

MOHAVE GROUND SQUIRREL
STUDIES AT
EDWARDS AIR FORCE BASE, CALIFORNIA
FINAL

JULY 1995

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Abstract: Surveys were conducted for the Mohave ground squirrel (*Spermophilus mohavensis*) in three study areas at Edwards Air Force Base, California. Sixteen Mohave ground squirrel individuals were identified during diurnal trapping studies. No juvenile Mohave ground squirrels were detected over the course of the study. Four Mohave ground squirrels were detected during visual and auditory surveys. On eight occasions, Mohave ground squirrels were detected incidental to the study. More Mohave ground squirrels were captured in the Southern Study Area than the Northern or Western Study Areas. Assessment line trapping was conducted to estimate the effective sampling area of one of the trapping grids. In this effort, two additional Mohave ground squirrels were captured. Results indicate that the sampling area for antelope ground squirrels on one grid was 10 times larger than the area physically covered by the trapping grid.

The Mohave ground squirrel (*Spermophilus mohavensis*) is a small ground squirrel (Family: Sciuridae) that occupies a restricted range in the northwestern Mojave Desert in parts of San Bernardino, Los Angeles, Kern, and Inyo counties, California (California Department of Fish and Game 1980). This diurnal species is active aboveground only in spring and early summer before entering aestivation (Bartholomew 1960). The species is currently listed as threatened by the State of California and is a Category 2 candidate for listing by the U.S. Fish and Wildlife Service.

Surveys for Mohave ground squirrels at Edwards Air Force Base (AFB), California, have been performed previously (ERC Environmental and Energy Services Co. 1989; U.S. Fish and Wildlife Service 1993; Mitchell et al. 1993). The purpose of this study was to determine the presence of the species and obtain relative abundance data at 25 locations within 3 study areas.

STUDY AREA

The three study areas are located on Edwards AFB (Figure 1). Five grids were located in the North Base area (Northern Study Area), 10 grids were arranged to sample the Off-Road Vehicle (ORV) area north of Rosamond Dry Lake (Western Study Area), and 10 grids were located south and southwest of Rogers Dry Lake (Southern Study Area).

Northern Study Area

The Northern Study Area encompasses approximately 15.5 square kilometers directly north of Rogers Dry Lake (Figure 2). It is bordered by Rosamond Boulevard on the west, the base boundary on the north, and Rogers Dry Lake on the south. The eastern edge of the study area is approximately 8.1 kilometers east of Rosamond Boulevard and overlaps an area where surveys for Mohave ground squirrels have been previously conducted (ERC Environmental and Energy Services Co. 1989; Mitchell et al. 1993). The study area contains many structures and is crossed by a network of paved and dirt roads. The zonal habitat is primarily arid phase saltbush (*Atriplex* spp.) scrub, although bands of halophytic phase saltbush scrub occur in the eastern portion. Topography is generally flat with little topographic relief in the western part of the study area, while the eastern portion contains a mosaic of large dunes and clay pans.

Grids N1 and N3 were placed in sandy soils in arid phase saltbush scrub and were in proximity to large clay pans. Grid N2, in arid phase saltbush scrub, straddled a large sand dune and was next to a large clay pan. This grid overlapped an area trapped previously for Mohave ground squirrels (Plot 3; ERC Environmental and Energy Services Co. 1989). Grid N4 was in sandy gravel soil in an ecotone between arid phase saltbush scrub and creosote bush (*Larrea tridentata*) scrub. Grid N5 was located in arid phase saltbush scrub in sandy soils without clay pans.

Western Study Area

The Western Study Area encompasses approximately 69.9 square kilometers in the northwestern portion of Edwards AFB (Figure 3) and contains a large portion of the base's designated ORV area. The study area is a circle with a radius of 4.8 kilometers centered on Section 34, T10N, R11W. No structures are

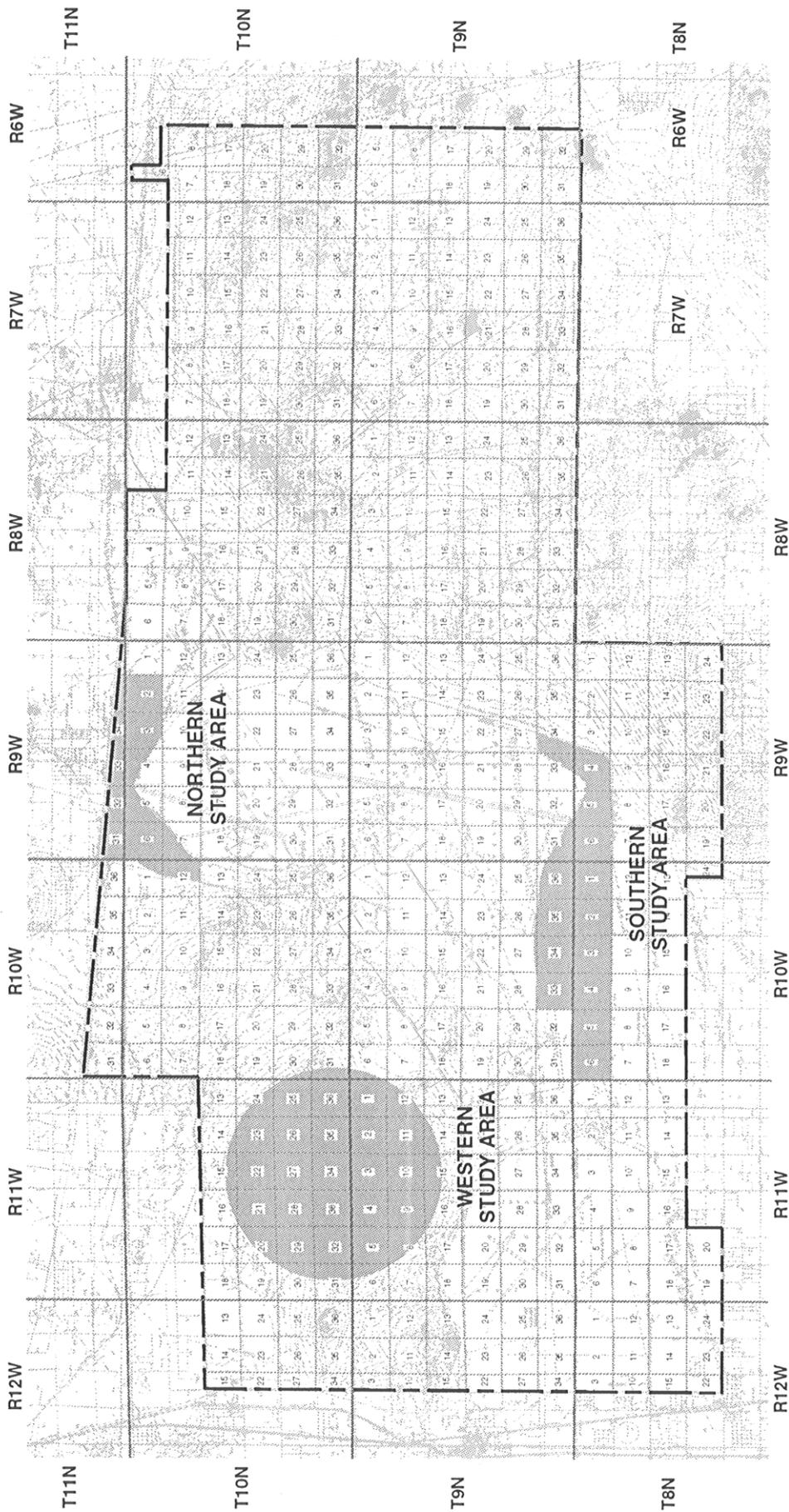
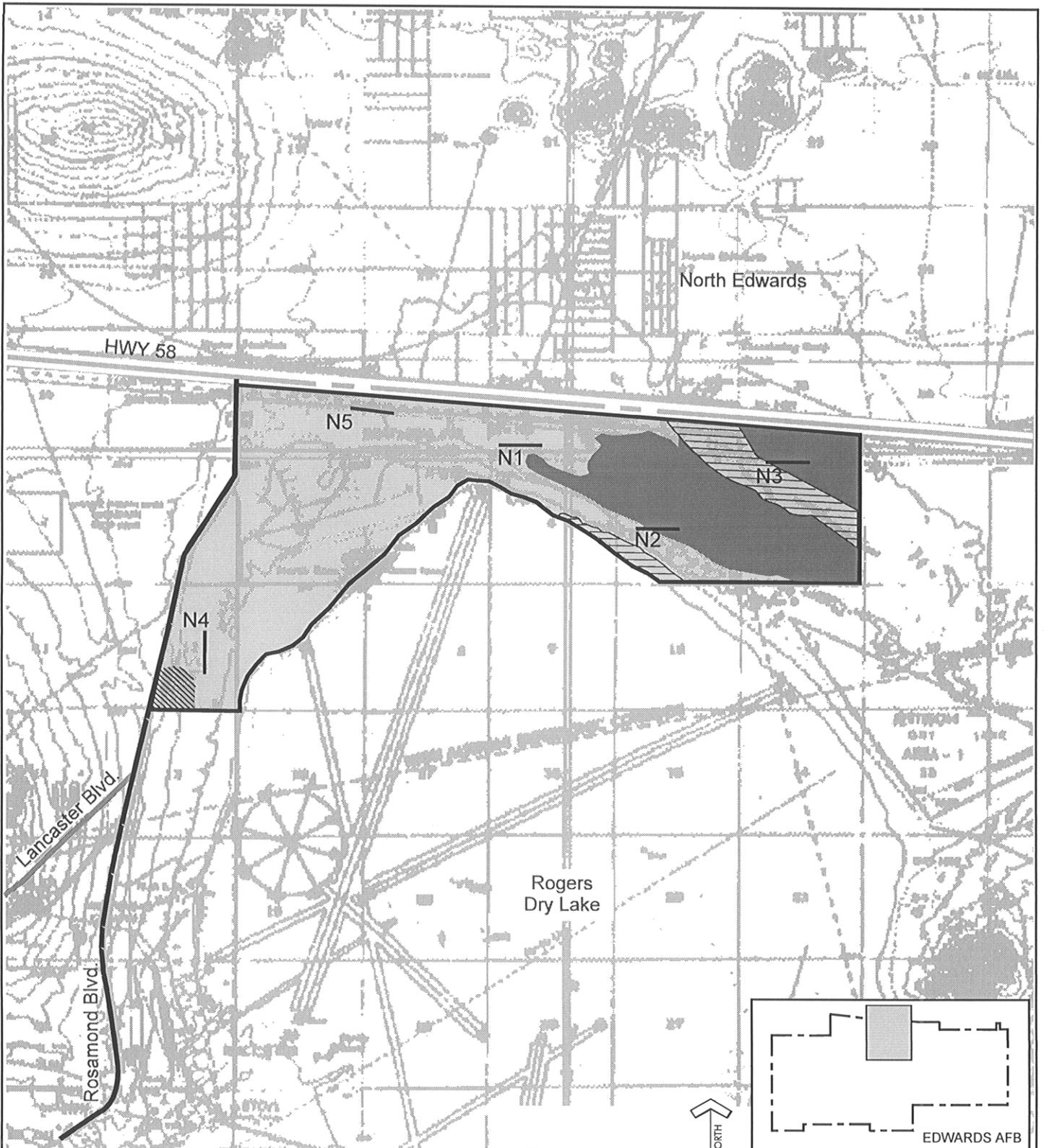


FIGURE 1
1994 MOHAVE GROUND
SQUIRREL STUDY AREAS
EDWARDS AFB

LEGEND

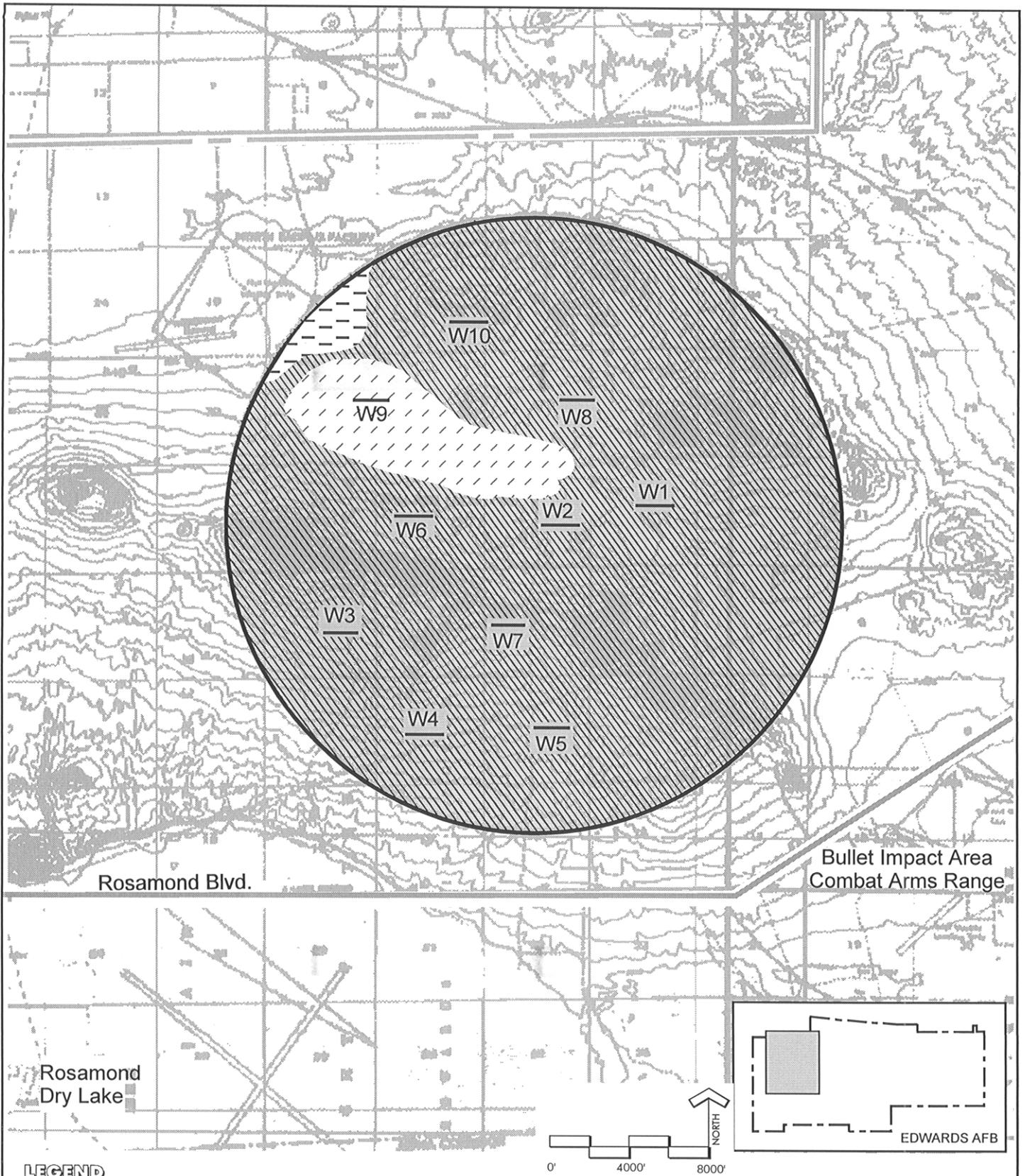
- Base Boundary
- ▨ Study Area



LEGEND

- Survey Area Boundary
- Trapping Grid
- N4 Grid Number
- Base Boundary
- ▨ Creosote Bush Scrub
- ▧ Halophytic Phase Saltbush Scrub
- ▩ Arid Phase Saltbush Scrub
- Lake Bed

