Yucatan – Friday, February 8th 1:00 – 3:00 PM
Moderator: Jennifer Frey

Wildlife Student Paper Competition

Following the wind? Predicting effects of wind energy on bats

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Oral Presentation

Introduction

Although wind turbines are a clean, renewable source of energy, turbines are associated with bat and bird mortality (Arnett et al. 2008, Baerwald and Barclay 2011). At wind energy facilities in the United States in 2012, an estimated 600,000 bats died from encounters with wind turbines (Hayes 2013). Migratory bat species such as hoary bats (*Lasiurus cinereus*) and Mexican free-tailed bats (*Tadarida brasiliensis*) had the highest mortality at wind energy facilities (Arnett et al. 2008, Ellison 2013, Kunz et al. 2007).

There are 268 megawatts (MW) of wind capacity currently operating or under construction in Arizona, making it the 28th in the U.S. for current wind capacity, but it ranks 5th in potential wind capacity (USDE 2018). At least 21 species occur in northern Arizona, and over half of these species migrate at least regionally, (Hinman and Snow 2003) so are at high risk of mortality from wind turbine interactions. However, we found no published studies of bat mortality or other risks to bats because of wind development in Arizona and only one study in the southwestern United States (Miller 2008). Our objectives were to 1) determine how bats use habitat during reproductive and migratory seasons in northern Arizona and 2) develop a risk assessment map for future wind energy development.

Methods

Our study boundaries included the northern, eastern, and western state borders of Arizona; the southern boundary was the Mogollon Rim. We selected sites that represented a variety of topographic positions and that were characteristically similar to sites for wind energy development in Arizona (open grassland and scrubland [G. Ritter, Arizona Game and Fish Department, personal communication, 11 February 2015]). At each of 70 points, we set up a SongMeter 3Bat (SM3Bat) echolocation detector from Wildlife Acoustics (Wildlife Acoustics, Inc., Maynard, MA). The microphone was attached to the top of an 8 m pole. Detectors recorded from sunset to sunrise each night. We collected data at each point from June to November of 2016 and 2017 to capture reproductive (15 June to 15 August) and migratory (15 September to 15 November) habitat use. We used the program SonoBat 3 (SonoBat version 3.2.1, Arcata, CA) to identify the calls to species and used AnalookW (AnalookW, version 4.2g, Columbia, MO) to verify calls and identify species that Sonobat 3 did not have the ability to discriminate. We focused on low frequency bats (frequency <33 kHz), Mexican free-tailed bats, and hoary bats since they are migratory. We calculated nightly bat activity indices by counting the number of

echolocation calls per night per detector. We used general linear mixed models with an information theoretic approach to determine what landscape features were driving bat habitat use in the reproductive and migratory seasons. We were interested in relationships with elevation, landform type, distance to cliffs, percent cliffs, distance to forest, percent forest, stream density, distance to water, wind class, slope, and aspect. Percent cliffs, percent forest, and stream density were analyzed at 7 different scales (90 m, 180 m, 360 m, 720 m, 1440 m, 2880 m, and 5760 m radius). Models with ΔAICc <4 were averaged to create model averaged coefficients. We used these coefficients to create a map indicating areas of high to low bat activity in northern Arizona for each bat species group in each season.

Results

We collected 99,671 bat calls across 70 sites in the summers and falls of 2016 and 2017. In the summer, bats responded positively to percent forest at a 5760 m scale, and distance to cliffs. Bats responded negatively to aspect, slope, elevation, distance to water, and distance to forest. Only the response to percent forest at a 5760 m scale was included in a model that was better than the null model. Low frequency bats responded positively to percent forest at a 5760 m scale and distance to forest in the summer. The low frequency group responded negatively to elevation, distance to water, aspect, distance to cliffs, and slope in the summer. The response to forest at a 5760 m scale was included in a model that was better than the null model. In the summer the null model was included in the top set of models for Mexican free-tailed bat. In the summer, hoary bats responded positively to distance to water, percent forest at a 90 m scale, elevation, aspect, and slope. Hoary bats responded negatively to distance to cliffs and distance to forest. The response to distance to water and percent forest at a 90 m scale were included in models that were better than the null model.

In the fall, the null model was included in the set of top models for all bats, low frequency, and Mexican free-tailed bats. The hoary bat responded positively to slope, distance to water, distance to cliffs, and distance to forest in the fall. Hoary bat responded negatively to stream density at a 1440 m scale, aspect, and elevation in the fall. Slope and stream density at a 1440 m scale were included in models that were better than the null model.

Discussion

Many bats roost in forests (e.g. the hoary bat [Willis and Brigham 2005]), which could explain why percent forest on a large landscape scale was important for most bats in the summer. There is probably also higher prey abundance in forests than in open grasslands and scrublands (Grindal 1996). There could be high risk of conflict between bats and turbines during the summer near forested areas and not when bats are migrating. Hoary bats also use forest in the fall, but at a smaller scale. The steep slopes may provide navigation to hoary bats in the fall for migration. However, we could have found fewer relationships in the fall because bats are more spread out across the landscape. For example, Mexican free-tailed bats were detected at almost every site. Our risk assessment map shows higher bat activity along the Mogollon Rim in the summer and fall, but also near steep slopes in the fall.

Management Implications

Avoid placing wind turbines near forested areas, especially large forest landscapes. Keep turbines away from steep slopes that might be used by migratory bats in the fall.

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Tracking the outcomes of burrowing owl translocations from urban development sites to artificial habitat in Arizona

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Oral Presentation

Introduction

The western burrowing Owl (*Athene cunicularia hypugaea*) is a declining native species of western North America that readily nests in human-altered landscapes and has been the subject of translocation efforts (Conway *et al.* 2006, Desmond *et al.* 2000, Leupin and Low 2001, Millsap and Bear 2000). This is still a developing technique as the methodologies for translocating the owls have been challenging, and sample sizes typically small (Nixon 2006). Conflicts between the owls and development in the southwestern region has led to an owl removal program in greater Phoenix, Arizona area carried out by the non-profit organization Wild At Heart. The goal of this study is to evaluate the effectiveness of the Wild At Heart translocation program to answer two key questions: (1) 'How well do translocation programs work for burrowing owls?' and (2) 'How can we improve the success of these programs?'. This will be accomplished by tracking the (1) survival, (2) fidelity, and (3) nesting fates of translocated and non-translocated local owls with the use of radio-telemetry.

Methods

We are monitoring survival, fidelity and nesting fates of 85 adult burrowing owls (43 translocated, 42 non-translocated) from March 2017 – April 2019 in at 4 release sites in Arizona using VHF radio-telemetry. Owls with transmitters were located every 2-3 days (or at least once a week during the non-breeding season) from the date of attachment until death, migration or transmitter failure. Survival (*S*) was estimated in terms of post-release days for translocated birds and post-transmitter attachment days for control birds. Nests were monitored throughout the breeding season. Productivity was estimated by conducting standardized fledge counts at 35-42 days of age at each nest. We constructed a set of *a priori* joint live-dead encounter models to assess the influence of sex, site, and translocation on survival and fidelity of owls tagged in 2017 and 2018 with Akaike's Information Criterion (AICC) goodness-of-fit tests in Program MARK (Burnham and Anderson 2002). Annual survival and fidelity were derived from the top-ranking models. Covariates include body weight and for translocated owls: # days in captivity, # males in tent, and release date. Daily nest survival (DSR) were modeled with the Mayfield method and the probability of surviving to fledge age was derived from the best fit models.

Results

Translocation and year were the best predictors of survival and fidelity. Annual survival was lower for translocated owls (0.38±0.14 in 2017, 0.03±0.06 in 2018) than non-translocated owls (0.71±0.12 in 2017; 0.78±0.14 in 2018). Annual fidelity was also lower for translocated owls (0.44±0.16 in 2017; 0.01±0.05 in 2018) than non-translocated owls (0.61±0.13 in 2017; 0.82±0.16 in 2018). Translocated owls had lower nest survival (0.23±0.06) than non-translocated owls (0.76±0.09) and lower productivity (0.5 fledglings/nest) than non-translocated owls (2.2 fledglings/nest).

