SURVEYS FOR RARE SPECIES AT THE WIND WOLVES PRESERVE, CALIFORNIA

PREPARED FOR THE WILDLANDS CONSERVANCY

Prepared by:
Brian L. Cypher, Christine L. Van Horn Job, Erin N. Tennant
Alexandra Y. Madrid, Tory L. Westall, and Scott E. Phillips

California State University, Stanislaus
Endangered Species Recovery Program
One University Circle
Turlock, CA 95382

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EXECUTIVE SUMMARY

During April – September 2010, surveys were conducted for selected rare species potentially occurring in valley floor habitats on the Wind Wolves Preserve in central California. The goal of this effort was to determine whether rare species were present on the Preserve, and then to identify management strategies to conserve populations of these species. Survey methods included transect surveys, automated digital camera stations, live-trapping, and opportunistic observations. During the surveys, 7 special status species were detected on the Preserve: blunt-nosed leopard lizard (Federal Endangered, California Endangered), San Joaquin antelope squirrel (Federal Species of Concern, California Threatened), Buena Vista Lake shrew (Federal Endangered, California Species of Special Concern), burrowing owl (Federal Bird of Conservation Concern, California Species of Special Concern), loggerhead shrike (Federal Bird of Conservation Concern, California Species of Special Concern), northern harrier (California Species of Special Concern), and San Joaquin whip snake (California Species of Special Concern). Other species that were not observed during these surveys but that are known to occur on the Preserve or are very likely to occur include badger (known to occur), San Joaquin kit fox (historic – likely to occur), Tulare grasshopper mouse (known to occur), short-nosed kangaroo rat (potentially occurs), and Le Conte's thrasher (known to occur). The Preserve supports a diversity of rare species and because of its size, habitat diversity, and habitat quality, the Wind Wolves Preserve can contribute significantly to the conservation of special status species as well as regional biological diversity. The populations of blunt-nosed leopard lizards and Buena Vista Lake shrews may be of particular conservation importance. Recommendations include (1) managing and enhancing habitat for rare valley floor species through vegetation management particularly the reduction of non-native grasses, (2) reestablishing shrubs, (3) installing artificial dens for kit foxes, (4) conducting additional surveys for special status species, (5) monitoring populations of special status species, and (6) gathering ecological and demographic information on special status species on the Preserve to facilitate long-term conservation.

INTRODUCTION

The Wind Wolves Preserve comprises 38,891 ha (96,100 ac) in Kern County in Central California (Figure 1). The Preserve is situated at the southern end of the San Joaquin Valley and extends up into the northern flank of the San Emigdio Range (part of the Transverse Ranges) with elevations ranging from 195 to 1830 m (640 to 6005 ft). Consequently, the Preserve encompasses a wide variety of habitats that support an immense diversity of animals and plants. Because of its size and contiguity, habitat quality, and diversity of biological resources, the Wind Wolves Preserve is of considerable importance to the conservation of regional biodiversity and ecosystem connectivity. The Preserve is owned and managed by The Wildlands Conservancy.

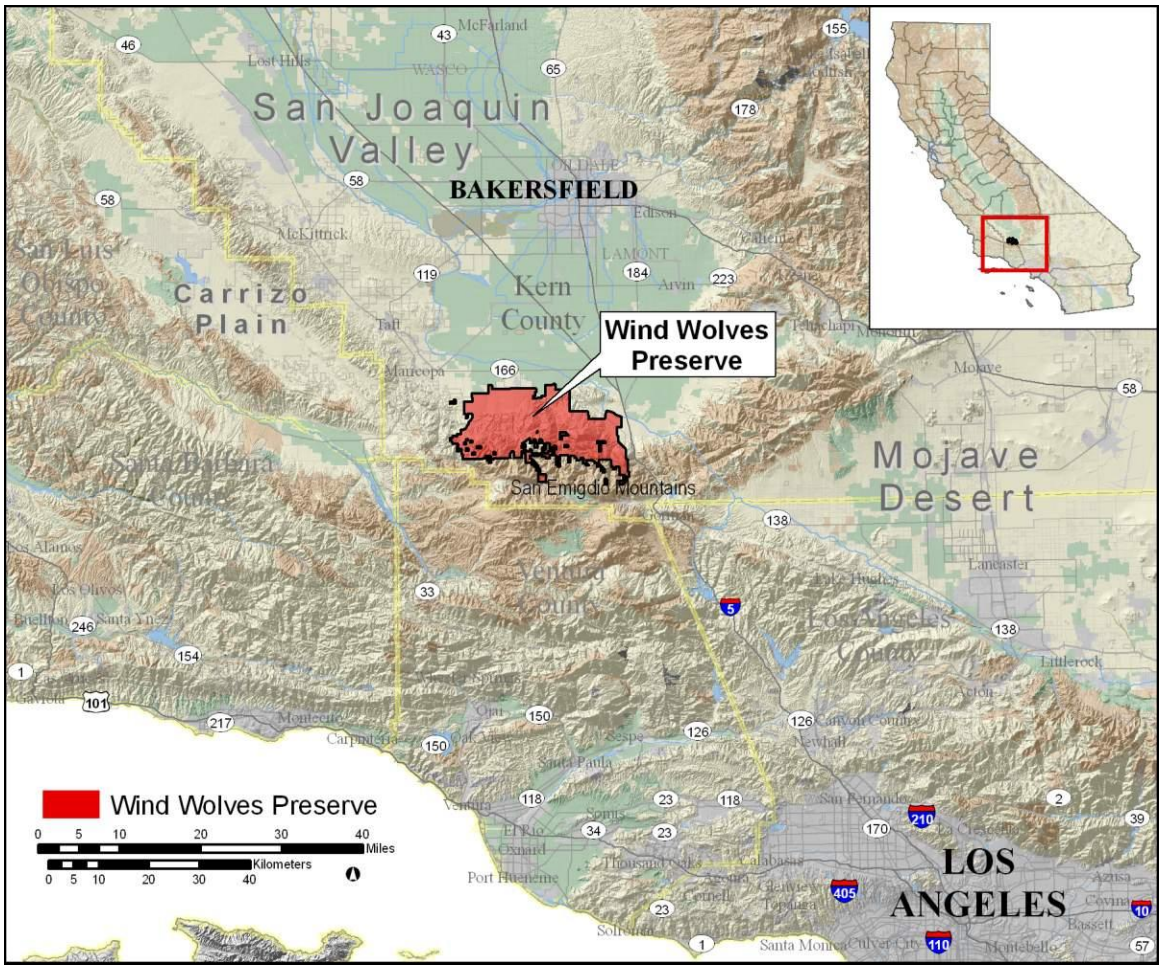

Figure 1. Location of the Wind Wolves Preserve in Central California.

The Wildlands Conservancy is striving to document biodiversity on the Wind Wolves Preserve, particularly the presence of any special status species in order to more effectively conserve these species. The Conservancy contracted with the California State University-Stanislaus, Endangered Species Recovery Program (ESRP) to conduct surveys for special status species occurring in habitats considered to be part of the San Joaquin Valley floor. Objectives of these surveys were to (1) determine the presence of

rare species in valley floor habitats, (2) attempt to determine the distribution of these species on the Preserve, and (3) provide any recommendations for the long-term conservation of these species occurring.

Efforts included surveys for plants, reptiles, birds, and mammals. The botanical surveys were conducted by David Magney Environmental Consulting and the results were provided previously in a separate report (Magney et al. 2010). Focused surveys for 2 special status bird species, least Bell's vireo (*Vireo bellii pusillus*; Federal Endangered, California Endangered) and southwestern willow flycatcher (*Empidonax traillii extimus*; Federal Endangered, California Endangered), were conducted in suitable habitat on the Preserve and the results also were provided in a separate report (Fiehler et al. 2010).

STUDY AREA

Surveys were conducted in the valley floor area of the Wind Wolves Preserve (Figure 1). This area extends across the northern portion of the Preserve and forms the southern extent of the San Joaquin Valley. The area encompasses approximately 8300 ha (ca. 20,500 ac) and generally is below 305 m (1000 ft) in elevation. The terrain is generally flat with gently sloping alluvial fans and well-developed washes present where creeks (dry most of the year) flow northward out of the San Emigdio Range. Grasslands comprising a diversity of native and non-native grasses and forbs are the dominant habitat in these areas. Stands of desert saltbush (*Atriplex polycarpa*) are present in some portions of the area. Limited riparian communities occur along some of the major creek drainages, primarily up in the mouths of the drainages as they exit the San Emigdio Range.

Several portions of the study area are grazed by cattle. The lands comprising the Preserve were grazed since the mid 1800s. Following acquisition by The Wildlands Conservancy in 1996, grazing was removed from sensitive areas such as riparian and wetland areas, and has been removed from certain pastures depending upon management objectives. In certain portions of the study area, oil and gas production facilities (e.g., extraction wells, pipelines, holding tanks) are present in low-densities. Public access to the Preserve for recreational and educational purposes is limited to certain days and areas, and is highly managed to limit human impacts.

METHODS

TARGET SPECIAL STATUS SPECIES

The purpose of the surveys on the Wind Wolves Preserve was to determine whether special status species were present. A number of special status species potentially occur in valley floor habitats on the Preserve (Table 1).

Table 1. Special status animal species potentially occurring in valley floor habitats on the Wind Wolves Preserve, California.

Common name	Scientific name	Federal status[1]	California status[1]	Notes
Mammals				
San Joaquin kit fox	*Vulpes macrotis mutica*	Endangered	Threatened	Historic occurrences on and near Preserve
Badger	*Taxidea taxus*	-	Species of Special Concern	Known to be present based on recent sightings
Giant kangaroo rat	*Dipodomys ingens*	Endangered	Endangered	No historic occurrences on or near Preserve
Short-nosed kangaroo rat	*Dipodomys nitratoides brevinasus*	Species of Concern	Species of Special Concern	No historic occurrences on or near Preserve
San Joaquin antelope squirrel	*Ammospermophilus nelsoni*	Species of Concern	Threatened	Historic occurrences near Preserve
Tulare grasshopper mouse	*Onychomys torridus tularensis*	Species of Concern	Species of Special Concern	Known to be present based on past live-captures
Buena Vista Lake Shrew	*Sorex ornatus relictus*	Endangered	Species of Special Concern	Know to be present in riparian areas in the San Emigdio Canyon
Birds				
Northern harrier	*Circus cyaneus*	Bird of Conservation Concern	Species of Special Concern	Known to be present based on recent sightings
Burrowing owl	*Athene cunicularia*	Bird of Conservation Concern	Species of Special Concern	Known to be present based on recent sightings
Loggerhead shrike	*Lanuis ludovicianus*	Bird of Conservation Concern	Species of Special Concern	Known to be present based on recent sightings
Le Conte's Thrasher	*Toxostoma lecontei lecontei*	Species of Concern	Species of Special Concern	Known to be present based on recent sightings
Reptiles				
Blunt-nosed leopard lizard	*Gambelia sila*	Endangered	Endangered	Historic occurrences on and near Preserve
San Joaquin coachwhip	*Masticophis flagellum ruddocki*	-	Species of Special Concern	Known to be present based on recent sightings

[1] From California Department of Fish and Game 2009.

