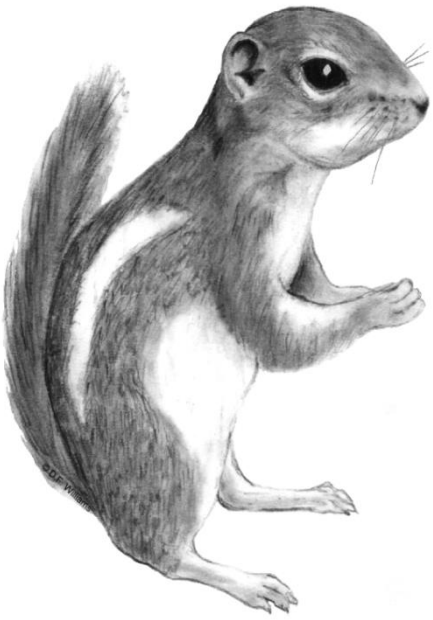
San Joaquin Valley
Natural Communities Conference
March 23, 2017
Hodel's Country Dining, Bakersfield

Program and Abstracts



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San Joaquin Valley Natural Communities Conference
March 23, 2017
Hodel's Country Dining

8:00 - 9:00	Registration	
9:00 - 9:10	Brian Cypher Larry Saslaw	Welcome to the Conference, Moderator Schedule details and announcements
9:10 - 9:30	Tory Westall	*Response to Sarcoptic Mange in Urban San Joaquin Kit Foxes (Vulpes macrotis mutica)*
9:30 - 9:50	Brian Cypher	*Spatial Spread and Routes of Transmission of an Emerging Epidemic of Sarcoptic Mange in Endangered San Joaquin Kit Foxes*
9:50 -10:10	Erica Kelly	*Desert kit fox (Vulpes macrotis arsipus) food habits and competitive interactions with coyotes (Canis latrans) in the Mojave Desert*
10:10 - 10:30	Mike Westphal	*Restoring California jointfir (Ephedra californica) to buffer climate change effects on Blunt-nosed Leopard Lizards (Gambelia sila) in the San Joaquin Desert*
10:30 – 10:50	BREAK	
10:50 - 11:10	Greg Warrick	*Effects of annual vegetation and late-season rainfall on the density of Atriplex polycarpa seedlings*
11:10 – 11:30	Christopher Hauser	*Valley Oak Growth and Survival in a Southern California Savanna*
11:30 – 12:30	LUNCH	***Registered participants will be served lunch.***
12:30 – 1:30		**Quick Talk Presentations**
	Alex Single	*Volunteers Needed for Black Swift (Cypseloides niger) Surveys in the Sierra Nevada*
	Petros Chrysafis	*Effects of human development and vegetation on riparian habitat use by mammals*
	Kristin Pittack	*Bakersfield Habitat Conservation Plan Update*
	Justin Purnell	*Bats at Topaz Solar Farms on the Carrizo Plain*
	Geoff Grisdale	*Nesting Swainson's Hawks at Pixley National Wildlife Refuge*
	Erin Tennant	*Update on Swainson's Hawk statewide status survey*
	Gary Adest	*Holistic streambed restoration*
	Kacy O'Malley	*TWS San Joaquin Valley Chapter*
1:30 – 1:50	Erin Tennant	*Non-invasive Survey Methods for Detecting the Endangered Buena Vista Lake Shrew (Sorex ornatus relictus)*
1:50 - 2:10	Brian Cypher	*Conservation of the Endangered Buena Vista Lake Shrew: Status Surveys, Habitat Suitability, and Conservation Strategies*
2:10 - 2:30	Robyn Powers	*Using Scent-Detection Dogs to Survey for the Giant Gartersnake (Thamnophis gigas)*
2:30 - 2:50	Melissa Odell	*Adapting with a Changing Climate: Plug and Pond Meadow Restoration in Mariposa County, CA - Status and Preliminary Monitoring Results*
2:50 - 3:10	BREAK	Silent Auction Closes and items are purchased.
3:10 - 3:30	Katie Brown	*The Future–Combining Energy Production with Rangeland Conservation.*
3:30 – 3:50	Christine Van Horn Job	*Use of Kit fox Artificial Dens as a Mitigation and Conservation Measure for the City of Bakersfield's Thomas Roads Improvement Program*
3:50 – 4:10	Brian Cypher	*Conservation of Endangered Tipton Kangaroo Rats: Status Surveys, Habitat Suitability, and Conservation Strategy*

