monitoring Habitat Use by the Great Basin Rattlesnake (*Crotalus lutosus*) to Resource Selection Patterns and the Thermal Environment in Eastern Nevada 11

(18) Digital Interpretation for This and Future Generations 12

(19) Vegetation Impacts Following Desert Fires in and Around the Mojave National Preserve 12

(20) Tortoise Habitat and Climate Change in Mojave National Preserve 13

(21) Wildfire, Retardant, and Invasive Annual Grass: A Case Study of the Geology Fire and Effects on *Schismus* species 14

(22) Thermal Life of the Relict Leopard Frog at Hot and Cold Springs 14

(23) Evaluating Groundwater Pumping Effects at Rogers and Blue Point Springs near Lake Mead, Nevada 14

(24) Climate Influences Recruitment, but not Flowering or Branching, in the Long-lived Joshua Tree 15

(25) Desert Tortoise Recovery at Mojave National Preserve 15

(26) The Present is Key to the Past: Where Historic Legacy Data & Collections Meet New Science 16

(27) Using Autonomous Recording Units (ARU's) to Document Avian Diversity at Tule Springs Fossil Beds National Monument 16

(28) Monitoring Bristlecone Pine Communities at Great Basin National Park 17

(29) Restoration of the Native Bonneville Cutthroat Trout in Great Basin National Park 17

(30) Update on Joshua Tree National Park Bighorn Sheep Program 17

Mojave Desert Network 2024 Science Symposium

Lake Mead National Recreation Area
Water Safety Center
Boulder City, NV 89005

DAY 1: Wednesday, October 16th, 8:30 am–4:30 pm

(1) Welcome to Lake Mead National Recreation Area

***Mike Gauthier**, Superintendent, Lake Mead National Recreation Area.*

Mike Gauthier, Superintendent of Lake Mead National Recreation Area, gave an overview of the park, including staffing by division. He discussed the significance of low water and how it has been affected by years-long drought, its impacts on operations, why it is a management priority, and how this informed the current Sustainable Low Water Access Plan. Other park-wide initiatives include education about and mitigation of increased trash, safety and the “Drive Like a Tortoise” campaign, and other safety initiatives related to water recreation.

(2) NPS Science-Based Leadership in the Face of Uncertainty

***Jane Rodgers**, Superintendent, Joshua Tree National Park*

Abstract not available.

(3) Managing Water for Wildlife in Mojave National Preserve

Neal Darby, *Wildlife Biologist, Mojave National Preserve*

Water management for wildlife in desert parks can be controversial. Though it has a long history of use both, indirectly through livestock management and directly by state wildlife agencies, there are conflicting and competing policy guidance on management, wilderness stewardship and climate resiliency. This is further driven by uncertainties of the importance of water sources to wildlife. We provide some basic understandings of wildlife interactions with water sources, including natural and developed springs, gallinaceous guzzlers, and big game guzzlers, based on over 205,700 hours of trail camera records, 1,280 hours of acoustic recordings and three water manipulation experiments. Cameras recorded 83 species. However, based on one developed spring, almost 30 percent were rare visitors, appearing only a few times over the monitoring period. Due to the numbers, we focus on bighorn sheep, mule deer, bobcats, and Gamble’s quail for behavior. Use for all species predominately occurred during summer months. Visits were largely crepuscular and nocturnal, depending on the species. Frequency of use appears strongly influenced by air temperature. Environmental factors such as vegetation cover, drought condition, and location also appear to influence use. Adding new water sources had no immediate effect and has taken up to five years before regular use by bighorn. Removal of water caused abandonment of the site by all wildlife, but acoustic recorders detected some bird

species remaining in the vicinity. Given climate predictions of higher temperatures and less precipitation, the need for more intense water management may be needed to maintain wildlife distributions.

(4) An overview of the Ash Meadows Fish Conservation Facility and the ecological monitoring efforts conducted on a 100,000-gallon artificial habitat designed to replicate Devils Hole

***Danny Villanueva**, Biologist, USFWS*

The Ash Meadows Fish Conservation Facility (AMFCF) was constructed in 2013 to support the conservation and recovery of Devils Hole pupfish, *Cyprinodon diabolis*. The three objectives of the AMFCF are to establish a self-sustaining population of Devils Hole pupfish, develop captive breeding methods, and conduct research on Devils Hole pupfish. The AMFCF also houses a 100,000-gallon refuge tank that is a replica of the Devils Hole habitat. The refuge tank serves to simulate the Devils Hole pupfish natural ecosystem. Ecological monitoring efforts are ongoing with monthly algae surveys, invertebrate surveys, and weekly predaceous diving beetle, *Neoclypeodytes cinctellus*, trappings to assess the health of this artificial ecosystem. Here, we analyze how aspects of the refuge tank community have changed over the years by examining the percent coverage of algae species in the shallow shelf of the refuge tank, invertebrate abundance, and population dynamics of *N. cinctellus*.

