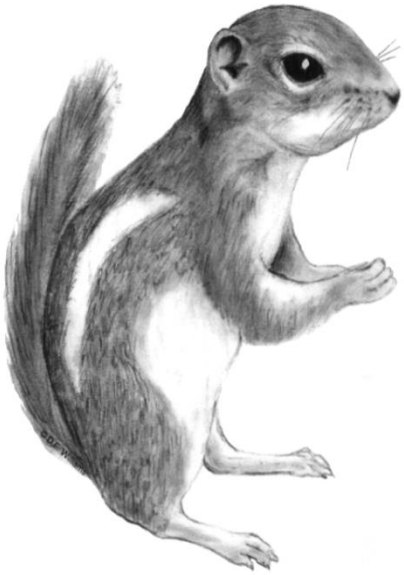
San Joaquin Valley
Natural Communities Conference
2022 Virtual Conference

Program and Abstracts



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SAN JOAQUIN VALLEY CHAPTER

THE WILDLIFE SOCIETY

San Joaquin Valley Natural Communities Conference
March 24, 2022

9:00 - 9:15	Brian Cypher (Moderator)	Welcome, schedule details, and announcements
9:15 - 9:35	Reagen O'Leary	*Investigating the Population Ecology of Blunt-nosed Leopard Lizards on Three Core Protected Sites in the San Joaquin Desert*
9:35 - 9:55	Kathryn Ramirez	*Observing predation pressure on the endangered blunt-nosed leopard lizard (Gambelia sila)*
9:55 - 10:15	Steven Sharp	*Reproduction of the Blunt-nosed leopard lizard (Gambelia sila) at Fresno Chaffee Zoo*
10:15 - 10:35	Erin Tennant	*Rapid growth of the Swainson's Hawk population in California since 2005*
10:35 - 10:55	**BREAK**	
10:55 - 11:15	Erica Kelly	*Sarcoptic Mange in Urban Kit Foxes: Potential for Cross-Species Transmission*
11:15 - 11:35	Brian Cypher	*Sarcoptic Mange in Kit Foxes: How Are City Foxes Hogging All the Mange?*
11:35 - 11:55	Lucas Hall	*Spatiotemporal interactions between San Joaquin kit foxes and other carnivores in an urban environment*
11:55 - 12:00	Nicole Deatherage	*Quick talk - Space Use Patterns of Endangered San Joaquin Kit Foxes at California Flats Solar Farm*
12:00 - 1:00	**LUNCH**	
1:00 - 1:20	David Wheatley	*The influence of habitat characteristics on the use of water by feral horses*
1:20 - 1:40	Magaly Jurado	*Predatory-prey interactions at man-made water sources in the Tehachapi Mountains*
1:40 - 2:00	Cody Hurt	*The influence of anthropogenic features on mammal activity in natural areas fragmented by urbanization*
2:00 – 2:20	David Germano	*Population Size and Demographic Characteristics of San Joaquin Antelope Squirrels (Ammospermophilis nelsoni) in the Lokern Area, Kern County*
2:20 - 2:25	David Germano	*Quick talk - Temperature and Humidity of Simulated Rodent Burrows in the San Joaquin Desert of California*
2:25 - 2:45	**BREAK**	
2:45 - 3:05	Madison Boynton	*Comparing camera traps and visual encounter surveys for monitoring small animals*
3:05 - 3:10	Ellen Cypher	*Quick talk - Survival of Propagated Bakersfield Cactus at Introduction Sites*
3:10 - 3:30	Julie Rentner	*River Partners Projects in the San Joaquin Valley*
3:30 - 3:35	Dawn Bradley	*Quick talk - Scientific Research and Volunteer Opportunities at California State Parks Great Basin District*
3:35 - 3:55	Ben Teton	*System level research and monitoring approaches at the Panoche Valley Preserve*
3:55 - 4:00	Mario Gaytan	*Quick talk - San Joaquin Kit Fox (Vulpes macrotis mutica) Predator-Predator Interaction with the American Badger (Taxidea taxus)*
4:00	SJV Chapter	Thanks, acknowledgements, and final announcements

Abstracts

Abstracts are listed in the order of presentation.
Presenters are listed in **bold**.