Abstracts

Oral Presentations

RESPONSE TO SARCOPTIC MANGE IN URBAN SAN JOAQUIN KIT FOXES (*VULPES MACROTIS MUTICA*)

Tory Westall, California State University, Stanislaus, Endangered Species Recovery Program, twestall@esrp.scustan.edu, P.O. Box 9622, Bakersfield, CA 93389, 661-835-7810

Erica Kelly[1], Brian Cypher[1], Jaime Rudd[2,4], Don Richardson[3], Kyle Tabor[1], Deana Clifford[2], and Janet Foley[4]

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Beginning in March 2013, the Endangered Species Recovery Program (ESRP) and the California Department of Fish and Wildlife (CDFW) began receiving reports of sick San Joaquin kit foxes (*Vulpes macrotis mutica*) in Bakersfield, California. The first case was confirmed to be an infestation of mites (*Sarcoptes scabiei*) which causes a skin condition known as sarcoptic mange. In the last four years, 209 kit foxes with sarcoptic mange have been reported from locations all over Bakersfield. ESRP has been working in collaboration with CDFW to respond and document the progression of this outbreak. When possible, live foxes are trapped and taken to the California Living Museum (CALM) for treatment. A total of 73 foxes have been recovered alive and hospitalized at CALM and of those, 62 have been successfully rehabilitated and released. Recovered foxes are released with a medicated collar that should provide protection for a much longer period than topical medications provide. In addition to hospitalized animals, 123 kit foxes have been medicated in the field to treat light mange infestations or to prevent mange in healthy individuals. In 28 cases, fox carcasses were collected and sent to the CDFW Wildlife Investigation Laboratory in Rancho Cordova for full necropsy and sample collection and testing. There have been 40 incidents of mange in which the fox was not recovered, but mange is fatal in kit foxes and these individuals are presumed dead. ESRP and CDFW will continue to work together to help kit foxes and address public concerns; learn what we can about the spread of the mites and the progression of the disease; and manage the epizootic if possible.

SPATIAL SPREAD AND ROUTES OF TRANSMISSION OF AN EMERGING EPIDEMIC OF SARCOPTIC MANGE IN ENDANGERED SAN JOAQUIN KIT FOXES

Brian Cypher, California State University-Stanislaus, Endangered Species Recovery Program, bcypher@esrp.csustan.edu, P.O. Box 9622, Bakersfield, CA 93389, 661-835-7810

Jaime Rudd[1,2,3], Tory Westall[1], Janet Foley[2], and Deana Clifford[3]