(5) Post-Wildfire Resprouting and Survival of Eastern Joshua Trees and Banana Yucca After the 2020 Dome Fire, Mojave National Preserve

***Melanie Davis**, Field Botanist, University of California, Riverside*

Mojave National Preserve protects a unique ecosystem including eastern Joshua tree woodlands from threats such as wildfire; a significant force influencing vegetation worldwide. We collected field data to produce empirical estimates of eastern Joshua tree (*Yucca jaegeriana*) survivorship after the 2020 Dome Fire at Mojave National Preserve to facilitate management planning and expectations for the recovery of burned Joshua tree woodlands. We also sought to leverage a long-term repeat photography project to produce a publicly-available web resource for conservation and science communication. Using both pre-fire photography and data from 18 sites spread across the burned area, we documented post-fire survivorship and other growth metrics for the eastern Joshua tree and banana yucca (*Yucca baccata*) in 2022 and 2023. We then used vegetation mapping data to select and survey 11 local unburned control sites that matched burn sites in classified vegetation type, shrub and tree community cover and composition, elevation and aspect. Overall we observed variable natural survivorship of eastern Joshua trees and banana yucca in our plots across the Dome Fire burn area, and we found a significantly higher survival in banana yucca (66%) than in the eastern Joshua tree (18%), 2.5 years post-fire. However, we found an annual decrease of approximately 5% of Joshua trees surviving during the year prior to the final survey. Further work will investigate generalizable patterns from these data in comparison to other stands and sites, for application to pre- and post-fire management of Joshua tree stands.

(6) Advances in Paleontological Resources Management within the National Park Service: NPS pilots a Southern Network shared paleontologist

***Aubrey Bonde**, Paleontologist, Southern Network Parks*

The Paleontological Resources Preservation Act of 2009 (PRPA) was published in the Federal Register and received final approval in 2022. This places paleontological resource regulation decades behind other important natural and cultural resources regulations. Major milestones of the PRPA are that it unifies policy and management obligations for bureaus within the Departments of the Interior and Agriculture by: managing nonrenewable paleontological resources using scientific principles and expertise; enforcing minimum requirements for the curation of federal fossils in approved repositories; enforcing minimum requirements for applicants of paleontological resource special use permits; and outlining civil and criminal penalties for the misuse of fossil resources.

In order to implement the PRPA and expand proper paleontological management practices into a wider network of National Park Service (NPS) units, the Southern Network shared paleontologist position was crafted. This is the first of its kind position for the NPS, made possible through a cost-efficient strategy and targets support to several important fossil rich parks that have lacked paleontological management staff. The NPS units shared by the Southern Network paleontologist are Tule Springs Fossil Beds National Monument, Death Valley National Park, Lake Mead National Recreation Area, Santa Monica Mountains National Recreational Area, and Great Basin National Park. These five units are provided support in the areas of paleontological field, museum, and lab work, database management, environmental planning and compliance, resource loss evaluation (natural and anthropogenic), and identification of long-term needs and priorities for NPS paleontology projects and programs.

(7) Drivers of variability in the population of endangered Devils Hole pupfish (*Cyprinodon diabolis*): a machine learning analysis with management implications

***Mark Hausner**, Associate Research Professor, Desert Research Institute*

The endangered Devils Hole pupfish (*Cyprinodon diabolis*), which occurs in a single, water-filled cavern in southern Nevada's Mojave Desert, was driven to near-extinction in the late 1960s when local groundwater pumping dewatered critical habitat that the pupfish used daily for spawning and foraging. Extensive litigation in the 1970s led to a finding of a federal water right and a cessation of nearby pumping, but neither the pupfish population nor the water level in Devils Hole ever fully recovered to pre-pumping levels. Since then, the *C. diabolis* population has fluctuated both seasonally in response to local phenology and over the long term in response to other environmental stressors. Fifteen years ago, the scientists who manage Devils Hole began an intensive long-term ecosystem monitoring program using a systematic protocol to collect a suite of biotic and abiotic data at regular intervals. We recently compiled and evaluated these data using machine learning methods to better understand the relative

importance of the different drivers of pupfish population dynamics. Results are largely consistent with our understanding of the dynamics of the ecosystem. For example, different food sources show up as critical in this food-limited ecosystem. Some results, however, are surprising – shallow shelf nitrite concentration, for example, appears to be related to the pupfish population.

