MOHAVE GROUND SQUIRREL CAMERA STUDY 2014
SURVEYS WEST OF CALIFORNIA CITY
REPORT TO CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

PREPARED FOR

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE
P.O. BOX 944209
SACRAMENTO, CA 94244-2090

Prepared by

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

David K. Delaney
U.S. Army CERL
P.O. Box 9005
Champaign, IL 61826-9005

February 5, 2015

ABSTRACT

The state-listed Mohave ground squirrel (*Xerospermophilus mohavensis*) occupies a small geographic range in the western Mojave Desert of California. Because of the great interest in development of renewable energy in the California deserts, accurate data on the distribution and status of this species are essential for conservation planning. Recent studies have provided useful information on Mohave ground squirrel occurrence patterns in several parts of its range, but data for certain areas are still lacking. The section of Kern County from California City west toward the town of Mojave and the foothills of the Tehachapi Mountains has high potential as a site for large-scale wind and solar facilities, yet the status of the Mohave ground squirrel here is poorly understood. The species was reported at only 4 locations in this area during the period from 1975 to 2002. There have been no more recent records there in spite of survey efforts. With funding from the California Department of Fish and Wildlife, we used trail cameras to conduct a survey for Mohave ground squirrels at 8 study sites on public lands in this area. No Mohave ground squirrels were detected during sampling at these sites in March and May 2014. These results are completely consistent with the evidence from other surveys in this area since 2002 and strongly suggest that the species may no longer be present here. This is in marked contrast to the situation to the east of California City where there is abundant evidence of a significant Mohave ground squirrel population distributed from the Desert Tortoise Research Natural Area south to Edwards Air Force Base. It is likely that siting renewable energy facilities in the area to the west of California City would have little or no adverse impact on the Mohave ground squirrel. On the other hand, we recommend strong conservation measures be applied in the areas to the east of California City that support an important Mohave ground squirrel population.

INTRODUCTION

The Mohave ground squirrel (*Xerospermophilus mohavensis*) is listed as a Threatened species under the California Endangered Species Act. It is found only in a relatively small geographic area in the western Mojave Desert of California. Because of the great potential for renewable energy development within its range, the Mohave ground squirrel (MGS) is of intense conservation interest. It has been designated as a covered species under the Desert Renewable Energy Conservation Plan (DRECP), which is being developed by a collaboration of federal and state agencies to permit renewable energy projects in the desert region of California while providing for the conservation of important biological resources. As a result, there is a critical need for current information on the distribution and status of the MGS.

During 2011 and 2012, an extensive study of MGS distribution was carried out using Reconyx® trail cameras (Leitner and Delaney 2014). A total of 123 study sites were randomly selected within 12 large blocks of habitat that covered a substantial portion of the geographic range of this species (Figure 1). However, this investigation was carried out only on public lands managed by the US Bureau of Land Management (BLM), California Department of Fish and Game[1], and California State Parks. No sampling was conducted on private or military lands, which together make up two-thirds of the area within the MGS range.

