Mohave Ground Squirrel 2016 Trapping Results for 11 Grids in the "Bowling Alley," San Bernardino County, California

Adult male Mohave ground squirrel trapped in saltbush scrub on Grid 1 on 8 May 2016

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November 2016

Executive Summary

Between March 8 and June 22, 2016, 22 biologists trapped 11 grids in the region north of Edwards Air Force Base, which has been colloquially referred to as the "Bowling Alley." Thirteen Mohave ground squirrels (MGS), including 4 adults and 9 juveniles, were captured on 6 of the 11 grids. Eleven of these MGS were captured in creosote bush scrub and 2 were captured in saltbush scrub communities. Evidence of desert tortoise was found on 7 of 11 grids, and 9 other special status plant, bird, and mammal species were identified.

Pending collection of new scientific data such as provided in this report, both the Bureau of Land Management and San Bernardino County Board of Supervisors have tentatively identified the larger region encompassing the Bowling Alley as the "North of Edwards Development Focus Area." In the California Department of Fish and Wildlife's latest draft of its MGS Conservation Strategy, the Bowling Alley is located within the "North of Edwards Key Population Center."

That 13 Mohave ground squirrels were captured from the north end to the south end of the study area during the 2016 trapping effort is considered reliable evidence that the MGS occurs throughout the Bowling Alley, persists within this area even though regional populations are in decline and may have been extirpated from the southern and western portions of the historic range, and in spite of recent years of drought.

Based on information provided in this report, we found:

● MGS have persisted in the Bowling Alley from 2011 to 2016 with 100% trapping success of the only two MGS studies ever performed in the region;

● MGS were detected in 2016 when long-term known MGS populations have been in decline over the past five years and were detected at reduced levels region-wide in 2016; and

● The Bowling Alley is comprised of suitable substrates; moderate-to-high diversity of perennial plants; a prevalence of ecologically-important spiny hopsage and winterfat plants; habitat for at least 10 other special status plant and animal species and resources detected during the study; and is minimally affected by low levels of human impacts (with the exception of sheep grazing).

Based on the positive MGS trapping results given herein, the presence of requisite suitable habitat components as identified by the MGS TAG, two decades of programmatic failure to trap MGS populations in the southern and western portions of its range, and confirmation of MGS persisting presence in the Bowling Alley over the past five years in spite of drought, we recommend that:

● The BLM withdraw the Bowling Alley area from further consideration as a Development Focus Area under the Desert Renewable Energy Conservation Plan; and

● The San Bernardino County Board of Supervisors no longer consider this as one of the five Development Focus Areas identified for energy development in their 17 February 2016 Resolution.

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Suggested Citation:
LaRue, E.L. 2016. Mohave ground squirrel 2016 trapping results for 11 grids in the "Bowling Alley," San Bernardino County, California. Unpublished report prepared for the Mohave Ground Squirrel Technical Advisory Group. Wrightwood, CA.

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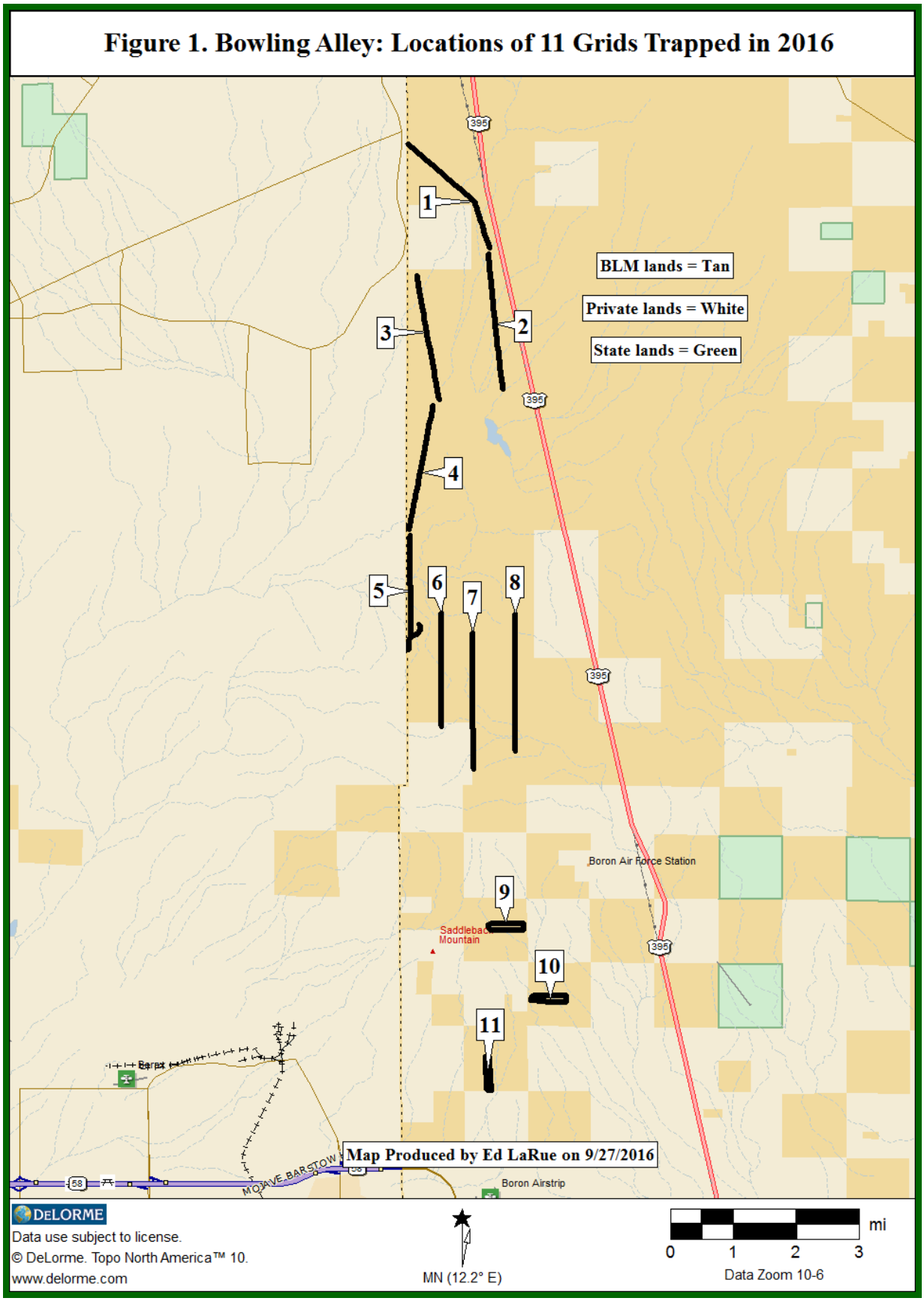

Mohave Ground Squirrel 2016 Trapping Results for 11 Grids in the "Bowling Alley," San Bernardino County, California

1.0. INTRODUCTION

1.1. Purpose and Need for Study. The Final Record of Decision (ROD) for the Desert Renewable Energy Conservation Plan (DRECP) (BLM 2016) indicates that there were insufficient data to determine how an area, colloquially referred to as the "Bowling Alley," should ultimately be designated relative to the conservation of the Mohave ground squirrel (*Xerospermophilus mohavensis*) (herein "MGS"), which is listed as "Threatened" by the California Fish and Game Commission. The DRECP ROD identified the following two Conservation Management Actions (CMAs) pertaining to this region:

> **DFA-BIO-IFS-4:** The DFA in the "North of Edwards" Mohave ground squirrel key population center is closed to renewable energy applications and any activity that is likely to result in the mortality (killing) of a Mohave ground squirrel until Kern and San Bernardino counties complete county General Plan amendments/updates that include renewable energy development and Mohave ground squirrel conservation on nonfederal land in the West Mojave ecoregion and the CDFW [California Department of Fish and Wildlife] releases a final Mohave Ground Squirrel Conservation Strategy, or for a period of 5 years after the signing of the DRECP LUPA ROD [Record of Decision], whichever comes first. If Kern and San Bernardino counties and CDFW do not complete their respective plans within the 5-year period, prior to opening the DFA to renewable energy applications and other impacting activities, BLM will assess new Mohave ground squirrel information, in coordination with the CDFW, to determine if modifications to the DFA or CMAs are warranted based on new Mohave ground squirrel information.
>
> **DFA-BIO-IFS-5:** Once the planning criteria in CMA **DFA-BIO-IFS-4**, are met, the DFA in the "North of Edwards" Mohave ground squirrel key population center will be reevaluated. If Kern and San Bernardino counties receive Mohave ground squirrel take authorizations from the CDFW through completed Natural Community Conservation Plans or county-wide conservation strategies that address Mohave ground squirrel conservation at a landscape level and include renewable energy development areas on nonfederal land in the West Mojave ecoregion, the "North of Edwards" key population center DFA will be eliminated and the management changed to General Public Lands, as part of adaptive management.