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In spring 2013, sarcoptic mange was detected and confirmed in a population of endangered San Joaquin kit foxes (*Vulpes macrotis mutica*) in Bakersfield, CA. All evidence indicates that this disease is fatal to kit foxes in the absence of treatment. We used molecular epidemiology to determine whether a single or multiple genotypes of the *Sarcoptes scabiei* mite are circulating among wildlife and domestic dogs in the Bakersfield metropolitan area. We also used two non-invasive methods, automated camera stations and molecular diagnostic assays on canid scat samples, to determine the spatial extent and patterns of spread of the mange outbreak in kit foxes in Bakersfield. Our data to date suggest that mites derived from kit foxes are genetically different from red foxes, coyotes, and dogs from various geographic locations. However, our mite samples from other species were limited. We are continuing efforts to secure additional mite samples and continue examining relationships among mites from various hosts in an effort to determine the source of sarcoptic mange in the Bakersfield kit fox population. We concluded that fecal-PCR testing for mites was not a sensitive method for detecting mange cases in kit foxes. However, automated camera stations constituted an effective technique for conducting surveys to detect kit foxes infested with sarcoptic mange. Foxes readily came to the stations, and in most cases the cameras captured multiple images of each individual from various angles providing an excellent opportunity to examine each fox for signs of mange. Our camera station surveys in 2015 and 2016 revealed distribution and spread patterns of mange and provided some evidence that transmission among kit foxes may be density related. This suggested that intervention strategies that reduce the density of susceptible individuals might be effective in interrupting transmission of the disease. Another survey will be conducted in 2017, and intervention strategies will be tested.

DESERT KIT FOX (*VULPES MACROTIS ARSIPUS*) FOOD HABITS AND COMPETITIVE INTERACTIONS WITH COYOTES (*CANIS LATRANS*) IN THE MOJAVE DESERT

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Canids have extremely diverse ecological attributes and various forms of competition are a common occurrence within this family. Throughout their range in southwestern North America, kit foxes (*Vulpes macrotis*) are sympatric with coyotes (*Canis latrans*) resulting in the potential for exploitative competition. Ecological interactions between coyotes and desert kit foxes (*V.m. arsipus*) in the Mojave Desert have not been investigated in detail, but based on previously completed studies between coyotes and foxes, it is expected that exploitative competition does occur between the two species. Also, an extensive multi-year analysis of desert kit fox diet has never been performed. A dietary analysis of desert kit fox scats collected from fall 2009 to summer 2014 (five years) in natural habitats in the Mojave Desert was completed. A total of 1230 desert kit fox scats was analyzed. A concurrent study on the diet of coyotes in the Mojave Desert allowed for a comparison between the two species to determine the degree of exploitative competition. Both species consumed primarily nocturnal rodents, rabbits, birds, reptiles, and insects, although in different proportions. Coyotes also consumed considerable fruit and anthropogenic items. Dietary breathe of coyotes may be broader while that of kit foxes may exhibit more specialization, particularly on nocturnal rodents. Clearly, resource use by these two species overlaps considerably, but exploitative competition may only be an issue when prey availability is limited (e.g., during prolonged drought). Interest in the conservation of the desert kit fox is increasing and further knowledge regarding this subspecies, including dietary patterns and preferences, would be useful. Determining their associations with competitors, such as the coyote, would be advantageous for understanding ecological relationships. Therefore, information obtained from this research project may assist in future management and conservation of the desert kit fox.

RESTORING CALIFORNIA JOINTFIR (*EPHEDRA CALIFORNICA*) TO BUFFER CLIMATE CHANGE EFFECTS ON BLUNT-NOSED LEOPARD LIZARDS (*GAMBELIA SILA*) IN THE SAN JOAQUIN DESERT

Michael Westphal; US Bureau of Land Management; 940 2nd Avenue, Marina, CA, 93933; 831-582-2229; mwestpha@blm.gov; **Alex Filazzola; Amanda Liczner; Christopher Lortie; Debra Woollett-smith; Alice Whitelaw**

The Federally endangered blunt-nosed leopard lizard (*Gambelia sila*) is endemic to the San Joaquin Desert of California. Recent research suggests that *G. sila* is vulnerable to predicted effects of climate change, particularly drought. Because of the paucity of undisturbed habitat remaining for the species, restoration of desert lands may be crucial to conserving the species. We investigated the role of a desert shrub (*Ephedra*

californica) in the ecology of *G. sila* and examined the resilience of the shrub to fire, outplanting, seeding, and removal. Scat detection showed a marked preference for use of *E. californica* by *G. sila* versus annual grassland devoid of shrubs. Two-year old greenhouse-starts of *E. californica* were heavily grazed by rodents in the first few days after outplanting at one site but showed greater success at a dune restoration site. Broadcast seeding was not successful, but *E. californica* was observed to resprout following fire and shrub removal. We measured the extent of resprouting via weighing and sprout counts. We conclude that, once methods for initial establishment have been perfected, *E. californica* may constitute a lasting improvement to *G. sila* habitat in the San Joaquin Desert.