FIGURE 2
NORTHERN STUDY AREA
TRAPPING GRID LOCATIONS
BY PLANT COMMUNITIES



LEGEND

- Survey Area Boundary
- Trapping Grid
- W6 Grid Number
- Base Boundary
- ▨ Joshua Tree Woodland
- ▩ Creosote Bush Scrub
- ▧ *Hymenoclea-Lycium* Association

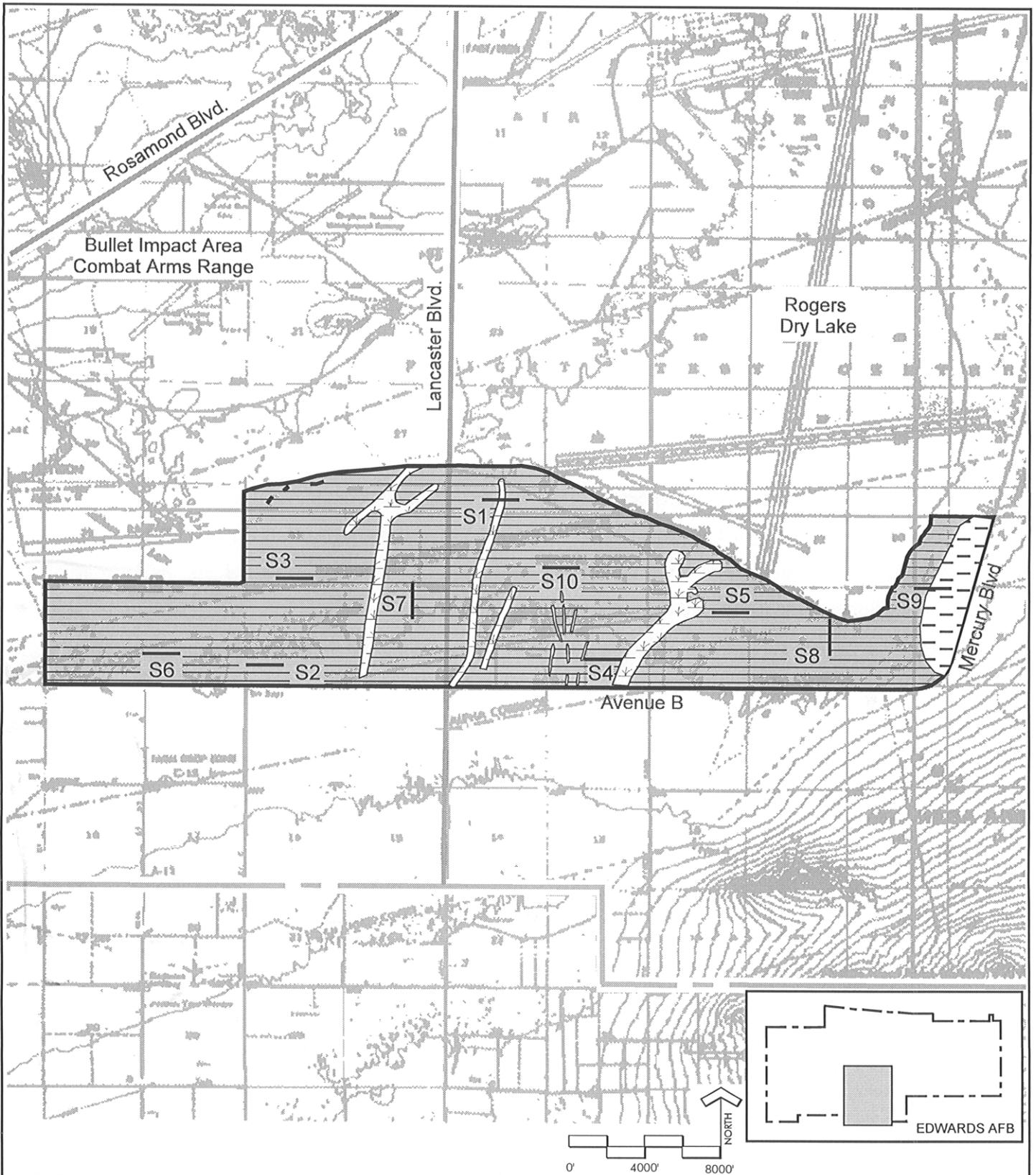
FIGURE 3
WESTERN STUDY AREA
TRAPPING GRID LOCATIONS
BY PLANT COMMUNITIES

present, although there are numerous internal dirt roads and trails. ORV use by base personnel and their families is permitted in this region; however, use is restricted to existing roads and trails. The Rosamond Hills run southeast to northwest through the southern half of the study area and the Bissell Hills run parallel through the northern portion of the area with a broad valley between these ridges. The area south of Rosamond Hills is a slope with a southwest aspect facing Rosamond Dry Lake. The dominant zonal habitat type is creosote bush scrub on sandy gravel soils. A plant association dominated by cheesebush (*Hymenoclea salsola*), with peach-thorn (*Lycium cooperi*) as the most common associate, is present on a wide alluvial fan in the valley between the Rosamond and Bissell hills. Neither creosote bush nor saltbush is present in this area. A small area of creosote bush scrub in the Bissell Hills on the sandy soils contains some Joshua tree (*Yucca brevifolia*) woodland.

Grid W1 was located in an ecotone between creosote bush scrub and the *Hymenoclea/Lycium* association described above. Grids W2 and W6 sampled the north-facing slope of the Rosamond Hills. The zonal habitat was creosote bush scrub on sandy gravel soil. Grids W3, W4, and W5 were all situated on the south-facing slopes of the Rosamond Hills in creosote bush scrub on sandy gravel soils. Grid W7 was located near the ridgeline of the Rosamond Hills also in creosote bush scrub. The soils were primarily sandy gravel, but contained many large rock outcrops. Grid W8 was located in sandy soils which supported some Joshua tree woodland. Grid W9 was entirely within the *Hymenoclea/Lycium* association. Grid W10 was in the Bissell Hills in an area typified by relatively sparse creosote bush scrub and gravel soils.

Southern Study Area

The Southern Study Area is located immediately south of Rogers Dry Lake and includes approximately 36.3 square kilometers (Figure 4). It is bordered on the east by Mercury Boulevard and on the south by Avenue B and extends west to Buckhorn Dry Lake. The southern edge of Rogers Dry Lake approximately delineates the northern border of this study area. This area is generally flat with very little topographic relief. Numerous structures are present in the area. Many paved roads, dirt roads, and trails occur within this study area. The zonal habitat is halophytic phase saltbush scrub. Azonal habitat includes mesquite woodlands in several washes south and southwest of Rogers Dry Lake and ruderal areas and clay pans throughout the study area.



LEGEND

- Survey Area Boundary
- Trapping Grid
- S6 Grid Number
- Base Boundary
- Mesquite Woodland
- Joshua Tree Woodland
- Halophytic Phase Saltbush Scrub

FIGURE 4
SOUTHERN STUDY AREA
TRAPPING GRID LOCATIONS
BY PLANT COMMUNITIES

Grid S1 was located on sandy soils in halophytic phase saltbush scrub with some Joshua trees. Grids S2 and S3 were also in halophytic phase saltbush scrub and crossed several small clay pans. Grid S4 was located in sparse halophytic phase saltbush scrub and contained a band of mesquite woodland. Grid S5 was in halophytic phase saltbush scrub, with sandy soils and relatively few clay pans. Grid S6 was situated on a large dune which supports Joshua tree woodland habitat. Grids S7 and S8 were located in a mosaic of small dunes and clay pans in halophytic phase saltbush scrub. Grid S9 was located on dunes in halophytic phase saltbush scrub. Grid S10 was in an area of Joshua tree woodland.

METHODS

Diurnal Trapping Studies

Trapping grids were located to avoid roads, playas, buildings, areas devoid of vegetation, and areas that may have posed safety threats to investigators. The grid locations were selected to sample different zonal habitats in each study area and were placed a minimum of 1.6 kilometers apart when possible (Figures 2, 3, and 4).

Each trapping site was sampled using 100 Sherman™ live traps (7.7 centimeters 9.0 centimeters x 30.8 centimeters) arranged in a 4-trap x 25-trap configuration with 25-meter spacing between traps. Traps were monitored for 5 consecutive days, then moved to a new area within the study area. Every trap location was individually identified with a letter and number. The same grids were trapped for another 5-day period following a break of at least 14 days. Traps were shaded in April with tents made from cloth sleeves and U-shaped metal spikes.

A brief experiment was conducted to determine if cardboard A-frame shades kept the inside of the traps cooler than cloth shades. Traps were placed under each type of shade and thermometers were used to monitor the temperatures inside the traps. Temperatures were recorded every 10 minutes during the morning until temperatures in both type of traps reached 32.2°C. The experiment was conducted on two consecutive mornings. Based on the results of the experiment, cloth shades were replaced with cardboard A-frames in May.

Traps were opened within an hour of sunrise, checked every 3 to 4 hours, and closed between 1700 and 1800 hours. Traps were closed when the ambient temperature in the shade reached 32.2°C. Traps were baited with commercially available horse feed ("sweet feed") consisting of molasses, rolled corn, rolled barley, and crimped oats.

Mohave ground squirrels captured on each grid were marked on the hips and shoulders using a binary numbering system. This system provides 15 combinations and allows for easy identification of each individual. A small amount of fur was cleanly removed using a battery-operated shaver or blunt-tipped scissors. White-tailed antelope ground squirrels (*Ammospermophilus leucurus*) were not individually given a unique mark, but were shaved on one hip to collect mark-recapture information. Sex, age, reproductive condition, and weight (measured with Pesola™ 300-gram spring scales) of all new captures were recorded. Measurements (in millimeters) of head/body, tail, and hind feet were recorded for each Mohave ground squirrel captured.

To test the effects of variation in length of trap days on capture success, regression analysis was performed for each grid. T-statistics were compared against a critical value oft based on a 95 percent confidence level.

Assessment Line Trapping

In order to measure the area which a trapping grid samples, assessment line trapping was conducted at one grid (S5) according to the method of O'Farrell, et al. (1977). In this method, after a grid has been trapped and individuals marked, assessment lines radiating out from the grid are trapped. All captures of marked individuals are plotted against the distance from the original grid. The width of the area of effect is based on the greatest distance from the original grid at which a marked animal was subsequently trapped (O'Farrell, et al. 1977). Two days following trapping at grid S5, eight assessment lines were established radiating out at 45-degree angles from the perimeter of the original trapping grid (Figure 5). Each line contained 13 traps spaced 25 meters apart, for a total of 104 traps. Trapping was conducted for 4 consecutive days.

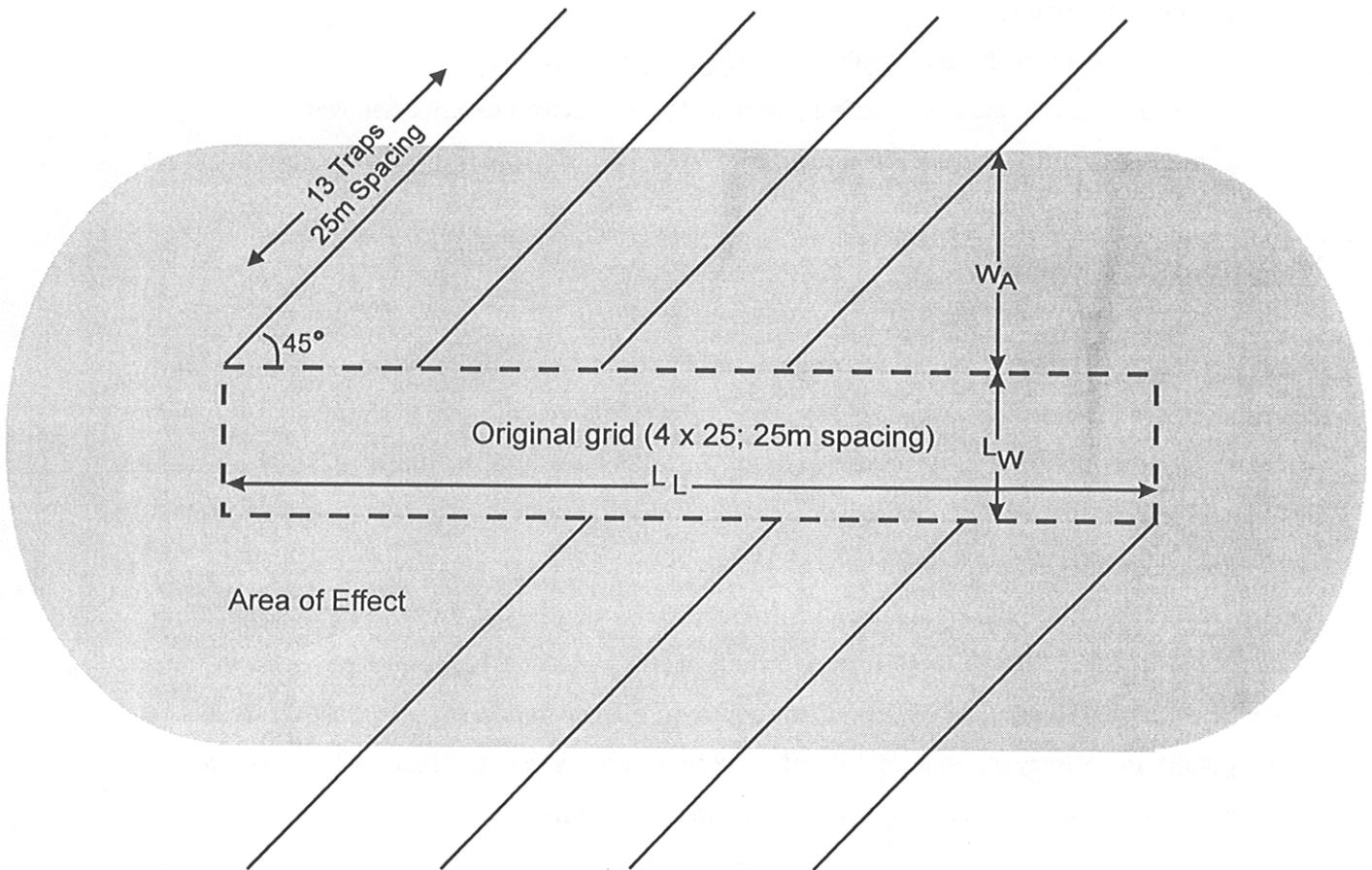


FIGURE 5
ASSESSMENT LINE TRAPPING
CONFIGURATION, EDWARDS AFB

The area of effect (Figure 5) was then calculated as:

$$A = L_W L_L + 2L_L W_A + \pi r^2$$

where:

A = the area of effect

L_W and L_L = the width and length of the trapping grid, respectively

W_A = the width of the area of effect (calculated by the method described above)

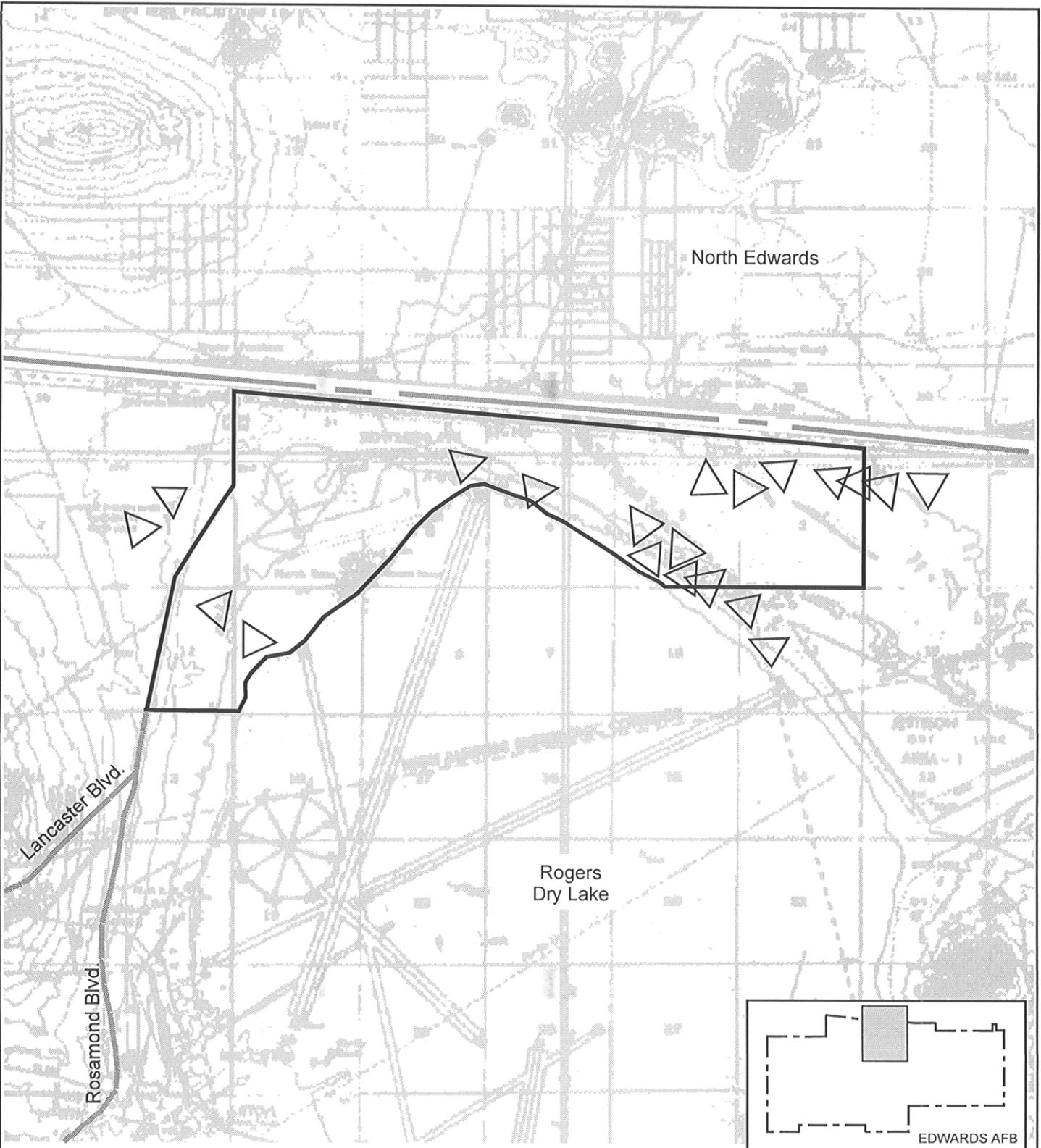
r = the width of the area of effect plus $\frac{1}{2} L_W$

Visual and Auditory Surveys

Mohave ground squirrel vocalizations are distinguishable from those of the antelope ground squirrel. Surveys designed to detect Mohave ground squirrels visually and vocally were performed in each study area along linear strip transects. Transects were similar to Emlen transects (Emlen 1971) for birds except that squirrel detections were recorded regardless of their distance from the centerline since the goal was simply to document the presence of Mohave ground squirrels. Surveys were conducted at least 1.6 kilometers away from active trapping grids (Figures 6, 7, and 8). Each transect took from 0.5 to 1.5 hours to complete. Because these surveys were generally conducted between trap checks, the linear strip transects were walked along the legs of an equilateral triangle to efficiently return the surveyor to the point of origin. Surveyors paused frequently to scan the area with binoculars. All squirrels seen or heard were recorded, as well as environmental conditions and habitat type,

Incidental Observations

All sensitive species that were detected incidental to surveys described above were recorded on field maps. An individual was recorded only if a surveyor was certain that it had not been recorded in the section previously. These data were compiled daily on a master map.



- LEGEND**
- Base Boundary
 - Survey Area Boundary
 - △ Survey Area Transects

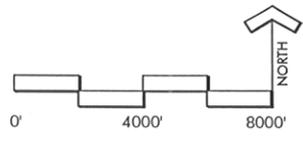
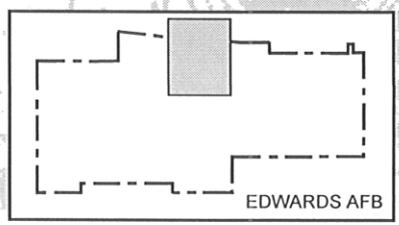
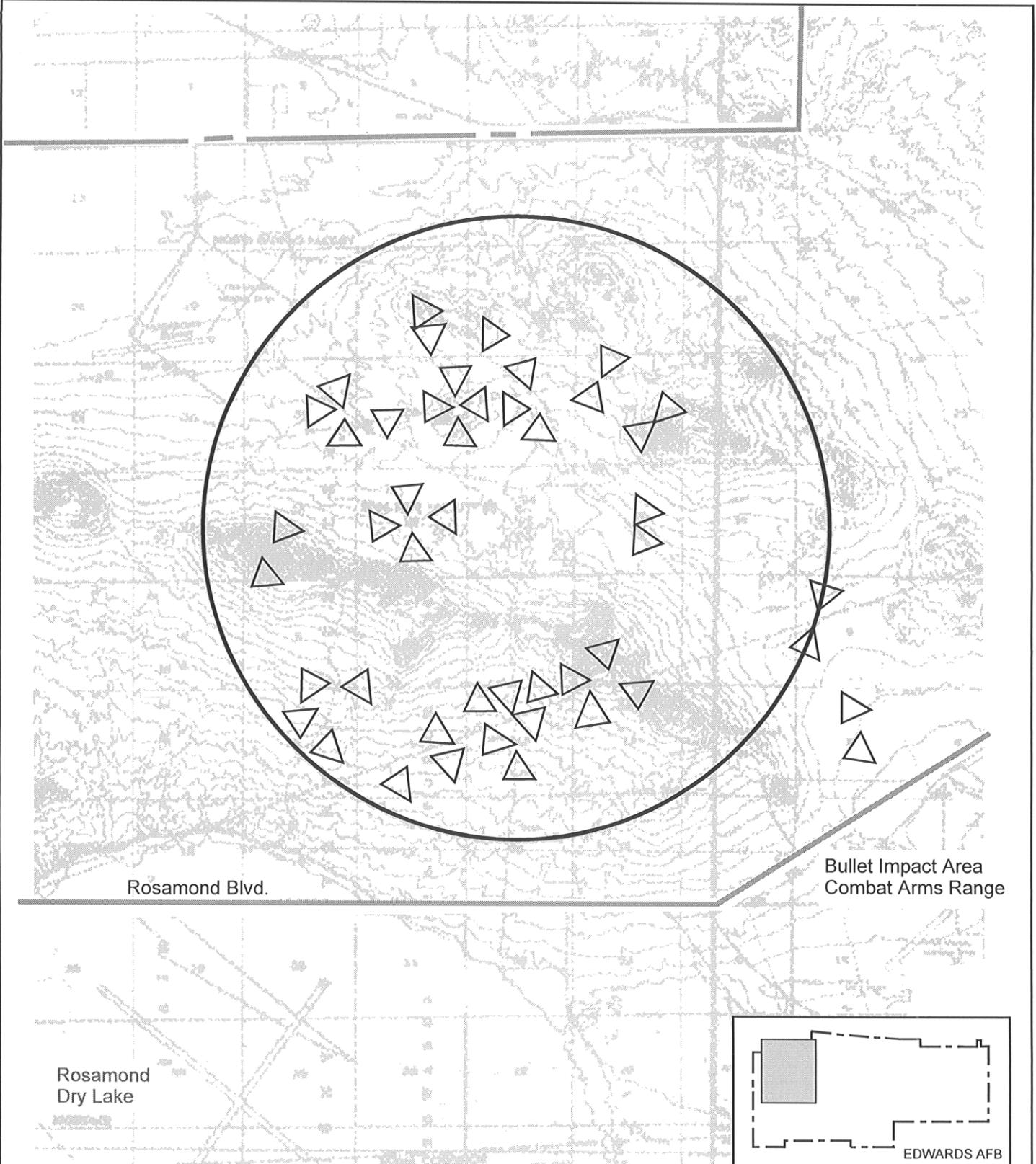


FIGURE 6
NORTHERN STUDY AREA VISUAL
AND AUDITORY SURVEY LOCATIONS



LEGEND

- Base Boundary
- Survey Area Boundary
- △ Survey Transects

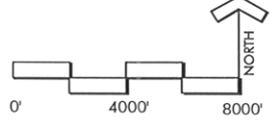
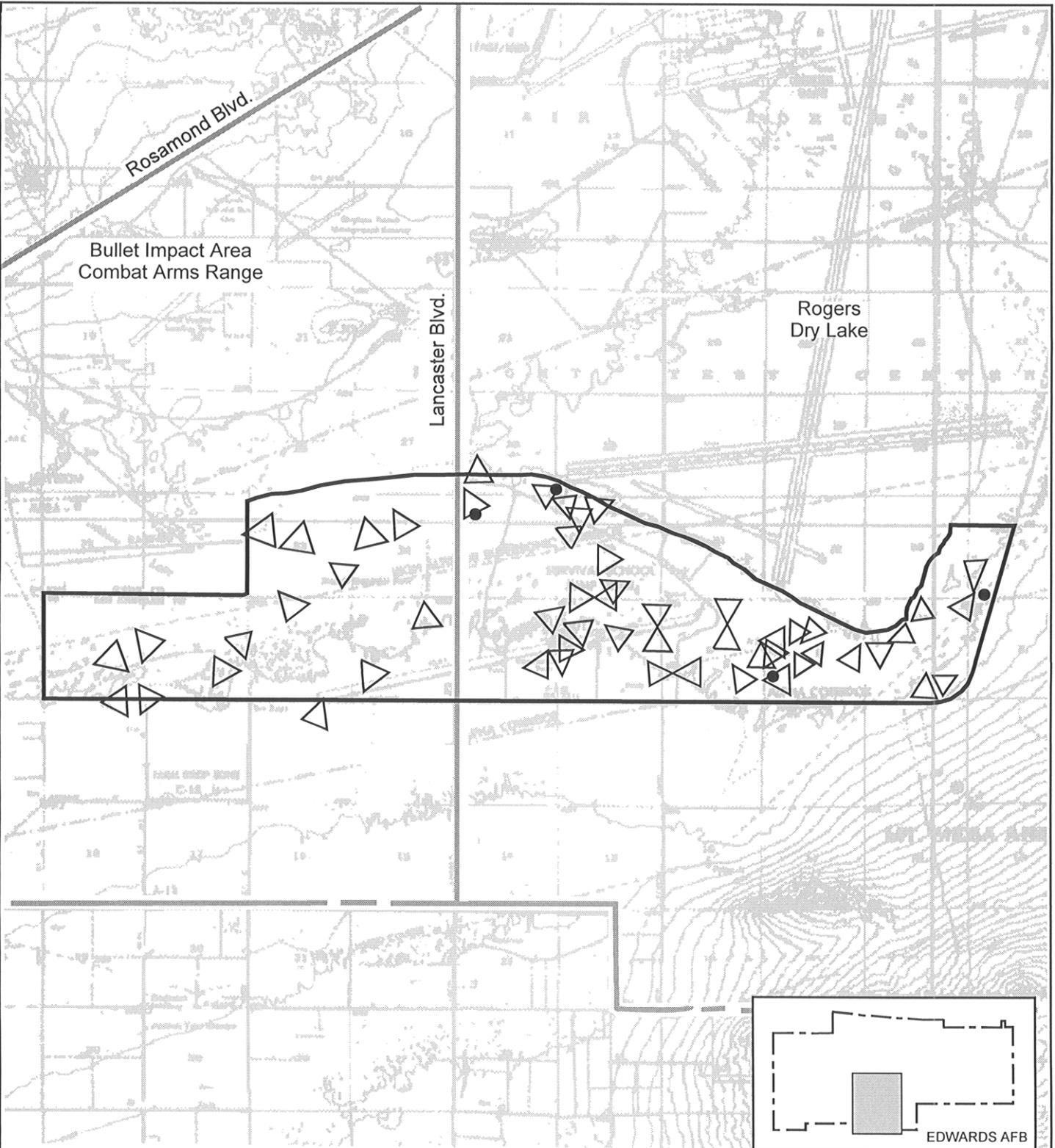


FIGURE 7
WESTERN STUDY AREA
VISUAL AND AUDITORY SURVEY LOCATIONS



LEGEND

- — — Base Boundary
- — — Survey Area Boundary
- △ Survey Transects
- Mohave Ground Squirrel Detection

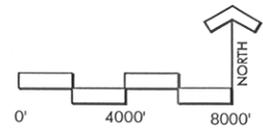


FIGURE 8
SOUTHERN STUDY AREA VISUAL
AND AUDITORY SURVEY LOCATIONS

RESULTS

Diurnal Trapping

The experiment conducted to determine if cardboard A-frame shades kept the inside of the traps cooler than the cloth shades revealed that it took an average of 40 minutes longer for temperatures in the cardboard shaded trap to reach 32.2°C. Temperatures remained an average of 2.2°C cooler under the cardboard shades.