There are several important observations with regards to these two CMAs:

1. The "North of Edwards key population center" of the MGS includes the Bowling Alley, which includes all Bureau of Land Management (BLM) lands located in San Bernardino County with Highway 395 to the east, Highway 58 to the south, the Kern County/San Bernardino County line to the west, and 20 Mule Team Road to the north (see Figure 1).

2. As per the first CMA given above (DFA-VPL-BIO-IFS-6), the purpose of this technical report is to provide BLM with the "…***new Mohave ground squirrel information … to determine if modifications to the DFA are warranted based on new Mohave ground squirrel information*** [emphasis added]**.**"

Similarly, San Bernardino County Board of Supervisors Resolution dated 17 February 2016 indicated "COUNTY indicates its general and tentative support for five (5) of the Development Focus Areas (DFAs) identified in the BLM DRECP LUPA (***North of Kramer Junction***, Trona, Hinkley, El Mirage, and Amboy), recognizing that ***further COUNTY evaluation of all BLM DFAs will continue*** in preparation, public review and ultimate adoption of its Renewable Energy Element [emphasis added]." This report is prepared, in part, for the County providing additional, important data for their consideration.

This report was prepared for and presented to the Mohave Ground Squirrel Technical Advisory Group (MGS TAG) for their consideration. Many of the biologists who performed the trapping studies are members of the MGS TAG and early drafts of this document were reviewed by MGS TAG members. Led by CDFW biologists, the MGS TAG is comprised of biologists, miscellaneous scientists, consultants, and other interested parties to provide coordination, guidance, and oversight for ongoing research, conservation, and communication among public (military, BLM, State Parks, counties, etc.) and private (environmental groups, consultants, etc.) entities.

The MGS TAG typically meets twice a year to discuss recent and upcoming trapping and research activities; consider current and historic MGS distribution; discuss new studies to ascertain the extent of hybridization between MGS and round-tailed ground squirrels (*Xerospermophilus tereticaudis*); identify project review and impact minimization measures; discuss research and monitoring priorities; and advise CDFW on the draft Mohave Ground Squirrel Conservation Strategy (CDFW 2016d). This technical report was discussed at the fall meeting of the MGS TAG in Ridgecrest, CA on 26 October 2016, resulting in several important changes to an earlier draft.

Even though the 2016 field studies were coordinated by Ed LaRue with significant input from Dr. Phil Leitner, MGS TAG members and others, particularly Lehong Chow, Adam Walters, Kathy Simon, Leo Simone, Erin Martinelli, Agnieszka Napiatek, and Erin Whitfield are Primary Investigators and/or holders of CDFW Memoranda of Understanding who were responsible for collecting the data and reviewing this report. Earlier drafts of this report were provided to all current members of the MGS TAG and have been modified accordingly.

1.2. Study Area and Transect Placement. The region was first referred to colloquially as the "Bowling Alley" by an unidentified MGS TAG member several years ago. The full extent of the region was not ascertained until BLM biologist, Amy Fesnock, provided a map via email to LaRue on 19 April 2016, which is shown as Figure 2 on the next page. Whereas most of the BLM lands are shown as a tan color, those public lands managed by the BLM within the Bowling Alley that were identified for potential inclusion as a DFA are shown as bright pink. Excluding two BLM parcels proximate to Highway 58, all BLM lands between Highway 395 and the Kern County line on a horizontal axis and between Highway 58 and 20 Mule Team Road on a vertical axis are within the Bowling Alley study area.

To avoid trespass on private lands, trapping grids were necessarily restricted to public lands managed by the BLM. That only 11 grids were trapped in 2016 was more a matter of personnel availability than project design. Importantly, this entire effort was an unfunded, volunteer effort. Based on average costs for MGS trapping, the study is valued at about $110,000.

Kathy Simon provided a series of USGS maps included in Appendix A that are enlargements of the Bowling Alley, showing BLM lands and the 11 grid locations. Whereas Grids 9 through 11, in the southern part of the Bowling Alley, were trapped in a typical grid configuration of four lines of 25 traps (i.e., 4 x 25 in Table 1), Grids 1 through 8 were spread out over two linear miles± to cover more surface area, which was intended to increase the likelihood of encountering more individual animals. Grids were strategically placed in what initially appeared to be creosote bush scrub and saltbush scrub throughout the entire area (upon closer inspection, the "saltbush" also include burrobush scrub). Whereas these descriptions provide the general approach for grid placement, site-specific information is given below in Table 1 and in Section 2.2, which present more detailed trapping methodologies.

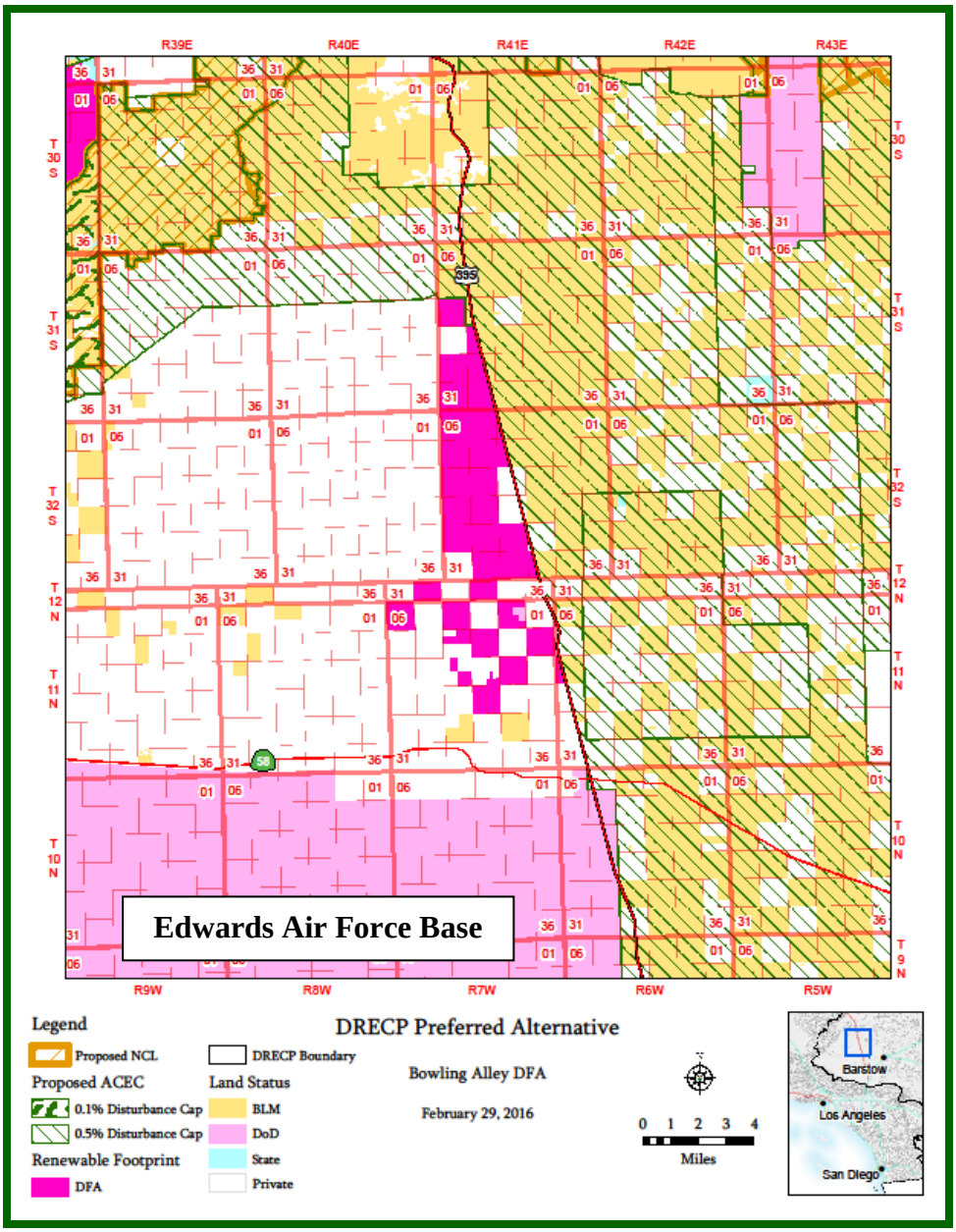

Figure 2. Proposed Development Focus Area in the Bowling Alley (bright pink)

