

Abstracts/Talk Summaries

Mojave Desert Network 2019 Science Symposium

DAY 1: Wednesday, November 6th 1–5 pm

Opening Presentation

1. Anthropogenic climate change across the Mojave Desert and US National Parks

Patrick Gonzalez – *Principal Climate Change Scientist, U.S. National Park Service; Associate Adjunct Professor, University of California, Berkeley; <http://www.patrickgonzalez.net>*

Greenhouse gas emissions from cars, power plants, and other human sources have caused anthropogenic climate change and impacts across the Mojave Desert and US national parks. From 1895 to 2016, annual temperature increased as much as 3.3°C in the Mojave Desert national parks and annual precipitation decreased as much as 54%. Consequently, anthropogenic climate change caused severe drought in California from 2012 to 2016 and in the Colorado River Basin since 2000, caused a loss of 43% of bird species across the Mojave in California from 1908 to 2016, doubled the area burned by wildfire across the western US since 1984, and doubled tree mortality across the western US since 1955. The combination of urban and agricultural water use and climate change has lowered the water level of Lake Mead 40 m and reduced its volume 60% since 2000. Under the highest greenhouse gas emissions scenario of the Intergovernmental Panel on Climate Change (IPCC), climate change could heat annual average temperature in the Mojave parks as much as 5.3°C from 2000 to 2100. Cutting emissions from human activities to meet the Paris Agreement goal could reduce projected heating in Mojave parks by two-thirds. Continued climate change could nearly eliminate suitable habitat for Joshua trees from Joshua Tree National Park, substantially reduce groundwater recharge in Death Valley National Park, reduce suitable climate for desert tortoise (*Gopherus agassizii*), and exacerbate other future risks to natural and cultural resources. IPCC analyses show that energy efficiency and conservation, renewable energy, public transit, and other actions can cut greenhouse gas emissions enough to keep global temperature increases below 2°C, which could avert the worst damage to nature and human well-being.

15-Minute Talks

2. Native Fish Conservation Activities Conducted in Lake Mead National Recreation Area under the Lower Colorado River Multi-Species Conservation Program

Nathan Lenon – Bureau of Reclamation: LCR Multi-Species Conservation Program

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) supports the conservation of covered native fish through population augmentations, habitat creation, population monitoring, and species research. Within the Lake Mead National Recreation Area, the LCR MSCP supports conservation of razorback suckers at Lakes Mead and Mohave, using two local hatcheries (and others) to rear wild-caught larvae to meet stocking goals for the LCR MSCP program area, including the Lake Mead National Recreation Area, other river reaches, and created habitats. Monitoring and species research activities are conducted to better understand population dynamics and inform management decisions. This presentation will discuss the LCR MSCP's native fish augmentation and monitoring efforts, within the context of Lake Mead National Recreation Area.

3. Long Term Monitoring of Devils Hole

Kevin Wilson – Death Valley National Park Aquatic Ecologist

Devils Hole is a 40-acre disjunct parcel of land that is part of Death Valley National Park and home to the iconic and critically endangered Devils Hole pupfish (DHP), *Cyprinodon diabolis*. DHP was first described as a distinct species by Joseph Wales in 1930 and was listed under the Endangered Species Preservation Act in 1967 in response to nearby groundwater pumping that caused habitat loss and population decline for the species. Since this first crisis, two additional crises have occurred, one in 2006-2007 and a second in the spring of 2013. Agency response to these crises was highly dependent on the availability of scientific information at the time. In 2008, DEVA received a base increase to start an Aquatics/Devils Hole program tasked with developing a comprehensive Long Term Ecosystem Monitoring Plan (LTEMP) for Devils Hole. The Devils Hole LTEMP went through an extensive peer-review process that included eighteen United States Geological Survey (USGS) reviewers and three internal NPS reviewers. The overall goal of the LTEMP was to describe spatial and temporal patterns across a suite of ecological parameters thought to influence ecosystem processes within Devils Hole. The LTEMP has provided managing agencies with high quality data to make more informed recovery and conservation decisions for Devils Hole and the DHP.

4. Innovative Approaches and Opportunities to Manage Invasive Plants Collaboratively Across Boundaries: An Inter-agency Model Partnering at All Levels of Government

Curt Deuser – *Lake Mead Inter-Regional Exotic Plant Management Team (LAKE EPMT)*
Program Manager

Cooperation is a cornerstone for building sustainable invasive plant management programs allowing for expansion across land units and beyond political boundaries. Collaboration is the way to share resources and to capitalize from strengths of each partner. The National Park Service Exotic Plant Management Teams (EPMT) and other professional weed management entities can be the foundation of the bridge to cooperation and collaboration. It is important to build the professional capacity of land management agency weed management programs. Professional weed management teams are a relatively new concept and most have been in existence for less than 20 years. There is a need and demand to further develop this concept beyond its current levels. The Lake Mead Inter-Regional EPMT was established in 1996 becoming a prototype for the EPMT model and has expanded this innovative approach through partnering at all levels of government by providing invasive plant management expertise and services to improve efficiency. The presence of an EPMT with relatively small base funds can grow through cooperation, collaboration, and sheer demand which eventually can become a pivotal foundation on a regional scale.