Investigating the Population Ecology of Blunt-nosed Leopard Lizards on Three Core Protected Sites in the San Joaquin Desert

Reagen O'Leary[1], Erin Tennant[1], David J. Germano[2]

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The blunt-nosed leopard lizard (*Gambelia sila*; BNLL) is a relatively large, predatory lizard that once occurred throughout much of the San Joaquin Desert and adjacent valleys and foothills. BNLL currently persists on less than 15% of its historical range, largely due to habitat loss. Despite having endangered status for over 40 years, basic population estimates and demographic data, which are crucial for understanding the status of BNLL throughout their range and gaining traction toward recovery actions, are lacking for several core sites. With federal funding (Section 6) we created three long-term population monitoring sites for BNLL at Lokern Ecological Reserve, Semitropic Ecological Reserve, and Pixley National Wildlife Refuge, and monitored these sites for three years (2015-2017). At each site we established a permanent survey grid, where we captured BNLL, permanently marked, and recorded metrics including sex, length, mass, coloration, and number of eggs palpated in females. Since 2017 we have continued monitoring these sites with a survey frequency adaption to transform the study into a manageable long-term survey effort. We present preliminary data from these long-term monitoring sites, including population structure, density estimates, and survivorship, and we discuss future research directions.

Reproduction of the Blunt-nosed leopard lizard *(Gambelia sila)* at Fresno Chaffee Zoo

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The Blunt-nosed leopard lizard *(Gambelia sila)* is an endangered and charismatic lizard species native to California's Central Valley. In partnership with The Bureau of Land Management and the Telemeco Reptile Ecology and Evolution lab at California State University, Fresno, emergency permission was granted to collected five adult *G.sila* (two male and three female) from the Panoche Hills plateau. This colony was taken to Fresno Chaffee Zoo to form the first captive assurance colony of *G.sila*. These five individuals at the time were thought to be the remainder of the Panoche hills plateau population. The lizards were subsequently acclimated to human care and taken through an artificial brumation cycle with the goal of breeding the group in the spring of 2021. Over the spring and summer of 2021, the group was successfully reproduced at FCZ resulting in 20 offspring (10 male and 10 female). This event represents the first time *G.sila* has ever reproduced in human care.

Observing predation pressure on the endangered blunt-nosed leopard lizard (*Gambelia sila*)

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The blunt-nosed leopard lizard (*Gambelia sila*) is a federal- and state- listed endangered species endemic to the San Joaquin Desert that is on the decline throughout much of its range. Although climate change and habitat destruction are commonly cited reasons for recent declines, increased predation pressure could also contribute. Common ravens (*Corvus corax*) are a known lizard predator that have greatly increased in abundance in recent decades. We hypothesized that this increase contributed to the recent decline and potential extinction of *G. sila* on the Panoche Plateau. We tested this hypothesis by deploying clay models color- and size-matched to live *G. sila* at the Panoche Plateau and a nearby site that has not declined. A subset of models was also paired with camera traps to aid predator identification. We observed attempted predation events from mammalian and avian predators at both sites, but we did not observe any attempted predation from common ravens. The most commonly observed predators were coyotes and loggerhead shrikes. Altogether, we are able to further pursue *G. sila* conservation by observing the effects that predation has on two distinct populations.