Table 1. Location Information for 11 Grids Trapped in the Bowling Alley in 2016							
Grid No.	**Legal Description**			**USGS 7.5' Quad**	**UTM Coordinates NAD 83/11S***		**No. Traps/Acreage/ Configuration****
Name	**T**	**R**	**S**		**Easting**	**Northern**	
Grid 1	31S	41E	17 18 20	Boron NE, Boron NW	0442603 0444291 0444654	3900292 3898813 3897640	100/80 acres 1 x 100
Grid 2	31S	41E	20 29 32	Boron NE, Boron NW	0444629 0444967	3897470 3894084	100/80 acres 1 x 100
Grid 3	31S	41E	30 31	Boron NE, Boron NW	0442819 0443348	3896967 3893826	100/80 acres 1 x 100
Grid 4	32S	41E	6 7	Boron NE, Boron NW	0443197 0442553	3893656 3890533	100/80 acres 1 x 100
Grid 5	32S	41E	18 19	Boron NW	0442596 0442523 0442801	3890378 3887493 3888133	100/80 acres 1 x 100
Grid 6	32S	41E	19 30 31	Boron NE, Saddleback Mtn.	0443378 0443372	3888421 3885526	100/80 acres 1 x 100
Grid 7	32S	41E	20 29 32	Boron NE, Saddleback Mtn.	0444172 0444166	3887900 3884442	100/80 acres 1 x 100
Grid 8	32S	41E	20 29 32	Boron NE, Saddleback Mtn.	0445247 0445246	3888369 3884900	100/80 acres 1 x 100
Grid 9	11N	41E	10	Saddleback Mtn.	0445392 0444565 0444523 0445431	3880372 3880385 3880527 3880538	100/80 acres 4 x 25
Grid 10	11N	41E	14	Saddleback Mtn.	0445639 0446494 0445593 0446506	3878705 3878700 3878599 3878550	88/70 acres See Figure
Grid 11	11N	41E	22	Saddleback Mtn.	0444531 0444425 0444465 0444575	3877155 3877180 3876348 3876327	100/80 acres 4 x 25

*For pairs of coordinates, the top pair is the north or west end of the grid and the bottom pair is the south or east end of the grid. For more complicated grids, like Grid 5, more than one pair of coordinates are given. For Grids 9, 10, and 11 the four corner points encompassing the 4 x 25 grids are given in the table.

** For each grid, acreage is determined by grid length (11,480 feet or 3,500 meters) times an effective width of 150 feet (45 meters) either side of the grid line (300 feet or 90 meters), so total acres trapped is X linear feet x 300 feet ÷ 43,560 square feet, which is ±80 acres for most grids. "1 x 100" = a single line of 100 traps; "4 x 25" = four lines of 25 traps, which describes Grids 9 and 11. Grid 10 had only 88 traps, so given the above calculations, approximately 70 acres were effectively trapped along Grid 10.

1.3. Mohave Ground Squirrel Life History. The MGS is approximately 20 to 23 centimeters (8 to 9 inches) in length, sandy-colored on top, lighter underneath, with a bi-colored (dark above, light below) tail flattened dorso-ventrally.

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The following information is published in various places (e.g., David Laabs' species account published in U.S. Bureau of Land Management 2005), and much of it was in the form of personal communication from Dr. Leitner to LaRue. Following winters of sufficient rainfall [e.g., a minimum of about 7.5 centimeters (3 inches)], MGS emerge in February from dormancy, reproduce, and have a litter of up to nine young in late March to early April; they forego reproduction if there is less than about 3 inches of rainfall. If reproductive, they will remain active into the summer, with adults becoming dormant in June and July and juveniles (= young of the year) as late as August; if there is no reproduction, adults will become dormant as early as late May. Their diet consists of seeds, leaves, flowers, and fruits of both annual and perennial plants; arthropods are occasionally taken.

At their long-term study sites in the Coso Range of China Lake Naval Air Weapons Station near the northern extent of the MGS range, Phil and Barbara Leitner have determined that winterfat (*Krascheninnikovia lanata*) and spiny hopsage (*Grayia spinosa*) are important perennial plants for the feeding ecology of the MGS, particularly during dry years. Their ability to overwinter depends on achieving a body weight of approximately 180 grams. The MGS is currently listed as Threatened by the California Fish and Game Commission; U.S. Fish and Wildlife Service (USFWS) has declined to list it federally following two petitions, the last of which was in 2005.

2.0. FIELD SURVEY METHODS

2.1. CDFW Standard Trapping Methods. Surveys were conducted, in part, according to the following recommended guidelines, with a few changes: California Department of Fish and Game (currently CDFW), Mohave Ground Squirrel Survey Guidelines (January 2003, revised in 2010). Whereas CDFW methods are intended for *protocol-level* surveys, the current study was more of a *regional* survey, so not all methods were implemented. In the following sections, the formal protocol-level method is reproduced in regular font, immediately followed by the implemented methodology shown in *italicized font* after each prescription (for those measures that do not apply, "Not applicable" follows the prescription).

1. Visual surveys to determine Mohave ground squirrel activity and habitat quality shall be undertaken the period of 15 March through 15 April. All potential habitat on a project site shall be visually surveyed during daylight hours by a biologist who can readily identify the Mohave ground squirrel and the white-tailed antelope squirrel (*Ammospermophilus leucurus*) [and, more importantly, round-tailed ground squirrel]. *Not applicable; no visual surveys were performed prior to setting up the grids.*

2. If visual surveys do not reveal presence of the Mohave ground squirrel on the project site, standard small-mammal trapping grids shall be established in potential Mohave ground squirrel habitat. The number of grids will depend on the amount of potential habitat on the project site, as determined by the guidelines presented in paragraphs 4 and 5 of these guidelines. *All grids were established in what appeared to be suitable MGS habitats. Only Grid 2 had to be repositioned several hundred meters north of its intended location to avoid barren and semi-barren, degraded habitats.*

3. For linear projects (for example, highways, pipelines, or electric transmission lines), each sampling grid shall consist of 100 Sherman live-traps (or equivalent; the minimum length of any trap is 12 inches) arranged in a rectangular pattern, 4 traps wide by 25 traps long, with traps spaced 35 meters apart along each of the four trap lines. At a minimum, one sampling grid of this type shall be established in each linear mile, or fraction thereof, of potential Mohave ground squirrel habitat along the project corridor. *For this study, Grids 1 through 8 consisted of 100 traps, spaced at 35-meter intervals, over the linear distance of approximately 2 miles. Grids 9 and 11 consisted of 100 traps, spaced at 35-meter intervals, in a formation of 4 lines with 25 traps per line. Grid 10 consisted of only 88 traps (see Figure 13 for its configuration).*

4. For all other types of projects, one sampling grid consisting of 100 Sherman live-traps (or equivalent; the minimum length of any trap is 12 inches) shall be established for each 80 acres, or fraction thereof, of potential Mohave ground squirrel habitat on the project site. The traps shall be arranged in a 10 x 10 grid, with 35-meter spacing between traps. *Given the exploratory nature of this study, we generally chose a more widespread configuration for the Sherman live traps (see Figures 4 through 14). This pattern was chosen using aerial photographs to assess the least disturbed portions of a given grid location. Eight of the 11 grids were also configured to cover as large an area as possible that could be safely trapped by a single permitted biologist.*