Because of the relatively large study area, 100% survey coverage was not possible. Furthermore, because of differences in habitat suitability across the study area, we felt that any randomized sampling approach might significantly decrease the probability of detecting special status species. Thus, we generally focused survey efforts on areas where we felt habitat suitability was most optimal for given species thereby increasing the probability of detecting those species if they were present.

TRANSECT SURVEYS

Transect surveys were conducted in most Sections with valley floor habitat on the Preserve. The surveys were conducted by 2-4 observers walking slowly through an area searching for target resources. We attempted to cover a minimum of 6.4 km (4 mi) of transects in each full Section surveyed (shorter distances were covered in partial Sections). Transects sometimes followed landscape features (e.g., large washes) where habitat was considered to be more suitable for target species. Locations were recorded for all resources of interest using a GPS unit.

Species targeted during transect surveys included blunt-nosed leopard lizards, kit foxes (sign such as dens and scats), giant kangaroo rats (burrow systems), San Joaquin antelope squirrels, and any non-listed Species of Special Concern. Transect surveys were primarily conducted during seasons (i.e., spring and early summer) and temperature ranges (i.e., 22-35 C) that optimized the probability of observing blunt-nosed leopard lizards.

CAMERA STATION SURVEYS

The species primarily targeted during camera station surveys included San Joaquin kit fox and badger. To increase the probability of detecting kit foxes and badgers, cameras were placed in open grasslands, along large washes that might be used as travel corridors, and near areas of concentrated kangaroo rat (*Dipodomys* spp.) activity. Cameras also were deployed at a site near where San Joaquin antelope squirrels had been observed just outside the Preserve boundary.

Camera station surveys were conducted by strategically deploying automated digital field cameras (Stealth Cam 3.0 MP Digital Scouting Cameras, Stealth Cam LLC, Bedford, TX; Cuddeback 3.0 MP Digital Scouting Camera, Non Typical, Park Falls, WI). The cameras were secured to 1.2-m (4-ft) U-posts with zip-ties. A can of cat food was staked to the ground approximately 2 m in front of each camera using tent stakes. Most cameras were deployed within about 2 km of the northern boundary of the Preserve where the habitat appeared most optimal for kit foxes. Each station was left in place for at least 30 days. We measured camera detections as the total number of visits by distinct individuals (as tallied on a per-night basis) divided by the number of camera-nights (one camera operational for one night = one camera-night).

LIVE-TRAPPING FOR RODENTS

Live-trapping for rodents was primarily conducted in areas that appeared suitable for short-nosed kangaroo rats. Thus, trap lines were established along large washes, areas with saltbush, and areas of relatively sparse grass cover along near the northern boundary of the Preserve. Such areas also comprise suitable habitat for Tulare grasshopper mice.

Trapping for rodents was conducted using aluminum Sherman box traps (7.5 x 9.5 x 30 cm) modified to avoid injury to long-tailed animals such as kangaroo rats. Trap lines consisted of 30 traps spaced approximately 15-m apart. The traps were opened in the evening, baited with white millet seed, and provisioned with unbleached paper towels to provide bedding material and insulation. All animals captured were identified to species, aged, sexed, belly-marked with a felt-tipped non-toxic marker, and released at the capture site. Trapping at each location was conducted for 3 nights.

LIVE-TRAPPING FOR BUENA VISTA LAKE SHREWS

Live-trapping for Buena Vista Lake shrews was conducted at 2 locations along San Emigdio Creek (i.e., The Willows and Twin Fawns) within the San Emigdio Canyon. Buena Vista Lake shrews primarily are found in riparian or wetland habitats. Specific sites where shrews have been captured commonly are characterized by moist soils, dense ground cover or litter, and woody canopy cover or at least tall herbaceous vegetation

(USFWS 1998, CSUS-ESRP unpublished data). Furthermore, most shrews are captured within 1-2 m of water (D. Newman, personal communication).

Trapping for Buena Vista Lake shrews was conducted using aluminum Sherman box traps (5.1 x 6.4 x 16.5 cm). Traps were set in selected sites based on the presence of micro-habitat features as described above. Thus, most traps were set in dense cover within willow (*Salix* spp.), cottonwood (*Populus fremontii*), or cattail (*Typha* spp.) stands near running or standing water. Traps were opened in the evening, baited with mealworms (*Tenebrio molitor*) or waxworms (*Galleria mellonella*), and provisioned with unbleached paper towels to provide bedding material and insulation. Shrew trapping was conducted during 5 nights. For the first 2 nights, traps were checked approximately 3 hours after being opened. For the last 3 nights traps were left open over night and checked the next morning. All animals captured were weighed, and approximately 2-3 mm of the distal end of the tail was collected for genetic analyses. After processing, shrews were released at the capture site.

OPPORTUNISTIC OBSERVATIONS

Opportunistic observations of special status species on the Preserve also were recorded. Such observations were recorded during reconnaissance visits and during the conduct of the survey and trapping efforts described above. GPS coordinates were recorded for most locations of special status species observed.

RESULTS

TRANSECT SURVEYS

Transect surveys were conducted on 12 days during May 17-June 16, and a resurvey of one area was conducted on 30 July (Table 2). Transect distances ranged from 0.8-6.4 km (0.5-4 mi) in partial Sections and from 4.8-20 km (3-12.5 mi) in full Sections (Figure 2). Surveys were repeated on 2 Sections in the Rincon area (T10N/R20W/Sections 1 and 2) because temperatures were lower than the optimal range for blunt-nosed leopard lizards during the first surveys (although a blunt-nosed leopard lizard was observed in Section 2 during the first survey). Surveys also were repeated in Santiago Creek area (T11N/R23W/Section 36, T10N/R23W/Section 1) in an effort to detect San Joaquin antelope squirrels.

Special status species observed during transect surveys included 3 blunt-nosed leopard lizards, 6 burrowing owls, 6 loggerhead shrikes (Figure 3), and 1 San Joaquin coachwhip, which was observed in the Rincon area. Also, 5 scats were found that potentially were produced by kit foxes, based on size and shape. These scats were collected and submitted to the Conservation Genetics Laboratory at the Smithsonian Institution for analysis. Three scats were identified as coyote (*Canis latrans*) and 2 were identified as non-native red fox (*Vulpes vulpes*).

Table 2. Logistical information for survey transects conducted at the Wind Wolves Preserve in 2010.

Township[1]	Section	Date	Approximate Distance (km)	Time (24-hour)		Temperature at start (ºC)
				Start	End	
T10N R20W	1	2010-05-17	10 (5 people)	10:55	14:30	18.3
	2	2010-05-17	12.5 (5 people)	10:50	14:46	18.3
	1	2010-06-16	2.5	11:15	16:00	27.2
	2	2010-06-16	4	11:15	16:00	27.2
	11	2010-06-16	4	11:15	16:00	27.2
	12	2010-06-16	2.5	11:15	16:00	27.2
	14	2010-06-16	0.5	11:15	16:00	27.2
T11N R21W	19	2010-05-25	4	11:30	15:18	24.7
	20	2010-05-25	4	11:30	15:18	24.7
	22	2010-05-19	6	11:10	15:38	25.9
	23	2010-05-20	4	14:10	16:00	23.9
	24	2010-05-20	2	14:10	16:00	23.9
	26	2010-05-20	1	14:10	16:00	23.9
	27	2010-05-20	4	11:05	13:30	16.9
	29	2010-05-27	4	12:00	16:00	19.1
	30	2010-05-27	5	12:00	16:00	19.1
T11N R22W	21	2010-06-08	4	08:15	11:20	25.5
	22	2010-06-03	4	10:25	13:48	28.5
	23	2010-06-03	4	10:25	13:48	28.5
	24	2010-06-03	5	10:25	13:48	28.5
	25	2010-05-28	5	11:45	14:17	19.7
	26	2010-05-28	3	11:45	14:17	19.7
	27	2010-06-08	3	12:00	14:25	29.7
	28	2010-06-08	4	08:15	11:20	25.5
	29	2010-06-09	3	10:55	14:10	25.5
	30	2010-06-11	6	11:55	14:55	23.8
	31	2010-06-11	5	11:55	14:55	23.8
	32	2010-06-09	4	10:55	14:10	25.5
	33	2010-06-08	3	08:15	11:20	25.5
	34	2010-06-08	2.5	12:00	14:25	29.7
	35	2010-05-28	2	11:45	14:17	19.7
	36	2010-05-28	0.5	11:45	14:17	19.7
T11N R23W	36	2010-06-15	5	11:30	14:30	19.7
	36	2010-07-30	2.5	09:26	10:50	28.5
T10N R23W	1	2010-06-15	2	11:30	14:30	19.7
	1	2010-07-30	2.5	09:26	10:50	28.5

1. San Bernardino Meridian

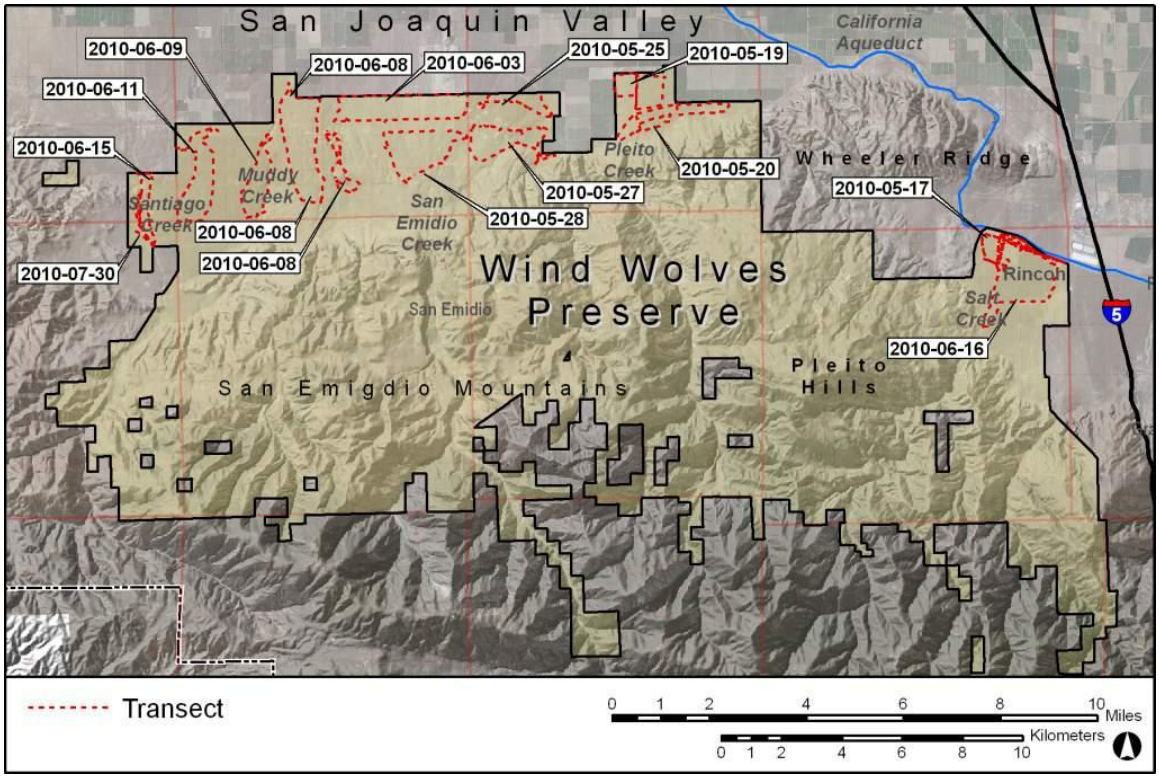

Figure 2. Locations of transect surveys conducted during 2010 on the Wind Wolves Preserve, California.