EFFECTS OF ANNUAL VEGETATION AND LATE-SEASON RAINFALL ON THE DENSITY OF ATRIPLEX POLYCARPA SEEDLINGS

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Reestablishing common saltbush (*Atriplex polycarpa*) and other shrub species within open grasslands is a potential method of enhancing habitat for some threatened and endangered species of the San Joaquin Valley. However, previous harrowing and broadcast seeding efforts in western Kern County have resulted in poor saltbush establishment during approximately 80% of the years, possibly due to competition with annual herbaceous vegetation and/or low soil moisture during the germination window for common saltbush (February-March). To evaluate whether these factors may be limiting saltbush recruitment, I evaluated the success of nine years of seeding efforts in relation to herbaceous cover and precipitation and found that saltbush seedling density was highest when herbaceous cover was <60 percent and a germinating rainfall event (>0.5 inches) occurred during February-March. I also directly assessed the effects of herbaceous cover on *Atriplex* by comparing counts of saltbush seedlings between transects sprayed with glyphosate (timed only to kill herbaceous plants) to unsprayed control transects. Shrub seedling numbers were significantly higher ($p<0.001$) on transects in which annual herbaceous vegetation was suppressed with glyphosate than on control transects. These results indicate that good conditions for germination and survival of common saltbush seedlings occur when sufficient precipitation for seed germination occurs late in the growing season and herbaceous cover levels are low-moderate. This combination of conditions appears to be naturally rare and may occur primarily during or shortly after multi-year droughts (e.g. 2013, 2015). Although natural conditions for germination and recruitment of common saltbush may occur infrequently, carefully-timed glyphosate treatments can reduce competition between annual vegetation and *Atriplex* seedlings, thereby increasing the potential for more frequent opportunities for saltbush reestablishment.

VALLEY OAK GROWTH AND SURVIVAL IN A SOUTHERN CALIFORNIA SAVANNA

Christopher Hauser, Center for Natural Lands Management, chauser@cnlm.org
Greg Warrick, Center for Natural Lands Management

Tree condition and survival are thought to be influenced by a variety of environmental factors and intrinsic physical characteristics. In this study, we took advantage of a natural experiment on a nature preserve and an adjacent golf course in Santa Clarita, Los Angeles County, in which about 900 valley oak (*Quercus lobata*) trees were measured and characterized in 1987, and then again in 2016 after an extreme drought in 2015 killed 25% of the trees. We investigated how growth rate, drought survival, and post-drought health were related to the growing environment and physical characteristics of each tree. The results showed that the 29-year trunk diameter (DBH) growth rate was strongly increased by supplemental summer irrigation, but was not significantly affected by any other environmental factors or physical characteristics. Drought survival was slightly higher if trees entered the drought as larger, healthier trees. Drought survival and post-drought health were much higher if the trees received supplemental summer irrigation. Surprisingly, trunk growth rate was not affected by tree size, and drought survival and post-drought health were not affected by slope aspect, percent slope, or proximity to ephemeral surface water. The results of this study will be used to inform future management of the oak population on this nature preserve, to create a demographic model of the tree population, and to guide the possible planting of replacement oaks following the drought.