[1] California Department of Fish and Wildlife since Jan. 1, 2013

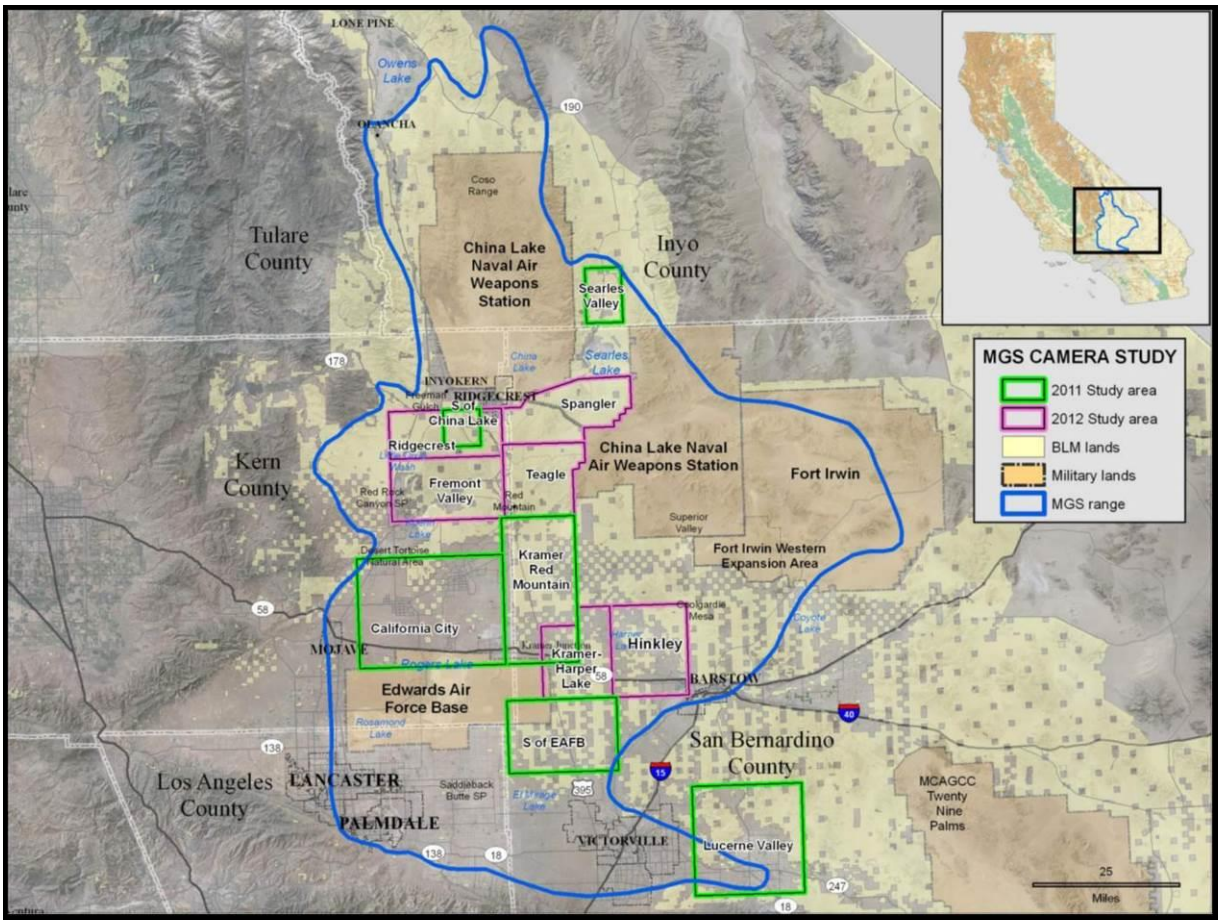

Figure 1. Locations of the 12 study areas used in the 2011-2012 camera study.

One of the camera study areas sampled in 2011 consisted of 1200 km^2 (463 mi^2) in eastern Kern County in the vicinity of California City. Because there is very little BLM or state land here, only a small portion of the California City study area could be surveyed. Five of the 12 randomly-selected study sites were in the vicinity of the Desert Tortoise Research Natural Area (DTRNA), while others were widely scattered through the western and southern portions of the study area (Figure 2). This survey confirmed the presence of MGS on 4 sections of public land adjacent to the DTRNA, as well as on a BLM parcel about 13 km (8 mi) to the southeast.

Because much of the California City study area is relatively level with good solar radiation, it has significant potential for large-scale solar energy development. Therefore, an additional trail camera survey was undertaken in the spring of 2013 to clarify the status and distribution of MGS within a large area to the south and east of California City. Seven camera sites were sampled on BLM, CDFW, and private lands where access could be obtained (Figure 2). The species was detected at 4 of these sites, indicating that MGS are widespread in this region (Leitner 2014b).

In spite of the 2011 and 2013 surveys, there was still very little data on the status of MGS in the area to the west of California City, toward the foothills of the Tehachapi Mountains and the town of Mojave. This data gap was of particular concern because this area has been proposed as a Development Focus Area for renewable energy in 6 of the 7 draft alternatives for the DRECP (2012). To date, at least one major solar facility has been permitted here and

others have been proposed. The current study was undertaken to collect urgently needed information regarding the potential of this area to support an MGS population.