Rapid growth of the Swainson's Hawk population in California since 2005

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By 1979 Swainson's Hawks (*Buteo swainsoni*) had declined to as low as 375 breeding pairs throughout their summer range in California. Shortly thereafter the species was listed as threatened in the state. To evaluate the hawk's population trend since then, we analyzed data from 1,038 locations surveyed throughout California in either 2005, 2006, 2016, or 2018. We estimated a total statewide population of 18,810 breeding pairs (95% CI: 11,353-37,228) in 2018, and found that alfalfa (Medicago sativa, lucerne) cultivation, agricultural crop diversity, and the occurrence of non-agricultural trees for nesting were positively associated with hawk density. We also concluded that California's Swainson's Hawk summering population grew rapidly between 2005 and 2018 at a rate of 13.9% per year (95% CI: 7.8-19.2%). Despite strong evidence that the species has rebounded overall in California, Swainson's Hawks remain largely extirpated from Southern California where they were historically common. Further, we note that the increase in Swainson's Hawks has been coincident with expanded orchard and vineyard cultivation which is not considered suitable for nesting. Therefore, we recommend more frequent, improved surveys to monitor the stability of the species' potential recovery and to better understand the causes. Our results are consistent with increasing raptor populations in North America and Europe that contrast with overall global declines especially in the tropics.

Sarcoptic Mange in Urban Kit Foxes: Potential for Cross-Species Transmission

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A robust population of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) occurs in the city of Bakersfield, CA. In March 2013, sarcoptic mange was detected in this population and the mite quickly spread. In January 2019, mange also appeared in a smaller kit fox population in the neighboring town of Taft, CA. To date there have been more than 430 confirmed cases and 100 confirmed deaths. An additional 160 individuals are considered deceased because there is no indication that kit foxes recover without medical intervention. These numbers are also presumed underestimations of the actual number of kit foxes that have contracted and died from mange. In addition to mange response, the Endangered Species Recovery Program (ESRP) has conducted a yearly citywide camera survey in Bakersfield since 2015 and Taft since 2019 to assess the occurrence of mange among kit foxes and the spatial pattern of spread. Based on the Bakersfield survey, the urban kit fox population has declined by 67% since 2015. This annual camera survey also provides useful information on co-occurring species that could contract or transmit mange. Of the total number of cameras that have detected kit foxes with mange, 88% of those also detected at least one secondary species including raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), California ground squirrels (*Otospermophilus beecheyi*), and domestic cats and dogs (*Felis catus* and *Canis familiaris*). The annual camera surveys have also detected coyotes (*C. latrans*), red foxes (*V. vulpes*), gray foxes (*Urocyon cinereoargenteus*), and opossums with active mange infestations. Transmission routes for all of these species remain uncertain and the potential for transmitting mites to new areas or new individuals of multiple species is possible. Overall, mange presents a risk to multiple species in the urban environment, including domestics, for as long as it continues to circulate.

Sarcoptic Mange in Kit Foxes: How Are City Foxes Hogging All the Mange?

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A sarcoptic mange epidemic has resulted in a significant reduction in the population of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) in the city of Bakersfield, California. Mange also has impacted another population of urban kit foxes in the city of Taft. Sarcoptic mange in kit foxes is always lethal if untreated. Thus, a significant concern is whether mange is spreading beyond the urban populations and constitutes a threat to the range-wide San Joaquin kit fox population. In addition to monitoring the urban populations, we have been monitoring exurban populations as well through camera station surveys, live-trapping, and opportunistic carcass examination. To date, mange has not been detected in exurban kit foxes. We also monitored kit foxes near the urban-exurban interface via telemetry. We found that urban kit foxes are frequently crossing this interface and moving up to 2.9 km out into exurban habitats, and commonly using dens in exurban areas. Thus, the potential for transmission of mange from urban to exurban foxes is considerable. A leading hypothesis for the apparent absence of mange in exurban populations may be differences in fox density. Density estimates for exurban populations range from 0.24-0.82/km^2 while estimates for urban foxes in Bakersfield range from 1.23-2.56/km^2. Higher densities result in greater spatial overlap and increased potential for contacts. More importantly, spatial overlap may result in more incidents of particular dens being used by adjacent social groups. This use does not need to be concurrent as mange mites potentially can live off-host in the dens for multiple days. Thus, higher urban fox densities in may facilitate mange transmission whereas lower exurban fox densities may result in transmission rates too low to sustain an epidemic. The role of dens in mange transmission will be investigated further and monitoring of both urban and exurban fox populations will continue.