Results from diurnal trapping surveys for Mohave ground squirrels are summarized in Table 1. Traps were left open for an average of 8.6 hours per day for a total of 214,610 trap-hours. Traps were closed on 99 of 250 grid-days (39.6%) because of high temperatures, and on 5 of 250 grid-days (2.0%) because of rain.

Sixteen adult Mohave ground squirrels were captured on 6 of the 25 grids during diurnal trapping surveys. Weights averaged 123.7 and 156.50 grams for females, and 131.0 and 157.67 grams for males captured in April and May, respectively (Table 2). Weights recorded ranged from 108 to 173 grams for males and females combined. Figure 9 charts weight of males and females against the date of their first capture.

Nine Mohave ground squirrels were recaptured on 31 occasions. The distance between initial capture location and recapture location ranged from zero to 301.0 meters and averaged 75.4 meters. When the maximum distance between captures was considered for each of the nine individuals, the average was 103.7 meters.

Antelope ground squirrels were captured at every grid (Table 3). A total of 1,535 antelope ground squirrel individuals were captured. The number of adult antelope ground squirrel individuals ranged from 31 (Grid W5) to 107 (Grids S6 and S7) per grid. The proportion of females to males overall was 0.53. Juvenile antelope ground squirrels were only captured in May and were captured at 5 of the 25 grids. A total of 14 juvenile antelope ground squirrels were captured. The relative frequency of juveniles in the population was 0.01. Regression analysis performed on data from each grid to test the correlation between length of trapping day and number of captures of antelope ground squirrels revealed

Table 1
Summary of Diurnal Trapping Results-Mohave Ground Squirrels

Grid #	Habitat	1st Session			# of Individuals	Total Trap-Hours	2nd Session			Total Trap-Hours	Overall # of Individuals	Rel. Freq.
		Dates Trapped	Capture Type	# of Individuals			Dates Trapped	Capture Type	# of Individuals			
N1	APSS	5-Apr	Adult Female	0	5,060	9-May	Adult Female	0	3,830	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		9-Apr	Total New	0		13-May	Total New	0			0.00	
N2	APSS	5-Apr	Adult Female	1	5,105	9-May	Adult Female	0	3,665	1	1.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		9-Apr	Total New	1		13-May	Total New	0			1.00	
N3	APSS	11-Apr	Adult Female	0	5,275	21-May	Adult Female	0	3,610	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		15-Apr	Total New	0		25-May	Total New	0			0.00	
N4	APSS/ CBS	17-Apr	Adult Female	0	2,915	15-May	Adult Female	0	5,035	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		21-Apr	Total New	0		19-May	Total New	0			0.00	
N5	APSS	17-Apr	Adult Female	0	2,890	15-May	Adult Female	0	5,180	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		21-Apr	Total New	0		19-May	Total New	0			0.00	
W1	CBS/ HYM/LYC	5-Apr	Adult Female	0	4,975	9-May	Adult Female	0	4,040	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		9-Apr	Total New	0		13-May	Total New	0			0.00	
W2	CBS	5-Apr	Adult Female	0	5,260	9-May	Adult Female	0	4,225	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		9-Apr	Total New	0		16-May	Total New	0			0.00	
W3	CBS	11-Apr	Adult Female	0	5,300	15-May	Adult Female	0	5,215	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		15-Apr	Total New	0		19-May	Total New	0			0.00	
W4	CBS	11-Apr	Adult Female	0	4,910	15-May	Adult Female	0	5,350	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		15-Apr	Total New	0		19-May	Total New	0			0.00	
W5	CBS	11-Apr	Adult Female	0	4,950	15-May	Adult Female	0	5,350	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		15-Apr	Total New	0		19-May	Total New	0			0.00	
W6	CBS	11-Apr	Adult Female	1	4,800	15-May	Adult Female	0	5,265	2	0.50	
		to	Adult Male	0		to	Adult Male	1			0.50	
		15-Apr	Total New	1		19-May	Total New	1			1.00	
W7	CBS	17-Apr	Adult Female	0	3,540	21-May	Adult Female	0	4,590	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		21-Apr	Total New	0		25-May	Total New	0			0.00	
W8	CBS	17-Apr	Adult Female	0	4,165	21-May	Adult Female	0	4,280	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		21-Apr	Total New	0		25-May	Total New	0			0.00	
W9	HYM/LYC	9-May	Adult Female	0	4,015	27-May	Adult Female	0	4,240	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		13-May	Total New	0		31-May	Total New	0			0.00	
W10	CBS	9-May	Adult Female	0	3,330	27-May	Adult Female	0	4,035	0	0.00	
		to	Adult Male	0		to	Adult Male	0			0.00	
		13-May	Total New	0		31-May	Total New	0			0.00	

Legend: APSS - Arid phase saltbush scrub
CBS - Creosote bush scrub
HPSS - Halophytic phase saltbush scrub
HYM/LYC - Scrub dominated by *Hymenoclea salsola* and *Lycium cooperi*
JTW - Joshua tree woodland
Total New - Total number of new captures
Rel. Freq. - Relative frequency

Table 1, Page 2 of 2

Grid #	Habitat	1st Session			Total	2nd Session			Total	Overall # of Individuals	Rel. Freq.
		Dates	Capture Type	#of Individuals		Dates	Capture Type	# of Individuals			
S1	JTW/ HPSS	5-Apr	Adult Female	1	4,825	9-May	Adult Female	1	4,025	2	1.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		9-Apr	Total New	1		13-May	Total New	1		2	1.00
S2	HPSS	5-Apr	Adult Female	0	4,940	9-May	Adult Female	0	5,150	0	0.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		9-Apr	Total New	0		13-May	Total New	0		0	0.00
S3	HPSS	5-Apr	Adult Female	0	4,960	15-May	Adult Female	0	5,100	0	0.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		9-Apr	Total New	0		16-May	Total New	0		0	0.00
S4	HPSS	11-Apr	Adult Female	0	5,200	21-May	Adult Female	0	3,510	0	0.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		15-Apr	Total New	0		25-May	Total New	0		0	0.00
S5	HPSS	11-Apr	Adult Female	0	5,050	21-May	Adult Female	0	3,275	0	0.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		15-Apr	Total New	0		25-May	Total New	0		0	0.00
S6	JTW/ HPSS	17-Apr	Adult Female	0	3,585	21-May	Adult Female	0	3,285	0	0.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		21-Apr	Total New	0		25-May	Total New	0		0	0.00
S7	HPSS	17-Apr	Adult Female	0	3,285	21-May	Adult Female	0	3,625	0	0.00
		to	Adult Male	0		to	Adult Male	1		1	1.00
		21-Apr	Total New	0		25-May	Total New	1		1	1.00
S8	HPSS	17-Apr	Adult Female	0	3,010	27-May	Adult Female	0	3,325	0	0.00
		to	Adult Male	0		to	Adult Male	0		0	0.00
		21-Apr	Total New	0		31-May	Total New	0		0	0.00
S9	HPSS	17-Apr	Adult Female	3	3,030	27-May	Adult Female	1	3,460	4	0.57
		to	Adult Male	2		to	Adult Male	1		3	0.43
		21-Apr	Total New	5		31-May	Total New			7	1.00
S10	HPSS	9-May	Adult Female	0	4,020	27-May	Adult Female	0	3,550	0	0.00
		to	Adult Male	2		to	Adult Male	1		3	1.00
		13-May	Total New	2		31-May	Total New	1		3	1.00
Sum North				(per 21,245 trap-hours)			(per 21,320 trap-hours)				
		Adult Female	1		Adult Female	0		1	1.00		
		Adult Male	0		Adult Male	0		0	0.00		
Sum West				(per 45,245 trap-hours)			(per 46,590 trap-hours)				
		Adult Female	1		Adult Female	0		1	0.50		
		Adult Male	0		Adult Male	1		1	0.50		
Sum South				(per 41,905 trap-hours)			(per 38,305 trap-hours)				
		Adult Female	4		Adult Female	2		6	0.46		
		Adult Male	4		Adult Male	3		7	0.54		
Sum Overall				(per 108,395 trap-hours)			(per 106,215 trap-hours)				
		Adult Female	6		Adult Female	2		8	0.50		
		Adult Male	4		Adult Male	4		8	0.50		
		Total	10		Total	6		16	1.00		

Legend: APSS - Arid phase saltbush scrub
 CBS - Creosote bush scrub
 HPSS - Halophytic phase saltbush scrub
 HYM/LYC - Scrub dominated by *Hymenoclea salsola* and *Lycium cooperi*

JTW - Joshua tree woodland
 Total New - Total number of new captures
 Rel. Freq. - Relative frequency

Table 2

Mohave Ground Squirrel Sex, Condition, and Weight Data

Date of First Capture	Sex	Reproductive Condition	Weight (g)
5-Apr	F	CL	110
6-Apr	F	CL	118
12-Apr	F	PF	134
17-Apr	F	CL	132
18-Apr	F	CL	140
21-Apr	F	CL	108
9-May	F	CL	145
31-May	F	CL	168
Total Females: 8			
		April avg	123.67
		May avg	156.50
20-Apr	M	AB	128
20-Apr	M	AB	134
9-May	M	AB	140
10-May	M	AB	173
16-May	M	AB	164
22-May	M	AB	173
27-May	M	AB	156
27-May	M	AB	140
Total Males: 8			
Total Individuals:			
16			
		April avg	131.00
		May avg	157.67