NON-INVASIVE SURVEY METHODS FOR DETECTING THE ENDANGERED BUENA VISTA LAKE SHREW (*SOREX ORNATUS RELICTUS*)

Erin Tennant[1,3], Brian Cypher[2], Larry Saslaw[2], Tory Westall[2], Jacklyn Mohay[1], Erica Kelly[2], and Christine Van Horn Job[2]

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When surveying for any wildlife species, but especially an endangered species, it is important to have non-invasive survey techniques available to prevent possible injury or death to target species. For small mammals, like the Buena Vista Lake shrew (*Sorex ornatus relictus*: BVLS), live-trapping in box traps, such as Sherman traps, or using pit fall traps, are typically the most common detection techniques. However, both methods have caused BVLS mortalities, with pit fall traps having particularly high rates of injury or death. In order to reduce impacts from live-trapping and possibly have better detection success, we investigated three potential non-invasive survey methods. These methods included track tubes, scat tubes, and camera traps. These three non-invasive survey techniques were initially tested in areas with high detection rates of shrews during previous live-trapping surveys. We found that Reconyx® camera traps specifically designed with a close focal distance outperformed all other survey methods. Track tubes were the least effective method. We followed up with a comparison test of scat tubes, camera traps, and small Sherman live-traps. Tests were conducted at three sites where

BVLS were known to occur. At each site, we established 10 stations, each with a scat tube, camera, and live-trap, and operated the stations for 3 nights. The number of shrews captured at the three sites was 1, 0, and 0. The respective number of scat tubes with putative shrew scats was 1, 6, and 4. The respective number of cameras that detected shrews was 8, 9, and 7. Furthermore, of the 24 camera stations that detected shrews, 21 detected them on the first night. Cameras typically captured multiple images of shrews, sometimes numbering in the dozens. Thus, the camera traps markedly outperformed the scat tubes and live-traps at all sites. Use of cameras is highly recommended for conducting surveys for BVLS.

CONSERVATION OF THE ENDANGERED BUENA VISTA LAKE SHREW: STATUS SURVEYS, HABITAT SUITABILITY, AND CONSERVATION STRATEGIES

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The Buena Vista Lake shrew *(Sorex ornatus relictus*: BVLS) formerly inhabited the interconnected seasonal and permanent lakes, wetlands, sloughs, and marshes around historic Tulare, Kern and Buena Vista lakes in the Tulare Basin of the San Joaquin Valley. Approximately 95% of riparian and wetland habitat in the San Joaquin Valley has been lost, leaving only isolated remnants of suitable habitat where BVLS still persists. Our objectives were to (1) complete a taxonomic review of shrews in the San Joaquin Valley via genetic analyses, (2) evaluate the status of BVLS on sites where it was previous detected, (3) conduct surveys and habitat assessments on previously unsurveyed sites, (4) investigate non-invasive detection techniques, and (5) develop conservation recommendations based on our results. Based on the current information from genetic analysis, only shrews south of Tranquility and Helm (Fresno County) should be considered the listed subspecies, and further genetic analyses may indicate that the northern boundary for this subspecies may be even farther south. We conducted surveys using a combination of live-trapping and camera stations in 13 general locations. BVLS were detected in just six of these locations. Three of the sites are created wetlands, two sites are along canals, and just one site is a natural wetland. Of the six sites, only two and part of a third are permanently protected. The presence of BVLS on the created wetlands indicates that wetland restoration or creation should be considered as a conservation strategy. Camera stations were much more effective in detecting shrews than were track tubes, "scat tubes" or live-trapping. These results will be covered in a companion presentation. Conservation recommendations include (1) conducting additional surveys, (2) examining population dynamics and movements in extant locations, particularly the response by shrews to fluctuating water levels, and (3) developing strategies for restoring or creating wetlands.