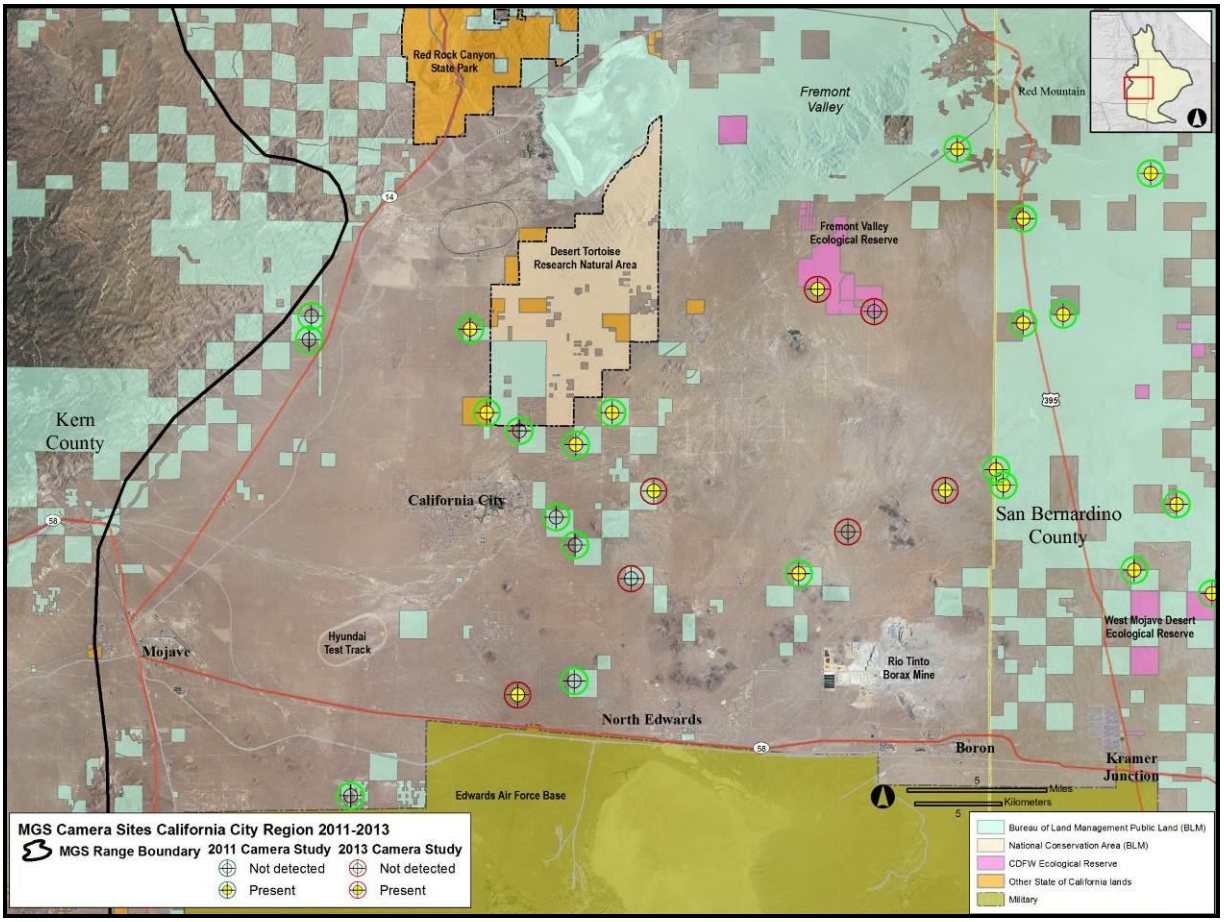

Figure 2. Map of the California City study area showing site locations and survey results for the 2011 and 2013 camera surveys.

METHODS

SITE SELECTION

The majority of land within the study area west of California City is in private ownership. Previous experience has shown that it is difficult to obtain permission to conduct biological surveys on private property (Leitner 2014b). However, there are scattered parcels of public land managed by U.S. Bureau of Land Management (BLM) within the 2014 region of interest west of California City. Eight study sites were selected on BLM properties, with special attention paid to sampling as widely as possible within the region (Figure 3). Just as in 2013, the 2014 study sites were selected based upon availability of access, unlike the random site selection carried out during the 2011-2012 study. Appendix A provides the UTM coordinates of the sites and their legal descriptions.