The multi-agency team that manages Devils Hole has recently completed a strategic plan that identifies ecosystem triggers expected to affect the pupfish population and lays out management responses to those triggers. Results of this project will be used in future reviews to inform the selection of ecosystem triggers and potential management strategies to mitigate negative effects to the ecosystem. The project results will also be used to refine the long-term monitoring protocols in Devils Hole to better target parameters that are relevant to the population dynamics of the ecosystem.

(8) Fall 2024 Overview and Update on the Recovery and Sustainment Partnership (RASP), an Interagency Tortoise Recovery Effort in the Western Mojave

***Clay Noss**, Partnership Coordinator, Mojave Desert Land Trust*

The Recovery and Sustainment Partnership (RASP) is a joint initiative between DOD and DOI to accelerate the recovery of priority species while providing DOD greater mission flexibility. In 2020 the Mojave desert tortoise (MDT, *Gopherus agassizii*) was selected as a RASP priority species, establishing a partnership between the National Fish and Wildlife Foundation (NFWF), the U.S. Marine Corps, U.S. Army, DOD, USFWS and BLM. A key part of the RASP strategy is concentrating resources in focal areas within Tortoise Conservation Areas in the western Mojave (Fremont-Kramer, Superior-Cronese and Ord-Rodman). Priority RASP strategies are drawn directly from the 2011 USFWS Revised Recovery Plan. These strategies include habitat protection (acquisitions), habitat restoration, highway exclusion fencing and crossings, community outreach (particularly to recreational off highway vehicle users), population augmentation through head-starting and improved population monitoring. Organizations apply for funds on an annual cycle. There are multiple metrics for evaluating RASP's success, with the most important being improved MDT population vital rates. As of Fall 2024, RASP funding has supported work by three non-profits, one agency (USFWS), and one for-profit company. Strategies funded to date include acquisitions, habitat restoration, community outreach and population monitoring. The RASP program has the potential to meaningfully contribute to MDT recovery. Challenges include securing appropriate funding levels, environmental and cultural clearances, broadening the applicant and grantee pool and coordinating strategies. Science needs include linking conservation actions to tortoise demographics, evaluating the impact of RASP at the species level and determining the appropriate spatial scale for conservation efforts.

(9) Evaluating the Use of Tree-Ring Data to Model Pre-Instrumental Water Levels in Devils Hole

***Laura Dye**, Hydrologist, US Geological Survey*

While the modern water level record in Devils Hole is strongly influenced by groundwater withdrawals in nearby areas, it is also affected by natural climate fluctuations. Both of these effects influence the fluctuation in water levels at Devils Hole, and ultimately, the suitability for pupfish habitat. Halford and Jackson (2020) developed a model relating the water level to winter precipitation as reported by the South-Central Nevada Precipitation Index (SCNPI). Given that winter precipitation from the Spring Mountains is a primary source of groundwater recharge to Devils Hole, the SCNPI data could be useful to model long-term water levels. However, this record only extends back to 1896. To capture the full range of natural variability in water levels at Devils Hole, including water-level extremes not present in the instrumental record, a longer record is needed.

One possible way to extend the climate record is using tree-ring data to statistically model the relationship of tree growth with climate for centuries preceding the instrumental record. These long-term tree-ring reconstructions better account for variability and identify hydroclimatic patterns that have not been previously documented. Robust tree-ring based reconstructions rely upon multiple tree-ring sites demonstrating a statistical relationship with the climate variable of interest. To test the tree growth-climate relationship in the Spring Mountains and the potential to collect other climate sensitive sites in the area, we evaluated the climate-growth relationship of existing Spring Mountain tree-ring (*Pinus longaeva* and *Pinus ponderosa*) collections using annual, seasonal, and moving correlations with precipitation, SCNPI, temperature, and snowpack. These initial analyses reveal tree linkages to water-year and cool-season precipitation and autumn temperatures. Results from this analysis provide plausible evidence that other trees in the area are recording climate information relevant to this study. Targeted and strategic sampling by elevation, species, and tree-ring proxy is expected to assist with answering specific questions about Devil's Hole water variability through time. For example, an extended record may be used to better predict return frequencies of major drought and pluvial events. Our preliminary evaluation of the possible use of tree-ring data to extend the Devils Hole water level record shows that it is a promising approach, but additional data are required.