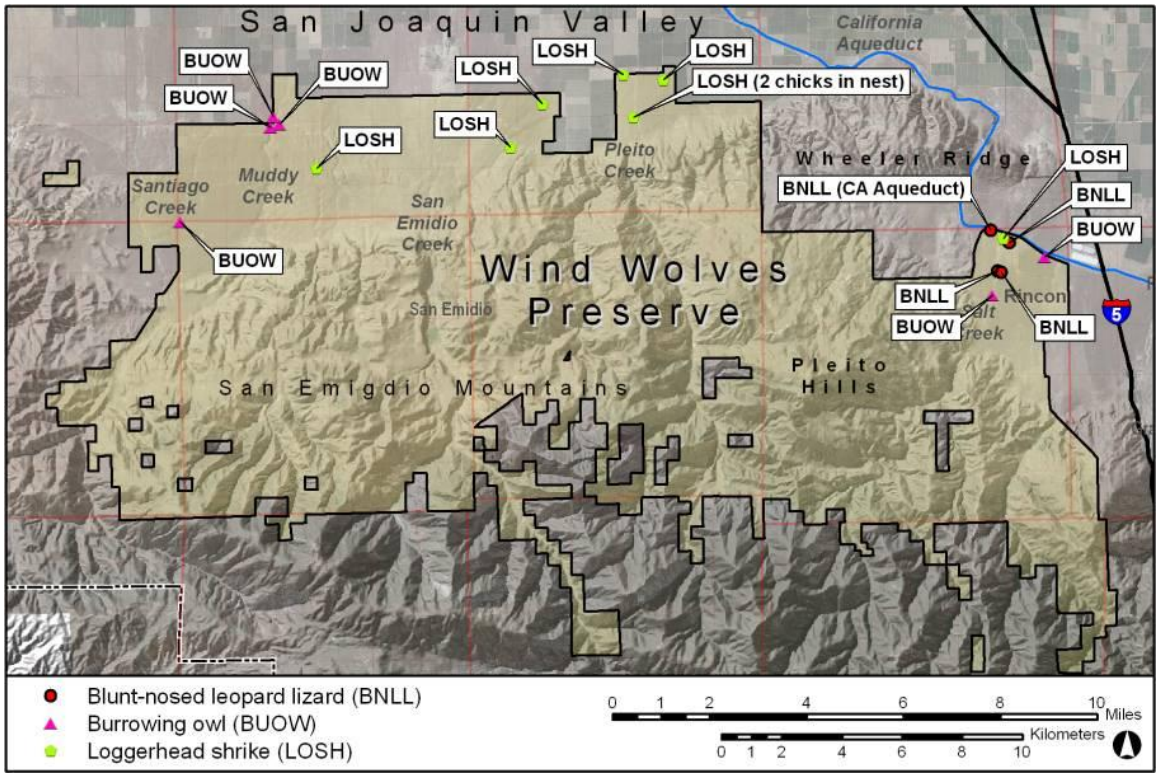

Figure 3. Locations of blunt-nosed leopard lizard, burrowing owl, and loggerhead shrike observations in 2010 on the Wind Wolves Preserve, California.

CAMERA STATION SURVEYS

Cameras were deployed on the Preserve during 12 May-18 June 2010, 22 June-30 July 2010, and 18 August-28 September 2010. Camera stations were established in 38 locations broadly grouped into 4 areas: Rincon, Pleito Creek, San Emigdio Creek, and Santiago Creek (Figure 4). One camera located in the Rincon area within sight of the California Aqueduct was not recovered and presumed to have been stolen. Most cameras were deployed for 36-41 days; several cameras were functionally operational for less time due to interference by cows (camera posts were knocked over). Where cows were present, numerous images of cows were recorded, but these were not tallied. Coyotes were the species detected most frequently by cameras (Table 3). Other species commonly recorded were jackrabbits (*Lepus californicus*), desert cottontails (*Sylvilagus audubonii*), and raccoons (*Procyon lotor*). Three images of San Joaquin antelope squirrels were recorded in the Santiago Creek area, just inside the Metson Lease gate (Figure 5, Figure 6). Also, three images of non-native red foxes were recorded in the Rincon area (Figure 7). For all species detected by the cameras, it is possible that the same individuals were recorded on multiple nights. Therefore, the detection rates should be considered as only a very general measure of abundance.

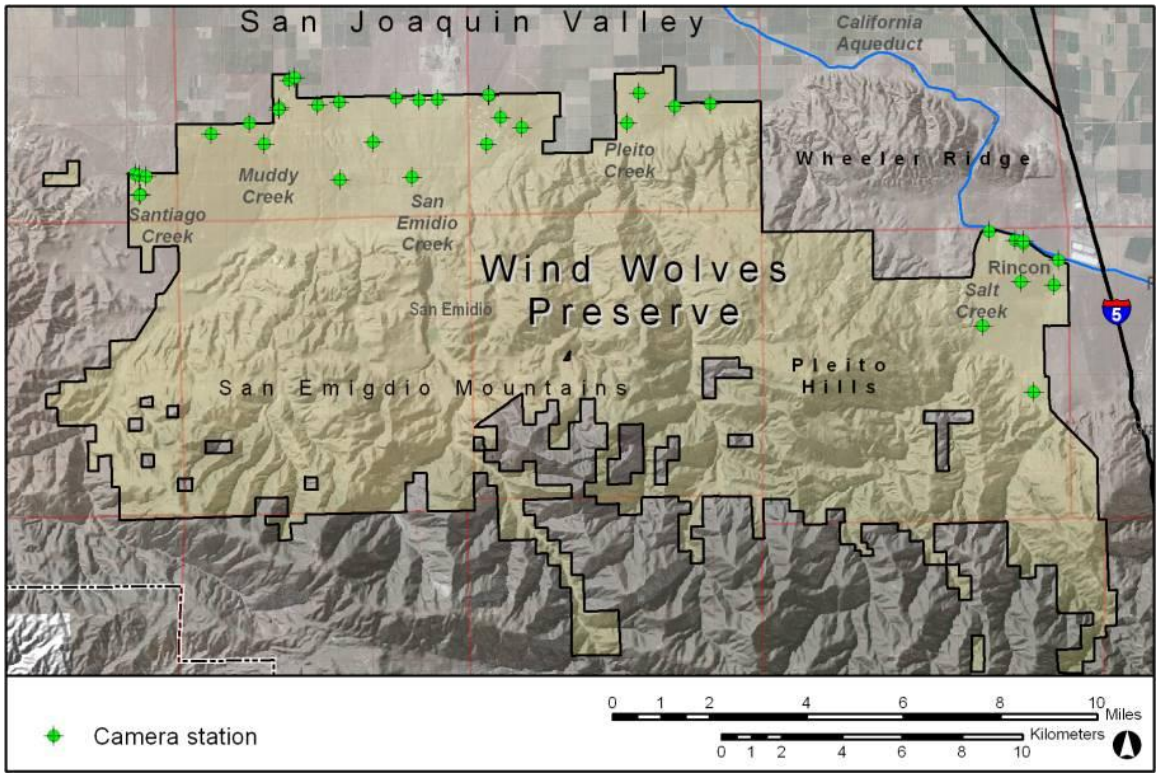

Figure 4. Locations of automated camera stations deployed in 2010 on the Wind Wolves Preserve, California.

Table 3. Wildlife species detected at automated digital camera stations on the Wind Wolves Preserve, California. Rate = number of detections/number of nights times 100.

	Area							
	Rincon 8 cameras/ 300 nights		Pleito Creek 4 cameras/ 144 nights		San Emigdio Creek 13 cameras/ 495 nights		Santiago Creek 12 cameras/ 454 nights	
Species[1]	No. Obs.	Rate	No. Obs.	Rate	No. Obs.	Rate	No. Obs.	Rate
Coyote	2	0.06	4	2.8	26	5.3	9	2.0
Red fox	3	1.0	-	-	-	-	-	-
Bobcat	-	-	2	1.4	-	-	-	-
Striped skunk	-	-	1	0.7	-	-	-	-
Raccoon	-	-	11	7.6	-	-	-	-
Jackrabbit	6	2.0	1	0.7	1	0.2	4	0.9
Cottontail	2	0.6	-		4	0.8	10	2.2
Antelope squirrel	-	-	-	-	-	-	3	0.7
Ground squirrel	-	-	-	-	5	1.0	-	-
Kangaroo rat	-	-	-	-	2	0.4	-	-
Unknown rodent	-	-	-	-	-	-	1	0.2
Raven	5	1.7	-	-	-	-	-	-

1 Coyote – Canis latrans; Red fox – *Vulpes vulpes*; Bobcat – *Lynx rufus*; Striped skunk – *Mephitis mephitis*; Raccoon – *Procyon lotor*; Jackrabbit – *Lepus californicus*; Cottontail – *Sylvilagus audubonii*; San Joaquin antelope squirrel – *Ammospermophilus nelsoni*; California ground squirrel – *Spermophilus beechyi*; Kangaroo rat – *Dipodomys spp*.; Raven – *Corvus corax*.

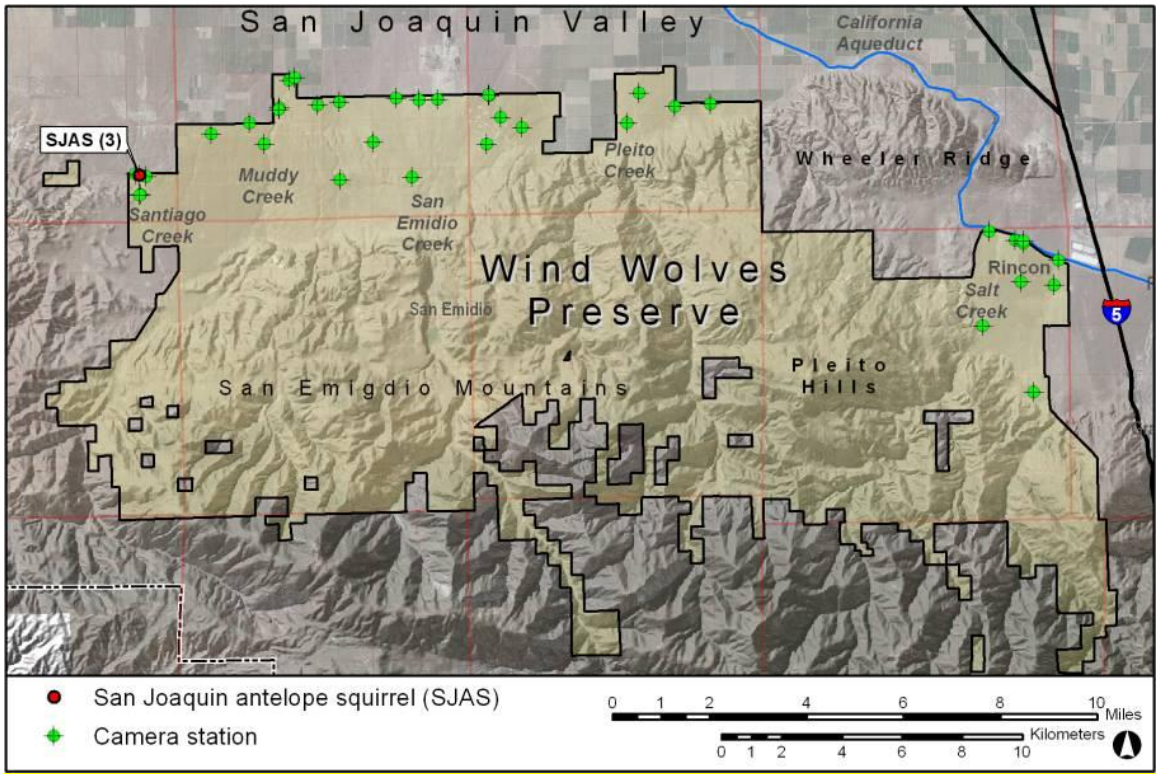

Figure 5. Locations of San Joaquin antelope squirrel observations in 2010 on the Wind Wolves Preserve, California.