Spatiotemporal interactions between San Joaquin kit foxes and other carnivores in an urban environment

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The endangered San Joaquin kit fox (*Vulpes macrotis mutica*) is a small desert carnivore subject to competition and predation from other carnivores. Kit foxes often use the available landscape dynamically to minimize potential interactions with larger competitors and predators. However, these interactions are likely complicated in novel environments where there are novel species of competitors and predators that may affect native species without evolved mechanisms of defense or avoidance. This may be the case for kit foxes in the San Joaquin Valley as they share the urban environment with novel carnivores (e.g., domestic dogs, cats, opossums, etc.). We hypothesized that the presence of novel competitors and predators would influence the spatiotemporal dynamics of kit foxes, causing kit foxes to avoid times and locations where other carnivores were present, with larger, dominant species (e.g., dogs, coyotes) eliciting the strongest avoidance response. We used remote cameras at school campuses across the southern San Joaquin Valley to monitor the presence and activity of urban carnivores in the fall, winter, and spring seasons of 2020 to 2022. We used generalized linear mixed models and AIC model selection and overlap indices to determine if the temporal and spatial activity of kit foxes was impacted by other urban carnivores. Substantial spatial and temporal overlap between kit foxes and most carnivores was observed in our study, however the effects of other carnivores on kit foxes were mixed. For example, striped skunks had a strong positive association with kit foxes, whereas domestic dogs had a strong negative association with kit foxes. Our findings provide support for the hypothesis that kit foxes spatially and temporally avoid larger, dominant species in an urban environment.

Space Use Patterns of Endangered San Joaquin Kit Foxes at California Flats Solar

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In fall 2020 the Endangered Species Recovery Program initiated a telemetry effort at California Flats Solar in Cholame Valley, Monterey County, CA to collect demographic, health, and other ecological data to contribute to a meta-population viability analysis for the endangered San Joaquin kit fox (*Vulpes macrotis mutica*). Kit foxes were live-trapped, tagged, sampled, and fitted with a GPS and/or VHF radio-collar if appropriate. In November 2020, 16 kit foxes were fitted with a radio-collar and in December 2021 seven of those individuals were re-collared and one fox received a new collar. Telemetry monitoring was conducted on at least a triweekly basis and if possible, collared foxes were tracked to dens or till they were directly observed and GPS data were downloaded from collars via Bluetooth. GPS units were programmed to take one location point at 1230h each day and two location points at varying times after dark each night. We used location data collected to date to estimate the proportion of points that occurred within the fence line of the solar panel arrays, within a 1.5-km buffer around the fence line, or outside the 1.5-km buffer for all foxes. We found on average most location points occurred within the 1.5-km buffer and the fewest occurred outside the buffer regardless of time of day. Location points collected at noon or during daylight occurred mostly within the array fence line while location points collected at night occurred mostly within the 1.5-km buffer on average. Based on this preliminary analysis, kit foxes are likely foraging outside the panels at night, though not traveling far from the panels, and returning to the panels during the day. Kit foxes may take advantage of the higher prey availability outside panels while retreating within the safety of the array fence line and solar panels for denning during the day.

The influence of habitat characteristics on the use of water by feral horses

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Feral horse populations across the American west pressure and often outcompete native species due to their high populations, broad environmental tolerance, and vagility. Water sources within these regions pose a high likelihood for interspecies interactions, including competition. The goal of this study is to understand the relationship between habitat characteristics and water source selection for horses. To measure horse activity, we used infrared-triggered cameras to monitor 32 water sources in the Great Basin Desert of western Utah across two field seasons (June-October). The 32 water sources consisted of 11 natural springs/seeps, 9 water developments for wildlife (i.e., guzzlers), 8 livestock troughs, and 4 ponds. To test our hypothesis that horses select water sources based on available habitat, we characterized the habitat surrounding each water source at varying scales (50m – 5000m). In each of these spatial scales, we included the number of water sources, mean slope, mean elevation, mean aspect, and the proportion of different types of vegetation cover, height, and type available using LANDFIRE data. Using generalized linear mixed models and AIC model selection, we compared models with a habitat covariate to an intercept only model that included just horse activity, limiting the models to no more than three variables due to our modest sample size. According to our findings, horses specifically selected water sources with a low proportion of shrub or tree cover. Moreover, horse activity around water sources increased as shrub and tree cover decreased. While these variables were the top competing models, density of water sources was also an influential variable. Our study showed that other habitat characteristics measured around the area did not influence horse activity. These results can inform prioritization strategies to mitigate conflict between native wildlife and feral horses.