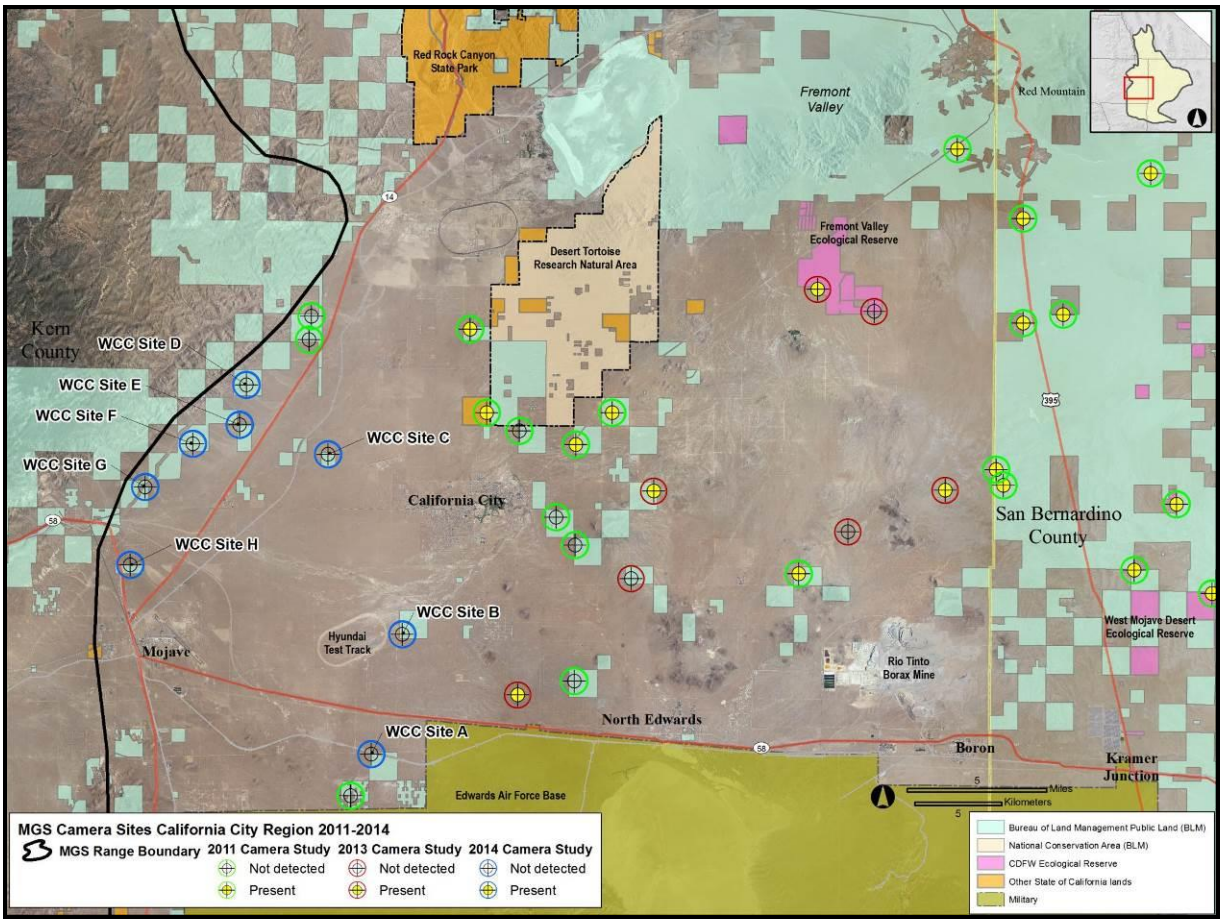

Figure 3. Map of the California City study area showing 2014 camera study sites west of California City (WCC) in relation to previous camera survey locations.

SAMPLING SCHEDULE

Camera trapping was carried out during the spring activity period of the MGS. Two sampling sessions were conducted at each site, the first during March and the second in May (Table 1). The March sampling period was scheduled at a time when all adult MGS were expected to be active above ground. There is evidence that 2014 was a reproductive year (see Discussion), so the May sampling period was at a time when juveniles would also be active above ground and beginning to disperse from their natal areas.

Table 1. Sampling schedule of 2014 camera study.

SITE NAME	SESSION 1	SESSION 2
Study Site A	Mar 10-15	May 11-16
Study Site B	Mar 10-14	May 11-16
Study Site C	Mar 17-21	May 19-23
Study Site D	Mar 10-14	May 11-16
Study Site E	Mar 17-21	May 19-23
Study Site F	Mar 10-14	May 11-16
Study Site G	Mar 17-21	May 19-23
Study Site H	Mar 17-21	May 19-23

OPERATIONAL PROCEDURES

At each study site, camera stations were established at 10 locations. The camera stations were arranged in two parallel lines with five cameras each. The two lines of cameras were oriented east-west or north-south, depending upon the shape of the parcel that was being sampled. At all sites the two lines were placed 150 m apart and camera stations within each line were separated by 150 m. The 150 m spacing was selected because it is similar to observed median values of maximum within-day distances moved by adult female MGS (Harris and Leitner 2004), thus increasing the likelihood of sampling a number of home ranges.

Cameras were usually operated from Monday through Friday, thus avoiding the weekends when there is often considerable recreational activity in the western Mojave Desert. Cameras were generally set up on Monday morning, allowed to operate 24 hr/day, and taken down on Friday afternoon. At study sites where the likelihood of theft or vandalism was considered minimal, cameras were sometimes set up on Sunday or taken down on Saturday. At each station, a 1.5 m steel post was driven into the ground at a slight angle and a Reconyx® trail camera was attached. Bait consisting of mixed grains (barley, oats, and corn) plus peanut butter was placed in front of each camera when it was first installed. On subsequent mornings, a member of the study team visited each camera station to replace bait and check camera battery condition. Cameras were serviced at or before dawn so that the camera station was fully functional before MGS became active.

On the afternoon of the last day in each session, SD cards with stored images were removed from the cameras and labeled. Then images were down-loaded in duplicate and stored on two external hard drives. Images were examined by members of the study team and wildlife data were entered on Excel spreadsheets. Wildlife images were classified by species and the date and time of visitation were recorded. Information regarding intra- and inter-specific behavioral interactions was noted as well.

RESULTS

No Mohave ground squirrels were detected at the 8 study sites that were sampled in 2014. White-tailed antelope squirrels (*Ammospermophilus leucurus*) were found at all study sites and were the only diurnal mammal species recorded. Nocturnal detections were dominated strongly by kangaroo rats (*Dipodomys* sp.) and kit foxes (*Vulpes macrotis*) were present at all study sites. Coyotes (*Canis latrans*) were recorded on 6 of the study sites, with an American badger (*Taxidea taxus*) detected at just 1 site. A description of the shrub vegetation and the detailed results of the camera study are presented below for each study site.

STUDY SITE A

This study site is located south of State Route 58, near the boundary of Edwards Air Force Base. The vegetation here consists of relatively diverse Creosote Bush Scrub, dominated by creosote bush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*). Subdominant shrubs include Cooper's boxthorn (*Lycium cooperi*), winterfat (*Krascheninnikovia lanata*), and spiny hopsage (*Grayia spinosa*). A few Joshua trees (*Yucca brevifolia*) are also present here. The diurnal activity recorded at the cameras consisted of visits by white-tailed antelope squirrels and common ravens (*Corvus corax*). Nocturnal detections were dominated by kangaroo rats, with many records of kit foxes as well.

STUDY SITE B

This study site is east of the Hyundai Test Track on a section of BLM land that supports Creosote Bush Scrub. In addition to the dominant creosote bush and white bursage, there are scattered Joshua trees as well as Cooper's boxthorn, Anderson's boxthorn (*Lycium andersonii*), and winterfat. During the March sampling period, there was virtually no diurnal wildlife activity detected at the camera stations. In contrast, white-tailed antelope squirrels were recorded at almost all camera stations in May, with some common raven activity as well. Kangaroo rats were common in the nocturnal records. Kit foxes were active at night, especially in March. There was a single coyote detection here in March.