USING SCENT-DETECTION DOGS TO SURVEY FOR THE GIANT GARTERSNAKE (*THAMNOPHIS GIGAS*)

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The giant gartersnake (*Thamnophis gigas*) is federally and state listed as a threatened species endemic to California's central valley. Giant gartersnakes require wetlands for foraging, upland areas for basking, upland refugia as summer shelter, and higher-elevation refugia for winter brumation. Giant gartersnakes are visually elusive and often occur in low-density populations making them difficult to detect, particularly when they are sheltering in upland refugia. Detection challenges have resulted in a poor understanding of occupancy throughout much of the species' range. H. T. Harvey & Associates tested the efficacy of using scent-detection dogs to recognize and alert to giant gartersnake residual scent and distinguish it from the scent of sympatric snake species. Field trials were used to test detection rates and error rates. H. T. Harvey & Associates partnered with Eric Hansen to conduct surveys for giant gartersnakes in their historic range in the Grasslands Ecological Area in Merced and Fresno Counties, where the species is critically imperiled. Two detection dog teams surveyed along canals and in sloughs located within the historic range of the species. Several detections were recorded and environmental DNA corroborated detections in a slough in which traditional survey techniques yielded negative results. The use of scent-detection dogs may offer an efficient and innovative survey approach enabling the detection of giant gartersnakes in water, above ground, and in upland refugia.

ADAPTING WITH A CHANGING CLIMATE: PLUG AND POND MEADOW RESTORATION IN MARIPOSA COUNTY, CA - STATUS AND PRELIMINARY MONITORING RESULTS

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Sierra Nevada meadows are hotspots of biodiversity. These meadows also play a critical role in the water system of California, providing 60 percent of the state's developed water supply. With a changing climate, restoring the function of meadow systems is critical; doing so is predicted to capture water, attenuate floods, and sustain summer stream flows, all while improving habitat for wildlife. In partnership with several organizations and grantors, Sierra Foothill Conservancy (SFC) has embarked upon a large-scale plug and pond restoration of Bean Creek Preserve, located in northern Mariposa County, California. Construction was completed in Fall 2016. In consort with the restoration, SFC is participating in the Sierra Meadow Restoration and Research Partnership (SMRRP), which is in its 2nd year of data collection. SFC is also partnering with Point Blue

Conservation Science's Rangeland Watershed Initiative for grazing management planning and collection of restoration co-benefit data. This research aims to measure responses to restoration, including greenhouse gas emissions, carbon stored in the soil, and documenting changes in groundwater storage, vegetation (including invasive species), livestock forage, and avian populations. Preliminary results will be presented, along with current status of the re-watering of 40 acres of wet meadow habitat.

THE FUTURE–COMBINING ENERGY PRODUCTION WITH RANGELAND CONSERVATION

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Alternative land use demands on rangelands are increasing as suburban expansion and energy development continue to rise. Land managers, owners, ranchers, and future energy developers need to work together to preserve rangeland production and the native species that rely on this habitat. Topaz Solar Farms, located on the Carrizo Plain in California exemplifies a successful partnership between agriculture, habitat conservation, and energy production. This 4,700-acre, 550-megawatt passive photo-voltaic solar farm is currently one of the largest solar projects in the world. Construction practices minimize environmental impacts while preserving natural resources, endangered species habitat, and existing agricultural land uses.
Monitoring studies found that native plant species occur more frequently in array fields than on reference sites. Average vegetation height is significantly greater in arrays compared with control sites. In 2014, grazing within 3348 acres of fenced arrays supported over 1000 head of sheep for 105 days (average stocking rate of 37 sheep per acre) while aiding in habitat management for endangered species, invasive weed control, and fire fuel reduction. Monitoring tracts the federally listed San Joaquin kit fox, and state protected American badger within completed solar array fields. Site design preserves pronghorn antelope and other animal movement corridors. Topaz Solar Farms is an example for future energy projects of how collaboration between agencies, ranchers, conservationists, and developers can combine sustainable energy production, rangeland conservation, and rare species protection.