Conclusions

Our results suggest that translocation techniques such as grouping owls, particularly males, for long periods of time may pose challenges for burrowing owls upon the first year of release. In Arizona, the owls are soft-released in groups of 10 owls/release cage with each cage varying in the ratio of males and females. We found that survival and fidelity decrease as the number of

males in the release cage increases. Translocated individuals nested at lower rates than local owls. Analysis is still being conducted on the 2018 cohort but survival and fidelity rates may have been lower in 2018 because release groups contained more males this year. We suggest that owls be held individually or as pairs for shorter periods of time, with releases staggered throughout the year. Owls captured in the spring and summer should be released as pairs during that breeding season as to avoid losing a year of breeding. Owls captured in the fall and winter should be released prior to the breeding season to allow time for the owls to establish territories to compete with local owls. These changes will minimize the amount of time owls are held in captivity. Fortunately, our results indicate that translocated owls that survive the first year readily join the breeding population and are as productive as non-translocated owls in following years.

Management Implications

This study will provide critical information related to the success and sustainability of the Wild At Heart translocation program and will be applicable to other burrowing owl translocation efforts. Findings will result in management recommendations for the long-term future and continuation of this program. Our study will also contribute to the body of research needed to understand the effectiveness of undertaking such efforts.

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Response of Lesser Prairie-Chicken Habitat to Prescribed Burning in the Shinnery Oak Prairie of Eastern New Mexico

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Oral Presentation

Introduction

The lesser prairie-chicken (LEPC) is an iconic species of the southern Great Plains that has declined substantially following the settlement of the West (Jackson and DeArment 1963, Crawford and Bolen 1976, Taylor and Guthery 1980). The occupied range of LEPCs is estimated to have declined by 92% and experienced a 97% population decline (Taylor and Guthery 1980). Causes of these declines have been attributed largely to human activities involving land conversion and overgrazing (Taylor and Guthery 1980, Applegate and Riley 1998). While research has focused on how to manage lands to increase LEPC populations, few studies have explored the impacts of prescribed fire, a commonly used management tool, on lesser prairie-chickens and their habitat. Furthermore, no such study has been conducted in the shinnery oak ecoregion in eastern New Mexico.

Developing habitat conservation plans using prescribed fire is a top priority for public land managers. Prescribed fire is believed to create a heterogeneous landscape containing different vegetation succession stages needed by lesser prairie-chickens. Because prescribed fire is being integrated into habitat conservation plans, it is important to examine its effects on habitat characteristics and ultimately, LEPC habitat use.

Methods

Bureau of Land Management personnel burned pre-selected plots (4.12 km², 6.83 km², 7.73 km², and 54.04 km²) in late-February and early-March of 2016 and 2017. We compared vegetation characteristics and invertebrate abundance between paired burned and unburned transects in June, July, and August. We randomly placed 50 m transects inside burn units, then placed a paired transect in the adjacent unburned unit based on a random bearing and a random distance ranging from 100 and 360 m. Each plot contained three or four transects depending on its size. We used line-point intercept to estimate the percent coverage of grass, forb, shrub, litter, and bare ground. We conducted belt transects to estimate shinnery oak density. Oak stems were considered the same plant if they were within 10 cm of each other. We measured the height of the tallest vegetation at one-meter increments. One hundred percent visual obstruction readings (VOR) were taken every 5 meters on both sides of the transect. These readings were averaged to get one value per transect per month. Invertebrate sampling occurred adjacent to these transects. Sweep net samples were conducted along three lines parallel to the transect with 100 sweeps per line. Pitfall trapping occurred on the opposite side of the transect, and traps remained open for 72 hours. We arranged pitfall traps in a 3x3 grid spaced 10 m apart and filled with at least 2 cm of propylene glycol. We sorted through invertebrate samples in a laboratory setting to the taxonomic level of order. All transects within a plot were averaged to obtain a single value for a plot for each measurement. We tested these differences between paired transects using paired t-tests.

Results

Unburned plots had greater grass cover than plots burned the same year. Year-of-burn plots also had less canopy cover than unburned plots. Plots that were one-year post-burn began to recover as demonstrated by increased cover compared to cover the year in which they were burned. Shrubs had greater basal cover in unburned plots than year-of-burn plots; however, one-year post-burn plots had higher densities than in unburned plots for June and August. Unburned plots had higher densities than year-of-burn plots across all three months. Year-of-burn plots also had more bare ground than unburned plots in across all three months. Visual obstruction readings

were lower in year-of-burn plots compared to unburned plots for all three months. This difference remained in June and July one-year post-burn, but was not detected in August. We did not detect any difference in the density of shinnery oak between any treatment groups using belt transects. Both maximum and mean height was lower for year-of-burn plots than unburned plot for all months. Mean heights were also lower for year-of-burn plots compared to one-year post-burn in all months.
Counts of Hemiptera in sweep net samples were detectably higher for year-of-burn plots than one-year post burn plots (ybar=4.625, SE=4.50 vs. ybar=2.250, SE=1.50) in July. Pitfall sampling resulted in lower average counts of Coleoptera for unburned versus year-of-burn plots, and higher average counts for year-of-burn plots versus one-year post-burn plots.

Conclusions
Our results show an expected significant reduction in grass cover and visual obstruction during the growing season for plots burned earlier that year. As a result, LEPCs would be more visible in these plots, which may explain reports of LEPCs using areas for lekking shortly after being burned (S. Carleton, personal communication, Cannon and Knopf 1979).

Management implications
While plant cover was reduced in areas immediately after burning, there was not a detectable difference in the invertebrate prey community of LEPCs. Our observations suggest that burned areas may provide good lekking areas but would decrease the available area for nesting. Prescribed burning may be a useful tool to manage lands without negatively affecting lesser prairie-chickens, but more research is needed to evaluate LEPC selection in burned areas and its effects on population demography.

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Estimating the prevalence of sarcoptic mange in a desert coyote population using multi-state occupancy models

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Oral Presentation

Colonization of urban areas by synanthropic wildlife introduces novel and complex alterations to established ecological processes. For example, access to anthropogenic resources can result in wildlife aggregating around clumped resources, which can promote horizontal transfer of disease agents (Wright and Gompper 2005), with far ranging species potentially infecting outlying rural populations (Reddell 2018). Understanding the spatial distribution of a host and the spatial extent of a disease it harbors, are critical to preventing and containing emerging wildlife epizootics (Alasaad et al. 2014). We used remote cameras and multi-state occupancy models to estimate the prevalence of sarcoptic mange, a contagious skin disease caused by the mite *Sarcoptes scabiei*, in an urban coyote (*Canis latrans*) population at the National Training Center (NTC), Fort Irwin, California, USA. Individuals infected with sarcoptic mange may exhibit hair loss over >50% of their body (Pence et al. 1983; Figure 1a), making the disease easily observable using remote cameras. The use of multi-state occupancy models enabled us to account for imperfect detection and determine the environmental factors that influenced both the detection of coyotes and the classification of infection. We also assessed the influence environmental factors had on the probability a site was occupied by a coyote and the probability a site was visited by an infected coyote.

The NTC is a U.S. military training facility located in the Mojave Desert encompassing 3,055 km2 with a permanently occupied garrison (18.3 km2) of 8,845 residents. We deployed remote cameras across 180 sites (Figure 1b) within the outlying desert. We used single-season multi-state occupancy models (MacKenzie et al. 2009) in program PRESENCE 12.7 (Hines 2017) to determine the proportion of camera sites visited by infected individuals. We denoted three site states: state 0, indicating a coyote was not detected at a site; state 1 (asymptomatic), indicating that a coyote was present at a site, but that mange was not detected; and state 2 (symptomatic) indicating that a coyote identified with mange was detected at a site. We estimated 5 parameters, including: 1) the probability of coyote occupancy (ψ), 2) the probability a site was symptomatic, conditional on occupancy (R), 3) the probability of detecting a coyote given a site's true state was either asymptomatic ($p1$) or 4) symptomatic ($p2$), and 5) the probability of correctly classifying a site as symptomatic (δ) given the site's true state was symptomatic. We selected 7 covariates that we believed would influence these parameters, including: trend over time, season, slope, distance to washes, distance to urban areas, elevation, and prey density. Due to the large number of covariates and multiple parameters, we used a three-stage modeling process. First, we developed a set of detection models to estimate $p1$, $p2$, and δ, then a set of occupancy models to estimate ψ, and finally a model set to estimate R (Robinson et al. 2014).