5. Desert wetlands in Tule Springs and Death Valley and the regional hydrologic response to climate change during the late Quaternary

Kathleen Springer – *U.S. Geological Survey Research Geologist*
Jeffrey Pigati

The Lake Rogers basin, located in the northern part of Death Valley National Park, is occupied by extensive, light-colored, fine-grained, vertebrate-fossil-bearing deposits that were interpreted for decades as a Pleistocene lacustrine sequence. New investigations show that the sediments actually represent widespread, spring derived desert wetlands, which are critical arid land ecosystems and are preserved in the geologic record as groundwater discharge (GWD) deposits. We are establishing both a detailed stratigraphy and a geochronologic framework for the “Rogers beds” using radiocarbon dating of charcoal and terrestrial gastropods, as well as luminescence dating for older deposits. Our results show that the beds document a long record of climatic and hydrologic conditions in the basin consisting of spring discharge events that are terminated by stable surfaces and/or erosion, followed by renewed spring activity. These wet-dry cycles indicate that wetland ecosystems in the Rogers basin waxed and waned in response to climate perturbations many times during last glacial period, including on submillennial-scale timescales within the Younger Dryas cold event. The timing and nature of changes recorded by the Rogers Beds is strikingly similar to the sequence of wetland deposits in the middle-late Pleistocene Las Vegas Formation in Tule Springs Fossil Beds National Monument, where we previously documented that desert wetlands in the Las Vegas Valley register dramatic hydrologic changes in response to abrupt climate oscillations during the late Quaternary, in temporal correlation with Greenland/North Atlantic climate proxy data. The timing of ecosystem response observed in the Las Vegas Formation, which serves as the linchpin sequence of our

studies, and the Rogers beds are also found in GWD deposits at multiple sites throughout the Mojave Desert and southern Great Basin. The fact that widespread desert wetland ecosystems closely track one another show that they are not simply reflecting local hydrologic conditions; rather, they are responding to changes in synoptic-scale climate patterns that operated over a large geographic region during the late Quaternary.

6. The emerging high resolution climate signature recorded in late Quaternary desert wetlands in the Mojave Desert and southern Great Basin

Jeffrey Pigati – U.S. Geological Survey Research Geologist

Kathleen Springer, Jeffrey Honke

A primary goal in paleowetland research is to determine how quickly desert wetland ecosystems responded to climate change in the recent geologic past. One of the preeminent examples of abrupt climate change that we use for this task is called the Younger Dryas (YD) climate event. The YD began 12,900 years ago with a warm-to-cold transition that occurred over just a few decades and ended 11,700 years ago with a cold-to-warm termination that took place over decades to years. As part of the USGS's Paleohydrology of Desert Wetlands project, we have discovered and studied paleowetland deposits at sites throughout the Mojave Desert and southern Great Basin that firmly date to the YD based on radiocarbon dating of charcoal, organic-rich sediment, and snail shells. Each of these sites exhibits evidence that climatic conditions during the YD were wetter/cooler than what prevailed both before and after. They also show that desert wetlands responded to the YD climate event faster than we can determine through radiocarbon dating, or, as we like to say, in a "geological instant." Recent studies of sediment cores taken near extant wetlands along the western margin of Soda Lake also show that desert wetlands expanded during the Little Ice Age, another short-lived climate event that occurred within the past few hundred years. Together, these results demonstrate that desert wetland ecosystems respond to climate change on timescales that are relevant to human society, which carries implications for their management and preservation.

7. Delineation of Flood-Inundation Areas in Grapevine Canyon near Scotty's Castle, Death Valley National Park (DEVA)

Chris Morris – U.S. Geological Survey Surface Water Specialist

On October 2015, a flash flood resulted in substantial damage to Scotty's Castle in DEVA. The area is expected to remain closed to the public until 2020 and cost \$50 million to repair. Using an existing flood-inundation map developed in 1989, high-water marks collected from the October flood predicted a flow of 12,000 cubic feet per second (cfs).; however, a post-flood indirect discharge measurement computed only 3,200 cfs. Over the preceding 26 years, channel changes resulted in the existing inundation map to be no longer applicable to current channel conditions. The Scotty's Castle area was subsequently surveyed in 2016 with a terrestrial laser scanner to collect high resolution elevation data and create a digital terrain model of the area. In the absence of a stream gaging station, regional regression equations were used to estimate stream flows having a 4, 2, 1, 0.5, and 0.2 percent chance of occurring. A hydraulic model was created using the digital terrain model to compute and map new flood-inundation boundaries for each of the estimated stream flows.