(10) Exploring Water Quality Trends in Upper Lake Mead

***Carissa Wilkerson**, Environmental Biologist, Southern Nevada Water Authority*

Lake Mead is a large, hydrodynamically complex reservoir with four tributaries including the Colorado River, Virgin River, Muddy River, and Las Vegas Wash. Over the last two decades, Southern Nevada Water Authority has collected water quality data on a monthly to biweekly basis, establishing a robust dataset for statistical analysis. While the lower region of the lake has been evaluated extensively for trends in water quality, data from upper Lake Mead have remained untouched. Exploratory analysis of these data revealed complex relationships and non-monotone patterns over time, highlighting the need for alternative approaches to traditional trend detection tests. This presentation will discuss the use of generalized additive models as a trend analysis tool, provide preliminary results for key water quality parameters, and preview plans to use machine learning for a better understanding of parameter interactions.

(11) Using the NABat Data Portal to Access Your Park's Data!

***Allen Calvert**, Network Program Manager, Mojave Desert Network*

The Mojave Desert I&M Network (MOJN) has been collecting bat monitoring data as part of a collaborative monitoring project since 2018. The three aspects of the monitoring plan include acoustic surveys, White-Nose Syndrome (WNS) Surveillance, and Network Bat Blitzes. Parks and MOJN have worked together to collect the data which is managed by MOJN. The North American Bat Monitoring Program (NABat) was established in 2015 to standardize bat monitoring across the continent. Initially, NABat focused on acoustic and roost surveys however they now provide the ability to include additional monitoring methods like capture surveys. The USGS, the lead agency for NABat, has developed an online data portal that allows partners to upload their survey data and also allows other researchers to request access to data for additional analysis. In the last year, the NABat portal has had a number of updates which have provided greater access and use of data. Using data collected from the MOJN project, I will provide a summary of how to access this data so parks can more easily obtain information collected within park boundaries. NABat has also provided some data visualizations and plan to provide more ways to visualize data in the future.

(12) Expanding Diverse Programming with Limited Resources at Red Rock Canyon

***Chad Hoing**, Park Ranger, Red Rock Canyon National Conservation Area*

In an increasingly urbanized and interconnected world, public lands like Red Rock Canyon National Conservation Area face the challenge of offering interpretive programming that resonates with diverse audiences and reflects the many ways people connect with nature. This presentation will explore strategies for engaging community organizations and building partnerships that create inclusive programming for underserved communities, fostering shared experiences in natural spaces.

Key approaches include collaborating with local cultural organizations to co-create programs that are culturally relevant and community-driven. We will also discuss how to adapt existing resources to better serve diverse groups, incorporating multiple perspectives. Gathering audience feedback will be emphasized as a critical component of program development, ensuring that the offerings are meaningful and reflective of the communities served.

We will highlight the process of assessing current programs to identify gaps in diversity and inclusion, and the essential role that community organizations play in co-developing tailored programming. By cultivating a culture of experimentation and collaboration, public lands can not only extend their interpretive reach to underserved communities but also promote a deeper appreciation of diverse cultures among all visitors. This presentation aims to inspire participants to rethink their programming strategies, embracing innovative, resource-efficient approaches to community engagement, and contributing to a more inclusive and enriched landscape.

(13) Geochemistry of Northern Death Valley Springs

***Katie Earp**, Hydrologist, US Geological Survey*

Few geochemical data exist for springs in the Scotty's Castle area in northern Death Valley. In February 2024, the US Geological Survey collected water quality samples at four springs in cooperation with the National Park Service. Samples and field parameters were collected at Mound Spring in the Grapevine complex, Stainginger Spring at Scotty's Castle, Surprise Spring near the Mesquite ranger station, and Mesquite Spring at the Mesquite Spring campground. The samples were analyzed for major ions, trace metals, radiocarbon (14C), stable hydrogen (2H/1H) and oxygen (18O/16O) isotopic ratios, strontium (87Sr/86Sr) isotopic ratios, dissolved noble gases, and tritium. Initial results indicate that Stainginger and Surprise springs have similar physical parameters with pHs of 8.0-8.2, specific conductivities of 725-751 µS/cm, and water temperatures of 24.9-25.0 °C. In contrast, Mound Spring has a pH of 7.1, specific conductivity of 1230 µS/cm, and water temperature of 37 °C, suggesting a different source or geologic controls on the spring. Mesquite Spring is lower in elevation and has a pH of 7.63, specific conductivity of 1385 µS/cm, and a temperature of 22.1 °C, which may be explained by the upgradient Mound, Stainginger, and Surprise springs feeding the alluvial fan complex and re-emerging at the campground site. The geochemistry of these sites will be compared to regional groundwater and springs to determine the source and age of the Scotty's Castle area springs.