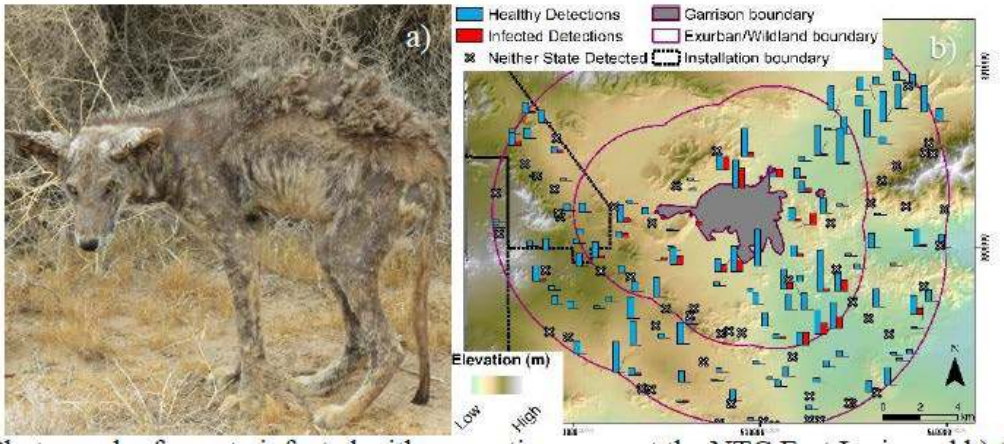

Figure 1. a) Photograph of coyote infected with sarcoptic mange at the NTC Fort Irwin and b) the frequency of detection days for asymptomatic (healthy) and symptomatic (infected) detections at each camera site (n = 180) at the NTC Fort Irwin from 2015-2017.

Asymptomatic coyotes were detected on 331 surveys at 120 sites, while symptomatic coyotes were detected on 63 surveys at 32 sites. Both $p1$ and $p2$ increased as a trend over time, while δ decreased as the distance to urban areas increased. ψ decreased with increasing slope and distance to both washes and urban areas, while R decreased as the distance to urban areas increased (Figure 2). The model averaged estimates for $p1$, $p2$ and δ were 0.263 (± 0.043), 0.721 (± 0.038), and 0.179 (± 0.031), respectively. The model averaged estimate of ψ was 0.748 (± 0.060) compared to a naïve estimate of 0.692, and R was 0.461 (± 0.134) compared to a naïve estimate of 0.258.

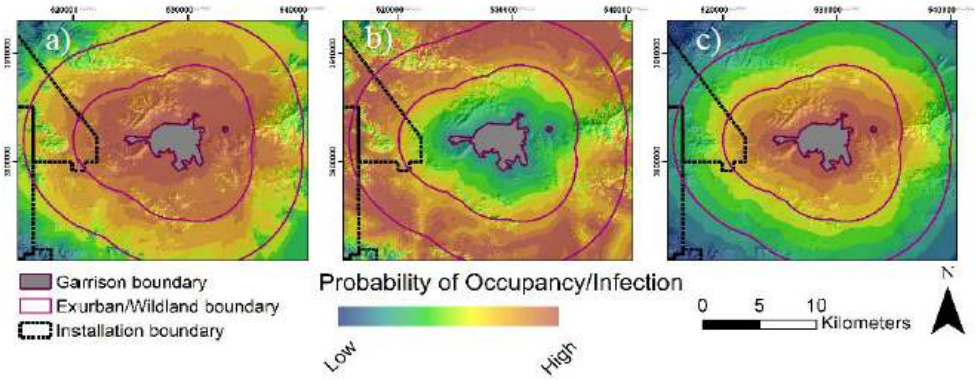

Figure 2. Probability maps at the NTC Fort Irwin from 2015-2017: a) probability of occupancy (ψ), b) probability of occupancy without infection (asymptomatic), and c) probability of occupancy with infection (symptomatic).

Coyotes selected for sites closer to urban areas regardless of infection status, however, sites closer to urban areas also had a higher probability of being used by coyotes infected with mange (ψR). The odds ratio of a site being symptomatic vs. asymptomatic was 4.1:1 at less than 500 meters from the urban area, 1:1 at 5,500 meters, and 1:2 at 7,500 meters. We found that R was 79% higher than naïve estimates and the overall probability a site was occupied with infection (ψR) was 93% higher than naïve estimates. The overall odds of a site being used by a symptomatic coyote was 1:2, compared to naïve estimates of 1:5, with an odds ratio of 2.5:1,

indicating that symptomatic coyotes were more than twice as likely to use a site compared to what we observed from raw counts alone. Our results show that remote cameras coupled with multi-state occupancy modelling can be an effective method for determining the spatial pattern of an observable disease and improves our ability to make informed decisions to mitigate disease outbreaks in wildlife populations, potentially reducing exposure to zoonotic disease agents for humans, domestic animals and wildlife.

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Spatial density estimation of mountain lions by cameras and genetic analysis in the desert southwest

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Oral Presentation

Introduction

Despite advances in wildlife monitoring technology and analytical techniques, the study of mountain lions (Puma concolor) remains heavily reliant on live captures to fit individuals with telemetry collars. Already costly, logistically challenging, and invasive, the relative lack of snow and large trees in many parts of the Southwest minimizes the efficiency and safety of hound work and incentivizes more time-intensive snaring strategies. Noninvasive techniques including genetic sampling of scat and hair have yielded mixed results; prevailing hot and dry weather

conditions in the desert southwest degrade scat samples and decrease detection rates for scat dogs. Cheek rub pads require a specific behavioral response that is more common in grey fox (Urocyon cinereoargenteus) and other species (Downey et al. 2007), than in the targeted felids. Remote cameras have proven valuable, but most camera surveys require at least a subset of the population to be marked with individually discernable ear tags or collars unless scars and other natural marks are evident (Kelly et al. 2008); leading researchers back toward live capture. Combined, these challenges have resulted in an underrepresentation of Southwestern mountain lion populations in scientific literature. This study aims to simultaneously address the dearth of information and its underlying cause by providing both 1) an estimate of population density in New Mexico's higher-quality mountain lion habitat and 2) a minimally invasive technique that could augment mountain lion research in the warm, dry environment of the arid southwest.

Methods

Prior to our study, we captured, processed, and released three mountain lions. All were marked with ear tags for photo identification and fitted with GPS/VHF collars. We also collected hairs from the lower leg as controls for any corresponding hair samples obtained from these individuals in the subsequent non-invasive survey.

Hair traps were developed from Belisle snare throwers, initially designed to throw a cable loop high on the leg before the jaws fell free of the captured animal. We coated the smooth wire jaws with vinyl tubing to increase surface area, followed by velcro and drywall sandpaper to retain hair. A metal tab between the jaws spaces them optimally to grip hair while allowing the paw to easily pull free.

We paired these hair traps with remote cameras along game trails in each of 22 units that comprised our 528 km² grid on the Ladder Ranch and adjacent Gila National Forest lands. After 30 days, each detection set was moved to a new site, where it was deployed for another 30 days. We then rotated the devices to a third site in each unit, until 66 total sites had been surveyed, culminating with 90 days of sampling per unit (~1,980 camera days).

We visited hair trap/camera sites approximately every 5 to 7 days to collect hairs, reset traps, and maintain the cameras. Hair samples were stored in coin envelopes with silica desiccant until the end of the survey, whereupon they were sent to University of Idaho for microsatellite analysis at 10 loci.

Results

We obtained twenty photos of mountain lions from the camera grid, while the associated hair traps collected 7 hair samples. Figure 1 demonstrates the breakdown of hair trap success or failure according to sampling period as detection devices rotated through locations in each unit. The samples we collected averaged >20 hairs, typically with the roots visible. All but one of the samples amplified via PCR to yield an individual genotype; two of the three marked cats left hair samples, both of which matched the genotypes from hairs pulled during live captures.

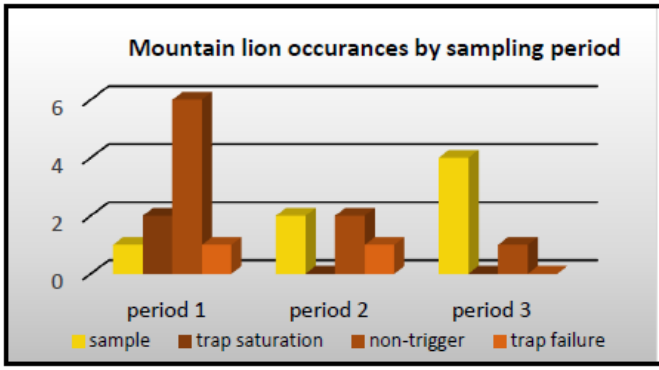

Figure 1: All cameras were paired with hair traps; thus, every photo of a mountain lion yields a hair sample (gold) or a missed opportunity for hair collection (shades of red). The graph depicts the increasing success of hair traps as sources of failure were mitigated, especially mountain lions not triggering the traps (non-trigger). Disruption by bears caused the trap saturation, while heavy rain and hardening mud caused trap failure.