5. Each sampling grid shall be trapped for a minimum five consecutive days, unless a Mohave ground squirrel is captured before the end of the five-day term on the grid or on another grid on the project site. If no Mohave ground squirrel is captured on a sampling grid on the project site in the first five-consecutive-day term, each sampling grid shall be sampled for a SECOND five-consecutive-day term. Trapping may be stopped before the end of the second term if a Mohave ground squirrel is captured on any sampling grid on the project site. If no Mohave ground squirrel is captured during the second five-consecutive-day term, each sampling grid shall be sampled for a THIRD five-consecutive -day term. The FIRST trapping term shall begin and be completed in the period of 15 March through 30 April. If a SECOND term is required, it shall begin at least two weeks after the end of the first term, but shall begin no earlier than 01 May, and shall be completed by 31 May. If a THIRD term is required, it shall begin at least two weeks after the end of the second term, but shall begin no earlier than 15 June, and shall be completed by 15 July. All trapping shall be conducted during appropriate weather conditions, avoiding

periods of high wind, precipitation, and low temperatures (<50°F or 10°C). *Dr. Leitner has established a regional trapping method where a single grid is trapped for five consecutive days. As such, most of the above description (e.g., three trapping sessions per grid) does not apply to the current effort. Also, we did not stop trapping when MGS were captured, as we were interested in studying demographics, reproductive status, and genetics. As such, tissue samples were collected from most of the animals and given to Dr. Marjorie Matocq for genetics analysis.*

6. For projects requiring two or more sampling grids, capture of a Mohave ground squirrel on any grid will establish presence of the species on the project site. Trapping may be stopped on all grids on the project site at that time. For linear projects, very large project sites, project sites characterized by fragmented or highly-heterogeneous habitats, or in other special circumstances, continued trapping may be necessary. *Not applicable.*

7. A maximum 100 traps shall be operated by each qualified biologist. Each trap shall be covered with a cardboard A-frame or equivalent non-metal shelter to provide shade. Trap and shelter orientation shall be on a north-south axis. All traps shall be opened within one hour of sunrise and may be closed beginning one hour before sunset. Traps shall be checked at least once every four hours to minimize heat stress to captured animals. When traps are open, temperature shall be measured at a location within the sampling grid, in the shade, and one foot (approx. 0.3 meters) above the ground at least once every hour. Traps shall be closed when the ambient air temperature at one foot above the ground in the shade exceeds 90°F (32°C). Trapping shall resume on the same day after the ambient temperature at one foot (approx. 0.3 meters) above the ground in the shade falls to 90°F (32°C) and shall continue until one hour before sunset. Suggested baits are mixed grains, rolled oats, or bird seed, with a small amount of peanut butter. *Most of these prescriptions were followed as given, including the number of traps, use of shade structures, trap orientation, bait type, and closing traps both due to rain and elevated temperatures.*

8. A qualified biologist shall complete the Survey and Trapping Form, which is found on page 5 of these guidelines. This biologist, or the lead agency for the project, shall submit the completed form to the appropriate Department [CDFW] office (see page 4) with the biological report on the project site. *The current report is being prepared in lieu of a specific form.*

9. The Department [CDFW] may allow variation on these guidelines, with the advance written approval of the appropriate regional habitat conservation planning office (see page 4). Such variations could include biologically-appropriate modification of the trapping dates or changes in grid configuration that would enhance the probability of detecting Mohave ground squirrels. Any variation which concerns trapping or marking methods must be incorporated into the MOU or permit that authorizes the work. *These types of changes are reflected in this subsection.*

10. If a survey conducted according to these guidelines results in no capture or observation of the Mohave ground squirrel on a project site, this is not necessarily evidence that the Mohave ground squirrel does not exist on the site or that the site is not actual or potential habitat of the species. However, in the circumstance of such a negative result, the Department [CDFW] will stipulate that the project site harbors no Mohave ground squirrels. This stipulation will expire one year from the ending date of the last trapping on the project site conducted according to these guidelines. *Not applicable, as these sites are NOT intended for development.*

2.2. Project Specific Methods. The specific grid line configurations and locations are shown in Figures 4 through 14. Although not required by CDFW methods, we marked most squirrels with a felt-tipped marker. Marking Mohave ground squirrels was particularly important so we would not mistakenly collect more than one tissue sample from a given squirrel. Data for all trapped squirrels (and other species) were recorded at the station where they were caught, measurements taken (i.e., weight, sex, reproductive, and capture statuses for squirrels), and then released. Abbreviations used in the results tables for each species captured are defined following Table 3.

LaRue collected other biological baseline data deemed to be useful along most of the 11 grids. These data included a cumulative list of plants observed during the study, which are listed in Appendix B. For special status species and their signs, a description was recorded and UTM coordinates (NAD 83) were collected for each occurrence. Given their ecological importance to Mohave ground squirrel, the numbers of winterfat and spiny hopsage plants observed within 5 meters (16 feet) either side of each grid were also recorded.

Except for Grids 2, 3, 4, and 5 where observable human disturbances were not tallied, LaRue tallied disturbances found within approximately 5 meters either side of the other 7 grid lines. The results of this method provide *encounter rates* for observable human disturbances. For example, if a single motorcycle trail was observed three times along a given grid line, it would be tallied three times (this relieves the observer from interpreting the same versus different impacts). The intent of this exercise is to quantify observable human uses on each grid so that comparisons may be made to determine relative levels of impacts among the grids sampled.

3.0. RESULTS

3.1. Results of Individual Grids. The next page summarizes the cumulative findings of this study, with grid-specific information given in the tables and figures following Figure 3. The results are reported for each of the 11 grids including dates of trapping; times when the first trap was opened and the last trap was closed with the total number of trapping hours given in parenthesis (except for Grid 10 with 88 traps, all grids had 100 traps); the numbers of antelope ground squirrels (AGS) and MGS trapped on each grid; other species trapped (see abbreviations following Table 3); and weather data collected at the beginning and ending of each day.

Using the CDFW's BIOS website, which includes a detailed vegetation community map (https://www.wildlife.ca.gov/Data/VegCAMP/Reports-and-Maps), we found that there are three main plant communities in the Bowling Alley associated with the 11 grids, including creosote bush scrub (*Larrea tridentata – Ambrosia dumosa* Alliance), saltbush scrub (*Atriplex spinifera* Alliance), and burrobush scrub (*Ambrosia dumosa* Alliance). There are several minor communities mapped (e.g., *Krascheninnikovia lanata* Alliance or winterfat scrub and small playas), but none of these occurred along the grids. The prevailing pattern includes areas of creosote bush scrub and saltbush scrub separated by burrobush scrub. Burrobush scrub tends to occur in bands between the other two communities (except for Grids 3 and 4, where it is the main community) and to be interspersed with saltbush scrub more so than creosote bush scrub.

The BIOS website was used to determine the dark green lines for creosote bush scrub, gray lines for burrobush scrub, and blue lines for saltbush scrub in Figures 4 through 14. The cumulative grid length of the 11 grids was 36,255 meters (22.5 miles). Using the BIOS website to determine the linear distances of each transect within each of the three plant communities, we found in descending order of prevalence that creosote bush scrub occupied 18,775 linear meters (52%), saltbush scrub occupied 9,770 linear meters (27%), and burrobush scrub occupied 7,710 linear meters (21%).