Poster Session

(14) Desert Spring Ecosystems: Biodiversity Hot Spots as Indicators of Anthropogenic Stressors

***Jennifer Edmonds**, Associate Professor, Nevada State College*

Abstract not available.

(15) Assessment of Periderm Herbivory by Small Mammals in *Yucca brevifolia* at Death Valley National Park

***Amanda Hernandez**, Natural Resource Management Assistant, Death Valley National Park*

Abstract not available.

DAY 2: Thursday, October 17th, 8:30 am–12:30 pm

(16) Lake Mead Gastropods and Canine Schistosomiasis

***Riley Rackliffe**, Aquatic Ecologist, Lake Mead National Recreation Area*

In recent years a number of dogs have been infected with canine schistosomiasis after visiting the Colorado River at Blythe, California. The cause of this disease, which can be fatal, is the parasitic flatworm *Heterobilharzia* americana, which is normally encountered in Texas and had never been reported in California. Researchers from UC-Riverside identified the parasite in its intermediate host, snails of the Galba genus, collected in the Colorado. A 2018 report had identified the same snail and parasite in Moab, Utah. With positive cases upriver and downriver from Lake Mead we invited the same UC-Riverside team to survey Lake Mead and Mohave for the presence of the snail or trematode. We collected approximately 1500 snails from 15 coves on each lake and have so far identified 5 distinct morphologies of flatworm, and 10 species of snails. In Lake Mead we found only 2 individual snails that matched the morphology of a Galba snail. We found a greater diversity of snails in Lake Mohave including many more of the Galba morphology. In humans, flatworms of these types result in the condition known as "swimmer's itch", which may explain why we get more reports of it from Lake Mohave. As of this abstract, DNA results are still pending to confirm species identities of the collected specimens and whether Lake Mead contains snails of the Galba genus with the potential to transmit the parasite to canine visitors of the park.

(17) Monitoring Habitat Use by the Great Basin Rattlesnake (*Crotalus lutosus*) to Resource Selection Patterns and the Thermal Environment in Eastern Nevada

***Colton Irons**, Graduate Researcher, University of Nevada, Reno*

Snakes and other ectotherms must select microhabitats that enable them to obtain adequate food resources, confer protection from predators, and enable them to thermoregulate effectively. Therefore, microhabitat characteristics such as vegetation structure and availability of belowground refuges can play an important role in resource selection and habitat quality for reptiles. We are currently assessing the thermal ecology and microhabitat selection patterns of the Great Basin rattlesnake (*Crotalus lutosus*) within a semi-arid montane region of eastern Nevada (Great Basin National Park). We surgically implanted rattlesnakes with radio transmitters and temperature dataloggers (n = 29), and we obtained locations for each snake 1-2x per week during the activity season. In addition, we deployed operative temperature models (n = 32) at a wide range of available above and below-ground microhabitats within our study area. We are using this information to assess how snakes select habitats throughout the activity season. Moreover, by comparing available operative temperatures with field-active body temperatures we will be able to study how snakes use microhabitats for thermoregulation and assess seasonal and diurnal changes in thermal preferences. Our preliminary analyses indicate that snakes tend to select higher elevation, south facing slopes with plentiful leaf litter and

abundant cover of forbs and grasses. We hope to learn how a changing climate affects body temperatures of rattlesnakes and how their movement behavior influences resource selection. This will help us better understand reptiles impacted by climate change and utilization of specific resources under similar environmental conditions within the Great Basin.

(18) Digital Interpretation for This and Future Generations

***Justin O'Dell**, Park Ranger, Bureau of Land Management*

Las Vegas is one of the fastest growing cities in the United States, with an increasingly youthful and connected community of diverse individuals beginning to explore their public lands. While in-person interpretation still plays a crucial role – and perhaps more than ever – public lands can derive enormous benefit from reaching these new audiences where they are using social media and video. Correspondingly, aging individuals and people with disabilities who may not be able to appreciate our public lands' resources in person can connect with our awe-inspiring wonders through similar techniques.

This presentation will focus on digital interpretation – especially video – as a means of connecting new audiences with their public lands and finding the best ways to encourage stewardship among our existing audiences. Main topics will include video as a means of reaching across boundaries, a review of current research on social media trends and how they relate to public lands, creating digital products with 21st century techniques (LiDAR, GIS, and photogrammetry), and helping the public fall in love with resources that are too sensitive or inaccessible to bring them in person.