To date, only the camera data have been incorporated into spatially explicit mark-resight models for a density estimate within a Bayesian framework. These data have yielded the density of mountain lions in and around the study area at 3.16/100 km² (SD = 1.76), with a baseline detection rate of 0.085/30 days (SD = 0.046). Continued analyses will include Bayesian SCR models for the genetic samples and combined genetic and camera detections. Simulations are also planned to determine which factors in the study (e.g., skewed sex ratio, size of the study area, trap spacing, etc.) may influence precision and bias in the density estimates.

Conclusions & Management Implications

The hair traps succeeded in pulling hairs with high amplification rates when the jaws closed on a mountain lion's leg; however, >50% of photo-documented occurrences did not yield hair when traps failed for various reasons (Fig. 1). We were able to reduce the rate of non-triggers by decreasing pan tension (i.e. the pressure required to trigger the trap) between sampling periods 1 and 2 (Fig. 1). Trap saturation can be reduced by more frequent trap checks, use of real-time cameras, or conducting winter surveys with minimal bear activity. With these changes, the hair traps are viable DNA sampling tools for abundance/density estimation, metapopulation/connectivity studies, and other DNA-based research.

Preliminary results of our density analysis have low precision, as is to be expected with the low sample sizes typical of cryptic large carnivores. At 3.16/100 km², our estimate is high relative to an expected density of 2-3/100 km² in "good" and "excellent" habitat in New Mexico (Perry, 2010). Nonetheless, density has been reported upwards of 3.7/100 km² in Montana (Russell et al. 2012) and 4.8/100 km² in Oregon (Davidson et al. 2014). Further analyses and simulations will serve to inform the reliability of our results before they are to be of use to managers as they regulate harvest limits and removals of mountain lions in New Mexico.

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Taos-Las Cruces – Friday, February 8th 1:00 – 3:00 PM
Moderator: Leland Pierce

Comparisons of Reptile Assemblages in two Subdivisions of the Sonoran Desertscrub Biotic Community

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Oral Presentation

Anthropogenic disturbances can have negative effects on species assemblages. This study was established to form baseline data on the environmental structure and reptile assemblages within a planned energy corridor in Pinal County, Arizona, prior to construction. We emphasized evaluating the differences in reptile assemblages in two subdivisions of the Sonoran Desertscrub, the Lower Colorado River Valley (LCV) and Arizona Uplands (AZU). Surveys were conducted on 50 sites (LCV = 15; AZU = 35) along the proposed 67.1-km long energy corridor through environmental surveys and 50 drift-fence trapping arrays with 400 box funnel traps. Vegetation height, number of burrows, and percent rock, ground cover, and coarse woody debris were significantly higher in the AZU than in LCV. Eighteen reptile species (n = 995 captures) were detected on the energy corridor including 8 lizard species (n = 952 captures) and 10 snake species (n = 43 captures). Species richness, evenness, and capture rates were not significantly different between the LCV and AZU; however, species diversity was significantly higher in the LCV. Reptile abundance (LCV = 281; AZU = 714) differed in the two subdivisions, yet rank-abundance curves revealed no difference in dominance of species. Post hoc examination revealed that the geographic separation of sites within the LCV and the location of the study area (along the ecotone) may have contributed to our results. We conclude that both subdivisions are equally important to the maintenance of local biotic diversity and recommend that any future land set-asides consider both subdivisions.

Drones, lizards, and fire: Quantifying the effects of wildfire on riparian vegetation and wildlife

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Oral Presentation

Southwestern riparian forests of cottonwood (*Populus fremontii*) and willow (*Salix gooddingii*) are well adapted to disturbances such as flooding, but much less adapted to wildfire. During the period of a three-year study on herpetofauna and riparian habitats on the lower San Pedro River in Arizona, the Roach fire burned 35 acres during year two. We compared abundance of two guilds of lizards before and after fire: one group were ground dwelling, active foragers (*Aspidoscelis tigris*, *A. sonorae*) and the other group was semi-arboreal, sit-and-wait foragers (*Sceloporus undulatus-cowlsei* complex, *S. clarkii*). We compared habitat structure by measuring foliar canopy, tree composition, litter, and woody debris before and after fire. To document the extent of the burn, we used drone remote sensing. We compared vegetation indices (NDVI) in burned and adjacent unburned areas. Overall, we found that wildfire altered the forest structure by reducing cottonwood and willow trees, increasing snags, reducing litter, and reducing NDVI. Wildfire affected lizards differently; tree-climbing species had similar abundances before and after fire, but ground-foraging species had lower abundances following the fire. Our observations suggests wildfire can alter structure of riparian forests and that some wildlife species have different vulnerabilities based on how they use the habitat.

The Effects of Urbanization on Gila Monster Populations in Oro Valley, AZ

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Oral Presentation

Urban development can have negative impacts on wildlife, as it often leads to habitat destruction and a loss of biodiversity. This study focuses on the effects of urbanization on Gila Monster (*Heloderma suspectum*) populations in Stone Canyon, a residential golf community located at the base of the Tortolita Mountains in Oro Valley, Arizona. During the spring and summer months, we conducted nightly surveys of the road and golf cart paths. We collected environmental (e.g. temperature, relative humidity) and location data (UTM coordinates) for each Gila Monster that was captured. After each survey, lizards were taken into the lab for processing. This included collecting body measurements (e.g. snout-vent length, mass), determining age and sex, and implanting passive integrated transponder (PIT) tags. We quantified the time spent and distance covered during our surveys, which allowed us to calculate the number of lizards per unit effort. We compare our results from 2017 and 2018 with our long-term (2002-2014) data set to understand how the ongoing development affects Gila Monster abundance, distribution, age structure, and sex ratios.

Mexican Gartersnakes in the Bill Williams Drainage, Western Arizona

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Oral Presentation

The Northern subspecies of the Mexican Gartersnake (*Thamnophis eques megalops*) is listed as threatened under the U.S. Endangered Species Act, a state endangered species in New Mexico, and a Species of Greatest Conservation Need in Arizona. The species was recently discovered by the Arizona Game and Fish Department in the Bill Williams River, 180 km from the nearest populations known at the time. Since that discovery, we have conducted 81,720 trap-hours over three years to improve our understanding of the species' distribution. These surveys have resulted in 30 captures of 28 individual Mexican Gartersnakes in the region, including in the Bill Williams River, the Big Sandy River, and the Santa Maria River. We will summarize the known extent of distribution, speculate on areas of likely absence, and discuss our plans and priorities for future surveys in the region.

The Effect of Moon Illumination on Nightly Snake Abundance

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Oral Presentation

Moon phase changes in a cyclic, repeated pattern from new moon to full moon, making it highly predictable and easily learned. While conducting surveys of snake species in a developing residential area, snake abundance was observed to fluctuate, sometimes dramatically, from night to night. Numerous studies have shown the influences of temperature and humidity on the activity of snakes, but few have focused on the effects of light availability on these nocturnal hunters. Even though sight is not the only method of prey detection for most snake species, light availability has been shown to affect the activity of many of their preferred prey species as well as other nocturnal predators. Changes in behavior of prey species relative to moon phase may

stimulate a learned change in behavior for snakes to increase their hunting efficiency. Snake species may also rely on lower light availability to avoid predation and increase their chance of survival. In the Sonoran Desert, some of the greatest observed times of snake activity are during the monsoon season from mid-June until late-August, which brings increased cloud coverage, negating possible effects of moon illumination. Our study used nightly moon phase and moon illumination data in conjunction with recorded temperature, humidity, and cloud coverage to compare observed nightly snake abundance per unit effort.