Figure 6. Camera station images of San Joaquin antelope squirrels recorded in 2010 on the Wind Wolves Preserve, California.

Figure 7. Camera station images of red foxes recorded in 2010 on the Wind Wolves Preserve, California.

LIVE-TRAPPING

Live-trapping for small mammals was conducted during June 28-July 23 2010 on the Preserve. Trap lines were concentrated in 4 areas: Salt Creek drainage, Pleito Creek drainage, Muddy Creek drainage, and Santiago Creek drainage. Four trap lines were established in the Salt Creek, Pleito Creek areas, and 3 were established in the Muddy Creek and Santiago Creek areas (Figure 8). Four different rodent species were captured (Table 4). San Joaquin pocket mice (*Perognathus inornatus*) were the most frequently captured species and were captured in all 4 areas. Heermann's kangaroo rats (*Dipodomys heermanni*) also were captured in all 4 areas. California pocket mice (*Chaetodipus californicus*) and deer mice (*Peromyscus maniculatus*) each were captured in 2 areas. No short-nosed kangaroo rats or other sensitive rodent species were captured.

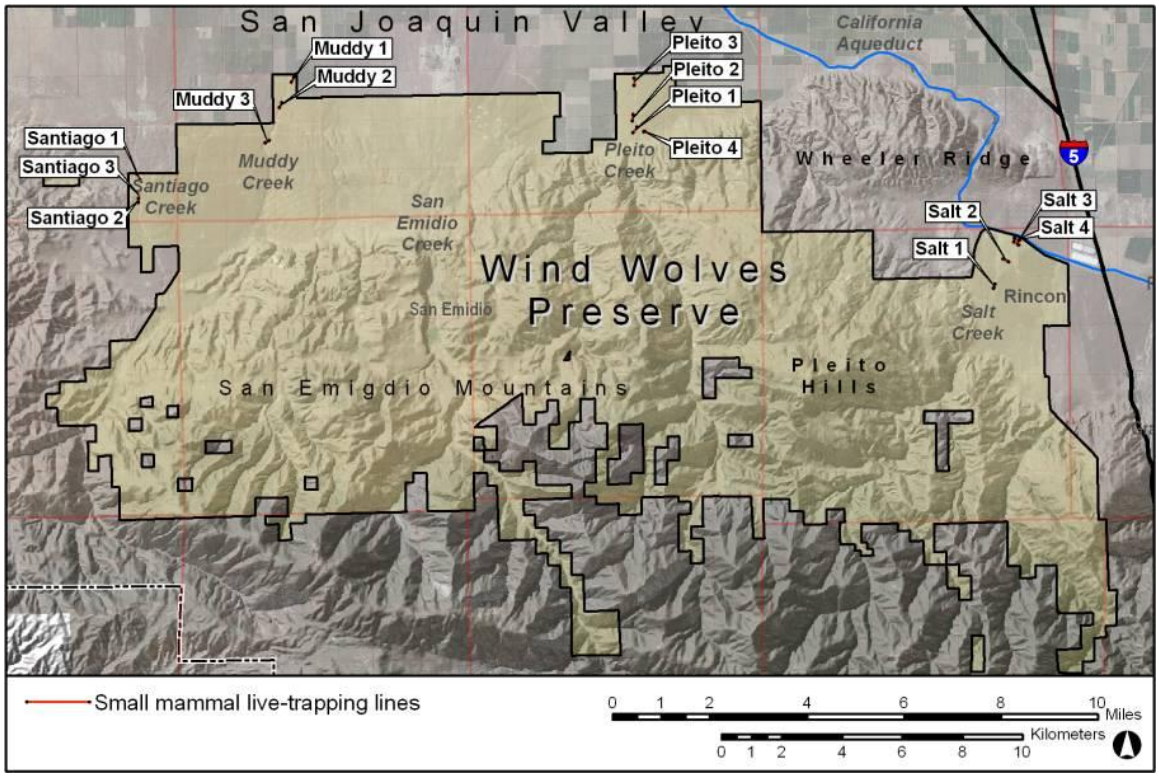

Figure 8. Locations of small mammal live-trapping lines in 2010 on the Wind Wolves Preserve, California.

Table 4. Small mammals captured during live-trapping on the Wind Wolves Preserve, California.

	Live-Trapping Areas							
	Salt Creek (360 trapnights)		Pleito Creek (330 trapnights)		Muddy Creek (270 trapnights)		Santiago Creek (270 trapnights)	
Species[1]	**No.**	**No. per 100 TN**	**No.**	**No. per 100 TN**	**No.**	**No. per 100 TN**	**No.**	**No. per 100 TN**
San Joaquin pocket mouse	20	5.6	74	22.4	17	6.3	12	4.4
Heermann's kangaroo rat	20	5.6	19	5.8	15	5.6	8	3.0
California pocket mouse	-	-	1	0.3	-	-	2	0.7
Deer mouse	5	1.4	6	1.8	1	0.4	-	-
Total	**45**		**100**		**33**		**22**	
Total per 100 TN	**12.5**		**30.3**		**12.2**		**8.1**	

1 San Joaquin pocket mouse – *Perognathus inornatus*; Heermann's kangaroo rat – *Dipodomys heermanni*; California pocket mouse – *Chaetodipus californicus*; Deer mouse – *Peromyscus maniculatus*.

LIVE-TRAPPING FOR BUENA VISTA LAKE SHREWS

Trapping for Buena Vista Lake shrews was conducted for 5 nights at The Willows and for 2 nights at Twin Fawns. Each night, 45-50 live-traps were set at The Willows site (241 total trapnights) and 27 traps were set at the Twin Fawns site (54 trapnights). No shrews were captured during the first 2 nights when the traps were checked later in the evening (Table 5). However, shrews were captured during each of the next 3 nights when traps were left open over night. In total, 7 shrews were captured at The Willows

and 4 were captured at Twin Fawns (Figure 9, Figure 10, Figure 11). Genetic samples were collected from all 11 shrews and were submitted to the Conservation Genetics Laboratory at the Smithsonian Institution for analysis.

Table 5. Captures of Buena Vista Lake shrews (BVLS) during September 2010 at the Wind Wolves Preserve, California.

Date	Location	No. of traps	No. of BVLS
2010-09-21	The Willows	50	0
2010-09-22	The Willows	50	0
2010-09-24	The Willows	47	2
2010-09-28	The Willows	47	3
	Twin Fawns	27	2
2010-09-29	The Willows	47	2
	Twin Fawns	27	2

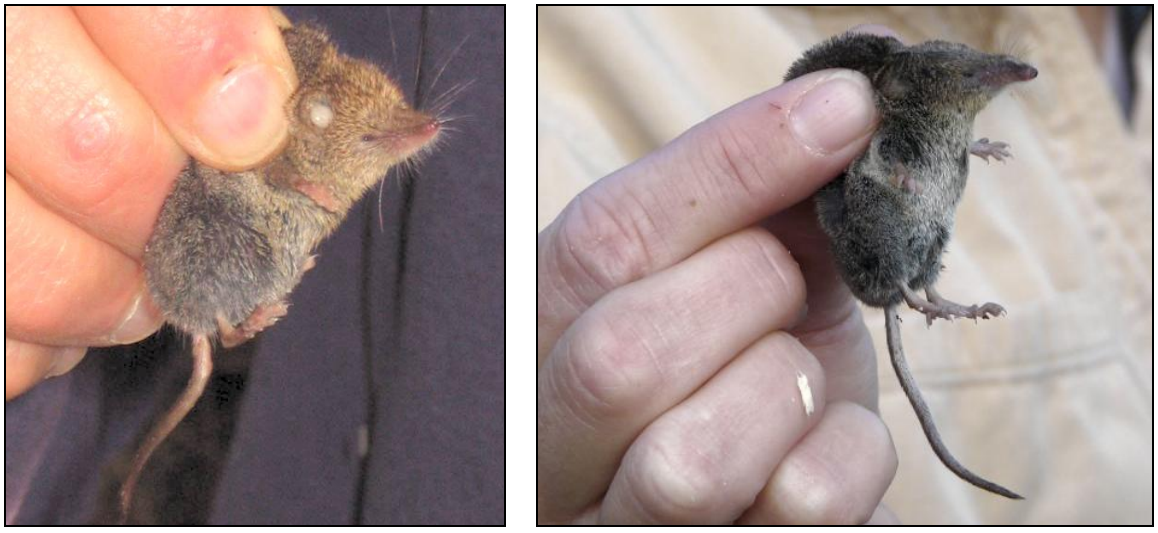

Figure 9. Buena Vista Lake shrews captured at The Willows (left) and Twin Fawns (right) in September 2010 at the Wind Wolves Preserve, CA.

Consistent with descriptions of Buena Vista Lake shrew capture sites elsewhere (CSUS Endangered Species Recovery Program unpublished data), all of the shrews captured at the Wind Wolves Preserve were captured in areas with dense litter or herbaceous cover, and usually with a woody overstory of willow or cottonwood (Figure 12). Also, all of the animals were captured within 2 m of open or running water. Other animals captured during shrew trapping included 7 deer mice and 3 western harvest mice (*Reithrodontomys megalotis*).