BOWLING ALLEY RESULTS FOR ALL 11 GRIDS

Table 2. Cumulative Results for 2016 Studies in the Bowling Alley

Grid #	MGS	Plant Community	Perennial Diversity	Other Rare Resources	Hopsage Winterfat Counts	Prevalence of Disturbances
1	**1 adult**	69% creosote bush 26% saltbush 5% burrobush	13 species = High	Tortoise, Swainson's hawk, LeConte's thrasher, Vaux's swift, American badger, Creosote rings	49 hopsage 727 winterfat	13 OHV tracks, 1 dirt road, 1 rifle shell. Sheep = moderate-to-heavy/fresh
2	**0**	89% saltbush 11% burrobush	5 species = Low*	None observed	43 hopsage 288 winterfat	Not counted. Sheep = Moderate/older
3	**0**	61% burrobush 39% saltbush	9 species = Moderate	LeConte's thrasher	171 hopsage 175 winterfat	Not counted. Sheep = Moderate/older
4	**0**	57% burrobush 43% saltbush	9 species = Moderate	Desert cymopterus, LeConte's thrasher, loggerhead shrike	293 hopsage 341 winterfat	Not counted. Sheep = Heavy/older
5	**1 adult**	57% burrobush 32% creosote bush 11% saltbush	12 species = High	Tortoise, Northern harrier, LeConte's thrasher, Loggerhead shrike, Creosote rings	308 hopsage 510 winterfat	Not counted. Sheep = Moderate/older
6	**1 juvenile**	76% creosote bush 13% saltbush 11% burrobush	15 species = High	Tortoise, LeConte's thrasher, Loggerhead shrike, Burrowing owl, American badger, Creosote rings	114 hopsage 294 winterfat	10 OHV, 5 dirt roads, 2 pieces litter. Sheep = Light/recent
7	**0**	40% creosote bush 34% saltbush 26% saltbush	18 species = High	Tortoise, Swainson's hawk, LeConte's thrasher, Burrowing owl, American badger, Creosote rings	121 hopsage 178 winterfat	12 OHV tracks, 5 dirt roads. Sheep = Moderate/older
8	**0**	73% creosote bush 22% saltbush 5% burrobush	16 species = High	Tortoise, Swainson's hawk, American badger, Creosote rings	129 hopsage 136 winterfat	15 OHV, 2 dirt roads, 1 paved road. Sheep = Moderate/older
9	**1 adult 5 juveniles**	100% creosote bush	9 species = Moderate	American badger, Creosote rings	14 hopsage 2 winterfat	5 OHV, 4 dirt roads, 1 target, 1 tire, 1 litter. Sheep = Heavy/recent
10	**1 adult**	82% creosote bush 18% saltbush	11 species = Moderate	Tortoise, American badger, Creosote rings	6 hopsage 13 winterfat	15 mine pits, 3 roads, 2 OHV, 2 pieces of litter. Sheep = Moderate/recent
11	**3 juveniles**	100% creosote bush	10 species = Moderate	Tortoise, Loggerhead shrike, American badger, Creosote rings	2 hopsage 0 winterfat	6 OHV tracks, 4 dirt roads, 2 mine pits, 1 litter. Sheep = Light/older
	13 = 4 adult 9 juveniles	**52% creosote bush 27% saltbush 21% burrobush**	**5 to 18**	**10 Special Status Species**	**2 ↑ 308 hopsage 0 ↑ 727 winterfat**	

*The low species diversity reported for Grid 2 is more likely due to undercounts by the observers than low diversity; this was the only grid on which LaRue did not record perennial species.

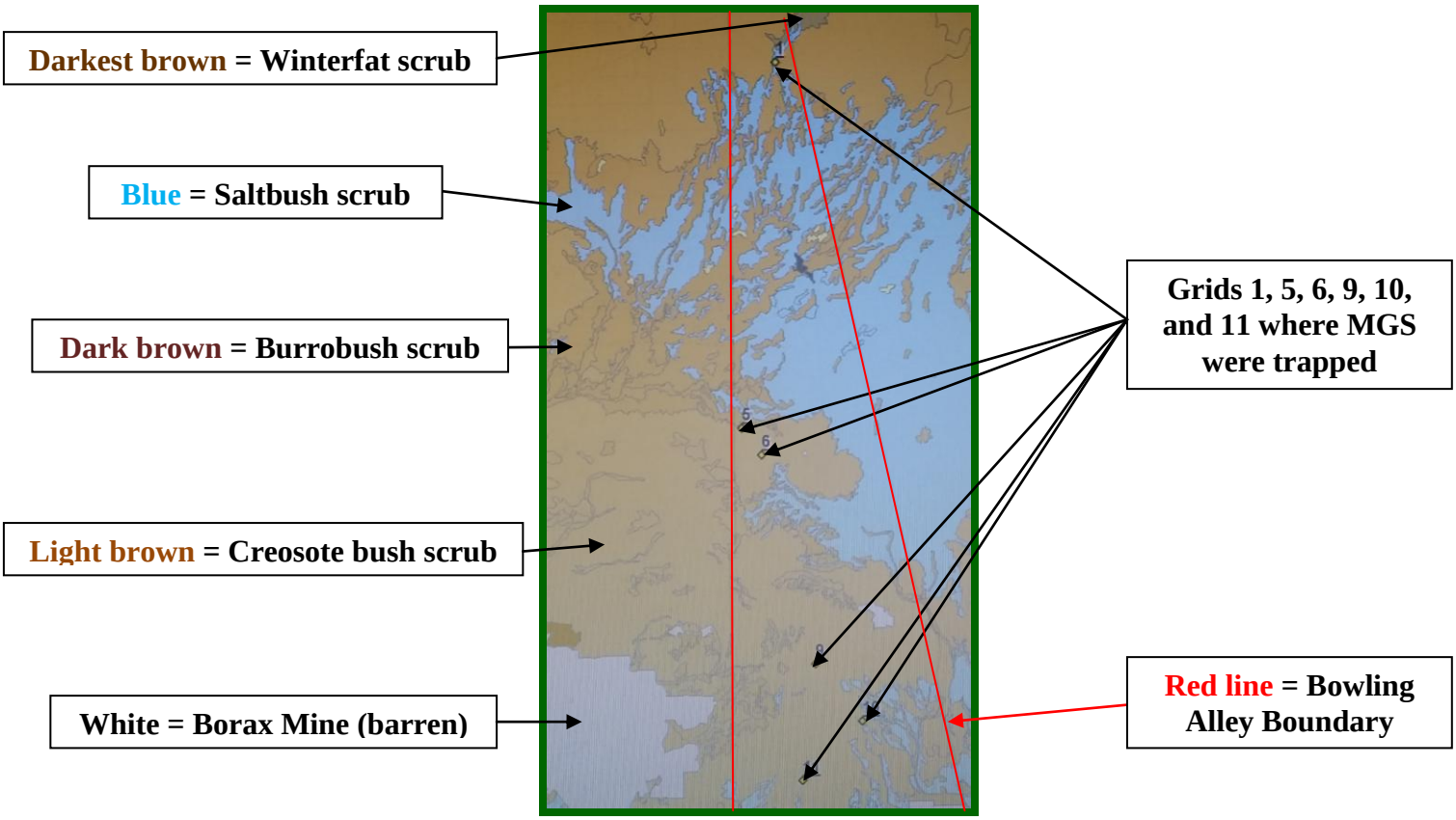


Figure 3. Distribution of the Three Main Plant Communities in the Bowling Alley

The prevalence and distribution of these plant communities is likely determined by elevation, substrates, and soil alkalinity. Grids 6, 7, and 8, which are mostly vegetated by creosote bush scrub, are found in a series of low, unnamed hills near the center of the Bowling Alley, where elevations range from about 3,000 feet (914 meters) down to 2,795 feet (852 meters) to the east. Elevations associated with creosote bush scrub communities to the south range from a high of 3,042 feet (927 meters) on Saddleback Mountain down to 2,500 feet (762 meters) near the Boron Airstrip shown in Figure 3. For comparison, saltbush scrub communities were found between 2,895 feet (882 meters) to the far north down to 2,455 feet (748 meters) a half mile north of Kramer Junction.

By plotting the 13 MGS UTM coordinates on the vegetation map in Figure 3, we found that 11 of the 13 MGS (on Grids 5, 6, 9, and 11) were in creosote bush scrub and 2 of the 13 MGS (Grids 1 and 10) were in saltbush scrub. It may be noteworthy that both of the MGS captured in saltbush scrub were adults. Figures D1 through D5 in Appendix D show enlargements of the vegetation map in Figure 3 and the GPS-based locations of the MGS captured on the six grids.

Substrates throughout the Bowling Alley range from being relatively sandy in saltbush scrub and level areas (demonstrated by the presence of desert cymopterus on Grid 4) to being rocky with boulder outcrops on the central hills and areas associated with Saddleback Mountain. As such, substrates throughout the Bowling Alley are considered to be ideally suitable for MGS.