Hormonal and behavioral responses to handling in captive narrow-headed gartersnakes

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Oral Presentation

Narrow-headed gartersnakes (*Thamnophis rufipunctatus*) are a federally threatened species, but captive programs have been established to facilitate species recovery. Reptiles may either habituate to captivity or experience chronic stress, which can lead to immunosuppression and reduced reproduction. As such, understanding species' response to potential stressors in captivity, like human handling, is important for success of recovery programs. Hormones, like corticosterone, and behavior can be useful indicators of stress or habituation. We examined the hypothesis that handling would increase corticosterone levels and alter behavior in a captive population of *T. rufipunctatus.* 26 individuals were handled daily for 17 days with two-week transition phases before and after the handling phase. Initial behavior was recorded daily, and corticosterone metabolites (fCMs) were measured from fecal samples. We found that tightening the coils ("tighten"), deep breathing ("panting") and raising the head ("head-up") were the most common initial behaviors regardless of experimental phase, with "tighten" being 4x more common than "head-up" on average. We also found that human handling resulted in decreased fCMs in wild-caught adult snakes but did not affect fCMs in captive-born snakes of any age. Lastly, fCMs were higher in wild-caught adult snakes than captive-born first-years for all experimental phases except the handling phase. These results indicate that *T. rufipunctatus* may respond hormonally, but not behaviorally, to human handling and that hormonal responses vary depending on age and/or captive status. Understanding hormonal and behavioral responses to handling provides insight into the effects of captivity on a federally threatened snake.

Yucatan – Friday, February 8th 3:20 – 5:00 PM
Moderator: Jim Stuart

Home on the Range: How far do New Mexico jumping mice go?

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Oral Presentation

The New Mexico jumping mice (*Zapus luteus luteus*) is considered a riparian obligate that uses tall, dense herbaceous vegetation along perennial flowing water. Jumping mice also use adjacent dry upland areas beyond the floodplain to nest, bear and raise young, and hibernate. Because the species is federally listed as endangered, knowledge of habitat use and home range can guide management decisions. We radio tracked jumping mice in Arizona, New Mexico, and Colorado to identify home range size, movement, and distance traveled from riparian areas. For radio collared jumping mice, home ranges calculated using Minimum Convex Polygon (MCP) and 95% Kernel Probability (K) averaged 1.67 ha and 1.63 ha, respectively. Animals moved an average of 8 m from streams but maximum distance from stream averaged 35 m. Mean and maximum distance moved from last location were 52 m and 222 m, respectively. Average distance from centroid was 60 m. Longest distance moved in one night was >500 m. Day nests for jumping mice were identified as either grassy bolus structures, under dead matted grasses, or underground (maternal, ~2.5 cm below ground) near streams. Females gave birth in mid-August. Based on 2 litters, young weighed ~10.5 g by end of August and were independent by the second week of September. Home ranges were small with animals using habitat in and immediately adjacent to riparian areas. The location with the greatest distance from a stream was in flat, open, upland grassland; jumping mice rarely moved into forested upland habitat.

Chasing chipmunks: inside the life of the Organ Mountains Colorado chipmunk

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Oral Presentation

There is a need to understand the ecology and habitat selection of the Organ Mountains Colorado chipmunk (*Neotamias quadrivittatus australis*) in order to evaluate threats and make informed management decisions. Our primary objective was to implement a radio-telemetry study to evaluate habitat selection at multiple scales. We conducted intensive live trapping surveys during summer 2018 to capture animals for the radio-telemetry study. However, a lack of captures suggested a lull in activity during summer months and led us to reevaluate our methods. To

determine where chipmunks are occurring, we deployed remote cameras. Some of these remote cameras successfully captured chipmunks and these camera data have allowed us to glean insight into multi-species interactions and natural history characteristics. To assess microhabitat selection, we collected habitat data on plots at locations where we detected chipmunks (cameras and opportunistic sightings), and at paired random sites. We analyzed the presence/absence data and evaluated important micro-habitat characteristics. We found that chipmunks were associated with upland Gambel's oak and ponderosa pine vegetation communities, arroyos with water, and rocky areas with high plant diversity. We used data on the closely related Oscura Mountain Colorado chipmunk (*N. q. oscurensis*) to assess influence of rock squirrels (*Otospermophilus variegatus*) on chipmunk occupancy and detection. Chipmunks were more likely to occupy sites where rock squirrels were present, but rock squirrels negatively influenced chipmunk detection probability. These results will aid development of an occupancy model study across the range of the Organ Mountains chipmunk and contribute new information about its ecology.

Cameras or traps? Evaluating survey techniques for the endangered Peñasco least chipmunk

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Oral Presentation

The Peñasco least chipmunk (*Neotamias minimus atristriatus*) is a candidate for federal listing under the Endangered Species Act and is only known to persist in the White Mountains subrange of the Sacramento Mountains, New Mexico. The species co-occurs with the morphologically similar grey-footed chipmunk (*N. canipes*). *N. m. atristriatus* is only known to persist at remote high elevation sites where traditional live trapping methods are logistically challenging. Camera traps provide an alternative method well-suited to occupancy analysis, which only requires detection/non-detection data. We developed and tested a diagnostic key for differentiating between the sympatric chipmunk species using photographs. When we reported mid to high confidence in our identifications, we correctly identified 98.14% of specimens, based on photographs of single nonants of verified specimens. We conducted paired surveys using Sherman live traps and remote cameras. The daily probability of detection was 0.781 using live trapping and was 0.542 using camera trapping. Naïve detection probability reached 98% by day 3 when Sherman live trapping and by day 5 when camera trapping. This suggests that where *N. m. atristriatus* is present it is readily detectable using either method, and that camera trapping can be used for surveying the White Mountains population. We also surveyed historical and new sites for presence of *N. m. atristriatus* and documented the subspecies in new localities. We provide preliminary data on the ecology of the White Mountains population of *N. m. atristriatus*.

Post-fire displacement in an endangered small mammal

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Oral Presentation

Altered fire regimes and drought are important drivers of disturbance events worldwide. Understanding how disturbance events such as fire influence space use, post-fire displacement, and survival, is key. The Pinaleño Mountains in southeastern Arizona, USA have experienced three increasingly catastrophic fires in 1996 (2,600 ha), 2004 (12,029 ha), and 2017 (19,604 ha), threatening the continued persistence of the endangered Mt. Graham red squirrel (*Tamiasciurus fremonti grahamensis*). In summer 2017, the 19,600 ha Frye Fire disproportionately impacted remaining red squirrel habitat; 31% of high-elevation forest experienced moderate - high severity burn, and 95% of available red squirrel territories were affected. We investigated how increasingly severe and extensive fires have influenced red squirrel home range size, spatial displacement, post-disturbance movements, and survival. We quantified red squirrel space use patterns for radio collared animals following fires in 2004 and 2017 and compared these metrics to those observed immediately before fires and during the same time periods in years without fire. In both 2004 and 2017 a subset of displaced radio collared animals made long-distance movements to new territories. Compared to non-fire year and pre-fire home ranges, home ranges calculated for 3 months immediately following fires were larger, as were the magnitude of individual movements within each home range. While most animals survived the fire itself, probability of survival decreased drastically as animals made large forays in search of food and new territories. Our results demonstrate how disturbance events present conservation challenges, particularly for small mammals with site fidelity.

Behavior and Spatial Ecology of a Desert-Adapted Mammal in a Rapidly Changing Environment

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Oral Presentation

The Sonoran Desert supports a large proportion of North American biodiversity but is threatened by continued anthropogenic exploitation and increasingly extreme climate trends. It is well understood that wildlife communities must alter their behavior and distributions to tolerate rapid changes; however, many animals endemic to the Sonoran Desert, such as the Harris' antelope ground squirrel (*Ammospermophilus harrisii),* are poorly studied. Lack of knowledge regarding habitat requirements prevents scientists from understanding how a species will respond to future change or if necessary habitat will be available and hinders the ability of managers to make

informed decisions. *A. harrisii* are representative of many Southwestern species in that they are widespread and well-adapted to extreme climates but face multiple stressors, including woody encroachment, grazing pressure, and urban expansion. The resulting habitat degradation and fragmentation could exacerbate the effects of climate change and limit species resilience. The extent of these effects is unknown, however, because no studies of *A. harrisii* spatial ecology exist. I used radio collars to study movement patterns and resource selection. Study individuals maintained very large home ranges with significant overlap within and between sexes. Further, squirrels may rely on a mosaic of bare ground and plant cover potentially as a function of vigilance and predator avoidance. Specific habitat requirements, as well as sensitivity to disturbance, may limit future squirrel distributions. I will discuss potential implications of further habitat alterations on antelope squirrel populations and other small mammals in the Southwest, as well as pathways for future research efforts.