Note: CL = Closed
 AB = Abdominal
 PF = Puffy Genitalia

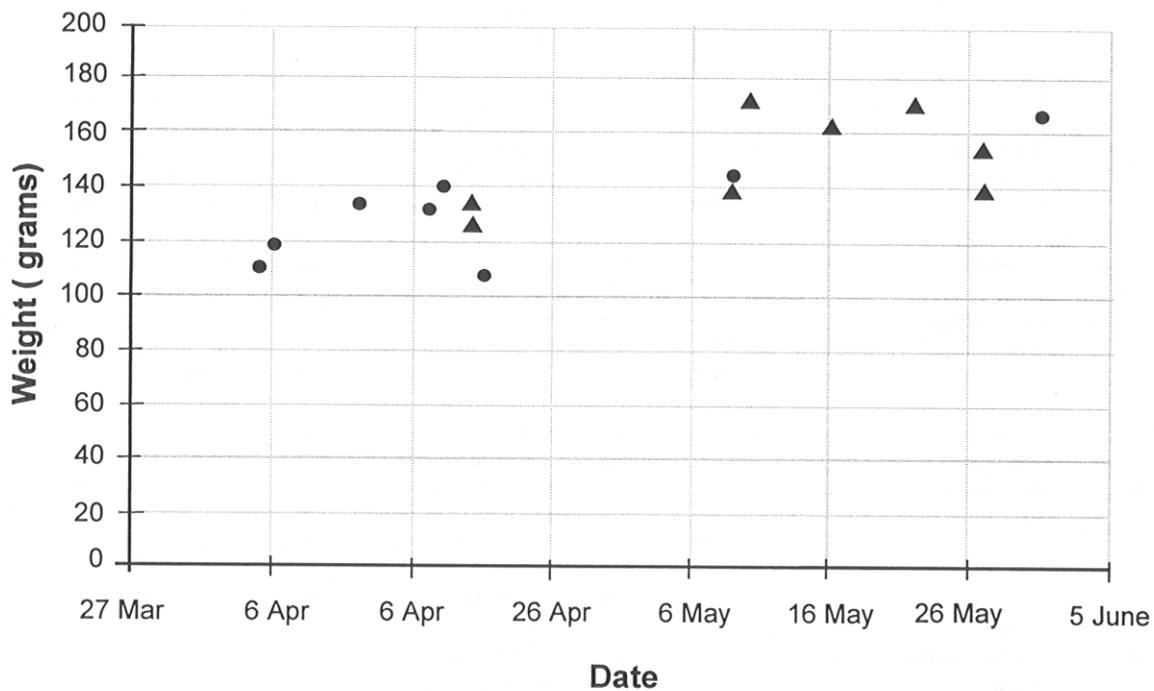


FIGURE 9
WEIGHT OF MOHAVE
GROUND SQUIRRELS VS.
DATE OF FIRST CAPTURE

Table 3
Diurnal Trapping Results - Antelope Ground Squirrels

Grid #	Habitat	1st Session			Total Trap-Hours	2nd Session			Total Trap-Hours	Overall # of Individuals	Rel. Freq.
		Dates Trapped	Capture Type	# of Individuals		Dates Trapped	Capture Type	# of Individuals			
N1	APSS	5-Apr	Adult Female	22	5,060	9-May	Adult Female	18	3,830	40	0.54
		to	Adult Male	18		to	Adult Male	15		33	0.45
		9-Apr	Adult Sex Unknown	1		13-May	Adult Sex Unknown	0		1	0.01
			Juvenile	0			Juvenile	0		0	0.00
			Total	41		Total	33	74		1.00	
N2	APSS	5-Apr	Adult Female	19	5,105	9-May	Adult Female	16	3,665	35	0.49
		to	Adult Male	18		to	Adult Male	18		36	0.50
		9-Apr	Adult Sex Unknown	0		13-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	1		1	0.01
			Total	37		Total	35	72		1.00	
N3	APSS	11-Apr	Adult Female	18	5,275	21-May	Adult Female	1	3,610	19	0.43
		to	Adult Male	15		to	Adult Male	7		22	0.50
		15-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	3		3	0.07
			Total	33		Total	11	44		1.00	
N4	APSS/ CBS	17-Apr	Adult Female	18	2,915	15-May	Adult Female	10	5,035	28	0.46
		to	Adult Male	19		to	Adult Male	14		33	0.54
		21-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	0		0	0.00
			Total	37		Total	24	61		1.00	
N5	APSS	17-Apr	Adult Female	28	2,890	15-May	Adult Female	11	5,180	39	0.66
		to	Adult Male	14		to	Adult Male	6		20	0.34
		21-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	0		0	0.00
			Total	42		Total	17	59		1.00	
W1	CBS/ HYM/LYC	5-Apr	Adult Female	25	4,975	9-May	Adult Female	19	4,040	44	0.50
		to	Adult Male	16		to	Adult Male	21		37	0.42
		9-Apr	Adult Sex Unknown	0		13-May	Adult Sex Unknown	7		7	0.08
			Juvenile	0			Juvenile	0		0	0.00
			Total	41		Total	47	88		1.00	
W2	CBS	5-Apr	Adult Female	16	5,260	9-May	Adult Female	18	4,225	34	0.53
		to	Adult Male	13		to	Adult Male	17		30	0.47
		9-Apr	Adult Sex Unknown	0		13-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	0		0	0.00
			Total	29		Total	35	64		1.00	
W3	CBS	11-Apr	Adult Female	25	5,300	15-May	Adult Female	15	5,215	40	0.59
		to	Adult Male	18		to	Adult Male	10		28	0.41
		15-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	0		0	0.00
			Total	43		Total	25	68		1.00	
W4	CBS	11-Apr	Adult Female	13	4,910	15-May	Adult Female	7	5,350	20	0.57
		to	Adult Male	9		to	Adult Male	5		14	0.40
		15-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	1		1	0.03
			Total	22		Total	13	35		1.00	
W5	CBS	11-Apr	Adult Female	14	4,950	15-May	Adult Female	4	5,350	18	0.53
		to	Adult Male	9		to	Adult Male	4		13	0.38
		15-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	3		3	0.09
			Total	23		Total	11	34		1.00	

Legend: APSS - Arid phase saltbush scrub
CBS - Creosote bush scrub
HPSS - Halophytic phase saltbush scrub

HYM/LYC - Scrub dominated by *Hymenoclea salsola* and *Lycium cooperi*
JTW - Joshua tree woodland
Rel. Freq. - Relative frequency

Table 3, Page 2 of 3

Grid #	Habitat	1st Session			Total Trap-Hours	2nd Session			Total Trap-Hours	Overall	
		Dates Trapped	Capture Type	# of Individuals		Dates Trapped	Capture Type	# of Individuals		# of Individuals	Rel. Freq.
W6	CBS	11-Apr	Adult Female	15	4,800	15-May	Adult Female	13	5,265	28	0.67
		to	Adult Male	9		to	Adult Male	5		14	0.33
		15-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
		Juvenile	0	Juvenile		0	0	0.00			
		Total		24		Total	18		42	1.00	
W7	CBS	17-Apr	Adult Female	21	3,540	21-May	Adult Female	24	4,590	45	0.60
		to	Adult Male	16		to	Adult Male	13		29	0.39
		21-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	1		1	0.01
		Juvenile	0	Juvenile		0	0	0.00			
		Total		37		Total	38		75	1.00	
W8	CBS	17-Apr	Adult Female	12	4,165	21-May	Adult Female	11	4,280	23	0.45
		to	Adult Male	14		to	Adult Male	14		28	0.55
		21-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	0		0	0.00
		Juvenile	0	Juvenile		0	0	0.00			
		Total		26		Total	25		51	1.00	
W9	HYM/LYC	9-May	Adult Female	19	4,015	27-May	Adult Female	9	4,240	28	0.67
		to	Adult Male	13		to	Adult Male	0		13	0.31
		13-May	Adult Sex Unknown	0		31-May	Adult Sex Unknown	1		1	0.02
		Juvenile	0	Juvenile		0	0	0.00			
		Total		32		Total	10		42	1.00	
W10	CBS	9-May	Adult Female	8	3,330	27-May	Adult Female	6	4,035	14	0.42
		to	Adult Male	7		to	Adult Male	12		19	0.58
		13-May	Adult Sex Unknown	0		31-May	Adult Sex Unknown	0		0	0.00
		Juvenile	0	Juvenile		0	0	0.00			
		Total		15		Total	18		33	1.00	
S1	HPSS/ JTW	5-Apr	Adult Female	8	4,825	9-May	Adult Female	19	4,025	27	0.40
		to	Adult Male	17		to	Adult Male	23		40	0.60
		9-Apr	Adult Sex Unknown	0		13-May	Adult Sex Unknown	0		0	0.00
		Juvenile	0	Juvenile		0	0	0.00			
		Total		25		Total New	42		67	1.00	
S2	HPSS	5-Apr	Adult Female	17	4,940	9-May	Adult Female	38	5,150	55	0.54
		to	Adult Male	17		to	Adult Male	29		46	0.46
		9-Apr	Adult Sex Unknown	0		13-May	Adult Sex Unknown	0		0	0.00
		Juvenile	0	Juvenile		0	0	0.00			
		Total		34		Total	67		101	1.00	
S3	HPSS	5-Apr	Adult Female	11	4,960	15-May	Adult Female	15	5,100	26	0.52
		to	Adult Male	14		to	Adult Male	10		24	0.48
		9-Apr	Adult Sex Unknown	0		19-May	Adult Sex Unknown	0		0	0.00
		Juvenile	0	Juvenile		0	0	0.00			
		Total		25		Total	25		50	1.00	
S4	HPSS	11-Apr	Adult Female	6	5,200	21-May	Adult Female	7	3,510	13	0.33
		to	Adult Male	11		to	Adult Male	9		20	0.50
		15-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	1		1	0.03
		Juvenile	0	Juvenile		6	6	0.15			
		Total		17		Total	23		40	1.00	
S5	HPSS	11-Apr	Adult Female	12	5,050	21-May	Adult Female	8	3,275	20	0.42
		to	Adult Male	16		to	Adult Male	10		26	0.54
		15-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	2		2	0.04
		Juvenile	0	Juvenile		0	0	0.00			
		Total		28		Total	20		48	1.00	

Legend: APSS - Arid phase saltbush scrub
CBS - Creosote bush scrub
HPSS - Halophytic phase saltbush scrub

HYM/LYC - Scrub dominated by *Hymenoclea salsola* and *Lycium cooperi*
JTW - Joshua tree woodland
Rel. Freq. - Relative frequency

Table 3, Page 3 of 3

Grid #	Habitat	1st Session			Total Trap-Hours	2nd Session			Total Trap-Hours	Overall	
		Dates Trapped	Capture Type	# of Individuals		Dates Trapped	Capture Type	# of Individuals		# of Individuals	Rel. Freq.
S6	JTW	17-Apr	Adult Female	37	3,585	21-May	Adult Female	20	3,285	57	0.53
		to	Adult Male	18		to	Adult Male	30		48	0.45
		21-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	2		2	0.02
			Juvenile	0			Juvenile	0		0	0.00
		Total		55		Total		52	107	1.00	
S7	HPSS	17-Apr	Adult Female	36	3,285	21-May	Adult Female	23	3,625	59	0.55
		to	Adult Male	32		to	Adult Male	15		47	0.44
		21-Apr	Adult Sex Unknown	0		25-May	Adult Sex Unknown	1		1	0.00
			Juvenile	0			Juvenile	0		0	0.00
		Total		68		Total		39	107	1.00	
S8	HPSS	17-Apr	Adult Female	13	3,010	27-May	Adult Female	6	3,325	19	0.43
		to	Adult Male	15		to	Adult Male	10		25	0.57
		21-Apr	Adult Sex Unknown	0		31-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	0		0	0.00
		Total		28		Total		16	44	1.00	
S9	HPSS/ JTW	17-Apr	Adult Female	11	3,030	27-May	Adult Female	8	3,460	19	0.51
		to	Adult Male	11		to	Adult Male	7		18	0.49
		21-Apr	Adult Sex Unknown	0		31-May	Adult Sex Unknown	0		0	0.00
			Juvenile	0			Juvenile	0		0	0.00
		Total		22		Total		15	37	1.00	
S10	HPSS	9-May	Adult Female	45	4,020	27-May	Adult Female	4	3,550	49	0.53
		to	Adult Male	31		to	Adult Male	6		37	0.40
		13-May	Adult Sex Unknown	0		31-May	Adult Sex Unknown	6		6	0.07
			Juvenile	0			Juvenile	0		0	0.00
		Total		76		Total		16	92	1.00	
Sum North				(per 21,245 trap-hours)				(per 21,320 trap-hours)			
			Adult Female	105		Adult Female	56		161	0.52	
			Adult Male	84		Adult Male	60		144	0.46	
			Adult Sex Unknown	1		Adult Sex Unknown	0		1	0.00	
			Juvenile	0		Juvenile	4		4	0.01	
		Total	190		Total	120		310	1.00		
Sum West				(per 45,245 trap-hours)				(per 46,590 trap-hours)			
			Adult Female	168		Adult Female	126		294	0.55	
			Adult Male	124		Adult Male	101		225	0.42	
			Adult Sex Unknown	0		Adult Sex Unknown	9		9	0.02	
			Juvenile	0		Juvenile	4		4	0.00	
		Total	292		Total	240		532	1.00		
Sum South				(per 41,905 trap-hours)				(per 38,305 trap-hours)			
			Adult Female	196		Adult Female	148		344	0.50	
			Adult Male	182		Adult Male	149		331	0.48	
			Adult Sex Unknown	0		Adult Sex Unknown	12		12	0.02	
			Juvenile	0		Juvenile	6		6	0.00	
		Total	378		Total	315		693	1.00		
Sum Overall				(per 108,395 trap-hours)				(per 106,215 trap-hours)			
			Adult Female	469		Adult Female	330		799	0.52	
			Adult Male	390		Adult Male	310		700	0.46	
			Adult Sex Unknown	1		Adult Sex Unknown	21		22	0.01	
			Juvenile	0		Juvenile	14		14	0.00	
		Total	860		Total	675		1535	1.00		

Legend: APSS - Arid phase saltbush scrub
CBS - Creosote bush scrub
HPSS - Halophytic phase saltbush scrub

HYM/LYC - Scrub dominated by *Hymenoclea salsola* and *Lycium cooperi*
JTW - Joshua tree woodland
Rel. Freq. - Relative frequency

significant positive correlation in 5 of the 25 grids (Grids N1, N3, W9, S6, and S10). Two grids (N4 and N5) showed a significant negative correlation between length of trap day and capture success.

Northern Study Area. One Mohave ground squirrel was captured in the Northern Study Area, at grid N2, during the first trapping session on April 5. This individual was a female weighing 110 grams. A total of 310 antelope ground squirrel individuals were captured in the Northern Study Area. The number of antelope ground squirrels per grid in this area ranged from 44 to 74. The average number individuals in the Northern Study Area was 62.0 antelope ground squirrels per grid. Four juvenile antelope ground squirrels were captured in this area.

Western Study Area. Two Mohave ground squirrels were captured at Grid W6 in the Western Study Area, one on April 12 and one on May 16. One of these individuals was a 134-gram female, and the other was a 164-gram male.

A total of 532 antelope ground squirrel individuals were captured in the Western Study Area. The average number of individuals in the study area was 53.2 squirrels per grid. The number of antelope ground squirrels captured ranged from 33 to 88 among the western grids. Four juvenile antelope ground squirrels were captured in this area.

Southern Study Area. Thirteen individual Mohave ground squirrels were captured in the Southern Study Area at Grids S1, S7, S9, and S10. The greatest number of individuals trapped was at Grid S9, in the far eastern part of the study area. Five females ranging from 108 to 168 grams (average 138.6 grams) and seven males ranging from 128 to 173 grams, with an average weight of 149.1 grams, were captured.

A total of 693 antelope ground squirrel individuals were captured in the Southern Study Area. The average number of individuals in the study area was 69.3 antelope ground squirrels per grid. The number of antelope ground squirrels captured on each grid ranged from 37 to 107. Six juvenile antelope ground squirrels were captured in this area.

Assessment Line Trapping

Assessment lines were used to determine the effective trapping area for antelope ground squirrels on Grid S5. The number of antelope ground squirrels captured that had been marked on the grid decreased as the distance from the grid increased. Conversely, the number of unmarked animals increased as the distance from the grid increased (Figure 10). Animals marked from the original grid were captured up to 194 meters away.

The width of the area of effect for antelope ground squirrels on Grid S5 was 203.3 meters, resulting in an area of effect of 47.1 hectares. The area of effect is considerably larger than the 4.5 hectares described by the physical outline of the original trapping grid.

During assessment line trapping, two Mohave ground squirrels were trapped that had not been trapped during the original effort. A male was captured approximately 70 meters from the original trapping grid, but was not recaptured. Another male was trapped approximately 212 meters from the original grid.

Visual and Auditory Surveys

A total of approximately 98 person-hours were spent in May conducting visual and auditory surveys for Mohave ground squirrels. A total of 434 antelope ground squirrels and 4 Mohave ground squirrels were detected during these surveys (Table 4). The largest number of antelope ground squirrels detected was in the Southern Study Area, where four Mohave ground squirrels were also detected. The Northern Study Area had the next largest amount of antelope ground squirrels detected, with the least amount detected in the Western Study Area.