The 2015 flood caused the incision of new channels, elimination of thick vegetation, and removal of sediment in a bridge opening. These changes have increased channel capacity and lowered the height of inundation near Scotty's Castle, but several buildings remain susceptible to future flooding. Additional hazards, such as gully and overland flows from hillsides still exist. This study highlights several important aspects of desert hydrology. The October 2015 flood was computed to have a 4 to 2% chance of occurring in any given year and was considered a normal event. Desert streams are dynamic, and the large amount of sediment moved and deposited are reflective of the high energy of these systems. Further, desert-stream environments typically receive less research and associated data collection than other environments.

8. Water Quality and Sediment Chemistry of Selected Habitats of the Mohave Tui Chub, Mojave National Preserve

Katie Earp – U.S. Geological Survey Hydrologic Technician

The Mohave tui chub, *Siphateles bicolor mohavensis*, was extirpated from the Mojave River drainage in California and listed as endangered in 1970. A source population of Mohave tui chub exists at MC Spring in Zzyzx and has been used for several reestablishment efforts in subsequent decades. Two potential habitats within the Mojave National Preserve with perennial sources of water have been identified by the National Park Service as candidates for Mohave tui chub reestablishment: West Pond and Rainbow Wells Pond. West Pond, an artificial pond at Zzyzx near MC Spring, contained a population of Mohave tui chub which died off in 1985 due to changes in water quality. The pond was rehabilitated in the past several years through re-excavation and by pumping fresh groundwater into the pond. Rainbow Wells Pond is an abandoned excavated mine site located on Cima Dome. The bottom of the excavation intersects the water table, forming a pond. In cooperation with the National Park Service, the U.S. Geological Survey conducted a study to monitor water-quality conditions at West Pond and Rainbow Wells for one year and characterize their suitability for reestablishment of Mohave tui chub populations. Water quality and sediment chemistry were determined through discrete quarterly sampling. Temperature was monitored continuously with deployed loggers. Data were also collected at three existing Mohave tui chub habitats in Mojave National Preserve to provide further information on the range of acceptable physical and chemical conditions. Initial water quality results at West Pond indicate that the pond is favorable habitat for the Mohave Tui chub. Initial water quality results at Rainbow Wells Pond suggest that the dissolved oxygen concentrations are lower than the long-term tolerable ranges for Mohave tui chub.

9. Distribution and Habitat Associations of the Blue Point Pyrgulopsis

Chenoa Wilcox – University of Nevada, Las Vegas Life Science Graduate Student

Blue Point Spring in Lake Mead National Recreation Area (LAKE) is one of the major thermal springs existing within the park. This particular spring contains three species of springsnails, at least two of which are endemic. One species is of particular conservation concern, the Blue Point *Pyrgulopsis*, because at times surveys have failed to detect it. Very little is known about the demography and biology of this springsnail species. We propose to investigate the distributions and abundances of the Blue Point *Pyrgulopsis* over an annual period, and to identify habitat features that may influence these snails. Our analyses will include assessments of a suite of biotic (e.g. presence of other

spring snail species or macroinvertebrates, presence of predatory fishes) and abiotic factors (e.g. water quality measurements, substrate type, distance from springhead) that may be limiting spring snail populations. We will also further assess the threat that exotic, predatory fishes present in spring pose to the Blue Point *Pyrgulopsis* through exclusion experiments. The information gained from this research will be available for use by the U.S. Fish and Wildlife Service in their process of assessing the Blue Point *Pyrgulopsis* for actions under the Endangered Species Act. Our findings will also be used by NPS officials at LAKE to make informed conservation decisions for the Blue Point *Pyrgulopsis*, as well as for the spring ecosystem.

10. Backcountry Meets Las Vegas Lights: Monitoring our Dark Skies in Parashant

Eathan McIntyre – Parashant National Monument Physical Scientist

Quantifying the effect of light intensity from urban centers onto dark skies is an evolving process with various methods and detection instruments. This study examines the approach of remotely located photometer sensors aimed towards urban centers with an unobstructed view. Methodology includes standardized photometer sensors (Uniherdon SQM device), time-lapse imaging, and statistical analysis to capture propagation of artificial light and ongoing trends as urban centers develop. Preliminary results indicate the horizontal placement of photometer sensors capture meaningful metrics, offering land management implications across public lands.

End-of-day Presentation & Discussion

11. Be the Change: Engaging Staff & Visitors on a Widespread Natural Resource Issue

Birgitta Jansen – Death Valley National Park Volunteer

In this presentation and exhibit, the increasingly common and alarming natural resource concern of Mylar balloons in the Mojave Desert national park units and public lands will be discussed using a case study and examples from Death Valley National Park. Mylar balloons (or foil balloons) pose significant risks to natural resources by killing wildlife, getting caught in power lines and starting fires, and diminishing the visitor experience due to litter. The use of helium is also becoming a serious concern. This presentation and discussion will focus on: 1) Engaging staff across Mojave Network parks and other agencies/organizations to become involved in increasing staff and public awareness of the issues, as well as finding ways of collecting data and surveying balloon sightings to determine the scale of the problem; and 2) Using social media and interpretive exhibits for visitor education and engagement.