(19) Vegetation Impacts Following Desert Fires in and Around the Mojave National Preserve

***Kevin Buffington**, Biologist, US Geological Survey*

Current methods for detecting burn severity do not adequately represent desert shrublands and other sparse vegetation types, making accurate damage assessments difficult. We report on vegetation impacts associated with two fires: the 46,000-acre Dome Fire burned extensive portions of the Mojave National Preserve during August 2020, and in July 2023 the York Fire burned an additional 92,540 acres in the Mojave National Preserve, Castle Mountains National Monument, and Bureau of Land Management areas to the east. The traditional Burned Area Reflectance Classification (BARC) analysis estimated 100% of these burned areas as “low severity” even though widespread incineration of plant canopies was evident following the fires. We incorporated field surveys with satellite remote sensing indices to estimate fire impacts across the Dome Fire footprint. We found drastic changes in plant cover between 2019 (pre-fire) and 2021 (one year post fire), including a 79% decrease in shrub cover (33% in 2019 to 7% in 2021), a 73% decline in perennial grass cover (9% to 3%), and a 52% increase in bare ground cover (57% to 87%). To aide long-term management, we also developed a model to detect eastern Joshua trees using available lidar, field surveys, and manual interpretation of high-resolution imagery. The random forest model predicted Joshua trees with 89.9% balanced

accuracy, however, this model is best suited for mature (tall) Joshua trees. The Dome Fire boundary overlapped the lidar domain by 29%: assuming an average density of Joshua trees detected with lidar, we estimated 837,334 Joshua trees within the Dome Fire footprint and 1,211,916 Joshua trees within the York Fire footprint. Collectively, our remote sensing analyses suggest a high burn severity across the Dome Fire compared with the traditional BARC approach and the extent of impact to the Preserve's iconic Joshua tree, thereby providing a framework for managing post-fire landscapes (e.g., fuels control and habitat restoration) in desert shrubland communities.

(20) Tortoise Habitat and Climate Change in Mojave National Preserve

***Debra Hughson**, Deputy Superintendent, Mojave National Preserve*

Climate change is expected to shift, degrade, and potentially eliminate habitat for Mojave Desert iconic species such as the desert tortoise (*Gopherus agassizii*). Lovich and others (2014) found reduced survivorship of desert tortoises in Joshua Tree National Park where previous modeling had indicated that climate change would render habitat unsuitable for tortoises. Barrows, Henen, and Karl (2016) modeled loss of more than half the tortoise habitat in the Marine Corps Air Ground Combat Center at Twentynine Palms, California by the end of the century. Here we use Maxent and Random Forest models of tortoise habitat in Mojave National Preserve to infer how tortoise habitat quality, on a scale from zero to one, might vary with increasing temperature and precipitation. The models were trained on live tortoise observations collected by the U.S. Fish & Wildlife Service Mojave Desert Tortoise Range-wide Monitoring Project from 2001 through 2016. Climate parameters used for this period were PRISM 1990 – 2020 normals of minimum and maximum temperature and mean precipitation. We used results from Gonzalez and others (2018) of increase in temperature and percent change in precipitation for the 2070 – 2100 period. Our model results suggest that tortoise habitat will be substantially degraded and reduced in area throughout the preserve by 2100. Pockets of remaining habitat will be small portions of once much larger and higher quality habitat. No new areas of tortoise habitat at higher elevations are expected.

Barrows, C.W., Henen, B.T. and Karl, A.E., 2016. Identifying climate refugia: a framework to inform conservation strategies for Agassiz's desert tortoise in a warmer future. Chelonian Conservation and Biology, 15(1), pp.2-11.

Gonzalez, P., F. Wang, M. Notaro, D.J. Vimont, and J.W. Williams. 2018. Disproportionate magnitude of climate change in United States national parks. Environmental Research Letters 13: 104001. doi:10.1088/1748-9326/aade09.

Lovich, J.E., Yackulic, C.B., Freilich, J., Agha, M., Austin, M., Meyer, K.P., Arundel, T.R., Hansen, J., Vamstad, M.S. and Root, S.A., 2014. Climatic variation and tortoise survival: Has a desert species met its match? Biological Conservation, 169, pp.214-224.