Incidental Observations

Seventeen sensitive species were detected during the Mohave ground squirrel surveys (Tables 5 and 6, Figures 11 through 13). Mohave ground squirrels detected outside of trapping, assessment line, and visual and auditory surveys are included.

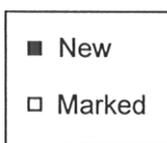
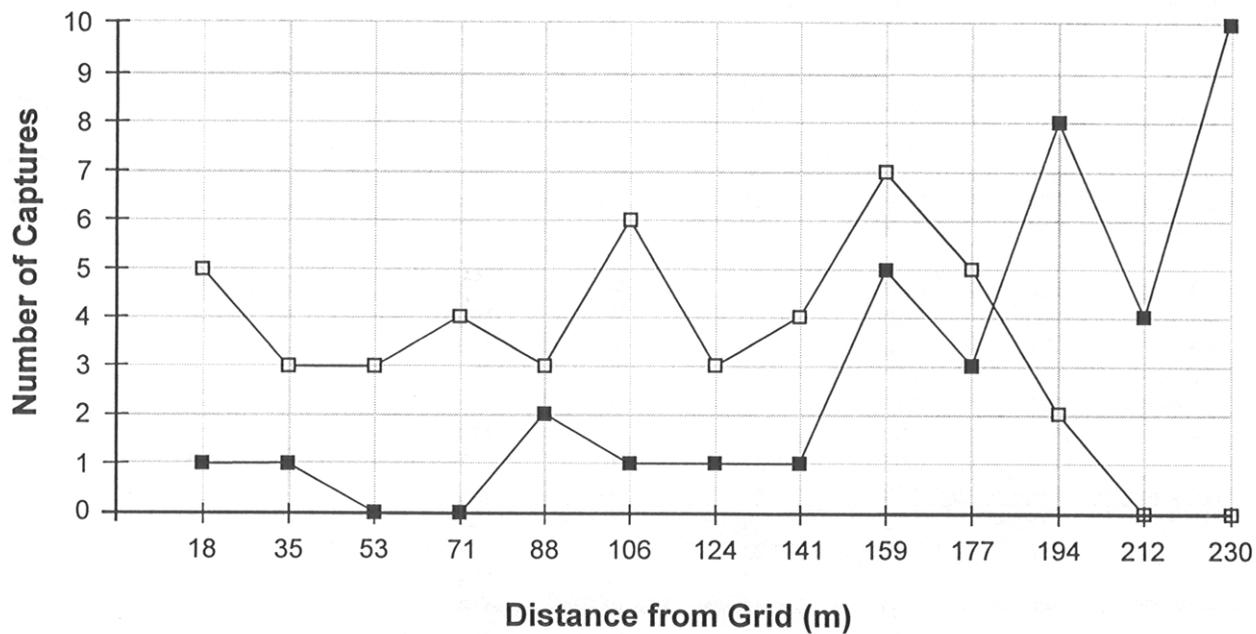


FIGURE 10
RESULTS OF ASSESSMENT
LINE TRAPPING
(ANTELOPE GROUND
SQUIRRELS ONLY)

Table 4
Results of Visual and Auditory Surveys

Date	Start	Time	Temp°C	Area	Obs	# AGS	# MGS
15-May	845	0.75	23	N	DL	1	0
15-May	930	0.75	24	N	MN	1	0
16-May	940	0.75	NC	N	DL	0	0
16-May	945	0.75	18	N	MN	4	0
18-May	845	0.75	11	N	DL	3	0
18-May	805	0.75	11	N	MN	1	0
18-May	950	0.75	14	N	MN	0	0
18-May	1630	0.75	18	N	MN	5	0
19-May	745	0.75	NC	N	DL	7	0
19-May	840	0.75	17	N	MN	11	0
21-May	830	1.00	20	N	MA	1	0
22-May	745	1.00	20	N	MA	5	0
22-May	1005	0.75	23	N	MA	0	0
23-May	715	0.50	19	N	MA	1	0
23-May	805	0.50	20	N	MA	1	0
23-May	910	0.75	26	N	MA	3	0
24-May	745	0.75	23	N	MA	4	0
24-May	930	0.75	28	N	MA	2	0
25-May	840	0.75	27	N	MA	3	0
25-May	1015	0.75	29	N	MA	12	0
9-May	835	0.75	26	W	MB	0	0
9-May	1000	1.50	28	W	MB	1	0
9-May	830	0.50	NC	W	DL	2	0
9-May	950	0.50	NC	W	DL	4	0
12-May	1720	0.75	31	W	DL	3	0
15-May	1445	1.00	31	W	MB	2	0
15-May	1445	0.92	31	W	KB	3	0
15-May	830	0.75	21	W	EL	7	0
15-May	1115	0.75	28	W	EL	5	0
15-May	830	0.75	23	W	MA	7	0
15-May	1115	0.75	29	W	MA	7	0
16-May	830	1.00	24	W	MB	1	0
16-May	935	1.00	25	W	MB	2	0
16-May	845	0.75	15	W	EL	4	0
16-May	1505	0.75	22	W	EL	7	0
16-May	845	0.75	16	W	MA	7	0
17-May	730	1.00	21	W	MB	0	0
17-May	1140	0.75	16	W	EL	5	0
17-May	1312	0.75	16	W	EL	3	0
17-May	1605	0.75	16	W	EL	2	0
17-May	1140	0.75	17	W	MA	4	0
17-May	1610	0.75	16	W	MA	1	0
18-May	815	0.83	16	W	KB	0	0
18-May	815	1.00	16	W	ML	0	0
18-May	745	0.75	9	W	EL	0	0
18-May	755	0.75	11	W	MA	6	0
19-May	730	1.00	22	W	MB	4	0
19-May	825	0.83	16	W	KB	4	0
19-May	755	0.75	12	W	EL	6	0
19-May	1220	0.75	21	W	EL	10	0
19-May	1520	0.75	22	W	EL	3	0
19-May	755	0.75	14	W	MA	11	0
19-May	1255	0.75	22	W	MA	11	0
19-May	1520	0.75	22	W	MA	7	0
21-May	915	1.00	24	W	MB	0	0

Legend: N - Northern Study Area
W - Western Study Area
S - Southern Study Area
NC - Not Collected

Date	Start	Time	Temp°C	Area	Obs	# AGS	# MGS
22-May	915	1.25	24	W	MB	6	0
23-May	830	1.50	26	W	MB	0	0
24-May	915	0.83	26	W	MB	1	0
25-May	910	1.42	24	W	MB	2	0
27-May	1215	0.75	31	W	EL	2	0
27-May	1330	1.00	29	W	ML	3	0
28-May	840	0.75	28	W	EL	3	0
29-May	840	0.83	29	W	ML	1	0
30-May	830	1.00	27	W	ML	1	0
30-May	1515	0.75	32	W	ML	0	0
30-May	830	0.75	25	W	EL	8	0
30-May	1505	0.75	32	W	EL	5	0
9-May	805	0.75	21	S	MN	2	0
9-May	805	1.00	21	S	MA	4	0
10-May	805	0.75	22	S	MN	6	0
10-May	1000	0.75	23	S	MN	2	0
10-May	800	0.92	22	S	MA	5	0
10-May	915	0.75	23	S	MA	1	0
11-May	840	0.75	27	S	MN	3	0
11-May	840	0.75	27	S	MA	1	0
12-May	910	0.75	27	S	MN	2	0
12-May	825	0.75	27	S	MA	2	0
13-May	725	0.75	20	S	MN	5	0
13-May	820	0.83	26	S	MA	7	1
16-May	820	0.75	26	S	ML	0	0
15-May	745	1.17	NC	S	PB	5	0
15-May	920	1.08	NC	S	PB	1	0
21-May	745	0.75	13	S	DL	2	0
21-May	900	0.75	21	S	DL	6	1
21-May	940	0.75	21	S	MN	4	0
21-May	855	0.75	18	S	KB	1	0
21-May	745	0.75	14	S	EL	6	0
21-May	900	0.75	18	S	EL	9	0
21-May	1600	0.75	31	S	EL	2	0
22-May	725	0.75	17	S	DL	11	0
22-May	830	0.75	20	S	DL	8	0
22-May	820	0.75	21	S	MN	3	0
22-May	820	0.75	18	S	KB	4	0
22-May	725	0.75	16	S	EL	9	0
22-May	825	0.75	20	S	EL	7	0
23-May	715	0.75	19	S	DL	4	0
23-May	800	0.75	22	S	MN	2	0
23-May	805	0.75	22	S	KB	3	0
23-May	715	0.75	19	S	EL	8	0
24-May	745	0.75	22	S	DL	8	0
24-May	745	0.75	22	S	MN	6	0
24-May	750	0.75	22	S	EL	8	0
25-May	730	0.75	18	S	DL	6	0
25-May	900	0.75	24	S	MN	0	0
25-May	730	0.75	18	S	EL	1	0
27-May	815	0.92	22	S	MB	0	0
27-May	815	0.75	20	S	DL	0	0
27-May	820	0.75	20	S	MN	3	0
27-May	915	0.75	22	S	MN	2	0
27-May	815	0.75	22	S	MA	1	1
28-May	850	0.75	21	S	MB	3	0

Legend: N - Northern Study Area
W - Western Study Area
S - Southern Study Area
NC - Not Collected

Table 4, Page 3 of 3

Date	Start	Time	Temp°C	Area	Obs	# AGS	# MGS
28-May	850	0.75	26	S	MA	3	0
29-May	745	0.75	24	S	MB	1	0
29-May	730	0.75	21	S	DL	3	0
29-May	735	0.75	24	S	MN	0	0
29-May	745	0.75	24	S	MA	1	0
30-May	815	0.75	18	S	DL	3	0
30-May	820	0.75	21	S	MN	5	1
31-May	850	0.75	25	S	MB	2	0
31-May	745	0.75	17	S	DL	2	0
31-May	835	0.75	17	S	MN	4	0
31-May	850	0.75	25	S	MA	1	0
Sum - North		15.00				65	0
Sum - West		40.16				171	0
Sum - South		42.67				198	4
Overall		97.83				434	4

Legend: N - Northern Study Area
W - Western Study Area
S - Southern Study Area
NC - Not Collected

Sensitive Species Detected During 1994 Mohave Ground Squirrel Surveys

Scientific Name	Common Name	Federal Status	State Status	CNPS Status
Plants				
<i>Chorizanthe spinosa</i>	Mojave spineflower	None	None	4
Reptiles				
<i>Gopherus agassizii</i>	Desert tortoise	FT, FSS	ST	NA
Birds				
<i>Accipiter cooperi</i>	Cooper's hawk	None	CSC	NA
<i>Aquila chrysaetos</i>	Golden eagle	Protected	CSC	NA
<i>Buteo swainsoni</i>	Swainson's hawk	None	ST	NA
<i>Circus cyaneus</i>	Northern harrier	None	CSC	NA
<i>Falco mexicanus</i>	Prairie falcon	None	CSC	NA
<i>Athene cunicularia</i>	Burrowing owl	None	CSC	NA
<i>Chaetura vauxi</i>	Vaux's swift	None	CSC	NA
<i>Toxostoma lecontei</i>	Le Conte's thrasher	None	CSC	NA
<i>Lanius ludovicianus</i>	Loggerhead shrike	C2	None	NA
<i>Dendroica petechia</i>	Yellow warbler	None	CSC	NA
<i>Piranga rubra</i>	Summer tanager	None	CSC	NA
<i>Pandion haliaetus</i>	Osprey	None	CSC	NA
Mammals				
<i>Spermophilus mohavensis</i>	Mohave ground squirrel	C2	ST	NA
<i>Taxidea taxus</i>	American badger	None	CSC	NA
<i>Vulpes macrotis</i>	Desert kit fox	FSS	Protected	NA

Notes: **Federal Status**
 FT = Federally-listed threatened
 FSS = Bureau of Land Management/Forest Service Sensitive
 C2 = Category 2 candidate species

State Status
 ST = State-listed threatened
 CSC = California Species of Special Concern

California Native Plant Society (CNPS)
 4 = List 4--Plants of limited distribution

NA = Not applicable.