DAY 2: Thursday, November 7th 8 am–12 pm

Opening Presentation

12. Modeling Desert Bighorn Sheep Habitat near Water Developments

Debra Hughson – Mojave National Preserve Chief of Science and Resource Stewardship

The California Desert Protection Act of 1994 designated wilderness that included six wildlife water developments for desert bighorn sheep (*Ovis Canadensis nelsoni*) within Mojave National Preserve. The National Park Service prepared an Environmental Assessment (EA) to resolve concerns regarding the maintenance of these installations in wilderness for conserving a native species. The EA relied on a statistical model of desert bighorn sheep habitat to design and select an alternative that had no significant impact. This model indicated that relocating water developments to new sites outside of designated wilderness could result in a net increase in summer season bighorn sheep habitat, based on the estimated utilization distribution within an area around a water development. I reproduced the analysis using data from a different selection of individuals and a different method of estimating utilization. Environmental covariates characterizing escape terrain, visibility, and distance to water explained about 10% of habitat utilization at the population level, and up to 60% of individual utilization within the Old Dad Peak area used for model training. New telemetry data from the South Soda Mountains, Clark Mountain, and the Marble Mountains, that were not available for preparation of the EA, validated the model where these same environmental covariates had similar values for the bighorn population in the new area. A significant negative coefficient representing the forested areas of Clark Mountain, that do not exist within the model training area of Old Dad Peak, confirmed overall low habitat quality in the vicinity of the Bicket-Landells (Clark Mountain) water development and may explain why bighorn sheep do not appear to utilize it. This analysis resulted in a similar predicted increase in summer season bighorn sheep habitat for the new water development configuration as was presented in the EA. It also indicated that habitat utilization with respect to these environmental covariates is highly variable on the scale of the preserve. Site-specific telemetry data are needed to confirm predicted habitat quality at locations of new water developments.

15-Minute Talks

13. Monitoring Springs in the Mojave Desert Network

Jennifer Bailard – Mojave Desert Inventory & Monitoring Network Physical Scientist

Although springs cover a small fraction of the Mojave Desert, they support dense vegetation communities and diverse assemblages of terrestrial and aquatic organisms compared to the surrounding landscape. They sustain wildlife with drinking water and provide habitat to endemic and endangered species. Many stressors can affect water availability at springs, including climate change, drought, invasive species, groundwater withdrawal, surface water diversion, and grazing.

The Mojave Desert Network monitors a rotating panel of 236 springs across five parks. Our primary objective is to determine the status and trends of water availability at the springs in each park so that we can know if the spatial or seasonal distribution of surface water is changing over time. We also measure water quality and record vegetation and disturbance to provide park managers with additional site condition information.

This presentation will introduce the Desert Springs monitoring protocol and discuss preliminary data from the first few years of implementation.

14. ERTH Census 2018: Status of the *Eriogonum thornei* Population in the East Mojave Desert

Drew Kaiser – Mojave National Preserve Biological Science Technician (Vegetation)

Thorne's buckwheat (*Eriogonum thornei* [Reveal & Hendrickson] L.M. Shultz) is a plant endemic to the New York Mountains within Mojave National Preserve. It is restricted to a single ridge and only occurs in 3 slightly separated concentrations. It has a strong affinity to copper-rich soils, but not much more is known about the physiology of this species. It has been subjected to numerous threats including mining activity, road construction, wildfire, and now, drought. Throughout all these events, the plant persists; however, no quantifiable data had been collected until 2011 to determine the status of the population. When possible, a complete census is the preferred monitoring method because no statistics are required to analyze the results. In 2011, a census was collected for the population and 12,734 individuals were counted. The population was resurveyed in 2018 using the same methods and 11,417 individuals were counted, indicating a 10% decline over 7 years. Further research is needed to determine if this decline is within the natural variability of the species or if it is a grim forecast of things to come. In either case, several management actions can be taken now to ensure the species is best preserved unimpaired for future generations.

15. Managing Increased Visitor Use

Jane Rodgers – Joshua Tree National Park Chief of Science and Resource Stewardship

In 2013, visitation began a marked increase at Joshua Tree National Park, and as of 2018 has almost tripled. Previous superintendents did not forecast the magnitude of this trend. The park is now playing catch up to incorporate visitor use management principles and planning in the midst of chaos. Approaching the problem with both triage and strategic planning, risk taking and staff inclusion have been key to mitigating visitor use impacts. Regional and national level resources are abundant, but only when parks are aware of what is available. In 18 months, the park implemented nearly a dozen different initiatives, studies, and campaigns. This presentation reviews results and the current state of affairs.

16. Interpretive Collaboration

Sasha Travaglio – Joshua Tree National Park

How are Joshua trees doing? And more importantly: how do we know? In this session, participants will have a chance to consider the importance of collaboration with interpreters in order to make relevant research a more prominent and interactive part of the visitor experience on public lands. Shared visualizations and tangible objects intrigue the public, resulting in science learning opportunities. Visitors have the chance to make observations, predictions, and to add to discussions of relevance. How can you help audiences care about resources so they might support the care for resources?