GRID 1

Table 3. Results for Grid 1									
DATE 2016	*TIME	**TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS^	***Other	AM	PM	**AM	PM
5/5 (100 traps)	0615	52°F	17 (12♂, 4♀, 1?)	0	1 RERA	60%	25%	10-15	25-30
	1930 (1,225)	67°F							
5/6 (100 traps)	0730	49°F	29 (17♂, 12♀)	1^	2 RERA	15%	40%	0-5	20-25
	1845 (1,125)	66°F							
5/7 (100 traps)	0730	50°F	31 (12♂, 16♀, 3?)	0	0	10%	100%	0-5	15-20
	1900 (1,150)	64°F							
5/8 (100 traps)	0700	52°F	38 (22♂, 14♀, 2?)	1^	0	40%	15%	0-5	15-20
	1900 (1,200)	69°F							
5/9 (100 traps)	0615	53°F	14 (9♂, 4♀, 1?)	1^	0	0%	0%	0-5	5-10
	1630 (1,025)	85°F							
100 Traps	**5,725 hours**	**49-85°F**	**129 (72♂, 50♀, 7?)**	**1 adult 3x^**	**3 RERA**	**0-60%**	**0-100%**	**0-15 mph**	**5-30 mph**

^- The same male MGS was captured three times: May 6, 8, and 9, 2016.
*- The upper times given in column 2 are when the first trap was opened each day; the lower times indicate when the last trap was closed each day; and the parenthetical numbers indicate the number of trap hours for that day (= closing time minus opening time multiplied by 100 traps = Trap hours).

**- Air temperatures measured 12" above the ground in new shade and maximum wind speeds were measured by a hand-held Kestrel® device at the indicated times.

***- Abbreviations for all animals trapped given in the 6th columns include:
AGS = Antelope ground squirrel (*Ammospermophilus leucurus*)
MGS = Mohave ground squirrel (*Xerospermophilus mohavensis*) highlighted in blue when trapped
POMO = Unidentified pocket mouse (*Perognathus* sp.)
RERA = Red racer (*Masticophis flagellum piceus*)

Habitat Description: The 3,450-meter grid is vegetated by creosote bush scrub (2,385 meters), saltbush scrub (880 meters), and burrobush scrub (185 meters) (see Figure 4). With 13 perennial species observed, the grid has a relatively high level of perennial diversity.

Dominant perennials: Creosote bush, burrobush, and winterfat are the dominant perennial species (see Appendix C for scientific names; observed plants given "1" in the left margin).

Other: Two types of spiny saltbush, spiny hopsage, peach thorn, Anderson's boxthorn, desert goldenhead, desert aster, cheesebush, Cooper's goldenbush, and cottonthorn are subdominants.

Spiny Hopsage & Winterfat: 49 spiny hopsage and 727 winterfat plants.

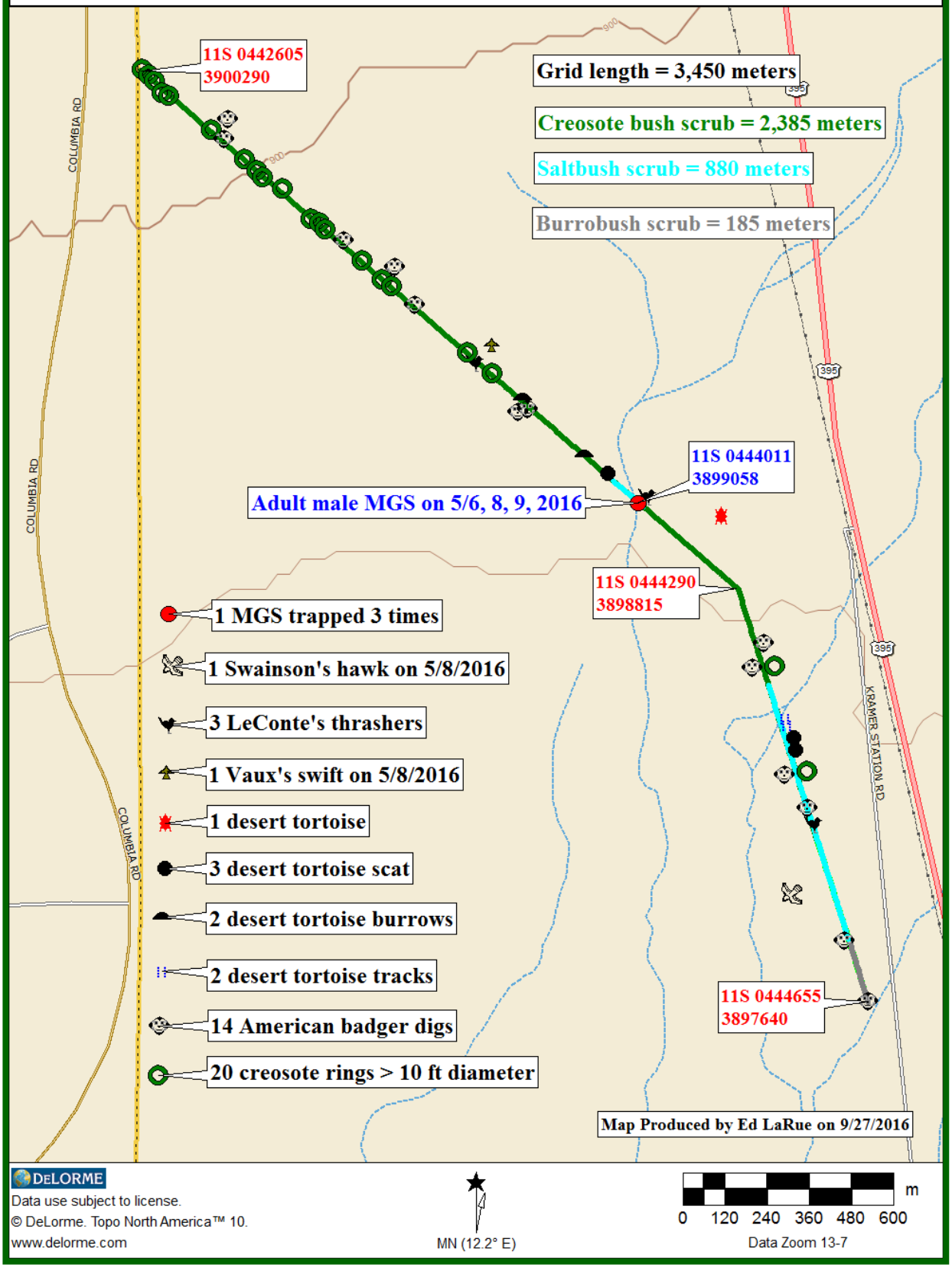
Observable human disturbances: 13 off-highway vehicle (OHV) tracks, 1 motorcycle trail, 1 rifle cartridge. There was fresh, moderate to heavy sheep scat over 2/3 of the grid.

Land form: Desert plain. **Soil type:** Sandy loam.

Slope: 0 to 3%. **Aspect:** South and east on northern parts of grid.

Elevational range: 906 meters (2,973 feet) at the north end of the grid down to 870 meters (2,854 feet) at the south end of the grid.

Figure 4. Grid 1: Locations of Special Status Resources



GRID 2

Table 4. Results for Grid 2									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
5/5 (100 traps)	1045	70°F	3 (2♂, 1♀)	0	0	2%	2%	15-20	15-20
	1745 (700)	63°F							
5/6 (100 traps)	0830	57°F	7 (2♂, 5♀)	0	1 (not recorded)	5%	20%	10-15	10-15
	1430 (600)	64°F							
5/7 (100 traps)	0830	61°F	12 (3♂, 8♀,1?)	0	0	2%	80%	10-15	10-15
	1815 (975)	67°F							
5/8 (100 traps)	0900	62°F	23 (12♂,10♀,1?)	0	0	10%	5%	0-5	15-20
	1700 (800)	82°F							
5/9 (100 traps)	0830	65°F	14 (5♂, 9♀)	0	0	0%	0%	0-5	5-10
	1200 (350)	77°F							
100 Traps	**3,425 hours**	**57-82°F**	**59 (24♂, 33♀, 2?)**	**0**	**1**	**0-10%**	**0-80%**	**0-20 mph**	**5-20 mph**

Habitat Description: The 3,420-meter grid is mostly vegetated by saltbush scrub (3,030 meters) with stretches of burrobush scrub (390 meters) (see Figure 5). With five perennial shrub, grass, and succulent species observed, the grid has a relatively low level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "2" in the left margin.