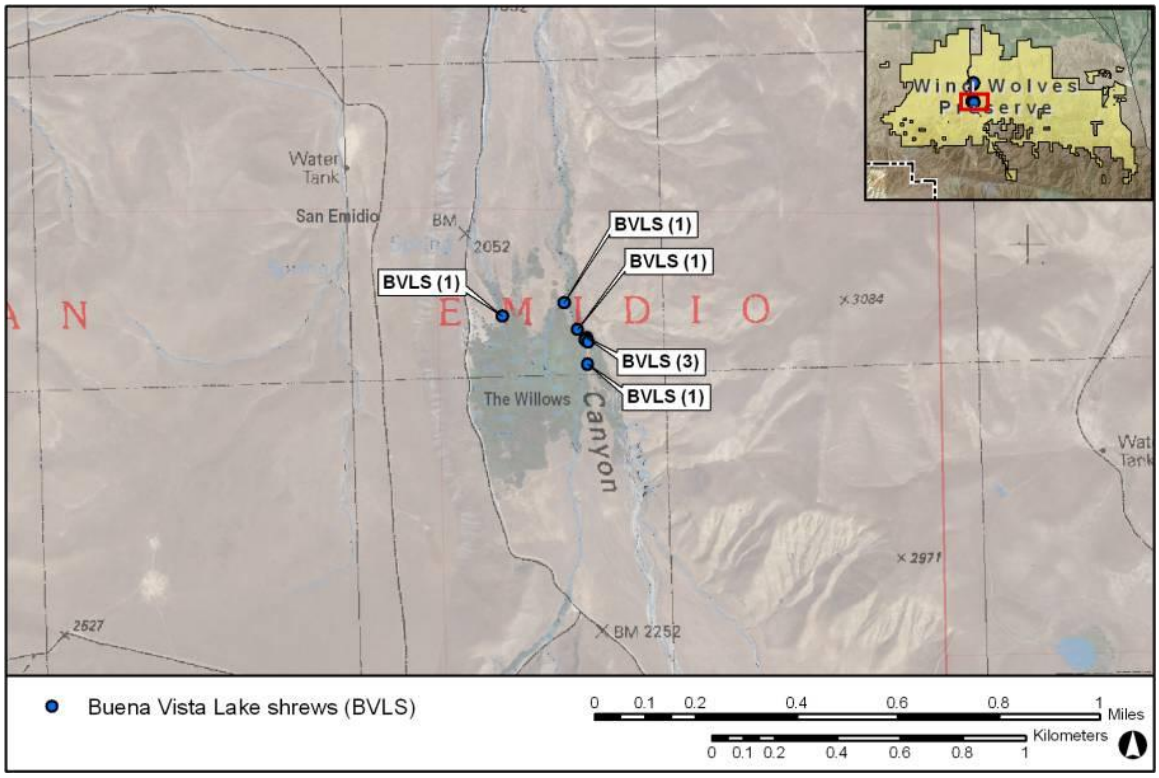

Figure 10. Capture locations for Buena Vista Lake shrews in September 2010 in The Willows area of the Wind Wolves Preserve, CA.

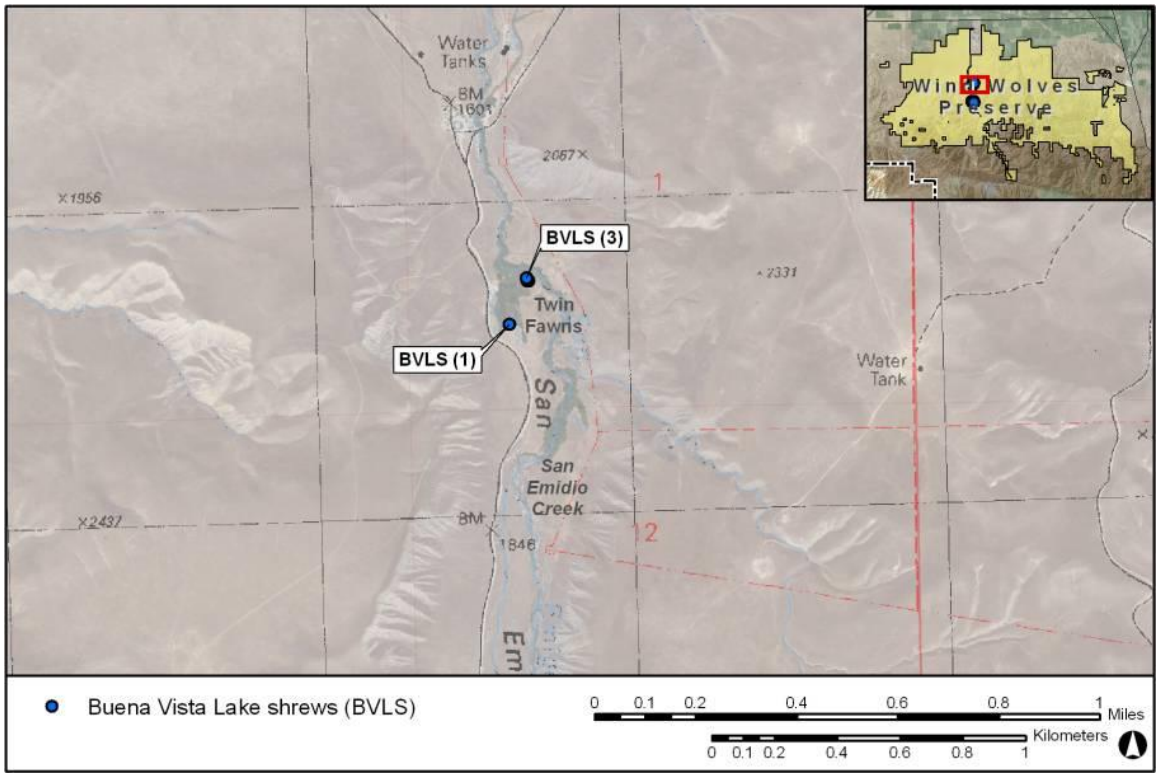

Figure 11. Capture locations for Buena Vista Lake shrews in September 2010 in The Twin Fawns area of the Wind Wolves Preserve, CA.

Figure 12. Capture locations for Buena Vista Lake shrews in September 2010 at The Willows area on the Wind Wolves Preserve, CA.

OPPORTUNISTIC OBSERVATIONS

Opportunistic observations of special status species included a San Joaquin antelope squirrel, burrowing owl, and loggerhead shrike. These locations are depicted in Figure 3 and Figure 5. The opportunistic shrike observation was particularly interesting as it included 2 birds that were presumed to be a pair and a nest with 2 chicks. Also, a blunt-nosed leopard lizard was observed just outside of the Preserve in the right-of-way for the California Aqueduct. This location is included in Figure 3.

In addition to special status species, a number of other vertebrates were observed during the project. These other species are considered to be common and all are already known to occur on the Wind Wolves Preserve. A list of these species and the mode of observation (e.g., transect survey, camera station, live-trapping, opportunistic observation) are presented in Appendix A.

DISCUSSION

The surveys conducted by ESRP were designed to target particular species, specifically special status species that occur in valley floor habitats. Accordingly, survey methods and locations surveyed were chosen to maximize the potential to detect special status species potentially occurring on the Wind Wolves Preserve. Because of this targeted approach, survey effort and methodologies varied across the available valley floor habitat area of the Preserve. Transect surveys were conducted throughout much of the valley floor area, but camera stations and small mammal traplines generally were concentrated within about 2 km of the Preserve's northern boundary where habitat conditions were considered to be most suitable for the target species. Furthermore, due to the very large area to be covered, including the area within 2 km of the northern boundary, 100% survey coverage was not possible in the time available. Thus, it is possible that target

species could be present in areas receiving less or no survey effort. Consequently, our survey efforts should not be considered exhaustive.

A number of species were detected during the surveys (Appendix A), and several of these were targeted special status species. These included blunt-nosed leopard lizard, Buena Vista Lake shrew, San Joaquin antelope squirrel, burrowing owl, loggerhead shrike, northern harrier, and San Joaquin coachwhip. These are discussed further below.

BLUNT-NOSED LEOPARD LIZARD

Blunt-nosed leopard lizards were observed on 3 occasions on the Preserve and on another occasion just outside the Preserve boundary. All of the observations were in the Rincon area of the Preserve. Specifically, all of the locations were in the alluvial fan area of Salt Creek. Habitat conditions favorable to blunt-nosed leopard lizards in this area include a higher composition of sand in the soils, presence of shrubs, and relatively sparse cover of herbaceous vegetation with areas of bare ground. The sparse vegetation cover appears to be a result of ground disturbance by periodic water flows down the drainage (probably mostly during winter storms) and grazing by cattle.

Blunt-nosed leopard lizards have been observed in the Rincon area previously, and as recently as 1991. Lizards were observed on at least 21 occasions during surveys conducted in 1991 for an Environmental Impact Analysis prepared for the proposed San Emigdio New Town development project (The Planning Center, unpublished data). These sightings primarily appeared to occur along the Salt Creek and Tecuya Creek alluvial fans, and the observations are much more widely dispersed than those recorded by ESRP. The differences in observation distribution could reflect a change in habitat suitability between 1991 and 2010. Alternatively, it may also reflect differences in levels of survey effort. The 1991 surveys were protocol-level surveys, and likely entailed 100% area coverage and possibly multiple surveys of some or possibly all of the area. However, the 1991 and 2010 results suggest that the blunt-nosed leopard lizard population in this area has been persistent, and potentially could continue to persist in this area with appropriate management.

The California Natural Diversity Database (CNDDB) also has 4 records of blunt-nosed leopard lizards occurrences in the northwestern portion of the Preserve. Two locations are along the San Emigdio Creek alluvial fan, one is along the Muddy Creek drainage and another is along the Santiago Creek alluvial fan. No blunt-nosed leopard lizards were observed during the ESRP surveys outside of the Rincon area. However, as stated previously, the valley floor portion of the Preserve covers a large area, and lizards potentially could be present but were just not detected during the survey. Areas where habitat conditions seemed particularly suitable for blunt-nosed leopard lizards included the drainages along Santiago Creek, Muddy Creek, and Los Lobos Creek. These areas in particular might warrant additional survey effort.

Although all areas with blunt-nosed leopard lizard populations are important for this endangered species, the Wind Wolves Preserve may be particularly important. Maintaining connectivity between populations is critical for maintaining demographic and genetic exchange, and also for maintaining recolonization opportunities in the event of extirpation of local populations. Most remaining blunt-nosed leopard lizard populations occur on the west side of the San Joaquin Valley, but a few populations also persist along the southeastern margin of the valley (e.g., Kern Front oil field, east side of

the city of Bakersfield, Tejon Ranch). The south margin of the valley appears to constitute the only remaining corridor between the west and east sides of the valley. Wind Wolves Preserve lands comprise a significant portion of this corridor. Maintaining this habitat linkage has been identified as a recovery action (Task 5.3.8 – Priority 2) in the recovery plan that includes blunt-nosed leopard lizards (U.S. Fish and Wildlife Service 1998). The Wind Wolves Preserve also is situated at the extreme southern end of the range of the blunt-nosed leopard lizard, and therefore this population may be important for maintaining genetic and morphological diversity for this species.