17. Communicating Science

Gretchen Baker – Great Basin National Park Ecologist

Communicating science to a wide audience requires much more than your standard scientific writing. Check out some guidelines on content and differentiating between the objective and subjective parts of scientific communication. Dive into the format of your communication and how important it is to simplify but not be simplistic. Learn how important it is to extend past intellectual communication to other forms, including emotional and instinctual to really make your message stick. And find out about various communication channels. Examples from Great Basin National Park, including its long-running resource management newsletter and the Facebook post that went viral, will be shared.

18. Opportunities for Shared NPS/BLM Inventory & Monitoring for DOI Unified Region 8

Jim Weigand –Bureau of Land Management Ecologist

DOI agencies have new impetus to produce information that goes beyond individual agency boundaries in the Mojave Desert. Direct impacts from climate change and indirect impacts from human efforts to curb climate change (renewable energy generation) require better characterization over time to optimize mitigation and reversal actions. Tracking implementation of the Desert Renewable Energy Conservation Plan (DRECP), for example, will determine how effective BLM National Conservation Lands are as biological corridors connecting Mojave Desert National Parks as Mojave Desert climate changes. Maintaining stability of physical processes will be a critical underpinning for more resilient biological habitats under climate change. The BLM employs AIM program protocols, a national system to monitor soil, water, and vegetation status. Specific to California, the BLM also works with NASA and USGS scientists to remotely sense desert surfaces for sediment transport and persistent stabilizing features such as soil crusts, desert pavements, and water recharge areas. Collaborative monitoring programs can ensure that key groundwater basins and shared watersheds function to maintain productivity. Concerted joint focus on monitoring habitats rangewide can ensure the appropriate scale for protecting climate-sensitive species such as Mojave Fringe-toed Lizard and for reintroducing Sonoran Pronghorn. The BLM along with the USGS and CDFW are presently developing remote acoustic systems for monitoring wildlife population in the

Chuckwalla Valley next to JOTR to discover how large-scale disturbance impacts different widespread species. Lastly, NPS and BLM wilderness areas need low-cost methods for monitoring trends in visual resources (e.g., dark skies, glare) and air quality as desert industrialization and residential development spread in the eastern Mojave Desert up to edges of wilderness in the face of declining budgets.

19. Population growth (λ), recruitment, and harvest potential of four Great Basin rattlesnake (*Crotalus lutosus*) populations

Bryan Hamilton –Great Basin National Park PhD Wildlife Biologist

Population growth (λ) is a direct measure of fitness necessary for science based wildlife management. Population growth rates of “uncharismatic”, cryptic species such as snakes have been particularly difficult to obtain. Interest is growing in the non-consumptive value of rattlesnakes for ecological services, recreational viewing, and photography. The current lack of population growth rates, abundance data, and population projections, are limiting the development of effective management, conservation and recovery goals for rattlesnakes. We used a long-term dataset and capture mark recapture models to quantify survival, recruitment, population growth (λ), and abundance in four populations of Great Basin Rattlesnakes (*Crotalus lutosus*). Based on estimates of population growth rates, survival, recruitment, and abundance, elasticity analyses were conducted, sustainable annual harvest rates calculated, and management implications discussed. Mean annual survival was estimated from the highest ranked model at 0.81. Apparent survival differed by age class, with YOY survival significantly lower (0.32) than juvenile (0.78) and adult survival (0.80). Temporal variation in survival was strongly supported, while variation in survival by size, sex, or location received very little support. Annual recruitment across the study was estimated at 0.123. Temporal variation in recruitment ranged from 0.01 - 0.33. Mean population growth, a derived parameter, was estimated at 1.00, indicating a stable population across the study. Estimated population growth by site varied from 0.93 - 1.08. Population growth was less than one for two sites indicating declining populations. Estimates of adult females per site in 2017 ranged from 9 - 35. One site warrants close monitoring as it seems likely bound for extinction (population growth = 0.93). Individuals from all sites lived well past average life expectancy. The oldest individuals were at least 17 years old. Survival overwhelmingly contributed to the value of population growth relative to recruitment (84% versus 21%). The allowable adult female mortality rate was 0.103. Site specific estimates of allowable harvest of adult females per population ranged from 1 - 7 per site or seven across all sites.

20. Getting into the Weeds: Monitoring Invasive Plants on Parashant National Monument

Jennifer Fox – Parashant National Monument Ecologist

In 2014, Parashant embarked on a systematic invasive plant survey of major Colorado Plateau travel corridors to attempt to determine the extent of invasive plant encroachment on the Monument. Over the next 4 summers, interns carried out repeat surveys for a suite of up to 44 genera or species along approximately 50 miles of dirt road using line transects and patterned walks.