STUDY SITE C

This quarter-section of BLM land is approximately 6 km (4 mi) northwest of California City. Vegetation here is low diversity Creosote Bush Scrub, strongly dominated by creosote bush and white bursage. There was only moderate diurnal activity by white-tailed antelope squirrels, with a number of common raven detections in May. Kangaroo rats and black-tailed jack rabbits (*Lepus californicus*) were active at night, but there were few kit fox records. In March there were 2 camera visits by American badgers and 1 coyote detection.

STUDY SITE D

This study site is the northernmost of a series of five sites on BLM parcels along the bajada slope west of State Route 14. It supports relatively diverse Creosote Bush Scrub, with spiny senna (*Senna armata*), bladder sage (*Scutellaria mexicana*), and cheesebush (*Ambrosia salsola*) found along small washes. There was essentially no diurnal wildlife activity here in March, with a moderate number of white-tailed antelope squirrel and common raven detections in May. Nocturnal species recorded here consisted almost entirely of kangaroo rats, with a few kit fox observations.

STUDY SITE E

This study site is located low on the bajada and just west of State Route 14. The vegetation is relatively diverse Creosote Bush Scrub with several shallow washes that support spiny senna, bladder sage, and cheesebush. A single BLM dirt bike track crosses the site. White-tailed antelope squirrels and common ravens were regular diurnal visitors to the cameras, with more raven activity noted in May. Kangaroo rats were commonly recorded at night, with a few kit fox occurrences and 1 coyote detection.

STUDY SITE F

Study Site F is high on the bajada slope, between a transmission line service road and the Los Angeles Aqueduct. Access is from a BLM four-wheel drive track. The vegetation community here is moderately diverse Creosote Bush Scrub, with California buckwheat (*Eriogonum fasciculatum*) and Nevada jointfir (*Ephedra nevadensis*) as important subdominants. Several small washes support bladder sage and cheesebush. Common ravens and white-tailed antelope squirrels were recorded regularly during the day, although the number of detections of both species was higher in May. Nocturnal observations were dominated by kangaroo rats, although black-tailed jack rabbits were recorded occasionally. There were also a few kit fox and coyote detections.

STUDY SITE G

This site is north of Cache Creek and just downslope from the Los Angeles Aqueduct. The shrub vegetation is strongly dominated by creosote bush and white bursage, with California buckwheat as the most important subdominant. Diurnal records here were entirely made up of white-tailed antelope squirrel detections, with increased activity in May. There were no common raven records. Kangaroo rats were commonly observed here at night, with occasional black-tailed jack rabbit records in May. In March there was occasional kit fox activity, but very little noted in May. There was also a single coyote detection in March.

STUDY SITE H

Study Site H is approximately 1.6 mi (1 km) north of the town of Mojave. The shrub community on this relatively level site is strongly dominated by creosote bush, with white bursage and Cooper's goldenbush (*Ericameria cooperi*) as the main subdominants. White-tailed antelope squirrels were detected regularly in both sessions, with a few common ravens appearing in May. Nocturnal records were made up almost entirely of kangaroo rats, although there were few kangaroo rat detections in May. There was an occupied kit fox natal den on the site and kit foxes were recorded regularly during both camera sessions. One coyote occurrence was documented in May.

DISCUSSION

The status of the MGS in the region west of California City toward the town of Mojave and the Tehachapi foothills has been poorly understood, primarily because most of the land here is in private ownership and it has been difficult to carry out systematic field surveys. MGS were reported at 4 locations in this region during the period from 1975 to 2002 (Figure 4). The MGS occurrences at 3 of these sites are listed in the California Natural Diversity Data Base (CNDDB) as visual observations only. There were sightings reported near the California City airport in 1975 and 1985, as well as at 2 locations just north of the town of Mojave in 1987 and 1998. Visual detections are problematic as there is no way to know whether diagnostic features were clearly seen by the observer. California ground squirrels (*Otospermophilus beecheyi*) occur throughout this area and juveniles can be mistaken for MGS. Only in one case, a 2002 occurrence at the Hyundai Test Track was the animal captured and identified with certainty as an MGS.

Although there were very few MGS records to the west of California City during the period from 1975 to 2002, there was solid evidence that the species occurred at that time in the vicinity of the DTRNA to the north and near North Edwards and Boron to the southeast. Figure 4 shows 12 occurrences in those 2 areas dating from 1973 to 1999. Six of these records (5 based upon live-trapping) were in or near the DTRNA, while there were 6 additional detections (2 from live-trapping) to the southeast of California City.