Dominant perennials: Spiny saltbush (*Atriplex spinifera*) and burrobush.

Other: Cooper's goldenbush, cheesebush, spiny hopsage, and winterfat.

Spiny Hopsage & Winterfat: 43 spiny hopsage and 288 winterfat plants.

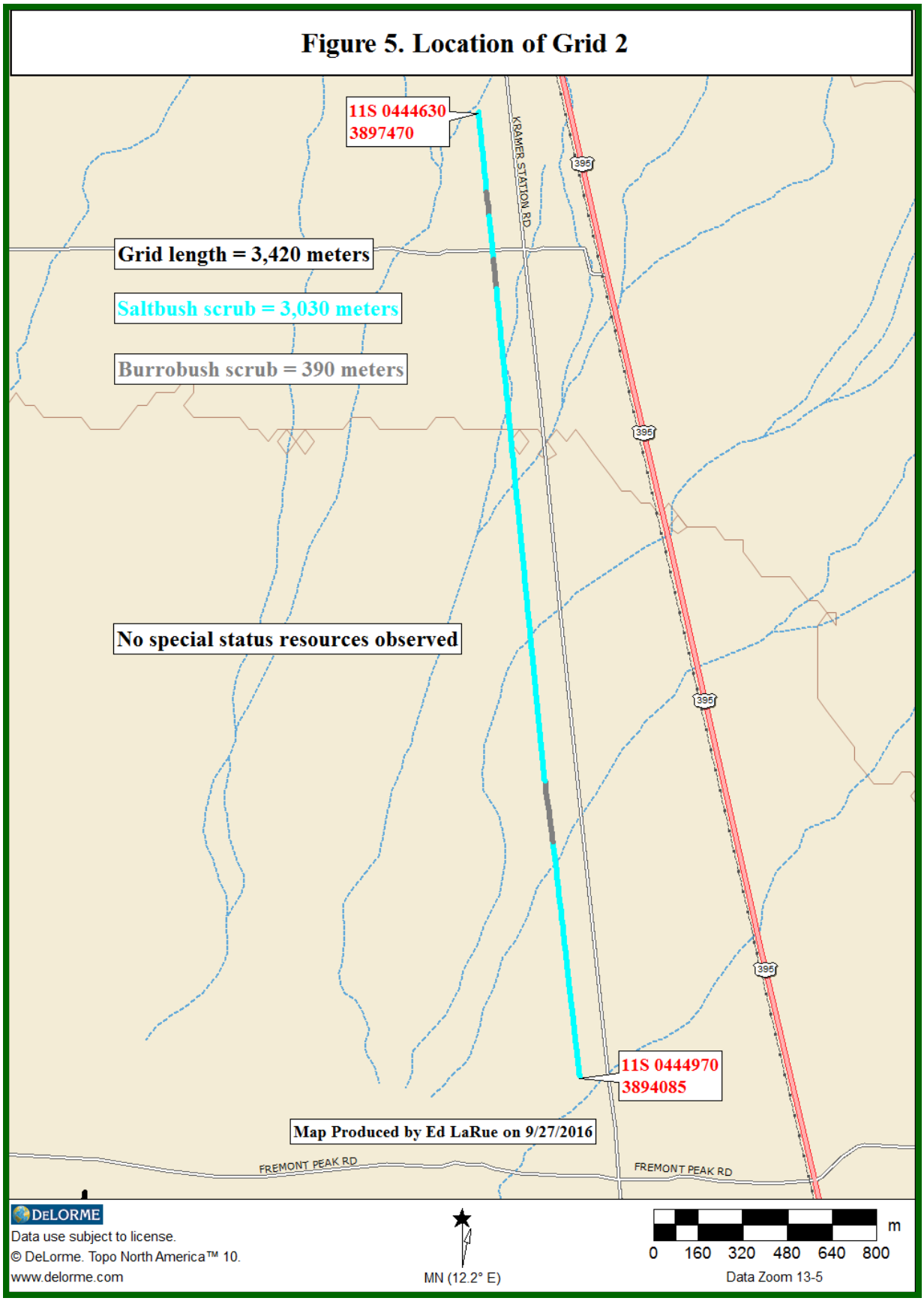
Observable human disturbances: Human disturbances were not tallied in the field but are similar to adjacent grids. Moderate, older sheep scat observed throughout.

Land form: Desert plain. **Soil type:** Sandy loam.

Slope: 0%. **Aspect:** None.

Elevational range: 869 meters (2,850 feet) at the north end down to 848 meters (2,782 feet) at the south end of the grid.

Figure 5. Location of Grid 2



GRID 3

Table 5. Results for Grid 3									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
3/8 (100 traps)	0900	48°F	5 (1♂, 4♀)	0	0	0%	10% (rain on 7th)	0-5	0-5
	1700 (800)	63°F							
3/9 (100 traps)	0845	55°F	6 (3♂, 3♀)	0	0	2%	80%	0-5	0-5
	1730 (875)	69°F							
3/10 (100 traps)	0815	61°F	13 (2♂, 10♀, 1?)	0	0	2%	80%	0-5	0-5
	1800 (975)	77°F							
3/11 (100 traps)	0815	62°F	7 (2♂, 4♀, 1?)	0	0	75%	95% (rain)	0-5	20-25
	1515 (700)	61°F							
3/12 (100 traps)	0800	46°F	6 (3♂, 3?)	0	0	0%	5%	10-15	0-25
	1345 (575)	63°F							
100 Traps	**3,925 hours**	**46-77°F**	**37 (12♂, 19♀, 6?)**	**0**	**0**	**0-75%**	**5-95%**	**0-15 mph**	**0-25 mph**

Habitat Description: The 3,240-meter grid is vegetated by burrobush scrub (1,980 meters) and saltbush scrub (1,260 meters) (see Figure 6). With nine perennial shrub, grass, and succulent species observed, the grid has a moderate level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "3" in the left margin.

Dominant perennials: Spiny saltbush (*Atriplex spinifera*) and Cooper's goldenbush.

Other: Burrobush, Anderson's boxthorn, needlegrass, peach thorn, allscale, and cottonthorn.

Spiny Hopsage & Winterfat: 171 spiny hopsage and 175 winterfat plants.