Species detected varied from 8 during a severe drought year to 17 during a year with significant late snows. Species detection was much higher using a patterned walk, as suggested in the literature, than a line transect method. Invasive species were typically found within 25 meters of the road, though several species, including *Bromus sp.* were found up to 100 meters from the road. Invasive plant presence varied by dominant vegetation with higher number of species found in pinyon-juniper woodland and sagebrush steppe than in ponderosa pine woodland. Surveys also showed that the classic “windshield survey” technique for invasive plant casual surveys would fail to detect the vast majority of invasive species on Parashant. To date, this study suggests that a foot survey approach with a patterned walk to 25 meters from the road, regardless of dominant vegetation type, should capture the vast majority of invasive species presence, but not their abundance.

21. Where the Young Ones Are: Monitoring Species across Joshua Tree National Park

Lynn Sweet – *University of California, Riverside Associate Research Ecologist*

Cameron W. Barrows, James Heintz, Josh Hoines, Neil Frakes, Nicolas Graver, Scott

Heacox, Kristin Lalumiere, Jeffrey Rangitsch, Jane Rodgers, Tyler Green, Michael Vamstad

Desert Parks protect a natural heritage of global significance and many or all of the US southwestern Parks are threatened by climate change. Identifying climate refugia within our National Parks using not only statistical models, but also robust field data should provide focus for managers in their stewardship of Parks’ biological resources. In the region surrounding Joshua Tree National Park, which straddles the Colorado and Mojave Deserts in southern California, previous research has predicted the widespread demise of its namesake iconic species, the Joshua tree (*Yucca brevifolia*). These climate change predictions point to hotter, drier deserts, which may be a challenge for even drought-adapted species. As part of a research partnership between UC Riverside and Joshua Tree National Park (JOTR), we have employed both field measurements using citizen scientists and statistical models to gather data needed to identify potential climate refugia for Joshua trees as well as other flora and fauna. We used historic gridded datasets representing the conditions where this species has occurred to predict the distribution of still suitable conditions (refugia) at the end-of-century under MIROC RCP4.5, a highly-mitigated climate change scenario. Such areas could serve as climate refugia for Joshua trees as well as other mid elevation Mojave Desert species. In order to validate model predictions, using teams of citizen scientists, we measured the demographic patterns of Joshua tree stands from low elevations to upper elevations within JOTR. Recruitment within stands show a strong concurrence with modeled climate refugia. Rather than an ominous prediction of extinction, climate refugia provide land stewards with targets for focusing protective management, giving desert biodiversity places to weather the future. As well, collaboration with citizen science NGO’s provides a powerful tool for boosting data-gathering capacity for anticipating and responding to management challenges.

22. A Multipronged Approach to Managing Invasive Burros in Death Valley National Park. Alison Ainsworth, Josh Hoines

Ali Ainsworth – Death Valley National Park Ecologist

More than 2000 invasive feral burros are estimated in Death Valley National Park (DEVA). In 1938, the park recognized the threat these donkeys pose with an estimate of 1500 within the monument, yet populations have persisted due to inconsistent management, continuous immigration from neighboring lands, and rapid population growth. Feral burro populations in the park have no natural predators or disease and are estimated to increase at 20% annually, doubling the populations every 4-5 years. The park is working with federal agency and non-profit partners to humanely capture and relocate burros from DEVA and nearby BLM and DOD lands. These efforts began in October 2018 and over 50 burros were removed during the first two weeks of trapping. However, the removal process is expected to take up to 10 years to reduce the population and cost more than \$5 million dollars. In the meantime, multiple fencing projects have been proposed to protect and restore habitat at spring sites by reducing burro browsing and trampling while still allowing native species access. Bighorn sheep, an iconic state protected species of concern, rely on springs during the summer months. Bighorn sheep have historically shared the same springs and forage preferences as burros. Park staff have observed springs that once supported bighorn sheep and no longer are visited by sheep because of the growing burro populations. Fencing springs should result in increased water quality, habitat, forage, and refugia for many native and endemic species. Strategically planned fencing will restore the specific sites and cut off the ability of burros to invade new areas, as well as concentrating the animals in specific locations; increasing the efficacy of our capture and relocation project with partners. Controlling burro populations, similar to most invasive species, requires partnerships to maintain a consistent yet adaptable landscape scale approach.

23. Mojave Desert Network Bat Monitoring - A Pilot Plan

Allen Calvert – Mojave Desert Inventory & Monitoring Network Program Manager

The Inventory and Monitoring (I&M) Program's Mojave Desert Network (MOJN) facilitated the development of a pilot bat monitoring plan for Network parks. In 2018, an initial test season of monitoring occurred within six MOJN parks. The pilot plan was adapted from the North American Bat Monitoring Plan which focuses on acoustic surveys using bat detectors that are deployed for multiple days and collect echolocation call data of all bats that fly close enough to the microphone to be recorded. Two to four detectors were deployed for at least four nights within random and non-random 10 km x 10 km grid cells in order to adequately sample each park. Across six MOJN parks, a total of 26 cells were sampled for a total of 232 individual detector nights of data collected. Call analysis is currently being conducted by the Northwest Bat Hub at Oregon State University- Cascades. The goal is to continue to monitor these same locations as well as add additional cells that can be sampled annually to document potential changes in species richness and/or species activity within each park. In addition to the acoustic surveys, MOJN has begun coordinating with network parks to host network bat Blitzes on an annual basis to provide parks with a snapshot inventory of bat occurrence within a park and provide park staff with training in acoustic and capture survey methods. The first network Bat Blitz was hosted by the Grand Canyon-Parashant National Monument in 2016 and the second

was hosted by Joshua Tree National Park. Each Blitz was attended by over 25 individuals from NPS park units within and outside the Mojave Network as well as state agency staff and other local bat experts. Continued coordination and collaboration between I&M and park staff is essential to implement the network monitoring plan long term.