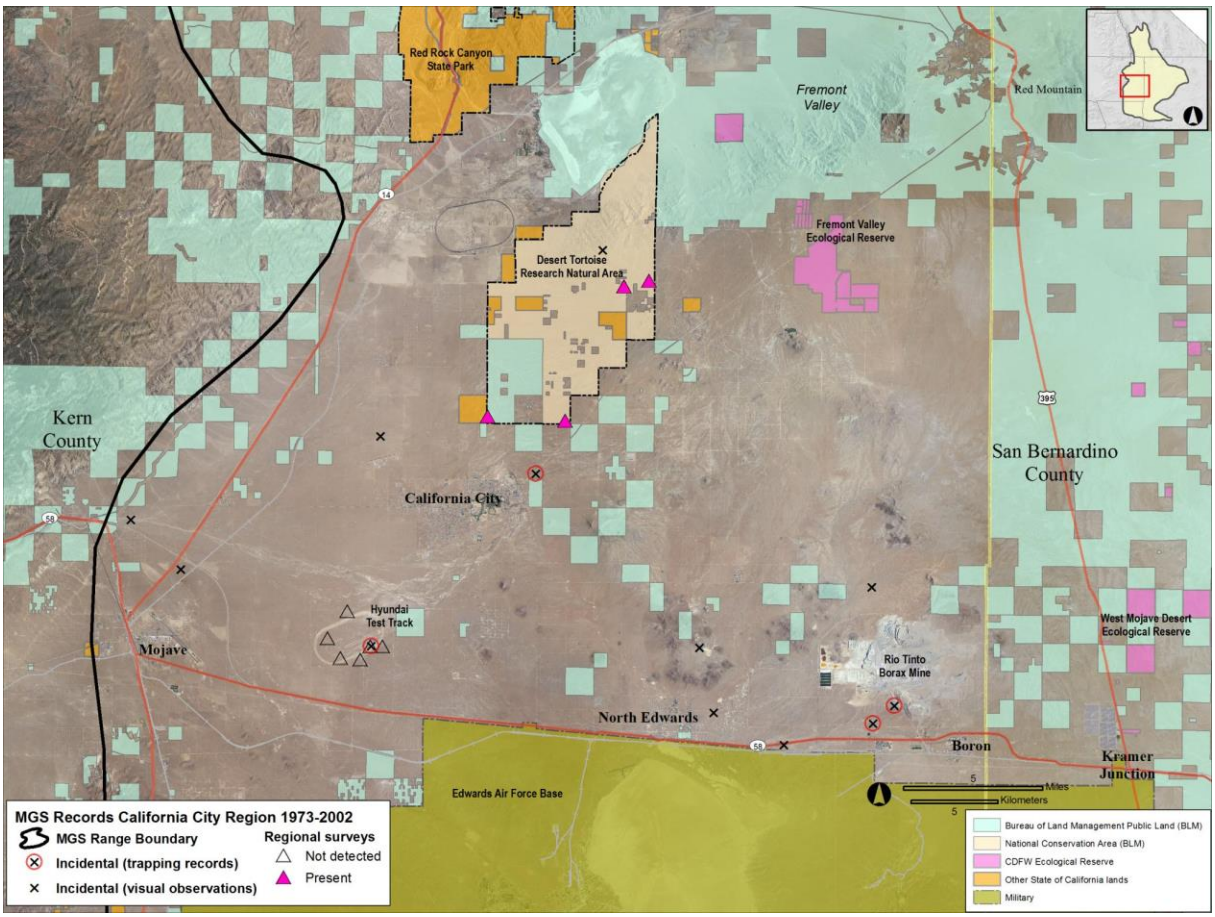

Figure 4. Map of the California City study area showing locations of MGS records for the period 1973-2002.

The results of surveys since 2002 have confirmed this distribution pattern (Figure 5). During this period, there have been no further MGS records west of California City. In connection with proposed wind and solar projects, intensive protocol trapping to the west and south of the town of Mojave since 2002 has failed to detect MGS. No MGS were recorded in recent years at several other protocol trapping sites north of Mojave and near California City (see Figure 5). Although a single MGS was observed and then trapped near the site of the Hyundai Test Track in 2002, subsequent trapping efforts in this area failed to capture any other specimens. Sampling in 2011 at 3 camera sites west of California City did not record any MGS, although the species was found to be present in the same year at 4 camera sites around the periphery of the DTRNA (Leitner and Delaney 2014). Finally, the lack of MGS detections at the 8 camera sites sampled in 2014 is consistent with the hypothesis that there is no significant MGS population present west of California City.

In contrast to the situation west of California City, surveys and incidental observations since 2002 have confirmed the presence of a widespread MGS population in the region stretching from the DTRNA south and east toward Edwards Air Force Base (Figure 5). Leitner (2008) identified the DTRNA as a known MGS population center and Edwards Air Force Base as a core area for the species. More recent data (Leitner 2014a) have confirmed the importance of these two areas and the 2013 camera study has provided evidence that the species is also present at a number of locations throughout the intervening habitat (Leitner 2013).

The western Mojave Desert has been suffering a prolonged drought since mid-2011, with no evidence of MGS reproduction in 2012 and 2013. However, late winter storms in late February-early March 2014 resulted in some growth of spring annual plants and MGS reproduction was documented at several sites (Leitner, pers. obs.). We installed 2 trail cameras in May 2014 at a site about 10 km (6 mi) south of California City where MGS had been photographed in 2013. These cameras detected at least 2 adult MGS and several juveniles. This suggests that if an MGS population had been present in the study area west of California City in the spring of 2014 it is very likely that dispersing juveniles would have been detected in May at our camera sites.