Blunt-nosed leopard lizards on the Wind Wolves Preserve potentially could benefit from habitat management, particularly that which reduces herbaceous cover. This species is closely related to the long-nosed leopard lizard (*Gambelia wislizenii*), which occurs in the Mojave Desert. As with long-nosed leopard lizards, blunt-nosed leopard lizards are essentially desert-adapted. Consequently, they favor sparse ground cover including areas with bare ground in areas of low relief (Montanucci 1965). Such conditions facilitate hunting prey and eluding predators. Chesmore (1980) suggested that 15-30% ground cover was optimal for blunt-nosed leopard lizards. Most of the habitat on the Wind Wolves Preserve exhibits a much higher ground cover, largely due to the predominance of non-native grasses (e.g., red brome [*Bromus madritensis*] and wild oats [*Avena spp.*]). These grasses have eroded habitat quality throughout the range of the blunt-nosed leopard lizard and may have contributed to the extirpation of populations in some locations (U.S. Fish and Wildlife Service 1998). Where blunt-nosed leopard lizards are still present in areas with dense herbaceous vegetation, their activities may be limited to more open areas, such as roads and washes (Warrick et al. 1998). Local extirpations and habitat limitation might characterize conditions on the Wind Wolves Preserve where lizards were not observed in some areas with historical records and where those lizards that were observed were found in wash complexes.

Habitat management strategies that result in a reduced herbaceous vegetation density might benefit blunt-nosed leopard lizard populations on the Wind Wolves Preserve. "Light to moderate grazing" has been hypothesized as being potentially beneficial to this species (U.S. Fish and Wildlife Service 1998). However, the important factor for blunt-nosed leopard lizards is to reduce the herbaceous cover to a low level, regardless of the intensity of grazing required to achieve this goal. For example, in areas on the Carrizo Plain National Monument where blunt-nosed leopard lizard conservation is a priority, residual dry matter levels of 1000 lbs/ac are considered acceptable and 500 lbs/ac are considered optimal (U.S. Bureau of Land Management 2010). Also, blunt-nosed leopard lizard numbers were considerably higher in the Lokern Natural area on grazed plots (RDM range 127-663 lbs/ac) compared to ungrazed plots (RDM range 894-1572 lbs/ac) (Germano et al. 2006). Management for blunt-nosed leopard lizards, of course, also needs to be balanced with other Preserve objectives. One possible approach is to designate specific management areas for blunt-nosed leopard lizards and to manage these areas accordingly.

BUENA VISTA LAKE SHREW

The captures of Buena Vista Lake shrews during this survey were significant. In total, 11 shrews were captured in the two locations in which live-trapping was conducted. Given the limited duration of the trapping effort, this number of captures suggests that the shrew

populations sampled may be relatively dense. Shrews were captured at both the Twin Fawns and Willows areas along the San Emigdio Creek. A shrew also was captured in the Willows area during 4 nights of trapping (405 trapnights) in 2005 (CSUS-ESRP, unpublished data).

Buena Vista Lake shrews are generally restricted to areas with wetland or riparian vegetation and moist soils (U.S. Fish and Wildlife Service 1998). The two sites along San Emigdio Creek where shrews were captured are consistent with this habitat characterization. Dense overstories of cottonwood, willow, coast live oak (*Quercus agrifolia*), and mule fat (*Baccharis salicifolia*) are present with dense stands of stinging nettle (*Urtica dioica*), sedges (*Carex* ssp.), spikerushes (*Eleocharis* ssp.), rushes (*Juncus* spp.), and cattails (*Typha* ssp.) in the understory and open wet areas. Other locations with similar habitat conditions exist on the Wind Wolves Preserve. Additional surveys in these sites may be warranted pending on-going genetic analysis of the shrews captured in at the San Emigdio Creek sites.

The taxonomic status of the Buena Vista Lake shrew is uncertain. The relationship between the Buena Vista Lake shrew and other subspecies of ornate shrew (*S. ornatus*) is still unresolved. The Buena Vista Lake shrew was described as a unique subspecies by Grinnell (1932) based on morphological characteristics, and results from on-going genetic analyses indicate that the Buena Vista Lake shrew is indeed a distinct evolutionary unit (J. Maldonado, Smithsonian Institution, unpublished data). Thus, available data appear to support that the Buena Vista Lake shrew may be a unique subspecies of ornate shrew. However, even if this proves to be the case, the range of the Buena Vista Lake shrew is not currently defined. Populations of the subspecies *S. o. ornatus* are thought to occur in the mountains surrounding the San Joaquin Valley and also in valley floor habitats in the northern portion of the Valley. Thus, *S. o. ornatus* populations are thought to completely encircle populations of subspecies *S. o. relictus* (Buena Vista Lake shrew), and the boundaries between the 2 subspecies have not been delineated. The two locations in the San Emigdio Canyon where the shrews were captured during this survey are sufficiently distant from the San Joaquin Valley floor that the animals captured potentially could be *S. o. ornatus*, although the analysis of the one specimen captured in 2005 suggested that these populations may be more closely aligned with *S. o. relictus*. The samples collected from the Wind Wolves populations were sent to the Smithsonian Conservation Genetics Laboratory, and genetic analysis will hopefully resolve the taxonomy of the San Emigdio Canyon shrews and provide direction regarding the value of additional surveys on the Wind Wolves Preserve.

If the Buena Vista Lake shrews do occur on the Wind Wolves Preserve, then these populations would be very important for the conservation and recovery of this species. Currently, Buena Vista Lake shrews are known from only about a dozen locations in the San Joaquin Valley. Thus, every population is important for the long-term viability of this species. Populations on the Wind Wolves Preserve would be particularly important because The Wildlands Conservancy has committed to conserving lands within the Preserve whereas most of the other known Buena Vista Lake shrew locations are not on lands where conservation is a priority. Also, as with the blunt-nosed leopard lizard, the Preserve would be at the southern extreme of the species' range and shrews in this location might possess genetic and morphological characteristics not found in the rest of the population.

SAN JOAQUIN ANTELOPE SQUIRREL

Four detections of San Joaquin antelope squirrels were recorded during survey efforts. Three were images recorded on a single camera station and the other was an opportunistic observation in the vicinity of the camera location. Given the close proximity of the locations, it is possible that all of the detections were of the same individual, although multiple individuals likely occur in the area. The camera station and opportunistic observation both were within 100 m of the Metson Lease gate in the very northwestern corner of the Preserve. The CNDDB also lists 3 antelope squirrel occurrences recorded in 1991 in this same general vicinity. All 3 are within 3 km of the Preserve boundary and located along the access road leading to the Metson Lease gate.

San Joaquin antelope squirrels are most commonly found in areas with flat or gently sloping terrain, sparse to moderate shrub cover, and relatively sparse herbaceous ground cover (U.S. Fish and Wildlife Service 1998). Habitat conditions in the area where the antelope squirrels were observed on the Wind Wolves Preserve are consistent with these habitat preferences. The area is along the Santiago Creek drainage, and the squirrels all were observed in large washes associated with this drainage. It is not known how far antelope squirrels extend into the Preserve in this area or the size of the population on the Preserve.

Habitat conditions in the Salt Creek drainage area, where the blunt-nosed leopard lizards were observed, also appear suitable for antelope squirrels, although none were detected there during the ESRP surveys. An area with suitable shrub densities also may be present in the Pleito Creek area. However, herbaceous ground cover in this area is relatively dense, which may discourage antelope squirrels. Rodent control measures targeting California ground squirrels in the adjacent agricultural lands could have adversely impacted any antelope squirrel populations that presently or formerly occur in the area. This area is isolated by incompatible terrain and land uses (e.g., agriculture), which would inhibit natural recolonization. In other parts of the Preserve, shrub restoration in conjunction with herbaceous vegetation management could potentially create habitat conditions suitable for San Joaquin antelope squirrels, but such efforts would likely need to be applied over a relatively large area, probably 1 km^2 or more, in order to support an antelope squirrel population.

OTHER SPECIAL-STATUS SPECIES DETECTED

Several other special-status species were detected on the Wind Wolves Preserve during the ESRP surveys. The species were loggerhead shrike, burrowing owl, northern harrier, and San Joaquin coachwhip. All of these species already were known to occur on the Preserve, and therefore the observations are generally unremarkable.

Loggerhead shrikes were observed on several occasions, including a nest with 2 chicks. Shrikes prefer some sort of structure, typically shrubs or fences, and most observations of shrikes were associated with such structures. Burrowing owls were observed in many locations on the Preserve. This species commonly uses the burrows of California ground squirrels, a species that is abundant and ubiquitous on the Preserve. Burrowing owls tend to prefer open areas with little or no shrub cover. They also prefer areas with a low ground cover as this facilitates hunting and predator detection. Consequently, habitat management strategies, such as grazing, that result in a low ground cover can be beneficial to burrowing owls. Northern harriers were observed on several occasions

foraging over Preserve lands. These birds are relatively common in the southern San Joaquin Valley. One San Joaquin coachwhip was observed in the Rincon area during transect surveys. Exceedingly little is know about coachwhip populations, both on the Preserve and elsewhere.

POTENTIAL FOR SPECIAL STATUS SPECIES NOT DETECTED

San Joaquin kit fox – No San Joaquin kit foxes were detected on the Wind Wolves Preserve during the ESRP surveys. When present, foxes usually are easily detected by automated camera stations, but no foxes were detected despite an extensive survey effort consisting of 37 stations operating for 1,393 station-nights. Five putative kit fox scats were collected, but genetic analysis revealed that these scats all were from coyotes or red foxes. Furthermore, despite many kilometers of transect surveys across the Preserve, no dens were located that exhibited signs consist with use by kit foxes. Despite the lack of kit fox detections, kit foxes might still occur on the Preserve, at least occasionally. Kit foxes using adjacent lands may periodically cross onto and use portions of the Preserve. The CNDDB lists several occurrence records for kit foxes on the Wind Wolves Preserve, with the most recent being in 1998, further suggesting that the Preserve is at least occasionally used by kit foxes.

The habitat in the valley floor portion of the Wind Wolves Preserve generally seems suitable for kit foxes. Indeed, in a recent analysis of habitat in the San Joaquin Valley (CSUS-ESRP, unpublished data), a suitability model classified much of the valley floor portion of the Preserve as suitable for kit foxes at some level (Figure 13). Thus, the lack of kit fox detections on the Preserve is somewhat surprising. The suitability model is largely based on terrain and ground cover density. The flat to gently rolling terrain throughout the valley floor portion of the Preserve is optimal for kit foxes. Vegetation density may vary temporally and this may offer a potential explanation for the lack of kit foxes. The vegetation values used in the model (Normalized Difference Vegetation Index) were from 2001-2006, which were years of generally lower annual precipitation. Lower vegetation density values would result in a higher suitability value. During years of higher annual precipitation, vegetation density would be higher and habitat suitability would be lower. Furthermore, much of the Wind Wolves Preserve has been grazed historically, and grazing intensity also can affect habitat suitability for kit foxes. As grazing intensity increases, vegetation density decreases and habitat suitability for kit foxes increases.