24. Why We Monitor: The MOJN I&M Vital Signs Monitoring Plan Past, Present, & Future + Vegetation Monitoring

Nicole Hupp – *Mojave Desert Inventory & Monitoring Network Ecologist*

National Parks house unending amounts of natural resources, which the NPS is charged with preserving and protecting in perpetuity. Parks in the Mojave, Great Basin, and Colorado Deserts, with their dramatic differences across the large elevational and climatic gradients, are excellent examples of how a region of parks can contain overwhelming ecological diversity. The challenge is that in order to preserve and protect these natural resources, we must identify them and determine how they are changing. How can we quantify the seemingly endless natural resources in national parks and understand their dynamics? Both exciting and daunting, answering these questions is necessary to fulfill the NPS mission of ensuring these resources remain intact for present and future generations. The Mojave Desert Network Inventory & Monitoring Program (MOJN) addresses these questions by monitoring natural resources in nine National Parks in Nevada, California, and Arizona. MOJN conducts vital signs monitoring, or monitors ecosystem indicators to understand park health. In this presentation we will consider the past, present, and future of MOJN monitoring efforts to demonstrate the value and also the challenges of long term monitoring. For this exercise, the past involves a process conducted in 2008, where MOJN and park natural resource staff debated which ecological indicators should be monitored in each park. From that, a Vital Signs Monitoring Plan was completed and published. Over these past 10 years, the Vital Signs Monitoring Plan has come to life. Using five MOJN vegetation protocols as case studies, we can see how MOJN is working to fill specific knowledge gaps about ecological resources in the parks, and how monitoring occurs across scales, from local to regional. The program sees a future of using science to inform management in ways that allow us to preserve unimpaired the natural resources in the parks for generations to come.

Posters

Seasonal variation in sex, age, and reproductive condition of Brazilian free-tailed bats at a migratory stopover roost in eastern Nevada

Joseph Danielson – *Wildlife Biologist, Great Basin National Park*

The Brazilian free-tailed bat (*Tadarida brasiliensis*) is widespread and abundant, with large aggregations often found in caves and abandoned mines. Although roosting associations of this species have been studied for decades, intensive demographic studies have seldom been conducted. The objective of this study was to evaluate seasonal variation in demographic composition of assemblages of *T. brasiliensis* at a migratory stopover roost in eastern Nevada by documenting sex, age, and reproductive status of captured individuals. We used a 2x2m double-frame harp trap to capture 38,627 *T. brasiliensis* from June to October of 2015-2018. Adult males made up the majority of captures from spring until late summer when adult females and juveniles were captured with more regularity. The sex ratio of adults varied by season and sex ratio of juveniles was skewed slightly towards males overall. While all males were non-reproductive, female reproductive status varied seasonally suggesting some level of maternity use within the roost. Seasonal variation in demographic composition of bat assemblages at this site may provide insight into migratory and reproductive behavior of this species and the importance of protecting migratory roosts for *T. brasiliensis*.

An Evaluation of Small Game Guzzlers

Neal Darby – *Wildlife Biologist, Mojave National Preserve*

Small Game Guzzlers have been constructed throughout the southwestern deserts. They are primarily designed to benefit small game animals by capturing and storing rainwater for use through the hot, dry period of summer and in droughts. It is apparent that desert wildlife use these structures but the degree to which they benefit these populations is not clear. To try and determine this we initiated a Before After Control Impact study whereas selected guzzlers were maintained with water for one year and a subset would be kept dry over the second year. Bat and bird diversity are being measured using acoustic recordings and Gambel's quail age ratios and habitat use are being followed. We will show results of the first year.

Getting into the Weeds: Monitoring Invasive Plants on Parashant National Monument

Jennifer Fox – *Parashant National Monument Ecologist*

In 2014, Parashant embarked on a systematic invasive plant survey of major Colorado Plateau travel corridors to attempt to determine the extent of invasive plant encroachment on the Monument. Over the next 4 summers, interns carried out repeat surveys for a suite of up to 44 genera or species along approximately 50 miles of dirt road using line transects and patterned walks. Species detected varied from 8 during a severe drought year to 17 during a year with significant late snows. Species detection was much higher using a patterned walk, as suggested in the literature, than a line transect method. Invasive species were typically found within 25 meters of the road, though several species, including *Bromus sp.* were found up to 100 meters from the road. Invasive plant presence varied by dominant vegetation with higher number of species found in pinyon-juniper woodland and sagebrush steppe than in ponderosa pine woodland. Surveys also showed that the

classic “windshield survey” technique for invasive plant casual surveys would fail to detect the vast majority of invasive species on Parashant. To date, this study suggests that a foot survey approach with a patterned walk to 25 meters from the road, regardless of dominant vegetation type, should capture the vast majority of invasive species presence, but not their abundance.