Taos-Las Cruces – Friday, February 8th 3:20 – 5:00 PM
Moderator: Bob Osborn

Quantifying spatio-temporal variability in thermal landscapes through a fiber-optic distributed temperature sensing system: implications for thermal ecology research

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Oral Presentation

Environmental conditions have long been understood to be fundamental in structuring ecological patterns and processes across multiple spatial and temporal scales. More specifically, thermal conditions (i.e., temperature) can dictate how organisms perceive and use their environment, and thus can influence patterns of habitat use, population dynamics, and biotic interactions. However, thermal conditions are highly variable across spatio-temporal scales, and an understanding of fine scale variability in thermal conditions has only recently received attention as an important element of biological conservation. Fiber-optic distributed temperature sensing (FO-DTS) systems offer a unique opportunity to quantify thermal landscapes at fine spatio-temporal scales across a continuous fiber-optic cable, thus providing temperature measurements along a continuum rather than at discrete points in space or time. We provide examples of both terrestrial and aquatic applications of this system to elucidate its use across multiple ecological disciplines. For the terrestrial application, we highlight the changes in thermal patterns that can occur in

relation to woody encroachment within temperate grasslands in the southern Great Plains. With regard to the aquatic application, we provide an example of using FO-DTS to collect fine-scale thermal data within a stream to characterize patterns of temperature-driven selection by stream fishes. Our results will illustrate how FO-DTS systems may be implemented in ecological research to better understand spatio-temporal variability of thermal conditions and we will provide insight into the future use of such systems in ecological studies while highlighting potential drawbacks and limitations.

Changes in Forage Biomass for Elk and Mule Deer Following 6 Years of Landscape Scale Forest Restoration and Monitoring in the Jemez Mountains, NM

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Oral Presentation

Due to historical land use and fire suppression, forests in northern New Mexico are at abnormally high risk for catastrophic wildfires. In response, a coalition of agencies under a USDA Collaborative Forest Landscape Restoration Project began restoring 210,000 ha in the Jemez Mountains via forest thinning and prescribed fire. As part of these restoration efforts, we are monitoring responses of radio-collared Rocky Mountain elk (*Cervus canadensis*) and mule deer (*Odocolius hemionus*) relative to changes in their forage biomass following restoration or wildfire. Since 2013, we have collected data from 200 vegetation plots (60-70 monthly in summer and seasonally; 130-140 annually in summer) randomly stratified within 6 dominant stand types (aspen, grassland, oak, pinyon-juniper, ponderosa, mixed conifer). Within each plot, we established a 200 m transect and measured herbaceous biomass, shrub biomass, shrub height, tree density, ungulate herbivory, and collected samples for nutritional content analyses. We developed regression models for estimating herbaceous biomass using disc meters as well > 40 species-specific basal diameter regressions for shrubs. Our preliminary results suggest that herbaceous biomass increases initially for 1-4 years following treatment or wildfire before subsiding, but there is substantial variability among stand and treatment type. Similarly, changes in shrubs biomass vary across stand and treatment types, but biomass within shrub-heavy stands increased over time. These results are crucial to evaluating the success of the larger restoration project while providing local and state managers with a rare long-term monitoring dataset to aid their management of ecologically and economically valuable species.

Safe Passages for Wildlife on Interstate-10 within the Rincon-Santa Rita-Whetstone Mountains Wildlife Linkage

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Oral Presentation

The 20-mile stretch of Interstate-10 (I-10) between Vail and Benson, east of Tucson, Arizona, divides the regionally important Rincon-Santa Rita-Whetstone Mountains Wildlife Linkage. This linkage is one of the few remaining north-south I-10 wildlife crossing points found between Tucson and New Mexico and it encompasses several protected areas and important waters, including Davidson Canyon and Cienega Creek, making it critically important for wildlife in the face of climate change. In the spring of 2017, the Coalition for Sonoran Desert Protection (CSDP), in conjunction with partners, conducted comprehensive assessments and wildlife surveys of the nearly 80 existing underpasses and drainage culverts in the study area. Our results indicate that this wildlife linkage could be made safer for wildlife and motorists by 1) installing wildlife funnel-fencing to keep animals off the highway and to direct wildlife toward existing crossing points; 2) retrofitting and widening existing drainage culverts located in high volume areas; 3) construction of an additional wildlife crossing between Cienega Creek and Marsh Station Rd Exit 291. Now in Phase II, we are using wildlife camera monitoring and roadkill surveys, with community science engagement, to gather species-specific baseline data on wildlife passage rates and roadkill hotpots. Preliminary results, including one black bear mortality, already begin to identify optimum locations for wildlife funnel-fencing, culvert retrofits, and wildlife crossings, and will inform State and County highway and wildlife officials on where to focus mitigation efforts to improve highway safety and minimize wildlife-vehicle collisions.

Preserving the Connection: Habitat Connectivity in McDowell Sonoran Preserve

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Oral Presentation

Large, contiguous landscapes are necessary to maintain wildlife species' access to resources, movement routes, and gene flow. Human development can fragment these landscapes and cut off wildlife movement. Scottsdale's McDowell Sonoran Preserve is uniquely situated to connect Tonto National Forest with McDowell Mountain Regional Park, providing nearly 3 million acres of protected habitat. Development is rapidly filling in around the Preserve, and a road cuts through a narrow corridor connecting the north and south sections. We are using a combination of wildlife cameras, telemetry, and acoustic monitoring to assess the mammalian community and habitat connectivity within the Preserve. We placed 20 cameras in washes in the Preserve and regularly process captured images. In August 2018, we installed acoustic monitoring devices in 12 of these cameras to determine how urban sounds propagate across the landscape. Using telemetry, we monitored movements and resource use of 38 mule deer (*Odocoileus hemionus*) within the Preserve and surrounding areas from February 2016 to February 2018. Preliminary results indicate that a robust mammalian community occupies all sections of the study area, including the narrow corridor. The road may form a barrier to movement; only four telemetered bucks crossed the road, whereas no female deer crossed. We will continue to monitor the wildlife cameras and acoustic recordings in the coming year. The results of these studies will help inform management decisions to maintain connectivity within the Preserve, including possible crossing structures to mitigate road impacts.

A lesser prairie-chicken's perspective on navigating the anthropogenic landscape

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Oral Presentation

Our perception of ecological relationships is dependent on our definition of scale in terms of time and space. These perceptions can influence policy and management decisions, which have important implications for species that respond to spatio-temporal patterns at multiple scales. Anthropogenic disturbances impact landscape patterns, and animal responses to these disturbances can vary across scales. We assessed spatio-temporal scale dependence in lesser prairie-chicken (LPC, Tympanuchus pallidicintus) movement and habitat selection using integrated step selection functions in relation to 4 types of anthropogenic features: roads, power lines, residential areas, and oil and gas wells. As the temporal grain (time between successive locations) of our analysis increased, the spatial extent (distance between successive locations) increased as well. We found that LPC movements were biased towards leks, and increasingly so as the spatio-temporal scale increased. Further, LPC selected for CRP land cover and avoided cropland across all scales. CRP land cover also facilitated LPCs in crossing roads across all scales. We did not find evidence that LPCs avoided power lines, residential areas, or oil or gas wells at any scale. However, steps that crossed powerlines or roads were longer than expected across all scales, indicating that LPCs minimized time spent under/crossing these features. The anthropogenic landscape was a primary driver of LPC habitat selection and movement patterns at

local and broad spatio-temporal scales. Human policy and management decisions can greatly affect the anthropogenic landscape for this sensitive species, therefore conservation planning should consider the arrangement of vegetation and anthropogenic features on the landscape.

Cancun – Saturday, February 9th 8:00 – 10:00 AM
Moderator: Ivana Mali

Finding Gold in the Old: Projects of NAU's Ancient DNA Lab

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Oral Presentation

Northern Arizona University's Ancient DNA Lab has tackled diverse projects concerning taxa, their diseases, and distributions across time and space. Ancient DNA is genetic material that is highly degraded or in low quantity that must be treated with strict protocols to avoid modern contaminants. This field of study developed in the mid-1980s and expanded recently with advancements in sequencing technology. We applied these developments to explore four projects since the opening of the lab in 2016: dung from mammoths and giant sloths to investigate microbial communities, jaws of 8500-year old bison (*Bison antiquus*) to identify a fungal pathogen, tissue from a mummified 2500-year old spotted bat (*Euderma maculatum*) for a phylogeographic study, and sediment cores from two Alaskan lakes. The Alaskan lake sediment project aims to determine when moose appeared in the Kenai Peninsula, while simultaneously identifying other taxa from the past and present communities of the lakes. We illustrate that ancient DNA is a significant source of information that can be used in collaboration with many disciplines to examine past communities.