(21) Wildfire, Retardant, and Invasive Annual Grass: A Case Study of the Geology Fire and Effects on *Schismus* species

***Annika Bjorksten**, Fuels and Vegetation Tech., Joshua Tree National Park*

The Geology Fire occurred in June 2023 in Pleasant Valley in Joshua Tree National Park. The human-caused fire spread across 1033 acres driven by winds and invasive annual grasses in an area where Joshua tree woodlands and Creosote shrublands intergrade. Fire suppression was aggressive with immediate direct attack allowing fire engines off-road travel and fire retardant dropped from aircraft to achieve containment. Phosphorus-based fire retardant is an effective tool for fire suppression but can act as a plant fertilizer and can result in increased abundance of invasive annual grasses, such as *Schismus*. Ten months after the fire, *Schismus* cover and density as well as plant community composition were measured in parallel unburned, retardant-impacted, and burned transects near the perimeter of the Geology Fire. Plant community composition did not differ across the three study areas. Density of *Schismus* post-fire was elevated in both the burned and retardant drop areas by the same amplitude, while percent cover of *Schismus* was lowest in unburned plots and *Schismus* cover did not differ between burned and retardant drop areas. *Schismus* density was greatest in burned and least in unburned areas. The use of fire retardant did not stimulate a *Schismus* increase beyond that observed in burned areas. Minimizing acreage burned was beneficial to this Mojave Desert vegetation community.

(22) Thermal Life of the Relict Leopard Frog at Hot and Cold Springs

***Robert Pelletier**, PhD Candidate, University of Nevada, Las Vegas*

Hot springs have been perceived as favorable habitat for the relict leopard frog (*Rana onca*) - a species of conservation concern. This perspective seems reasonable given that all remaining historical populations occupy hot springs. On the other hand, hot spring populations generally appear to be small with limited recruitment, and several large, robust populations have been established at cold springs through translocations. We aimed to understand the thermal ecology of this species by comparing temperature profiles of individuals at hot and cold springs, especially during critical seasons when ambient temperatures are at the extremes (summer and winter). We collected continuous body temperature data from adult frogs in the wild using implanted data loggers, with the intent of capturing seasonal patterns in the populations over a year. We placed loggers within habitat to record general ambient temperatures and to monitor water temperatures experienced by eggs and tadpoles. We also conducted laboratory experiments to determine seasonal temperature preferences of adult frogs from both sites. Our intent is to provide managers of R. onca with information to better assess habitat quality and target efforts to expand critical habitat for the species.

(23) Evaluating Groundwater Pumping Effects at Rogers and Blue Point Springs near Lake Mead, Nevada

***Chris Morris**, Hydrologist, US Geological Survey*

Rogers Spring and Blue Point Spring are in the Lake Mead National Recreation Area have long term continuous records of spring discharge measured by the U.S. Geological Survey and the National Park Service Mojave Desert Inventory and Monitoring Network. Groundwater discharging from the springs is sourced primarily from the regional carbonate aquifer. Declining discharges from the springs have been observed and could be related to increased groundwater pumping or declining recharge from precipitation. Groundwater pumping and water-levels from wells were compiled and evaluated to examine regional trends. Total groundwater pumping from the regional aquifer has generally been flat for last 15 years, but water-levels continue to decline, except for those wells closest to Rogers and Blue Point Springs, that have no clear trend. In contrast, water-levels in other aquifers that are distant from groundwater pumping have increasing water-levels. Exploratory water-level model testing could not match Rogers or Blue Points Springs discharge or nearby water-level records to groundwater pumping or precipitation.

(24) Climate Influences Recruitment, but not Flowering or Branching, in the Long-lived Joshua Tree

***Nick Graver**, Vegetation Monitoring Lead, Joshua Tree National Park*

Species distribution models suggest that *Yucca brevifolia* is especially threatened by climate change, but the mechanism for climate impacts is unknown, particularly whether increased aridity affects flowering, adult mortality, or recruitment success. Western Joshua trees' iconic branching patterns provide a rare unstudied window into their reproductive history; branches are produced only when a flower stalk occupies an apical meristem of the branch, forcing branching if new growth is to occur. I present a method for counting flower stalk branching scars in *Y. brevifolia* to determine total reproductive rates over each tree's lifespan, using a simple algebraic formula relating flower stalks to terminal apical meristems. This method will allow an analysis of Joshua tree reproductive attempts from large demographic datasets collected by USGS and NPS researchers which only contain information about branch terminal ends. I use a two-timestep dataset of 55 monitoring plots for *Y. brevifolia* across Joshua Tree National Park (2018-2023) to build a structural equation model which shows that increased minimum temperature is a significant influence on the emergence of new juveniles but not on flower stalk production, and a significant influence of flowering on juvenile recruitment. This suggests that climate warming is acting not on the reproductive potential of adult trees, but instead on the outcome of those reproductive attempts, likely through seedling mortality. This finding favors management interventions which promote establishment of seedlings, such as outplanting and herbivory protections in climate refugia.