The relationship between kit foxes and vegetation density is complex as it also involves kangaroo rats, which are the primary prey for kit foxes. Kit foxes are adapted to arid environments and a relatively short, open vegetation structure facilitates mobility and predator detection. Furthermore, kangaroo rats also are adapted to arid environments, and kit fox abundance generally is positively related to kangaroo rat abundance (Grinnell et al. 1937, McGrew 1979, Cypher 2003). Dense vegetation, particularly that associated with the non-native grasses (e.g., *Avena spp.*, *Bromus spp.*) that now dominate herbaceous plant communities in the San Joaquin Valley, can significantly limit kangaroo rat populations and even cause local extirpations under certain conditions (Single et al. 1994, Germano et al. 2001). During live-trapping surveys on the Wind Wolves Preserve, capture rates for kangaroo rats were relatively low in general, and most kangaroo rats were captured in or near washes where vegetation usually was more sparse. Very few

kangaroo rats were captured in areas where vegetation density was relatively high, and particularly if a dense thatch layer was present. One possible scenario is that kangaroo rat populations on the Preserve have been reduced in the past by periods of high precipitation and dense ground cover, particularly when such conditions persist for multiple years. Under such a scenario, kangaroo rats might be restricted to areas where conditions are more favorable, such as in and near washes. This situation would be further exacerbated by any reductions or elimination of grazing. Such a scenario could explain the limited distribution and abundance of kangaroo rats observed on the Preserve and concomitant lack of kit fox detections.

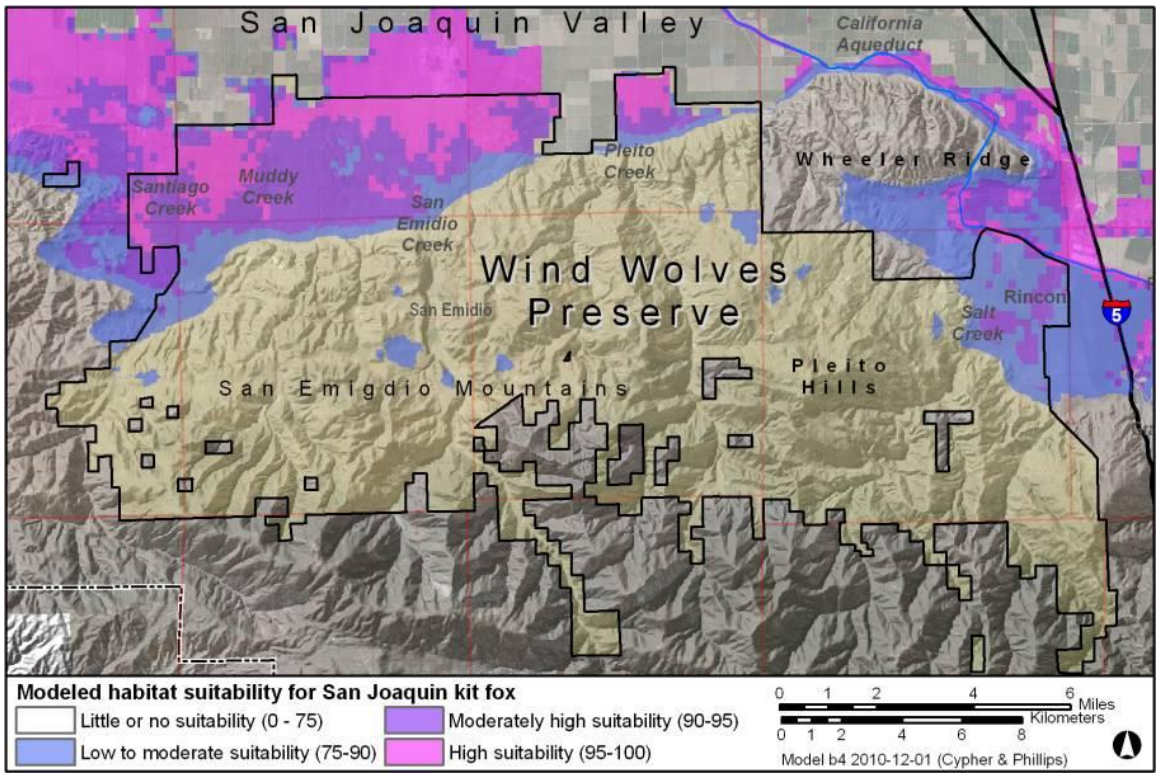

Figure 13. Modeled habitat suitability for San Joaquin kit foxes on the Wind Wolves Preserve.

Habitat management and enhancement potentially could increase the suitability of habitat on the Preserve for kit foxes. In particular, management strategies that reduce the vegetation height and density to produce a shorter, sparser structure could be beneficial. Grazing is probably the most practical and effective strategy for managing vegetation on the Preserve. A grazing program and infrastructure are already in place on most Preserve lands. Improvements in habitat suitability might be achieved simply by altering the timing and intensity of grazing to further reduce vegetation density. Furthermore, improving habitat suitability for kit foxes also would benefit other special status species that share similar habitat requirements, such as blunt-nosed leopard lizards, San Joaquin antelope squirrels, burrowing owls, and Tulare grasshopper mice. As suggested earlier for blunt-nosed leopard lizards, to accommodate other Preserve objectives, one possible approach is to designate specific management areas for kit foxes and associated species, and to manage these areas accordingly.

Habitat suitability for kit foxes also might be enhanced through the installation of artificial dens. Kit foxes are critically dependent on dens for avoiding predators, avoiding temperature extremes, conserving moisture, daytime resting, and rearing young. On average, each kit fox annually uses approximately 11 different dens, which are scattered around its home range (Koopman et al. 1998). Den availability may be a limiting factor in areas that are used intermittently by foxes or that are used primarily for movement (e.g., dispersal). The installation of artificial dens can provide additional refugia that could facilitate use of or movement through an area by kit foxes. Accordingly, through a grant from the U.S. Bureau of Reclamation, CSUS-ESRP recently contributed materials for artificial dens to the Preserve and a number of dens already have been installed.

The conservation and maintenance of suitable habitat for kit foxes on the Wind Wolves Preserve is considered important for the long-term conservation and recovery of the species. Recovery Task 5.3.8 in the recovery plan that includes kit foxes (U.S. Fish and Wildlife Service 1998) calls for maintaining a linkage area for kit foxes and other species along the southern edge of the San Joaquin Valley from McKittrick over to the Kern River. This linkage currently is the only connectivity between the east and west sides of the San Joaquin Valley. The Wind Wolves Preserve is a key-stone property in this linkage.

Red foxes were detected on the Preserve in the Rincon area. This non-native species has been increasing in abundance in the San Joaquin Valley during the past 2 decades (B. Cypher, personal observation). The effects of this species on native wildlife are unknown. Of potential concern are impacts to kit foxes through interference and exploitation competition (Cypher et al. 2001, Clark et al. 2005). Red foxes potentially could displace kit foxes. However, in an interesting ecological dynamic, coyotes appear to effectively limit or even exclude red foxes in natural habitats (Cypher et al. 2001). Consequently, red foxes in the San Joaquin Valley are mostly relegated to anthropogenic habitats such as agricultural and urban areas. Red foxes also are generally found near water sources. Indeed, the red fox detections on the Preserve were recorded at camera stations that were within 0.5 km of the California Aqueduct. Thus, although red foxes may be present on the Preserve, their distribution may be largely limited to areas along the northern boundary that are adjacent to the Aqueduct or irrigated agricultural lands.

Short-nosed kangaroo rat – Many of the rodent traplines established for the live-trapping surveys on the Wind Wolves Preserve were specifically located in areas where habitat conditions appeared to be suitable for short-nosed kangaroo rats. These areas included large washes, areas with sandy soils, and areas where ground cover was more sparse. This species generally favors areas of flatter or gently rolling terrain with light friable soils, sparse or no shrubs, and low-density ground cover (U.S. Fish and Wildlife Service 1998).

Short-nosed kangaroo rats have been reported from locations just west and just east of the Preserve (U.S. Fish and Wildlife Service 1998). Habitat in some areas of the Preserve appears suitable for this species, particularly along the northern boundary and along large wash complexes. Trapping was not conducted in all potential areas, and it is possible that short-nosed kangaroo rats persist in some locations. As with kangaroo rats in general, dense ground cover reduces habitat suitability for this species. As with blunt-nosed leopard lizards and kit foxes, habitat management strategies that reduce vegetation density could improve habitat conditions for short-nosed kangaroo rats.

Giant kangaroo rat – Giant kangaroo rats were not captured during live-trapping surveys and sign of this species (e.g., burrow systems) was not observed during transect surveys. Habitat conditions appeared sufficiently suitable on the Preserve to include giant kangaroo rats as a target species in the surveys. However, the nearest known occurrences for this species are approximately 20 km to the northwest near the city of Taft (U.S. Fish and Wildlife Service 1998). Thus, the Wind Wolves Preserve may be outside of the historic range for this species.

Tulare grasshopper mouse – No Tulare grasshopper mice were captured during live-trapping surveys on the Wind Wolves Preserve. However, this species has been captured previously on the Preserve (D. Clendenen, TWC, personal communication) and in all likelihood is still present. Grasshopper mice occur in arid grasslands and shrublands in the San Joaquin Valley and appear to tolerate a broader range of habitat conditions, compared to species like the short-nosed kangaroo rat (U.S. Fish and Wildlife Service 1998). However, this species generally is difficult to detect because it uses home ranges that are inordinately large relative to the size of the animal and naturally occurs at low densities (McCarty 1975). Thus, capture rates commonly are very low, even in areas considered optimal for this species (Cypher 2001).

Badger – Badgers were not observed during surveys on the Preserve or detected on cameras. However, badgers have been seen previously on the Preserve by ESRP staff and are routinely seen by TWC staff and others. The badger population on the Preserve is generally considered to be robust.

Le Conte's thrasher – Le Conte's thrashers were not observed during the surveys, but have been seen previously on the Preserve. The thrashers prefer areas with shrub cover and commonly are observed in desert saltbush (*Atriplex polycarpa*) stands in the San Joaquin Valley. Individual birds may require 11-20 ha (27-49 ac) of such habitat, and isolated fragments of shrub habitat may need to be a minimum of 130 ha (320 ac) to support a persistent population of thrashers (Shepard 1996). Thus, suitable areas for Le Conte's thrashers may be somewhat limited on the Preserve, although proposed shrub restoration efforts could increase the amount of thrasher habitat.

HABITAT CONDITIONS

As alluded to in the species-specific discussions above, much of the valley floor habitat on the Wind Wolves Preserve may be suboptimal for many special-status San Joaquin Valley species. The suboptimal conditions are largely attributable to a relatively high density of ground cover, and this high density is a function of a combination of factors, particularly greater precipitation associated with being located near an ecotone and invasion of vegetation communities by non-native grasses.

The valley floor portion of the Preserve is positioned at the base of the San Emigdio Mountains at the southern end of the San Joaquin Valley. Much of the valley floor is below 150 m (500 ft) while the mountains rise up over 2400 m (8,000 ft). Cooler temperatures at the higher elevations result in higher precipitation. Consequently, the city of Bakersfield on the San Joaquin valley floor receives an annual average of 16.5 cm (6.5 in) of precipitation while the average at Frazier Park, less than 60 km (38 mi) south at an elevation of about 1450 m (6,750 ft) is about 34.3 cm (13.5 in). Much of the valley floor portion of Preserve is located on alluvial fans emanating from the San Emigdio range and therefore is higher than the San Joaquin Valley floor. In fact, some of the

valley floor habitats on the Preserve are above 300 m (1,000 ft). Thus, the valley floor portion of the Preserve generally receives higher precipitation than much of the southern San Joaquin Valley. This higher precipitation promotes greater plant productivity resulting in a denser ground cover.