An Overview of Bat Research in the Snake Range

Kelsey Ekholm – *Wildlife Biologist, Great Basin Institute*

The Snake Range of east central Nevada contains Great Basin National Park, many of the state’s highest peaks, and plentiful bat habitat. The majority of this range is in White Pine County, which has over 70 known caves and several thousand abandoned mines. Unfortunately, this county has been listed as particularly vulnerable to the spread of White Nose Syndrome (WNS), and many of these subterranean features and the bats that inhabit them may be susceptible to this disease, which is projected to arrive in the state of Nevada by 2021. While several surveys and studies have been conducted in this area, few have been published or the data from these projects are not widely available, found only in technical reports, graduate theses, and personal notes. Therefore, the goal of this project is to compile these data and to present an overview of their findings, and their implications for management and future studies. Studies have been conducted by a number of public, private, and academic organizations and individuals using a multitude of methodologies (roost surveys, WNS swabbing, mist netting, capture-mark-recapture, acoustic monitoring, radio telemetry, and more) to investigate various research questions (landscape and habitat use, general ecology, WNS, renewable energy development, and more). The results of these studies can inform many conservation and management decisions, and help to mitigate potential threats to bats, including White Nose Syndrome, habitat loss, and renewable energy development.

Fusion of In-situ and Remotely Sensed Soil Moisture Data

David Gundlach – *Physical Scientist/GIS Specialist, Bureau of Reclamation*

The US Bureau of Reclamation has developed a soil moisture monitoring network to create and maintain habitat for endangered species in designated conservation areas along the Colorado River in the Mojave Desert. Although soil moisture data loggers provide continuous and accurate information, their use is limited due to cost and logistics. Imagery from satellites and airborne platforms cover large areas, are of high quality, and have numerous applications; however, their timing and spatial resolution are not always well suited to the habitat of interest. Timely and accurate soil moisture information is vital to the effective water management of protected areas which have experienced drought for two decades.

We tested the Enhanced Spatial and Temporal Adaptive Reflectance Fusion Model (ESTARFM) algorithm in order to combine MODIS and Landsat satellite imagery and produce soil moisture data with increased resolution and accuracy beyond that of soil moisture products derived from satellite data alone. While ESTARFM has been employed to create maps of soil composition, its use in formulating soil moisture data has been minimal. Our study also tested in-situ soil moisture data as a means of model calibration and as a model input that can further increase the output accuracy and resolution.

ERTH Census 2018: Status of the *Eriogonum thornei* Population in the East Mojave Desert

Drew Kaiser – Mojave National Preserve Biological Science Technician (Vegetation)

Thorne's buckwheat (*Eriogonum thornei* [Reveal & Hendrickson] L.M. Shultz) is a plant endemic to the New York Mountains within Mojave National Preserve. It is restricted to a single ridge and only occurs in 3 slightly separated concentrations. It has a strong affinity to copper-rich soils, but not much more is known about the physiology of this species. It has been subjected to numerous threats including mining activity, road construction, wildfire, and now, drought. Throughout all these events, the plant persists; however, no quantifiable data had been collected until 2011 to determine the status of the population. When possible, a complete census is the preferred monitoring method because no statistics are required to analyze the results. In 2011, a census was collected for the population and 12,734 individuals were counted. The population was resurveyed in 2018 using the same methods and 11,417 individuals were counted, indicating a 10% decline over 7 years. Further research is needed to determine if this decline is within the natural variability of the species or if it is a grim forecast of things to come. In either case, several management actions can be taken now to ensure the species is best preserved unimpaired for future generations.

Backcountry Meets Las Vegas Lights: Monitoring our Dark Skies in Parashant

Eathan McIntyre – Parashant National Monument Physical Scientist

Quantifying the effect of light intensity from urban centers onto dark skies is an evolving process with various methods and detection instruments. This study examines the approach of remotely located photometer sensors aimed towards urban centers with an unobstructed view. Methodology includes standardized photometer sensors (Uniherdon SQM device), time-lapse imaging, and statistical analysis to capture propagation of artificial light and ongoing trends as urban centers develop. Preliminary results indicate the horizontal placement of photometer sensors capture meaningful metrics, offering land management implications across public lands.

Measuring Acoustic Characteristics of Roadway Preservation Treatments in Death Valley

Ashley Pipkin – Biologist, Natural Sounds and Night Skies Division

National Parks have some of the most pristine natural soundscapes in the US. Death Valley is one of the most naturally quiet places in the lower 48, but anthropogenic noise emanating from roadways can contribute significantly to the overall acoustic environment. In an effort to reduce road noise this study evaluates four types of pavements commonly used within NPS units to determine which one has the least acoustic impact.