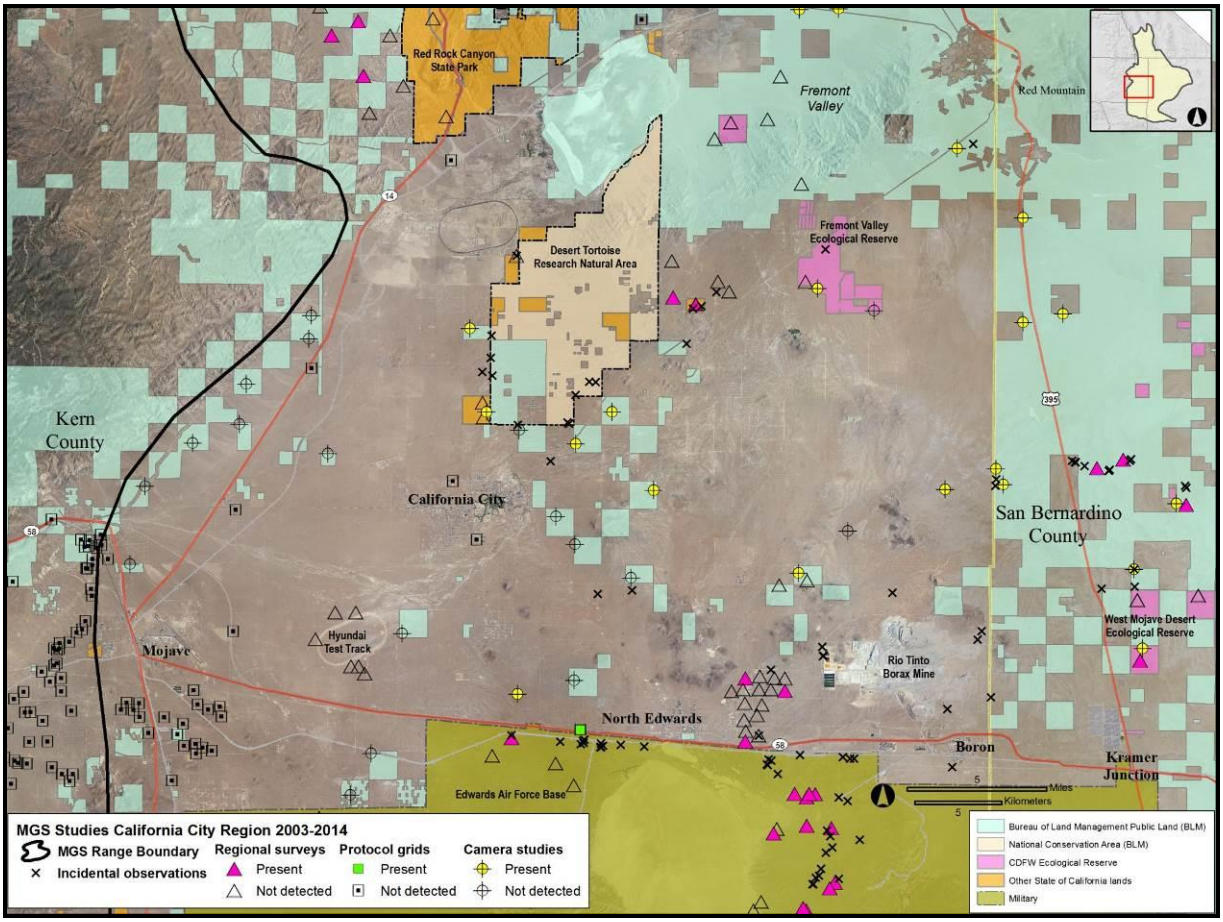

Figure 5. Map of the California City study area showing locations of MGS studies for the period 2003-2014.

To summarize, we have evaluated all available data regarding the status of MGS within the current study area to the west of California City. We conclude that there is no evidence for the existence of a significant MGS population here. In fact, it seems likely that the species no longer occurs in this area. On the other hand, there are abundant records dating from 1973 to the present that confirm the presence of an important resident population distributed from the DTRNA south to Edwards Air Force Base. Figure 6 shows the possible western boundary of MGS occurrence in this region. We recommend strong conservation measures to protect MGS habitat east of this proposed boundary. However, siting renewable energy facilities in the area to the west of this boundary is unlikely to result in significant adverse impacts to this species.