Table 6
Sensitive Species Detections

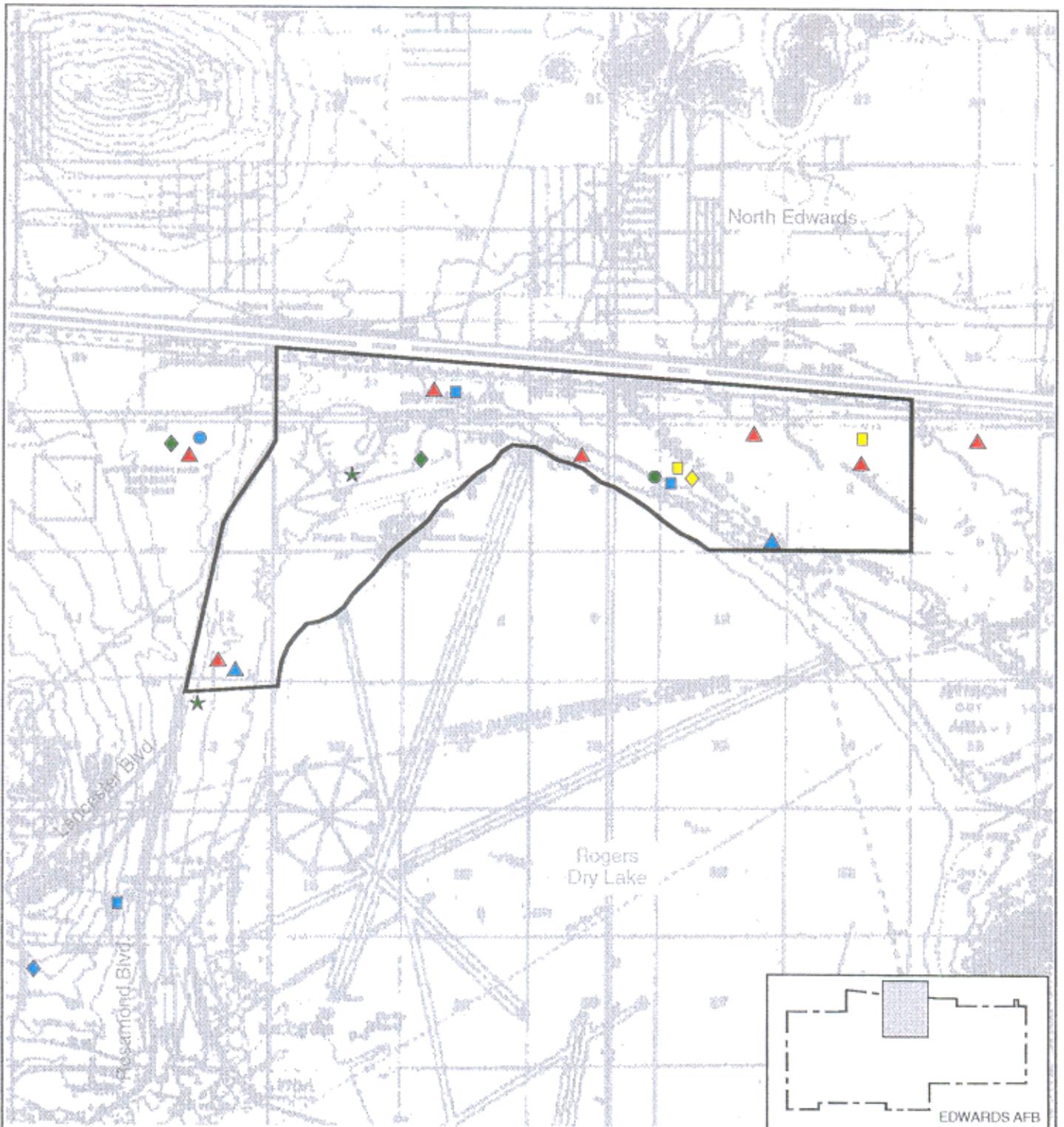
Township	Range	Section	Date	Scientific Name	Common Name	Comments
Northern Study Area						
10N	9W	4	5-Apr	<i>Gopherus agassizii</i>	Desert tortoise	
10N	10W	23	5-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	Pair observed here on 31-May
10N	9W	4	6-Apr	<i>Aquila chrysaetos</i>	Golden eagle	
10N	9W	5	7-Apr	<i>Circus cyaneus</i>	Northern harrier	
10N	9W	1	11-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Adult near burrow
10N	9W	6	12-Apr	<i>Falco mexicanus</i>	Prairie falcon	Flying near JPL facility
10N	10W	26	14-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
11N	9W	32	17-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Scat; burrow; live female observed
10N	9W	2	17-Apr	<i>Vulpes macrotis</i>	Desert kit fox	Scat
10N	10W	12	18-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Scat
11N	9W	32	18-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	Pair
10N	10W	13	20-Apr	<i>Falco mexicanus</i>	Prairie falcon	
10N	11W	3	12-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	At N2
10N	10W	12	15-May	<i>Chaetura vauxi</i>	Vaux's swift	At N4
10N	9W	3	16-May	<i>Chaetura vauxi</i>	Vaux's swift	
10N	9W	2	18-May	<i>Gopherus agassizii</i>	Desert tortoise	10" male; burrow
10N	10W	1	19-May	<i>Gopherus agassizii</i>	Desert tortoise	
10N	10W	1	19-May	<i>Athene cunicularia</i>	Burrowing owl	
10N	10W	1	19-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
10N	9W	3	23-May	<i>Gopherus agassizii</i>	Desert tortoise	Scat
10N	9W	3	23-May	<i>Vulpes macrotis</i>	Desert kit fox	Sign
10N	9W	3	23-May	<i>Taxidea taxus</i>	American badger	Sign
10N	9W	3	24-May	<i>Vulpes macrotis</i>	Desert kit fox	Sign
10N	9W	3	24-May	<i>Taxidea taxus</i>	American badger	Sign
Western Study Area						
9N	11W	1	4-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	10W	7	5-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	34	5-Apr	<i>Taxidea taxus</i>	American badger	Previous night's sign
9N	11W	1	6-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
9N	10W	7	7-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
10N	11W	28	9-Apr	<i>Falco mexicanus</i>	Prairie falcon	
9N	10W	7	10-Apr	<i>Circus cyaneus</i>	Northern harrier	
9N	11W	5	10-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Scat on W3
10N	11W	33	11-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Scat on hills north of W3
9N	10W	7	12-Apr	<i>Falco mexicanus</i>	Prairie falcon	
9N	11W	17	12-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	35	13-Apr	<i>Aquila chrysaetos</i>	Golden eagle	
10N	11W	31	13-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Scat; not this year's
9N	11W	5	14-Apr	<i>Buteo swainsoni</i>	Swainson's hawk	At W3; flying NW to SE
10N	11W	34	14-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	28	14-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	Pair
10N	11W	35	15-Apr	<i>Gopherus agassizii</i>	Desert tortoise	Male
10N	11W	33	15-Apr	<i>Pandion haliaetus</i>	Osprey	
9N	11W	1	18-Apr	<i>Falco mexicanus</i>	Prairie falcon	Perched in Joshua tree

Table 6, Page 2 of 3

Township	Range	Section	Date	Scientific Name	Common Name	Comments
10N	11W	27	19-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	22	8-May	<i>Athene cunicularia</i>	Burrowing owl	
10N	11W	35	9-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	29	9-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	27	10-May	<i>Gopherus agassizii</i>	Desert tortoise	
10N	11W	28	11-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
10N	11W	35	11-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
9N	11W	17	15-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
9N	11W	16	15-May	<i>Vulpes macrotis</i>	Desert kit fox	Several burrows at natal den
9N	11W	15	15-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	33	15-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	11W	3	16-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	11W	10	16-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	11W	10	16-May	<i>Vulpes macrotis</i>	Desert kit fox	Several dens in area on W5
9N	11W	9	17-May	<i>Gopherus agassizii</i>	Desert tortoise	This year's adult scat
9N	11W	8	17-May	<i>Taxidea taxus</i>	American badger	Digs
9N	11W	8	17-May	<i>Vulpes macrotis</i>	Desert kit fox	Dens
9N	11W	9	17-May	<i>Vulpes macrotis</i>	Desert kit fox	4-6 openings to natal den; fresh scat
9N	11W	9	17-May	<i>Taxidea taxus</i>	American badger	Digs
9N	11W	2	18-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	10W	7	19-May	<i>Athene cunicularia</i>	Burrowing owl	Observed at burrow
9N	10W	7	19-May	<i>Vulpes macrotis</i>	Desert kit fox	Natal den
9N	10W	7	19-May	<i>Gopherus agassizii</i>	Desert tortoise	Adult burrow
9N	10W	7	19-May	<i>Gopherus agassizii</i>	Desert tortoise	Adult male carcass < 1 year
9N	11W	15	19-May	<i>Athene cunicularia</i>	Burrowing owl	Pair
9N	11W	15	19-May	<i>Vulpes macrotis</i>	Desert kit fox	Sign
9N	11W	15	19-May	<i>Taxidea taxus</i>	American badger	Sign
10N	11W	26	21-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
9N	11W	3	22-May	<i>Gopherus agassizii</i>	Desert tortoise	Scat
10N	11W	22	23-May	<i>Gopherus agassizii</i>	Desert tortoise	Male
10N	11W	26	25-May	<i>Gopherus agassizii</i>	Desert tortoise	Live tortoise observed
10N	11W	20	26-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
10N	11W	21	26-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
10N	11W	21	27-May	<i>Vulpes macrotis</i>	Desert kit fox	1 burrow; several scat at W10
10N	11W	27	29-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
10N	11W	19	30-May	<i>Athene cunicularia</i>	Burrowing owl	Observed in Joshua tree
9N	10W	6	30-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
Southern Study Area						
8N	10W	9	5-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	10W	4	5-Apr	<i>Chorizanthe spinosa</i>	Mojave spineflower	Numerous individuals; all dead
8N	10W	9	5-Apr	<i>Chorizanthe spinosa</i>	Mojave spineflower	Numerous individuals; all dead
9N	10W	34	5-Apr	<i>Accipiter cooperi</i>	Cooper's hawk	
8N	10W	14	5-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	10W	3	6-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	10W	4	6-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	10W	2	7-Apr	<i>Circus cyaneus</i>	Northern harrier	
9N	10W	34	7-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	

Table 6, Page 3 of 3

Township	Range	Section	Date	Scientific Name	Common Name	Comments
9N	10W	34	7-Apr	<i>Falco mexicanus</i>	Prairie falcon	
8N	10W	7	7-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
8N	10W	6	8-Apr	<i>Gopherus agassizii</i>	Desert tortoise	2 scat/1 burrow
8N	10W	1	8-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	10W	33	8-Apr	<i>Chorizanthe spinosa</i>	Mojave spineflower	
9N	10W	35	8-Apr	<i>Chorizanthe spinosa</i>	Mojave spineflower	
9N	10W	33	9-Apr	<i>Vulpes macrotis</i>	Desert kit fox	Burrows
9N	10W	32	9-Apr	<i>Vulpes macrotis</i>	Desert kit fox	Burrows
9N	10W	32	9-Apr	<i>Taxidea taxus</i>	American badger	Complex of burrows
9N	10W	36	11-Apr	<i>Circus cyaneus</i>	Northern harrier	
9N	10W	34	16-Apr	<i>Dendroica petechia</i>	Yellow warbler	At Branch Memorial Park
8N	10W	17	16-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	10W	2	17-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
8N	10W	3	18-Apr	<i>Toxostoma lecontei</i>	Le Conte's thrasher	
8N	10W	5	18-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	10W	35	19-Apr	<i>Taxidea taxus</i>	American badger	
9N	10W	32	19-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	10W	26	19-Apr	<i>Lanius ludovicianus</i>	Loggerhead shrike	Pair
9N	10W	34	10-May	<i>Dendroica petechia</i>	Yellow warbler	
9N	10W	36	12-May	<i>Taxidea taxus</i>	American badger	Sign
9N	10W	36	12-May	<i>Vulpes macrotis</i>	Desert kit fox	Sign
9N	10W	35	13-May	<i>Spermophilus mohavensis</i>	Mohave ground squirrel	Crossing road
8N	10W	4	18-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	Pair
9N	10W	33	19-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	10W	34	21-May	<i>Piranga rubra</i>	Summer tanager	At Branch Memorial Park
8N	9W	5	21-May	<i>Chorizanthe spinosa</i>	Mojave spineflower	Numerous individuals; all dead; at S5
8N	9W	6	21-May	<i>Taxidea taxus</i>	American badger	At S5
8N	10W	6	23-May	<i>Dendroica petechia</i>	Yellow warbler	Near grid S6
8N	9W	6	23-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	9W	6	23-May	<i>Chorizanthe spinosa</i>	Mojave spineflower	
8N	9W	6	23-May	<i>Spermophilus mohavensis</i>	Mohave ground squirrel	First year individual
8N	9W	6	23-May	<i>Circus cyaneus</i>	Northern harrier	Single male observed
9N	10W	36	23-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
9N	9W	34	27-May	<i>Taxidea taxus</i>	American badger	Active den, fresh tracks
9N	10W	34	27-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	9W	5	28-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	3 birds
9N	10W	33	28-May	<i>Taxidea taxus</i>	American badger	Sign
8N	10W	4	29-May	<i>Taxidea taxus</i>	American badger	Sign
8N	10W	4	29-May	<i>Lanius ludovicianus</i>	Loggerhead shrike	
8N	10W	5	30-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	3 birds
8N	10W	4	30-May	<i>Gopherus agassizii</i>	Desert tortoise	This year's scat at NE corner of S8
9N	10W	36	31-May	<i>Toxostoma lecontei</i>	Le Conte's thrasher	



LEGEND

- Base Boundary
- Survey Area Boundary
- ▲ Desert tortoise (*Gopherus agassizii*)
- ◆ Loggerhead shrike (*Lanius ludovicianus*)
- Golden eagle (*Aquila chrysaetos*)
- Le Conte's thrasher (*Toxostoma lecontei*)
- ◆ Northern harrier (*Circus cyaneus*)
- ★ Prairie falcon (*Falco mexicanus*)
- Burrowing owl (*Athene cunicularia*)
- ▲ Vaux's swift (*Chaetura vauxi*)
- Desert kit fox (*Vulpes macrotis*)
- ◆ American badger (*Taxidea taxus*)