Environmental DNA for ecological monitoring

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Oral Presentation

Environmental DNA (eDNA) detection is a noninvasive method for monitoring species presence without physical contact. Originally pioneered to monitor invasive fish populations, this technique has been modified for the detection of cryptic wildlife. The use of eDNA has potential to supplement surveys of mammals including bats and endangered New Mexico jumping mice. We hypothesized that we could detect eDNA in water from three different studies. First, we wished to determine if we could detect bat eDNA in water of cattle tanks where bats were observed. We used an assay for bat species detection in serially diluted DNA to determine the limit of detection. Next, we applied our assay to water samples collected from cattle tanks and agricultural troughs. Although our initial attempts to detect bats were unsuccessful, we are refining our techniques for eDNA detection using water samples from controlled collections. Second, we hypothesized that we could detect eDNA of jumping mice from abandoned nest samples. We applied a rodent specific assay to known jumping mouse nests. DNA from jumping mice was successfully detected in one nest sample. We are now developing an assay to target a smaller DNA fragment to improve our ability to detect low concentration jumping mouse DNA from environmental samples. Our final eDNA effort involves characterizing creek, spring, and aquafer water in the Grand Canyon. We are using multiple assays to characterize eukaryotic and microbial communities. Our results will contribute to a better understanding of the flow patterns and ecological communities of spring systems.

Using environmental DNA and next-generation sequencing to characterize biological communities in the Central Highlands of Arizona

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Oral Presentation

Historically, surveys for fish and wildlife have required a significant number of person-hours in the field, using methods that can be stressful to the species being observed. However, the analysis of environmental DNA (eDNA), left behind by organisms in water, soil, and air, is revolutionizing biologists' ability to rapidly assess biodiversity. In this study, the application of the 16S rRNA mitochondrial gene for vertebrate eDNA metabarcoding was explored in Arizona's Verde River, home to over fifty species of fish and wildlife that are endangered, threatened, or of conservation concern. Water was collected from four sites along the river and vacuum filtered to collect eDNA. DNA was amplified by polymerase chain reaction and sequenced on an Illumina MiSeq FGx Forensic Genomics System. Sequences were compared to the NCBI nucleotide database using BLAST. Multiple vertebrate taxa were identified from sequences, including fish, reptiles, amphibians, birds, and mammals. All taxa that were detected corresponded to those known to occur in the Verde River riparian corridor, but there were also new discoveries at the species-level. This technique represents a novel method to characterize vertebrate communities from water samples that is more efficient and less stressful to species than traditional survey methods, as eDNA analysis takes fewer person-hours in the field than traditional methods, and no capturing of wildlife is required. Greater than 25 species from diverse taxa were identified with a single water sample collected in a few minutes. The use of eDNA can supplement or potentially replace traditional techniques for surveying wildlife.

Hybridization between Red-eared Slider (*Trachemys scripta elegans*) and Big Bend Slider (*Trachemys gaigeae*) in New Mexico

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Oral Presentation

Big Bend Slider (*Trachemys gaigeae*) is a freshwater turtle with a highly restricted range in the southwestern United States, occupying only portions of the Rio Grande drainages of New Mexico and Texas. Although it is considered imperiled in the state by the New Mexico Department of Game and Fish, it lacks protection at the state or federal level. The major threat to its persistence is hybridization with the non-native Red-eared Slider (*Trachemys scripta elegans*), whose populations in New Mexico persist presumably due to release of pet turtles. In this study, we focus on analyzing over 200 turtles trapped between 2011 and 2013, predominantly at Elephant Butte Reservoir. We genotyped turtles at 13 microsatellite loci as well as using mtDNA, and compared the results to field identifications in light of detection probabilities from trapping efforts. We confirm previous findings of hybridization between the two species, in addition to detecting a small genetic effective size and low genetic diversity in Big Bend sliders in New Mexico. When compared to genetic data, field identification of Big Bend Sliders was found to be reliable when done by experienced observers. In contrast, less than

a quarter of individuals identified as Red-eared Sliders were confirmed to be as such, the remainder being genotyped as hybrids. We did not find significant differences in overall detection probabilities between the two species, thus relative proportions of trapped turtles are likely to reflect the composition of the larger populations within Elephant Butte Reservoir. Our results suggest that hybridization is a serious threat to persistence of Big Bend Slider in New Mexico. Thus, a comprehensive conservation strategy must include monitoring of relative proportions of both species and their hybrids, aggressive campaigns to reduce Red-eared Slider introductions and genetic characterization of Big Bend Sliders.

Reproductive demography and basking behavior of Rio Grande Cooters on the Black River, New Mexico

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Oral Presentation

Rio Grande Cooter, *Pseudemys gorzugi*, is one of the least-studied species of freshwater turtles in North America. In New Mexico, the species is listed as threatened while the United States Fish and Wildlife Service is currently reviewing its status for potential federal protection. Little is known about *P. gorzugi* ecology making implementation of proper conservation and management practices challenging. In 2018, we studied reproductive ecology and basking behavior of Rio Grande Cooters on the Black River, New Mexico. From mid-May to mid-August, we surveyed *P. gorzugi* using traditional hoop net traps. Females (n=159) were x-rayed and ultrasounded to assess their reproductive status. We found 16 females containing shelled-eggs and 27 females containing oviductal follicles. High proportions of gravid females were observed at the end of May and mid-June. The size of the smallest gravid female was 185 mm in plastron length. Mean (± 1SD) clutch size (n=15) and egg width (n=144) were 9.33±2.89 and 30.07±1.72 mm, respectively. In August 2018, we deployed game cameras and temperature data loggers at 4 locations along the Black River, with a goal to monitor species year-round basking activity. Our preliminary results showed that ambient temperature, date (seasonality), and time of day affected basking frequency. Basking activities were highest during mid-day, although the activities increased in the morning and evening on warmer days. As expected, basking activities occurred less frequently in colder months. Overall, our two studies significantly contribute to our understanding of *P. gorzugi* ecology, which is useful for planning conservation strategies.

Yucatan – Saturday, February 9th 8:00 – 10:00 AM
Moderator: Lindsey Mangipane

Survival and causes of mortality among pre-breeding age golden eagles in the Southern High Plains

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Oral Presentation

The Southern High Plains provides extensive habitat for golden eagles (*Aquila chrysaetos*), a species with tentative population status in the United States. Direct impacts of humans on eagles using these habitats are not well understood, e.g., effects of increasing energy development in the region. During 2015-2018 we used satellite transmitters to document survival of 29 golden eagles produced in the SHP, starting at the eagles' late nestling stage (~7 weeks of age). Ten (34.5%) of the eagles died just before or during fledging, mostly due or likely due to parasitism by Mexican chicken bugs (*Haematosiphon inodorus*; MCBs). Only 11 (37.9%) of the eagles lived beyond their first year, nearly half of the normal first-year survival rate; four remained alive as of December 2018. Causes of mortality among the 15 SHP eagles that fledged plus seven golden eagles we tagged as nestlings in adjoining regions and that died after moving to the SHP included: powerline electrocution (n=10 eagles) and collision (1); wind turbine collision (1); poisoning or shooting (4); winter exposure/starvation (1); likely MCB parasitism (1); and unknown (4). Action to improve golden eagle survival in the SHP could first focus on reducing electrocution risk, given its broad distribution and the marked effectiveness of standard corrective measures. Extent of MCB parasitism at nests warrants further evaluation; control of the parasite may be a cost-effective means of offsetting losses of golden eagles elsewhere.

Comparing survival rate, dispersal, and cause of mortality of released captive-bred and wild born black-footed ferrets within a reintroduction site, Aubrey Valley, AZ.