Predator-prey interactions at man-made water sources in the Tehachapi Mountains

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Artificial water sources such as reservoirs, impoundments, and livestock tanks serve as sources of drinking water for many birds and mammals. They are often introduced to areas with hot, dry environments as forms of wildlife management practices to ensure that the animals have access to enough drinking water. Because water sources are communal resources, it is likely that they are used by both predator and prey, possibly increasing the chance of predation. The objective of this project was to observe and document predation events at different artificial or altered water sources on the Tejon Ranch Conservancy, California. Twelve Reconyx trail cameras were located along two creeks and six troughs in our study area. The cameras were installed in 2014, and visited once a month, or as weather permitted, for 7 years. Out of roughly 12,000 videos that were captured, five occurrences of predation were caught on camera, totaling less than 1% of the videos captured by the trail cameras. Predation events occurred at all hours of the day and among different species. Most predation events included bobcats (*Lynx Rufus*), but we also observed a predation event by an American black bear (*Ursus americanu*s). We also observed mountain lions (*Puma concolor*) caching their prey near water sources, suggesting that predation occurred at or near the water sources. Overall, predation events at water sources were rare among mammals in the Tejon Ranch, indicating that artificial water sources do not increase the risk of predation for prey species.

The influence of anthropogenic features on mammal activity in natural areas fragmented by urbanization

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Habitat loss is one of the primary drivers of loss of global biodiversity. Much of the habitat loss is due to anthropogenic activities (e.g., urbanization). While urbanization has varying effects on biodiversity, these effects are still coming into view for many wildlife species. Specifically, we do not understand how animal communities respond to anthropogenic features in fragmented urban landscapes. Our objective was to quantify the influence of urbanization on mammal activity in a natural fragment within an urban area. We hypothesized that proximity to anthropogenic features would influence the activity of a mammal community. We used remote cameras to monitor mammal activity at the Robert J. Bernard Biological Field Station in Southern California during the fall and spring seasons of 2018 and 2019. We used generalized linear models and AIC model selection to determine the potential effects of anthropogenic features on each mammal species. We had enough data to model the response of four different species of mammals: bobcat (*Lynx rufus*), California ground squirrel (O*tospermophilus beecheyi*), coyote (*Canis latrans*), and desert cottontail (*Sylvilagus audubonii*). Our focal species of mammals had mixed responses to urbanization. We found that bobcats had a negative response to roads, California ground squirrels had a positive response to fences, coyotes had a negative response to fences, whereas desert cottontails did not respond to the anthropogenic features that we measured. Overall, our study illustrates that anthropogenic features influence different species of mammals inhabiting natural habitat fragmented by urbanization.

Population Size and Demographic Characteristics of San Joaquin Antelope Squirrels (*Ammospermophilis nelsoni*) in the Lokern Area, Kern County