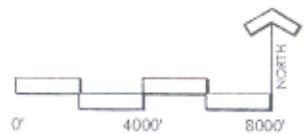
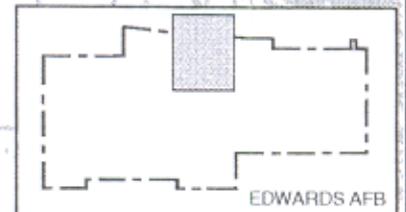
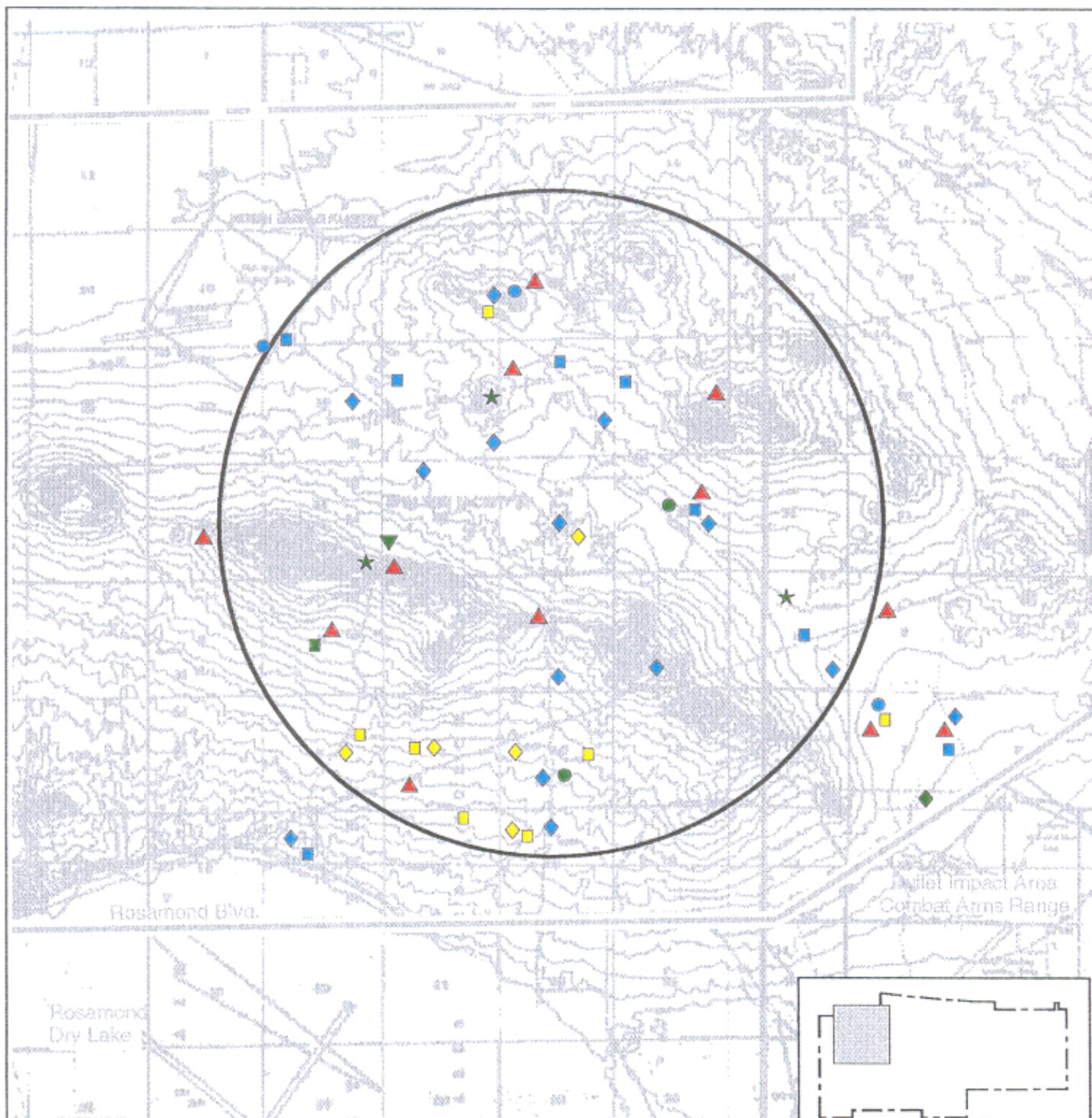


FIGURE 11
NORTHERN STUDY AREA
INCIDENTAL SENSITIVE
SPECIES DETECTIONS



LEGEND

- Base Boundary
- Survey Area Boundary
- Desert tortoise (*Gopherus agassizii*)
- Loggerhead shrike (*Lanius ludovicianus*)
- Golden eagle (*Aquila chrysaetos*)
- Le Conte's thrasher (*Toxostoma lecontei*)
- Northern harrier (*Circus cyaneus*)
- Prairie falcon (*Falco mexicanus*)
- Swainson's hawk (*Buteo swainsoni*)
- Osprey (*Pandion haliaetus*)
- Burrowing owl (*Athene cucularia*)
- Desert kit fox (*Vulpes macrotis*)
- American badger (*Taxidea taxus*)

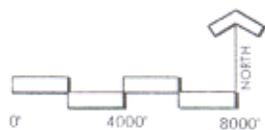
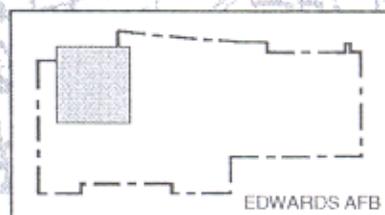
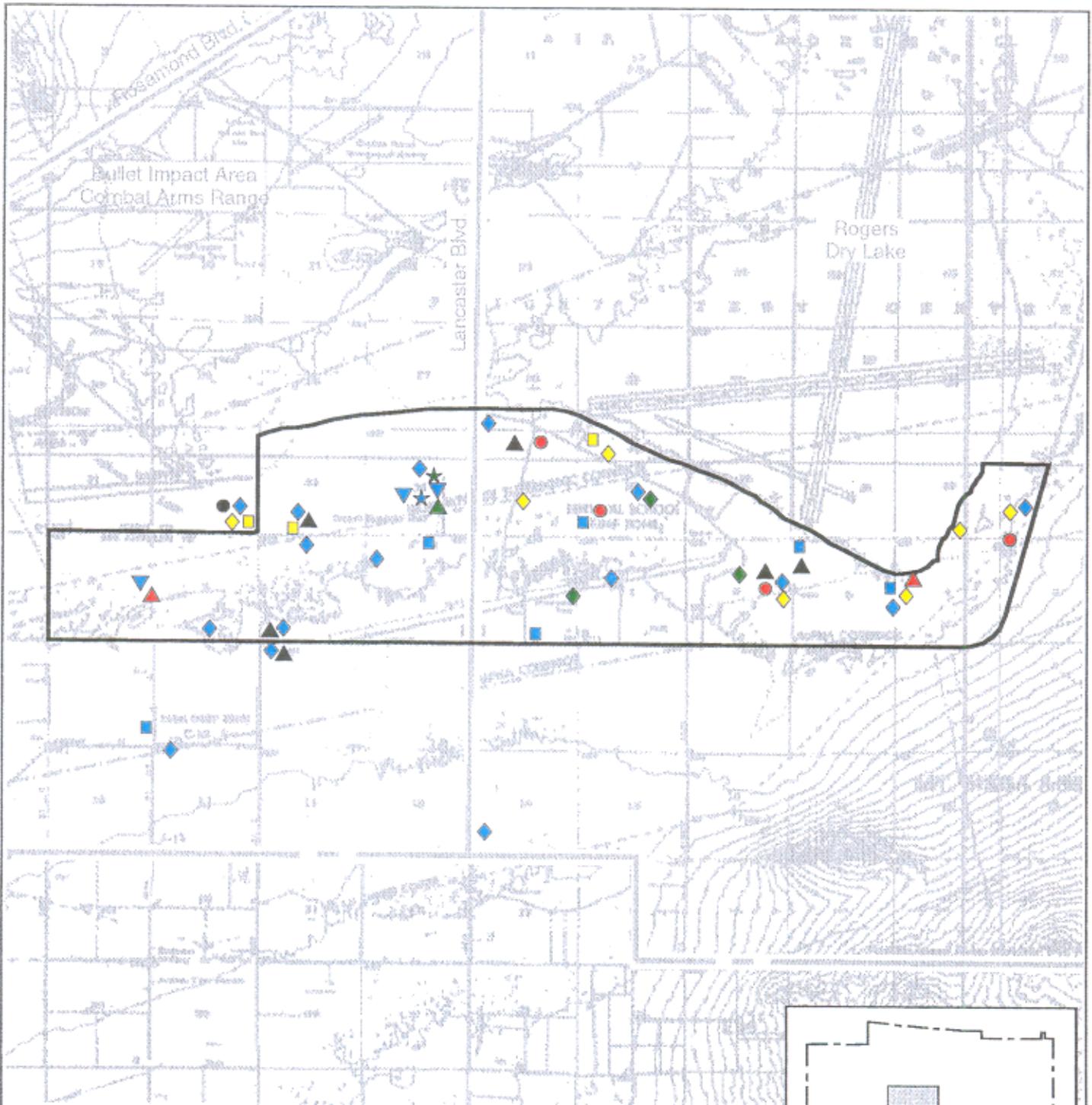


FIGURE 12
WESTERN STUDY AREA INCIDENTAL SENSITIVE SPECIES DETECTIONS



LEGEND

- Base Boundary
- Survey Area Boundary
- ▲ Desert tortoise (*Gopherus agassizii*)
- Mohave ground squirrel (*Spermophilus mohavensis*)
- ◆ Loggerhead shrike (*Lanius ludovicianus*)
- Le Conte's thrasher (*Toxostoma lecontei*)
- ◆ Northern harrier (*Circus cyaneus*)
- ★ Prairie falcon (*Falco mexicanus*)
- ▼ Yellow warbler (*Dendroica petechia*)
- ▲ Cooper's hawk (*Accipiter cooperi*)
- ★ Summer tanager (*Piranga rubra*)
- Desert kit fox (*Vulpes macrotis*)
- ◆ American badger (*Taxidea taxus*)
- Lancaster milkvetch (*Astragalus prussii* var. *laxiflorus*)
- ▲ Mojave spineflower (*Chorizanthe spinosa*)

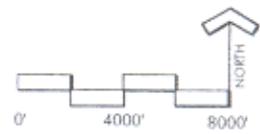
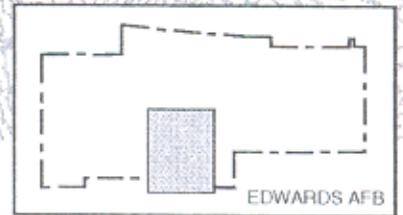


FIGURE 13
SOUTHERN STUDY AREA
INCIDENTAL SENSITIVE
SPECIES DETECTIONS

During trapping activities, incidental detections of Mohave ground squirrels were made on eight occasions. Observations were made on five occasions in the vicinity of Grid S9. A single individual was observed approximately 200 meters west of Grid S5 on May 23. On May 30, repeated vocalizations were heard off the northwestern corner of Grid S10, and one individual was seen crossing the road near Grid S1 on May 13.

Several species were also detected which had not been detected in 1993 studies at Edwards AFB (Mitchell et al. 1993), including osprey (*Pandion haliaetus*), Swainson's hawk (*Buteo Swainsoni*), yellow warbler (*Dendroica petechia*), and summer tanager (*Piranga rubra*).

DISCUSSION

Results from this study indicate that Mohave ground squirrels are present in all three study areas. Based on trapping results, as well as visual and auditory surveys and incidental sightings, the species was more common in 1994 in the Southern Study Area than in either of the other areas.

Diurnal Trapping

The number of individual Mohave ground squirrels captured per grid is comparable to results from previous studies performed on the base. In 1989 at the Gravity Wave site, east of the Northern Study Area, the number of individuals ranged from 3 to 7 per 100-trap grid (ERC Environmental and Energy Services Co. 1989). In 1992 at Complex One Charlie, southeast of the Southern Study Area, a total of nine individuals were trapped in approximately 1,500 trap-days (U.S. Fish and Wildlife Service 1993). In 1993, the number of individuals ranged from zero to three adults per 100 trap grid. Also during the 1993 study, a 500-trap grid in Complex One Charlie yielded one adult Mohave ground squirrel (Mitchell et al. 1993).

No juvenile Mohave ground squirrels were detected during this study. Juveniles have been detected at Edwards AFB during the past 2 years. In a 1993 study, juveniles were trapped at four of five trapping locations and constituted 80 percent of all individuals trapped (Mitchell et al. 1993). A single juvenile and nine adults were trapped at Complex One Charlie in 1992 (U.S. Fish and Wildlife Service 1993). A female trapped on grid W6 showed some signs of reproductive activity ("puffy" genitalia),

but no other evidence of reproduction in the species was observed during this study. No juveniles were observed by several other researchers conducting Mohave ground squirrel trapping studies in the western Mojave Desert during 1994 (Scary 1994; Leitner in Prep).

The weight of Mohave ground squirrels increases through the season as individuals accumulate body fat prior to aestivation (Bartholomew 1960). Although the current study found males active into late May, they have generally been reported to enter aestivation before females in mid-May (Leitner, et al. 1991). During this study, Mohave ground squirrels captured in May averaged 157.7 grams for males and 156.5 grams for females. In comparison, other researchers have reported pre-aestivation weight for males of between 180 to 220 grams (Recht 1977). At the Coso Geothermal area in 1990, maximum body weight for males and females combined averaged 168 grams and was reached in mid-May. In 1992, Mohave ground squirrels captured in the last week of May and first week of June averaged 211.7 grams for males and 183.0 grams for females (Leitner 1993). Weights taken at Edwards AFB in 1994 appear to be lower than reported by other researchers.

The proportion of juvenile antelope ground squirrels was lower than in studies conducted in 1993. Juveniles made up only 1 percent of individuals trapped during this study, as compared to 13 percent in 1993 (Mitchell, et al. 1993).

Trapping periods were shortened by high temperatures (above 32.2°C) on several days during the study period. This is a potential source of bias in trapping results. However, on 20 of 25 grids, there was not a significant positive correlation between length of trap day and total number of antelope ground squirrels captured. Data were insufficient to reliably calculate correlation between these variables for Mohave ground squirrels. Other factors, such as behavioral patterns and environmental conditions, are also likely involved with trap success.

Assessment Line Trapping

Assessment line trapping has been proposed as a method of determining density by measuring the area which a trapping grid samples ("the area of effect") (O'Farrell et al. 1977). Results of assessment line trapping showed that the area of effect for antelope ground squirrels for Grid S5 was more than 10 times larger than the area physically covered by the trapping grid. The area of effect may be influenced by

habitat type, vegetation, season, and other factors. For this reason, calculating density figures utilizing an expression for area is inappropriate without additional trapping studies. The capture of two additional Mohave ground squirrels during assessment line trapping, one within 70 meters of the original grid, is noteworthy because no Mohave ground squirrels were captured during the 10 days of diurnal trapping at the original grid.

Visual and Auditory Surveys

Auditory surveys have proven effective in detecting Mohave ground squirrels as confirmed by follow-up trapping efforts (U.S. Fish and Wildlife Service 1993). Transect counts have also been shown to be a valid means of estimating abundance of San Joaquin antelope squirrels (*Ammospermophilus nelsoni*) (Harris and Stearns 1991).

During transect surveys, Mohave ground squirrels were detected only in the Southern Study Area, the area in which the majority of Mohave ground squirrels were trapped. Only one of these detections was made by call. The success of auditory surveys for Mohave ground squirrels is dependent on how vocal the species is. Visual detections are often made after vocalization of the species. It is suspected that the species is more likely to call when juveniles are present. Literature on calling behavior in Mohave ground squirrels is sparse, but research on the closely related round-tailed ground squirrel (*Spermophilus tereticaudus*) has shown that vocalizations function most frequently as alarm calls, and have evolved via kin selection (Dunford 1977). It is possible that these surveys would be more successful in a year with higher reproductive success.

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