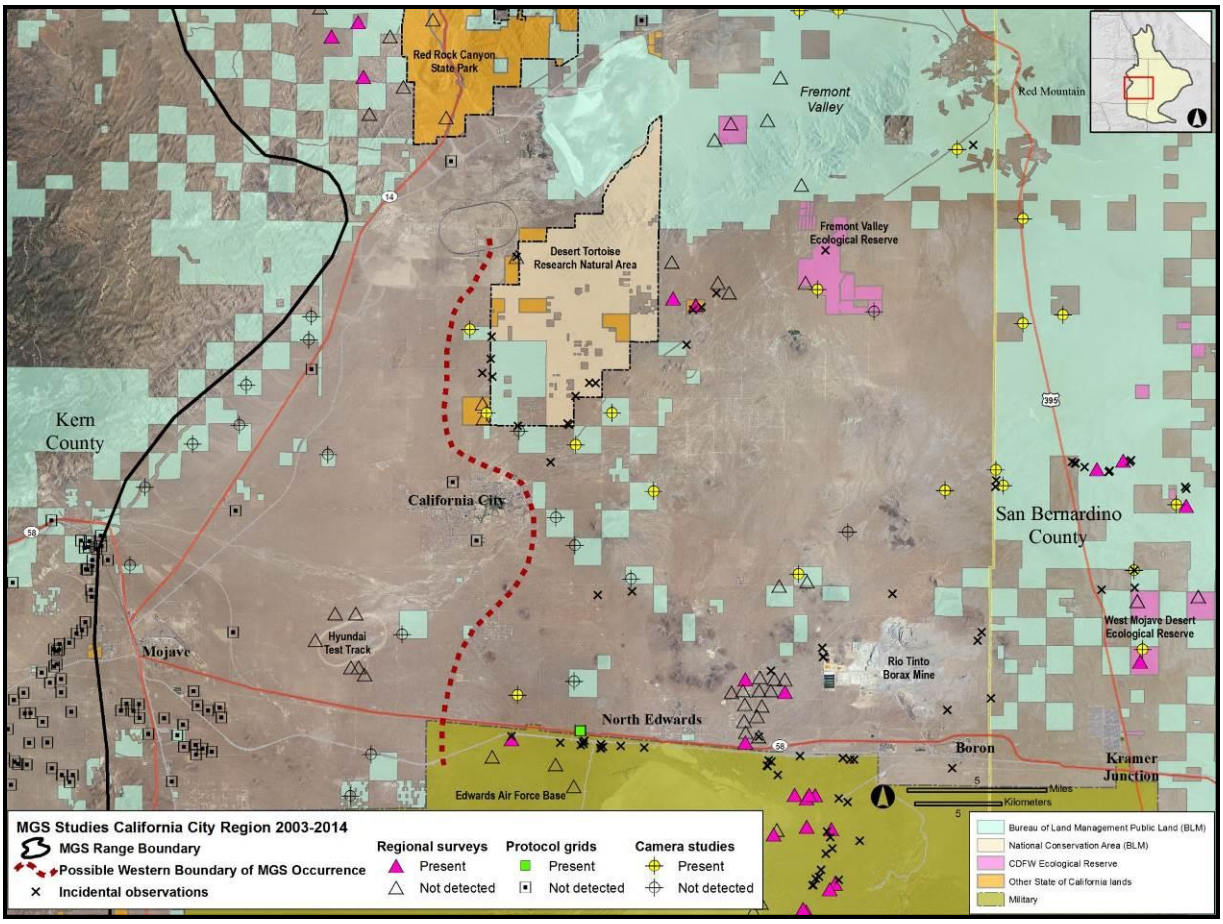

Figure 6. Map of the California City study area showing locations of MGS studies for the period 2003-2014 and the possible western boundary of MGS occurrence in this area.

ACKNOWLEDGEMENTS

Funding for this project was provided by the California Department of Fish and Wildlife (CDFW). We would like to thank A. Ellsworth, R. Logsdon, and M. Mantor of CDFW for their support and encouragement. T. Edgarian and O. Routt provided invaluable assistance with field data collection. The BLM gave permission to access the study sites.

LITERATURE CITED

Desert Renewable Energy Conservation Plan. 2012. Description and Comparative Evaluation of Draft DRECP Alternatives. <www.drecp.org/documents/docs/alternatives_eval/index.php>. Accessed 01 July 2014.

Leitner, P. 2008. Current status of the Mohave ground squirrel. Transactions of the Western Section of The Wildlife Society 44:11-29.

Leitner, P. 2014a. Current status of the Mohave ground squirrel, a five-year update, 2008-2012. Prepared for California Department of Fish and Wildlife, Renewable Energy Program, Sacramento, CA. 20 pp. + appendix.

Leitner, P. 2014b. Mohave ground squirrel camera study 2013. Prepared for California Department of Fish and Wildlife, Inland Deserts Region, Ontario, CA. 12 pp. + appendix.

Leitner, P. and D.K. Delaney. 2014. MGS camera study 2011-2012. Prepared for California Department of Fish and Wildlife, Sacramento, CA. 10 pp.

APPENDIX A. LOCATIONS OF 2014 CAMERA STUDY SITES

SITE NAME	UTM COORDINATES[1]		LEGAL DESCRIPTION[2]		
	EASTING	NORTHING	SECTION	TOWNSHIP	RANGE
Site A	0406675	3873000	Section 2	10 North	11 West
Site B	0408700	3880125	Section 12	11 North	11 West
Site C	0404175	3890300	NW ¼ Section 18	32 South	37 East
Site D	0399700	3894525	Section 34	31 South	36 East
Site E	0399300	3892225	W1/2 Section 10	32 South	36 East
Site F	0396600	3891125	Section 8	32 South	36 East
Site G	0393625	3888400	NE ¼ Section 24	32 South	35 East
Site H	0393300	3884125	NE ¼ Section 32	12 North	12 West

[1] UTM Zone 11, North American Datum of 1983

[2] Sites A, B, and H are on San Bernardino Baseline & Meridian; all other sites are on Mount Diablo Baseline & Meridian