(25) Desert Tortoise Recovery at Mojave National Preserve

***Mike Burchett**, Biological Technician, Mojave National Preserve*

The Mojave desert tortoise (*Gopherus agassizii*) faces conservation challenges within Mojave National Preserve, prompting a variety of management strategies. Five miles of tortoise exclusion fencing has been installed to reduce vehicle related mortality and additional fencing projects are in the planning phases. Planning for fencing and tortoise crossings is paired with

habitat modeling to identify critical areas for protection. The Preserve is home to the Ivanpah Desert Tortoise Research Facility which operates a headstarting program, where young tortoises are raised in captivity until they are large enough to survive predators. This process aims to bolster tortoises in areas of reduced populations. Wildfires, exacerbated by climate change and invasive grasses, pose a significant threat to the tortoise habitat. Ravens and other predators, such as coyotes, continue to pressure tortoise populations, by preying on juvenile and also adult tortoises. Raven management, including deterrents and population control, is crucial to reducing predation. Roadwork and facility projects within the Preserve require careful planning and monitoring to minimize impacts on tortoises and their habitats.

Overall, there are many challenges to the management and conservation of Mojave desert tortoise. Future work will focus on reducing mortality from human impacts while working to increase tortoise populations through headstarting. Education remains a key aspect of tortoise management at Mojave National Preserve and additional endeavors will support public outreach and safety to ensure the long-term survival of this threatened species.

(26) The Present is Key to the Past: Where Historic Legacy Data & Collections Meet New Science

***Lauren Parry-Joseph**, Park Ranger, Tule Springs Fossil Beds National Monument*

For over 100 years, scientific investigation has revealed stories of our past at Tule Springs Fossil Beds. Stories of desert wetlands, extinction, adaptation and survival have been interpreted from the rock, fossil, and archeological records of the Tule Springs area; But how have those stories evolved with us? TUSK has developed methods to redocument and reinvestigate historic excavation sites and legacy paleontological collections and archives. These efforts to investigate historic data and collections help inform contemporary science, resource management, and interpretation. Collecting and preserving the history of science at TUSK illustrates how science can evolve over time and reframe our past with new perspectives and technology.

(27) Using Autonomous Recording Units (ARU's) to Document Avian Diversity at Tule Springs Fossil Beds National Monument

***John Mark Simmons**, Wildlife Technician, Tule Springs Fossil Beds National Monument*

ARU's are becoming an increasingly effective and efficient tool for monitoring landbird diversity, especially at national parks with minimal staff and funding. From early 2022 to 2023, three Wildlife Acoustics SM4 Song Meters were strategically placed at TUSK in different habitats and set to record at certain intervals each day for a year. The goals of this project are (1) to better inform park staff of the existing bird diversity at TUSK and (2) to test the effectiveness of detecting cryptic species such as LeConte's Thrasher by audio only.

(28) Monitoring Bristlecone Pine Communities at Great Basin National Park

***Jeff Galvin**, Ecologist, Mojave Desert Network*

Abstract not available.

(29) Restoration of the Native Bonneville Cutthroat Trout in Great Basin National Park

***Parker Brannon**, Fisheries Technician, Great Basin National Park*

The Bonneville Cutthroat Trout (*Onchorynchus clarki utah*) (BCT) is a subspecies of Cutthroat Trout native to Utah and parts of Wyoming, Idaho, and Nevada including Great Basin National Park. After the desiccation of Lake Bonneville, BCT were left stranded in cold, high-mountain streams and thought to be extirpated from the park. During a fisheries inventory survey in 1999, a population of BCT were rediscovered in Mill Creek, sparking a 25-year restoration effort focused on this unique species. Various streams across the park have been reintroduced with BCT including Strawberry Creek, Snake Creek, South Fork Baker Creek, and South Fork Big Wash. BCT were also introduced to Johnson Lake in 2020 and are scheduled to be introduced to Baker Lake in mid-September of 2024. Both lakes reside above 10,500 feet in elevation and may be less impacted by drought and wildfire. Establishing populations of BCT within Great Basin National Park has been a continuous collaborative effort across multiple agencies, forming partnerships and strengthening relationships with local, state, and federal organizations.

(30) Update on Joshua Tree National Park Bighorn Sheep Program

***Michael Vamstad**, Wildlife Ecologist, Joshua Tree National Park*

Abstract not available.