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Although a state-listed threatened species, the San Joaquin Antelope Squirrel (*Ammospermophilis nelsoni*; SJAS) has not received the attention that other protected species have in the San Joaquin Desert, especially population dynamics and demographic characteristics. A notable exception is the study by Germano et al. (2012), which tracked populations of SJAS (and other species) at the Lokern Natural Area. The focus of that study, however, was on the effect of cattle grazing on population abundance and trapping only occurred once per year. A direct comparison of marked SJAS with multiple trapping sessions per year has not been conducted. To determine more precisely changes in population size and demographics of SJAS, we trapped squirrels quarterly on two 8 × 8 trapping grids on the Lokern in Kern County from 2019–2022. One grid was in an area with *Atriplex* shrubs, and one was almost devoid of shrubs. At both sites, the number of SJAS increased over the 3-y study, despite relatively low annual rainfall. The trendline for the population on the grid without shrubs was greater than the shrub grid. Reproductive activity was limited to fall and winter months for males, and for the most part only to winter (January or February) for females, although a few females were found post lactating in spring. For the most part, we found the greatest number of young in May, perhaps indicating only one bout of reproduction a year, but we found a few young in summer on the shrub plot. Activity does not seem to be greatly different across seasons. Once the population numbers increased from the beginning of our trapping, we caught many squirrels in November and February, even though nighttime temperatures were in the 30s. Apparently enough rain fell at the correct times during our study to produce food sufficient to sustain a growing population.

Temperature and Humidity of Simulated Rodent Burrows in the San Joaquin Desert of California

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In 2003, we initiated a study to better understand the key environmental factors (temperature and humidity) that rodents and lizards experience underground. It is expected that rodents in desert areas, particularly, would benefit by escaping adverse temperatures by remaining underground during some times of the day and night. Also, humidity levels in burrows are likely higher and less variable in burrows than above ground, which can be vital for species that do not drink free water most of the year. We installed 40 temperature and relative humidity loggers (Hobo Pro RH/Temp, model H08-032-08) on the study site in the Lokern Natural Area, split evenly between one control and one treatment plot. At the time of the study, we had older Hobo data loggers that were fairly large compared to newer units. Therefore, we dug artificial slanting burrows that were 12.7 cm in diameter (so that the loggers would fit), about 115 cm deep and about 30–40 cm below the surface at the distal end. The size of the tubes approximate the size of burrows use by Giant Kangaroo Rats (*Dipodomys ingens*) and San Joaquin Antelope Squirrels (*Ammospermophilus nelsoni*). We also installed four above ground data loggers. Loggers recorded data from November 2003 to May 2007 every day at 0000, 0600, 1200, and 1800. We have yet to fully analyze our data but, in general, underground temperatures were markedly less variable than above ground, and varied from about 7° C to about 14° C in the winter despite freezing low temperatures above ground. In July temperatures were generally between 35°–40° C compared to highs above ground reaching 46° C. Relative humidity was also highly variable above ground but varied between 85–95% in January and 65–85% in July underground.

Comparing camera traps and visual encounter surveys for monitoring small animals

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Amphibian and reptile species face numerous threats including disease, habitat loss and degradation, invasive species, and global climate change. However, effective management and conservation of herpetofauna largely depends upon resource-intensive survey methodologies. Recent research has shown promise in the use of camera trapping techniques, but these methods must be tested alongside traditional methods to fully understand their advantages and disadvantages. To meet this research need, we tested two herpetofauna survey methods: a modified version of the Adapted-Hunt Drift Fence Technique, which combines a drift fence with camera traps; and a traditional method of visual encounter surveys (VES) with cover boards. Between June and August 2020, we conducted two VES and installed one drift fence with camera traps at ten sites in Monterey County, CA, USA. The drift fence/camera setup outperformed the VES in terms of number of observations and herpetofauna species detected. Drift fences with cameras produced a mean of 248 images of three to six species per site, while VES and cover objects produced a mean of 0.6 observations of zero to one species per site. Across all sites, we detected seven reptile and one amphibian species with the drift fence/camera setup, while VES resulted in identifications of two reptile and one amphibian species. In addition, drift fence/camera setups recorded a minimum of nine non-herpetofauna species including small mammals, birds, and invertebrates. Our research supports that drift fences combined with camera traps offer an effective alternative to VES for large-scale, multi-species herpetofauna survey efforts. Furthermore, we suggest specific improvements to enhance this method's performance, cost-effectiveness, and utility in remote environments. These advances in survey methods hold great promise for aiding efforts to manage and conserve global herpetofauna diversity.