USE OF KIT FOX ARTIFICIAL DENS AS A MITIGATION AND CONSERVATION MEASURE FOR THE CITY OF BAKERSFIELD'S THOMAS ROADS IMPROVEMENT PROGRAM

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Brian Cypher[1], Tory Westall[1], and Erica Kelly[1]
[1]California State University, Stanislaus – Endangered Species Recovery Program

Access to den sites is essential to San Joaquin kit fox ecology. Installation of artificial dens for kit fox has often been implemented as a mitigation strategy on projects where kit

foxes will be impacted. Artificial dens are installed, for example, when a known or potential kit fox den has to be removed for a project development, with the goal of providing the kit fox(es) another den site in a safe location. Kit fox use of artificial dens has been documented in urban and exurban environments. The Thomas Roads Improvement Program (TRIP) is a Federal and State funding program for six major road construction and improvement projects in the City of Bakersfield. The final 2010 TRIP San Joaquin Kit Fox Effects, Analysis, Mitigation Strategy and Implementation Plan incorporated a Sump Habitat Program (SHP) to address the cumulative road construction impacts to kit foxes. The SHP utilizes kit fox artificial den installation, monitoring, and maintenance as a mitigation measure and conservation strategy in place of purchasing habitat compensation outside the city's limits. After an extensive analysis of kit fox land use within Bakersfield and the City's legal access to sites, nine water retention basins (sumps) and five locations at the Bakersfield Sanitary Landfill where chosen as artificial den sites for kit fox. Biologists at the CSU Stanislaus, Endangered Species Recovery Program assisted the City of Bakersfield and Caltrans in the process of site selection, artificial den design and installation, site access via fence openings, and kit fox habitat signage. The ESRP is also conducting the long term monitoring and reporting on the dens sites spring 2017-spring of 2019.

CONSERVATION OF ENDANGERED TIPTON KANGAROO RATS: STATUS SURVEYS, HABITAT SUITABILITY, AND CONSERVATION STRATEGIES

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Tipton kangaroo rats (*Dipodomys nitratoides nitratoides*: TKR) once were widely distributed in arid scrub habitats on the valley floor but much of this habitat has been converted to agricultural, urban, and industrial uses. Habitat loss is still occurring and threatens to extirpate existing populations and could even preclude recovery. Our objectives were to (1) conduct surveys throughout the range to identify sites where TKR were extant, (2) assess habitat attributes on all survey sites, (3) use the attribute data from sites with and without TKR to generate a GIS-based model of TKR habitat suitability in the southern San Joaquin Valley, (4) extend the model across the TKR range to determine the quantity and quality of remaining habitat, and (5) use the results from the above tasks to develop conservation recommendations. We conducted surveys using live-trapping on 44 sites where access was granted, and detected TKR on 15 of the sites. Sites with TKR tended to have larger alkali scalds and no obvious sign of past tilling compared to sites without TKR. Also, sites with TKR usually had relatively sparse ground cover and seepweed was present. Finally, a larger competitor, Heermann's kangaroo rat (*Dipodomys heermanni*), was either absent or present in relatively low numbers at sites with TKR, and when present its abundance was inversely related with that of TKR. Habitat attributes from sites with and without TKR were used to further refine the habitat

suitability model. The final model was applied across the range of TKR and revealed that an estimated 30,000 ha of moderately-high or high quality habitat and 60,000 ha of lower quality habitat remain. However, habitat is still being lost and conversion of at least one survey site with TKR occurred during this project. Conservation recommendations resulting from this project are to (1) conduct additional TKR surveys on additional sites as opportunities present themselves, (2) conserve habitat on unprotected lands where TKR have been detected as well as lands with highly suitable habitat, (3) manage vegetation on lands if necessary to reduce ground cover and enhance suitability for TKR, (4) conduct further research into translocation strategies, (5) conduct translocations of TKR to unoccupied sites with suitable habitat, and (6) develop and test strategies for restoring disturbed lands to make them suitable for occupation by TKR.