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Oral Presentation

The Aubrey Valley, located 10 miles west of Seligman, AZ, is a long-standing reintroduction site for black-footed ferrets (BFF). In 2010, the U.S. Fish and Wildlife Service declared the Aubrey Valley a successful reintroduction site, but the population has recently experienced a severe

decline. Since 2012, the Arizona Game and Fish Department (AZGFD) has released 109 captive-bred animals that have never been recaptured, and the BFF population has shown no signs of improvement. In response to this decline, AZGFD and Northern Arizona University (NAU) have launched a 2-year study to determine whether the current methodology of 'hard-released' captive-bred ferrets is an ideal method for supplementing the current population, or if alternative methods should be considered. In the Fall of 2018, the Department released 28 radio-collared black-footed ferrets (14 captive-bred, 14 wild-born) and tracked them over a 30-day period to determine if either method was better suited for reestablishment. Of these animals, six were predated (2 wild/4 captive), three died of unknown causes (0 wild/3 captive), nine survived (6 wild/3 captive), and the fates of ten remain unknown (6 wild/4 captive). Dispersal data for the first year has not yet been analyzed. Additional captive-bred and wild-born ferrets will be collared, released and monitored in the Fall of 2019.

Mountain Lion Prey Composition in West Central Arizona

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Oral Presentation

Mountain lion foraging behavior and prey composition are ecologically compelling and central to decisions regarding management of mountain lions and ungulate prey species. To document lion foraging patterns on ungulates in West Central Arizona, we captured and deployed GPS radio collars on 4 male mountain lions. Between January 2014 and July 2017, we investigated potential kill sites (n = 279) identified using GPS location clusters and documented prey composition. Mountain lions predominately preyed on juvenile animals and prey species at kill sites varied between individual mountain lions. Our study identified burros and cattle as the predominant prey sources for mountain lions. This result suggests a highly subsidized mountain lion population and has important management implications for the impact of mountain lions on prey species.

Elucidating the effects of land use on the movement patterns of *Puma concolor*

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Oral Presentation

Contiguous interconnected stretches of habitat are vital to the long-term survival of wildlife pushed to the fringe of growing cities. Preservation of lands to maintain connection are crucial. However, the idiom "build it and they will come" seldom applies in corridor creation. Typically, conservation planners must choose the most viable of available land which is typically already at some stage of development or facing development pressures. This research employs the machine

learning based algorithm MaxENT to ascertain landscape characteristics associated with utilization by mountain lions. We examine the relationships of 14 different environmental, demographic, and land use based variables with respect to radio-collared points associated with 4 mountain lions (*Puma concolor)* living in the Sandia and Manzano Mountains west of Albuquerque. We elucidate the interrelationship between development, human demographic, and landscape characteristics to determine environmental variables most influential to mountain lion presence. We find that land use ranks consistently in the top 3 categories most predictive of mountain lion presence, while vacant housing (according to the 2010 US Census) also contributes to the model. Understanding how landscape features influence movement patterns of a wide-ranging predator can inform policy and land acquisition strategies for interconnected habitat at the urban-wildland interface, to guide city and conservation planners alike.

Taos-Las Cruces – Saturday, February 9th 8:00 – 10:00 AM
Moderator:

New Mexico Environmental Review Tool: A New Interactive Online Conservation and Project Planning Tool

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Oral Presentation

The New Mexico Environmental Review Tool (NM ERT) is a new online tool, available to all, that provides conservation information on wildlife and habitat diversity, protected lands, and other natural resources. NM ERT allows users to view and intersect a broad array of conservation-related spatial layers for conservation planning and project assessment. This automated tool allows users to submit proposed projects for review of potential impacts to species of conservation concern and their habitats in New Mexico, and generates customized reports with sensitive species lists and conservation recommendations. We will present the NM ERT website and discuss its role in the New Mexico Conservation Information System.

Updating the Biota Information System of New Mexico User Interface: A Building Block of the New Mexico Conservation Information System

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Oral Presentation

The Biota Information System of New Mexico (BISON-M; bison-m.org) is a web-based, searchable database that is maintained by New Mexico Department of Game and Fish (NMDGF) in collaboration with Natural Heritage New Mexico (NHNM). The database contains accounts for over 6,800 species, many of which are found in New Mexico. Information in the database is being updated continually. Since the early 90's, the associated BISON-M website has been developed by multiple programmers. The website code and functionality was in need of a facelift. In 2018, NMDGF, NHNM, and DataWizards collaborated on a recode and update of BISON-M's functionality. This update involved combining functionality on multiple screens into a single screen to simplify the user's experience. It also involved adding functionality to facilitate and improve the quality of the data entry process, including a "Pending Changes" screen where system administrators can view and approve changes made to species accounts. This update is part of a bigger project being undertaken by NHNM to develop a Conservation Information System (CIS) for New Mexico. This system will ultimately provide access to many different sources of information on flora and fauna in NM relevant at different spatial scales. These information sources include New Mexico's State Wildlife Action Plan, Crucial Habitat Assessment Tool, Environmental Review Tool, and BISON-M. I will review the updates made to BISON-M as well as how BISON-M fits into the CIS.

Candidate conservation agreements and candidate conservation agreements with assurances for the lesser prairie-chicken and dunes sagebrush lizard in New Mexico

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Oral Presentation

Besides providing habitat for the lesser prairie-chicken (Tympanuchus pallidicinctus) (LPC) and dunes sagebrush lizard (Sceloporus arenicolus) (DSL), the landscape, including historic and current home ranges of both species, is subject to many land use practices including oil and gas production and livestock grazing. Due to a variety of factors, multiple petitions to list both species under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531, et seq.) have been filed with the United States Fish and Wildlife Service (FWS). Candidate conservation agreements for both species in New Mexico were executed in 2008 by the FWS, Bureau of Land Management, and Center of Excellence to eliminate or reduce threats to both species. These voluntary agreements include a suite of conservation measures implemented by livestock producers and oil and gas operators that will preserve and protect suitable or occupied LPC and DSL habitat. The agreements provide participants with a high degree of certainty on federal lands and assurances on non-federal lands that their operations would not be significantly impacted if either species were to be listed as threatened or endangered under the ESA. Contributions through industry participation in the program are used for projects including but not limited to habitat reclamation and restoration, education, and research, resulting in increased cover, additional water sources, and reduced habitat fragmentation for both species.

Update on review of wildlife issues in review of renewable energy development projects, including addition of energy storage, and transmission lines.

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Oral Presentation

Renewable energy generation projects include wind turbines, solar photovoltaic, concentrating solar trough, and power tower technologies although photovoltaic is now most common. Electricity transmission projects are built to support new generation projects. Extra high voltage transmission lines, sometimes direct current, are used to reduce transmission losses over long distances. Wildlife issues include loss or change of habitat for all types of projects and impacts associated with operation and maintenance, which vary by technology. Vegetation maintenance to maintain conductor clearance is a potential ongoing impact for transmission lines, which can be at least partially addressed during project design. Mortality from collision has occurred at wind farms, solar photovoltaic, and solar trough projects. Heat injuries have occurred at power tower projects. Potential regulatory issues include compliance with the federal Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act. Through National Environmental Policy Act documents Federal agencies analyze and disclose potential impacts of projects under review. Plans of Development are required prior to issuance of a Notice to Proceed and must include details. Unanticipated impacts have occurred after construction of some projects and efforts, including monitoring and research, are underway to better understand and predict issues. Concurrently, energy markets are evolving, including the renewable energy element, as is related electricity transmission planning. To address differences in time of day of output of renewable energy projects with customer usage energy storage is now planned. An update on the status of major ongoing projects will be provided.

Post construction fatality monitoring at a wind energy facility in south Texas.

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Oral Presentation

Wind energy development has long been known to cause bird and bat fatalities; despite emphasis on understanding and reducing these impacts, there is a paucity of publicly available data in the Great Basin/Southwest region and Mexico. We conducted post construction fatality monitoring at a wind energy facility in south Texas for 12 months (March 2017-March 2018). We established 100 x 100 m radius search plots at eight randomly selected turbines and searched the

roads and pads at an additional 92 turbines. Turbines were searched weekly from spring through fall and bimonthly during winter. In addition to standard fatality searches, we conducted searcher efficiency and carcass removal trials. We found 238 bats and 78 birds. The majority of bat fatalities were *Tadarida brasiliensis* at 76%, and the majority of bird fatalities were *Colinus virginianus* and *Cathartes aura*, with 17% and 12% respectively. The corrected fatality estimates were 2.0 birds/MW/year and 16.5 bats/MW/year. Post construction mortality monitoring data are rarely published, so making these data publicly available is of the utmost importance toward reducing turbine-caused fatalities.