Survival of Propagated Bakersfield Cactus at Introduction Sites

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In 2014, propagated plants of endangered Bakersfield cactus (*Opuntia basilaris* var. *treleasei*) were out-planted at nine locations in the southeastern San Joaquin Valley, California. Small natural populations of Bakersfield cactus were present at two of the sites while the other seven constituted new populations. To propagate the new plants, pads were collected from the existing or nearby natural populations, placed in pots with soil, and grown in a propagation facility for one year. In total, 385 plants were outplanted in the nine populations (range = 25-53). We visited the populations in February 2022 to assess survival of the transplants. One population had failed completely (0% survival). Survival at the remaining eight populations ranged from 5.9% to 57.7%. Overall success was 35.1% (135/385). Reasons for plant mortality are unknown but could include suboptimal soil conditions, competition from other vegetation (particularly non-native grasses), drought, damage from cattle, and a grasshopper infestation in 2020. Despite the mortality, plants were established at eight of the sites resulting in six new populations and two expanded populations. Surviving plants were largely thriving. All of the transplants began with 1-3 pads. Almost all of the surviving plants had a considerable number of new pads with 29 of the 135 surviving plants having 50 or more pads. Propagation and outplanting constitutes a promising strategy for establishing new Bakersfield cactus populations and expanding existing populations. An analysis of optimal site conditions for Bakersfield cactus could facilitate the identification of appropriate sites for population establishment and increase the probability of success.

Scientific Research and Volunteer Opportunities at California State Parks Great Basin District

Dawn Bradley, California State Parks

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A quick overview of the many parks within the Great Basin District that includes parks in the San Joaquin Valley, Tehachapi Mountains, and Mojave Desert. We are looking to invite and see if there is interest from various academic, consulting, and citizen scientists groups to assist and/or conduct their own research at some of the parks. The discussion will go over the various parks within the Great Basin District as well as some of the current activities being conducted by Environmental Scientists and potential activities that could be conducted at these sites.

System level research and monitoring approaches at the Panoche Valley Preserve

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In 2018 the Center for Natural Lands Management acquired the 27k acre Panoche Valley Preserve in San Benito and Fresno Counties. Since that time, Preserve Managers have developed a landscape-scale research and monitoring regime designed to help better understand and steward the numerous special status species that occur there. This presentation will describe how species monitoring approaches at the Panoche Valley Preserve have been organized within a research framework to provide real-time insights for managers, while addressing long-term ecological research objectives relevant to native species conservation throughout the San Joaquin Valley.

San Joaquin Kit Fox (*Vulpes macrotis mutica*) Predator-Predator Interaction with the American Badger (*Taxidea taxus*)

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Multiple examples of canid-badger interactions have been described in American folklore and recent literature. While some studies suggest that these canid-badger interactions could be mutually beneficial, many observations appear to show that canid-badger interactions may be commensal, at best. While the coyote (*Canis latrans*) might have an advantage from the interaction, the American badger may merely tolerate the coyote (Minta et al. 1992). In instances in which coyote-badger interactions are observed, the coyote follows the badger catching any prey that is flushed back towards its direction. These interspecies observations indicate that coyote hunting success increased, while badger hunting success may have remained relatively the same (Scobie 2002). We found only one paper discussing kit fox-badger interactions. Similarly, as badgers with coyotes, badgers were seen as merely tolerant of kit foxes during hunting events, potentially being energetically costly or risky for foxes and badgers to interact in an antagonistic manner, and therefore tolerance represents a least-cost pathway (Clark et al. 2015).
There were no recordings or observations of badgers following canids while hunting until a few years ago. In February 2020, a video was released of a coyote eagerly waiting for a badger to catch up before going through a culvert together. Recently, kit fox-badger interactions were observed in the Lokern preserve on two occasions. During both, the badger was closely following a lone kit fox during what seemed to be typical kit fox hunting behavior. Generally, it appears, badgers usually derive neither benefit nor harm in this commensal relationship. However, our observations indicate that there might be some benefit to the badger. The driver of this behavior is not entirely certain, but it could be a combination of factors. Continued study might provide further understanding on badger-canid interactions and mutualistic behavior.