Posters

USE OF STABLE ISOTOPES OF OXYGEN AND HYDROGEN TO TRACE WATER IN THE SAN JOAQUIN RIVER

Monet Gomes, California State University, Fresno. **monetgomes@mail.fresnostate.edu**
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Typically, flow on the San Joaquin River changes dramatically with season. There is also commensurate seasonal variation in water temperature, which affects both evaporation and the solubility of oxygen and its evasion from the river. These dynamics between river flow, temperature, and oxygen are important for several reasons. First, oxygen is critical for organisms in the river such as fish. Second, oxygen solubility in water decreases with temperature, but ironically organisms' metabolic need for oxygen increases with temperature. Third, these dynamics can be revealed by examining the stable isotope ratios of oxygen and hydrogen in the water. Finally, these chemical 'signatures' ($\delta^{18}O$ & $\delta^{2}H$) can be used to track fish movements and ranges, because water and gas with 'light' isotopes will preferentially evaporate or evade with higher temperatures. My research focuses on how flow rates can affect how dissolved oxygen concentrations and $\delta^{18}O$ levels differ over space and time.

San Joaquin River water was sampled during July, August, and December 2015 to generate data to relate the effects of flow rates to variation in chemical tracers along the river course. Samples were taken from five different sites along ~25 miles of the San Joaquin River from just below Friant Dam. Water temperatures (°C) and oxygen concentrations (mg/L) were recorded using a dissolved oxygen (DO) meter. In July, water temperatures increased dramatically from 14.5 °C at the base of the dam to 29.8°C 25 miles downstream (+0.57°C/mile), and dissolved oxygen saturation decreased from 70.5% to 64.9%. Toward the end of July, large water releases from Friant Dam changed the characteristics of the river. Water ranged from 17.1°C at the base of the dam to 21.2°C downstream (+0.16°C/mile). Dissolved oxygen decreased from 103.7% at the base of the dam to 85.5% downstream. Sampling in December, with lower flow rates and air temperatures resulted in changes of 15.0°C to 8.7°C (-0.25°C/mile) and dissolved oxygen changed from 109.2% to 103.8% downriver. Water samples were analyzed for $\delta^{18}O$ and $\delta^{2}H$ at the UC Davis Stable Isotope Facility. As expected, July had the lowest levels of $\delta^{18}O$, followed by December. August exhibited the highest levels of $\delta^{18}O$, possibly resulting from high levels of water releases from Friant Dam during the entire month of July. These data show how water quality can dramatically change with seasonal variations and as it flows downstream, changing the stable isotope signatures of the stream. Results can help us determine fish ranges by comparing stable isotope signatures in the tissues to the isotopes in the water. Additionally, stable isotope values in fish tissues are direct reflections of the water in their environment.

ANALYZING GROWTH RATE VARIATIONS AMONG JUVENILE CHINOOK SALMON POPULATIONS

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The aim of the San Joaquin River Restoration Program (SJRRP) is to restore flows into San Joaquin River from the Friant dam up to the confluence of the Merced River in order to reestablish a self-sustaining Chinook Salmon population. Our lab is an important part of the SJRRP as we study the vulnerable salmon juveniles and their habitat requirements. The research question I am addressing is what is the extent of growth rate variation among juvenile Chinook Salmon populations. Analyzing and comparing growth rates are one way to measure the longevity of salmon and the productivity of their surrounding environment. I am conducting this study by performing literature meta-analysis of previous studies and comparing the growth rate values from these studies to our growth rate data from the San Joaquin River. Based on our current research we find that much variation in growth rates does indeed exists, both across diverse habitats and lakes and also within local regions such as the San Joaquin River. Additionally, Chinook Salmon strains in the San Joaquin and Merced Rivers have relatively higher growth rates compared to those in northern California and other Pacific states. Continuous research will help determine the underlying cause within the environment that accounts for variation in growth rates of juvenile Chinook Salmon populations. The results from this study will aid in determining the feasibility of SJRRP's salmon restoration goals.