Furthermore, a relatively high proportion of this ground cover consists of non-native grasses such as bromes (*Bromus spp.*), wild oats (*Avena spp.*), wild barley (*Hordeum spp.*), and Mediterranean grass (*Schismus spp.*). These species are aggressive, invasive, and well adapted to the Mediterranean style climate characteristic of the San Joaquin Valley. Thus, they achieve relatively high densities resulting in a ground cover that likely is much denser than that which occurred in the region historically. Prior to the introduction of the non-native grasses, herbaceous plant communities in the region probably consisted primarily of annual forbs that did not achieve densities comparable to the non-native grasses, and also that did not produce dense thatch layers like the non-native grasses do (Minnich 2008).

Many of the special-status valley floor species are adapted to arid conditions, including a relatively sparse, low-density ground cover with bare, exposed ground. Thus, the invasion and domination of regional plant communities by the non-native grasses has reduced habitat quality and suitability for these species (U.S. Fish and Wildlife Service 1998). Potential impacts to native species, including possible local population extirpation, are described in Schierenbeck 1995, Goldingay et al. 1997, U.S. Fish and Wildlife Service 1998, Cypher 2001, and Germano et al. 2001.

Habitat management strategies that markedly reduce herbaceous ground cover could improve habitat conditions for special-status valley floor species. Potential strategies include grazing, burning, and mechanical or chemical removal. Advantages and disadvantages of each strategy are discussed in Germano et al. 2001. In summary, mechanical removal (e.g., by mowing or disking) and chemical removal (e.g., herbicide spraying) generally are not practical on a landscape scale. These approaches also may have unacceptable collateral impacts, such as collapsing burrows and indiscriminately killing desirable native plants. Burning can be applied on a landscape-scale and has been shown to effectively reduce ground cover, but the effect generally is short-term (e.g., 1-2 years). Use of fire also has significant drawbacks such as the danger of wildfire and reduction in air quality. Furthermore, valley floor habitats are not fire-adapted and therefore burning commonly kills any shrubs that are present. Once killed, reestablishing shrubs either through natural colonization or restoration can be a slow and expensive process.

Grazing may be the most practical strategy for landscape-level habitat management on the Wind Wolves Preserve. One great advantage is that grazing has been a historical activity on Preserve lands, and much of the infrastructure necessary to conduct a grazing program is in place. Grazing also provides a high degree of flexibility for achieving management objectives through the use of fencing, stocking rates, and timing (e.g., seasonal versus year-round). Grazing has potential drawbacks such as impacts to shrubs and some native plants, but generally may be the most effective and cost-effective approach for reducing herbaceous ground cover density, including accumulated thatch. A grazing program that resulted in residual dry matter levels of less than 1,000 lbs/ac should provide more favorable habitat conditions for many special-status valley floor species. As alluded to previously, this goal does not need to be implemented across the entire valley floor portion of the Preserve, but instead could be applied to specific areas

where the primary management objective is the maintenance of populations of special-status valley floor species.

CONCLUSIONS AND RECOMMENDATIONS

The surveys conducted by ESRP in 2010 confirmed the presence of several special-status valley floor species on the Wind Wolves Preserve. These surveys also contributed significantly to Recovery Task 3.2.23 in the *Recovery Plan for Upland Species of the San Joaquin Valley*, California (U.S. Fish and Wildlife Service 1998). This task calls for surveys to be conducted for special status animals along the southeastern and southern edge of the San Joaquin Valley. The special status species detected included the blunt-nosed leopard lizard, Buena Vista Lake shrew, San Joaquin antelope squirrel, burrowing owl, loggerhead shrike, northern harrier, and San Joaquin coachwhip. Other special status species were not detected but are known to occur on the Preserve (e.g., badger, Le Conte's thrasher, Tulare grasshopper mouse), or potentially occur (e.g., San Joaquin kit fox, short-nosed kangaroo rat). Habitat management strategies that reduce dense herbaceous ground cover on the Preserve could improve habitat suitability for special-status valley floor species.

RECOMMENDATIONS

Based on the results of this project, the following recommendations are offered:

1. Manage habitat for special-status valley floor species

Habitat management potentially could increase the security and persistence of existing populations of special status species, and even could facilitate increases in abundance and expansion of areas used by these species. In particular, maintaining a relatively short-structured, low-density vegetation structure would improve habitat suitability for these species. Vegetation management would probably best be achieved through grazing. Areas could be identified on the Preserve where the primary objective would be to manage the habitat specifically to benefit special status species. Potential target areas for such management could include lands along the northern boundary of the Preserve, and large washes and alluvial fan areas associated with major creek drainages such Salt Creek, Pleito Creek, Los Lobos Creek, Muddy Creek, and Santiago Creek. Managing and enhancing habitat along the northern boundary of the Preserve also would contribute significantly toward maintaining habitat connectivity across the southern end of the San Joaquin Valley.

2. Restore and enhance shrublands

Efforts to restore shrubs or expand existing stands could benefit special status species. In particular, the presence of shrubs could significantly improve habitat suitability for Le Conte's thrashers, loggerhead shrikes, San Joaquin antelope squirrels, and blunt-nosed leopard lizards. Shrubs provide perches, cover, and shade for these species. Low-density shrub cover (e.g., shrubs not touching and separated by open ground) would be optimal. Shrub stands of about 40 ha (100 ac) or larger also would be optimal, particularly for Le

Conte's thrashers. Larger stands of 100 ha (250 ac) or greater might be necessary to support San Joaquin antelope squirrels.

3. Enhance habitat for kit foxes

Vegetation management as described above could improve habitat suitability for kit foxes. Furthermore, the installation of artificial dens also could benefit kit foxes. The availability of natural dens generally is low in areas of low or intermittent kit fox use. The installation of artificial dens could increase the potential for occupation of or movement through an area by kit foxes. With some assistance from ESRP, the Preserve has initiated the installation of artificial dens, and the continuation and expansion of this effort is encouraged.

4. Conduct additional surveys for special status species

The surveys conducted by ESRP were of limited scope and duration. Additional survey efforts may detect additional special status species as well as provide additional distribution and abundance information on previously detected special status species. Such surveys are particularly recommended in conjunction with any new management strategies implemented on the Preserve to determine the efficacy of the strategies.

5. Conduct population monitoring for special status species

Monitoring is recommended for special status species to track population trends. Such monitoring is particularly recommended for listed species known to occur on the Preserve, such as blunt-nosed leopard lizards, Buena Vista Lake shrews, and San Joaquin antelope squirrels. Annual monitoring of populations is recommended, and this will facilitate "adaptive management", specifically the implementation of new or altered management strategies in response to any observed population declines.

6. Gather information on special status species

Data gathering through scientific research and monitoring is recommended to provide information that could contribute to the conservation of special status species. Particularly important data would include distribution, abundance, population trends, demographic patterns (e.g., survival rates, reproductive rates), and ecological parameters (e.g., preferred habitat types and attributes, space use, interspecific interactions). Information on habitat relationships could be particularly valuable as habitat conditions appear to be a critical determinant of the occurrence and abundance of special status species on the Preserve.

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APPENDIX A. VERTEBRATE SPECIES OBSERVED ON THE WIND WOLVES PRESERVE DURING SURVEYS CONDUCTED BY THE CALIFORNIA STATE UNIVERSITY-STANISLAUS, ENDANGERED SPECIES RECOVERY PROGRAM IN 2010.

	Order	Family	Common Name	Scientific Name	Detection Method(s)[1]
Mammals	Insectivora	Soricidae	Buena Vista Lake shrew	*Sorex ornatus relictus*	B
	Lagomorpha	Leporidae	Audubon's cottontail	*Sylvilagus audobonii*	T, C
			Black-tailed jackrabbit	*Lepus californicus*	T, C
	Rodentia	Heteromyidae	San Joaquin pocket mouse	*Perognathus inornatus*	S
			California pocket mouse	*Chaetodipus californicus*	S
			Heermann's kangaroo rat	*Dipodomys heermanni*	T, C, S
		Muridae	Western harvest mouse	*Reithrodontomys megalotis*	B
			Deer mouse	*Peromyscus maniculatus*	S, B
		Sciuridae	San Joaquin antelope squirrel	*Ammospermophilus nelsoni*	C, O
			California ground squirrel	*Spermophilus beecheyi*	T
	Carnivora	Canidae	Coyote	*Canis latrans*	T, C
			Red fox	*Vulpes vulpes*	C
		Procyonidae	Raccoon	*Procyon lotor*	C
		Mustelidae	Long-tailed weasel	*Mustela frenata*	T
		Mephitidae	Striped skunk	*Mephitis mephitis*	C
		Felidae	Bobcat	*Lynx rufus*	C
	Artiodactyla	Cervidae	Elk	*Cervus elaphus*	O
			Black-tailed Deer	*Odocoileus hemionus*	O
Birds	Galliformes	Odontophoridae	California Quail	*Callipepla californica*	T
	Falconiformes	Accipitridae	Red tailed hawk	*Buteo jamaicensis*	T
			Northern harrier	*Circus cyaneus*	O
		Falconidae	American kestrel	*Falco sparverius*	T
			Prairie falcon	*Falco mexicanus*	T
	Columbiformes	Columbidae	Mourning Dove	*Zenaida macroura*	
	Strigiformes	Tytonidae	Barn owl	*Tyto alba*	T
		Strigidae	Burrowing Owl	*Athene cunicularia*	T
	Caprimulgiformes	Caprimulgidae	Lesser Nighthawk	*Chordeiles acutipennis*	T
	Apodiformes	Trochilidae	Anna's Hummingbird	*Calypte anna*	T
	Passeriformes	Tyrannidae	Western Kingbird	*Tyrannus verticalis*	T
		Laniidae	Loggerhead Shrike	*Lanius ludovicianus*	T
		Corvidae	Common raven	*Corvus corax*	T, C
		Alaudidae	Horned lark	*Eremophila alpestris*	
		Hirundinidae	Cliff Swallow	*Petrochelidon pyrrhonota*	T
		Emberizidae	White crowned sparrow	*Zonotrichia leucophrys*	T
		Icteridae	Bullock's Oriel	*Icterus bullockii*	T
			Brewer's Blackbird	*Euphagus cyanocephalus*	
			Western meadowlark	*Sturnella neglecta*	T
Reptiles	Squamata	Phrynosomatidae	Side-blotched lizard	*Uta stansburiana*	T
		Crotaphytidae	Blunt-nosed leopard lizard	*Gambelia sila (silus)*	T
		Teiidae	California whiptail	*Aspidoscelis tigris munda*	T
		Viperidae	Northern Pacific Rattlesnake	*Crotalus oreganus oreganus*	T, O
		Colubridae	California Nightsnake	*Hypsiglena torquata nuchalata*	O
			Long-nosed snake	*Rhinocheilus lecontei*	O
			Gopher snake	*Pituophis catenifer catenifer*	O
			San Joaquin Coachwhip	*Masticophis taeniatus ruddocki*	T
Amphibians	Anura	Hylidae	Pacific treefrog	*Pseudacris regilla*	O

1. T = Transect surveys, C = Camera station surveys, S = Small mammal trapping, B = Buena Vista Lake shrew trapping, O = Opportunistic observation