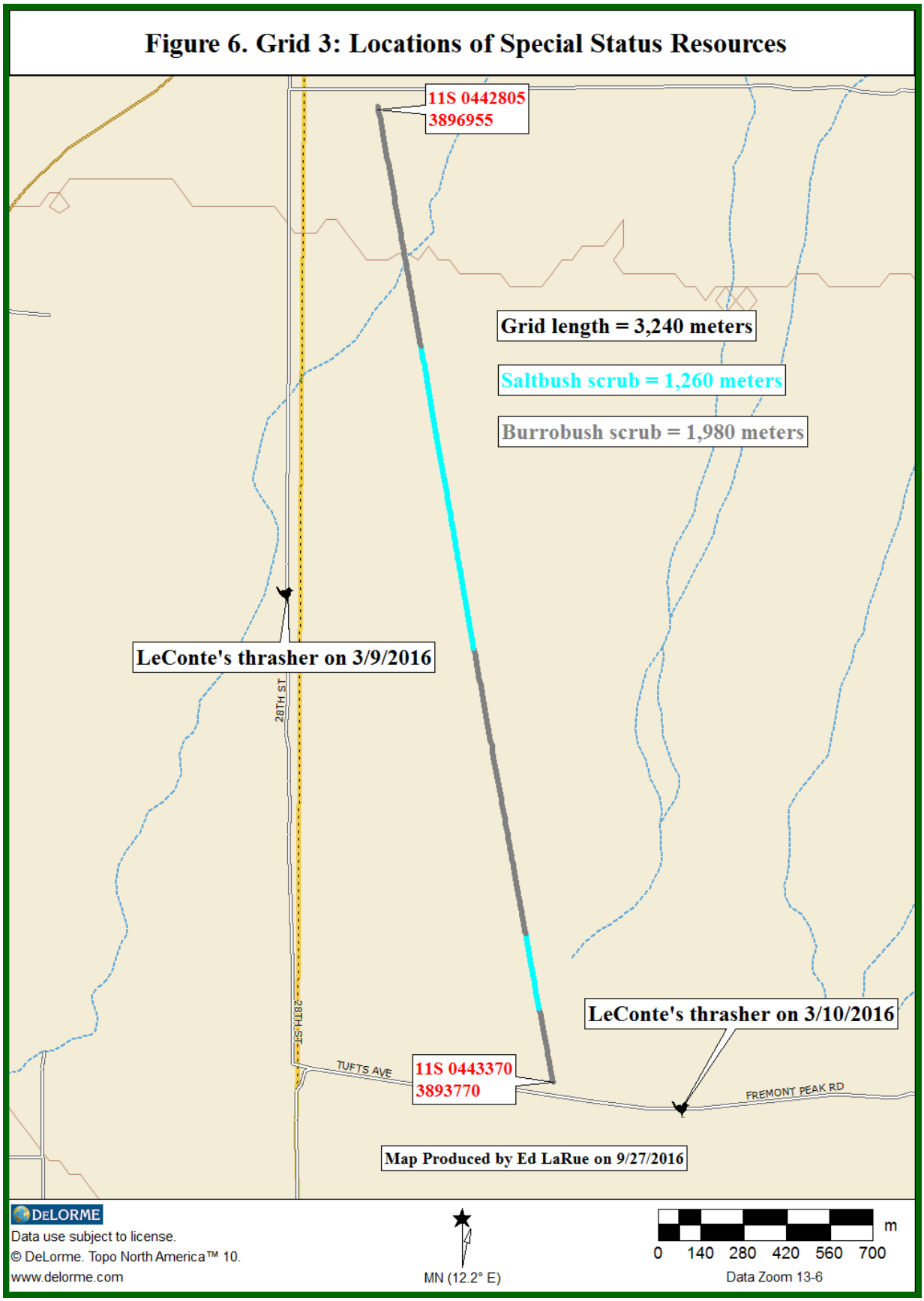
Observable human disturbances: Human disturbances were not tallied in the field but are similar to adjacent grids. Moderate, older sheep grazing observed throughout.

Land form: Desert plain with slight hills. **Soil type:** Sandy loam.

Slope: 0-1%. **Aspect:** Slight southern aspect.

Elevational range: 864 meters (2,835 feet) at the north end down to 845 meters (2,772 feet) at the south end of the transect.

Figure 6. Grid 3: Locations of Special Status Resources



GRID 4

Table 6. Results for Grid 4									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
3/8 (100 traps)	0900	48°F	4 (2♂, 2♀)	0	0	0%	5% (rain on 7th)	0-5	0-5
	1700 (800)	63°F							
3/9 (100 traps)	0845	55°F	5 (3♂, 2♀)	0	0	2%	80%	0-5	0-5
	1730 (875)	69°F							
3/10 (100 traps)	0815	61°F	7 (4♂, 2♀, 1?)	0	0	2%	20%	0-5	5-10
	1730 (875)	77°F							
3/11 (100 traps)	0815	58°F	6 (2♂, 4♀)	0	0	90%	100% (rain)	0-5	25-30
	1515 (700)	61°F							
3/12 (100 traps)	0800	46°F	6 (3♂, 3?)	0	0	0%	5%	10-15	0-25
	1345 (575)	63°F							
100 Traps	**3,825 hours**	**46-77°F**	**28 (12♂, 19♀, 6?)**	**0**	**0**	**0-90%**	**5-100%**	**0-15 mph**	**0-25 mph**

Habitat Description: The 3,200-meter grid is vegetated by saltbush scrub (1,375 meters) and burrobush scrub (1,825 meters) (see Figure 7). With nine perennial shrub, grass, and succulent species observed, the grid has a moderate level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "4" in the left margin.

Dominant perennials: Spiny saltbush (*Atriplex spinifera*), burrobush, winterfat, spiny hopsage, and Cooper's goldenbush (in places).

Other: Anderson's boxthorn, budsage, cottonthorn, needlegrass, cheesebush, and desert goldenhead.

Spiny Hopsage & Winterfat: 298 spiny hopsage and 341 winterfat plants.

Observable human disturbances: Human disturbances were not tallied in the field but are similar to adjacent grids. Older scat of relatively heavy sheep grazing and semi-barren bedding area observed near north end.

Land form: Desert plan with several low hills.

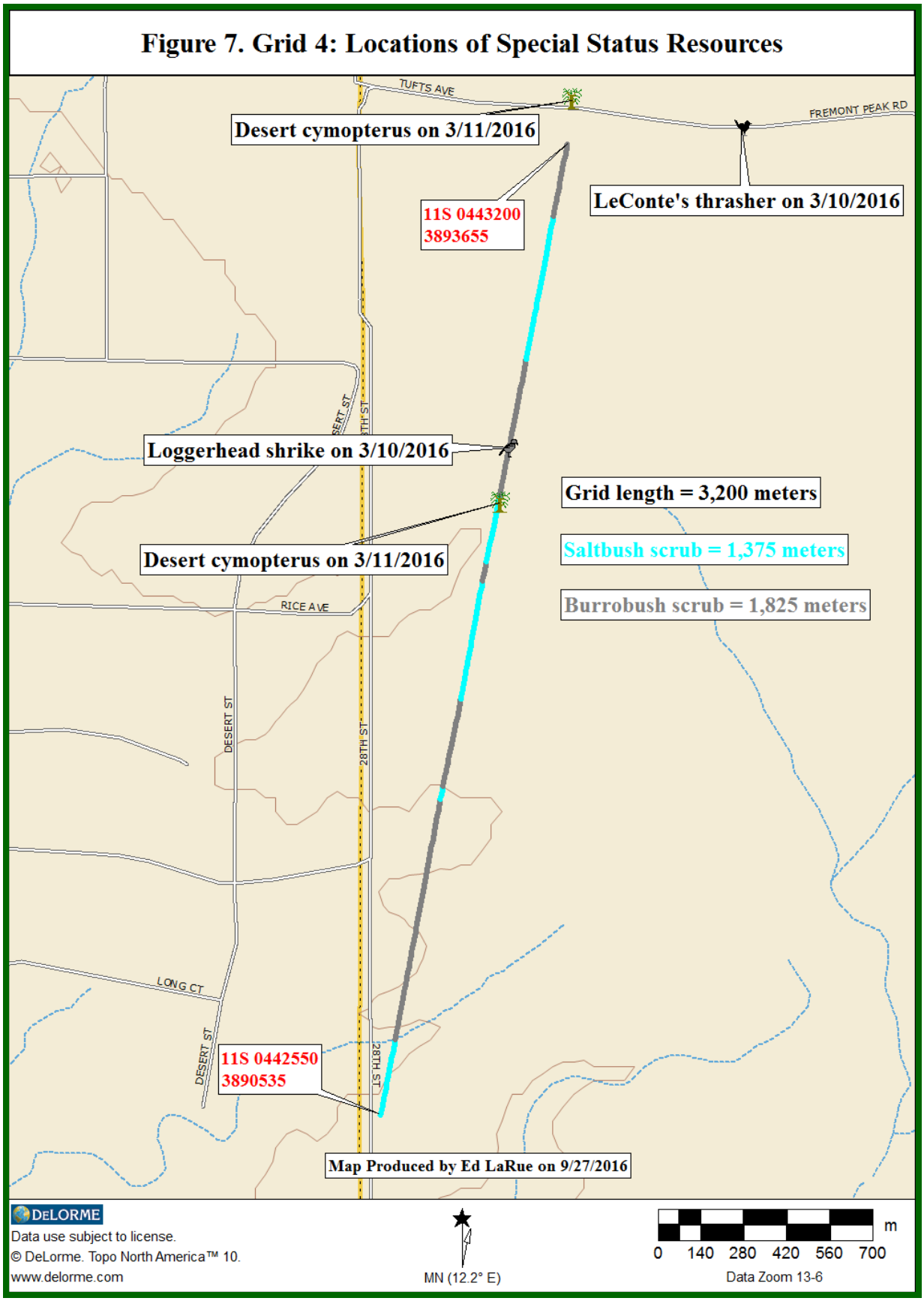
Soil type: Sandy to rocky.

Slope: 0 to 5%.

Aspect: Mostly none and variable.

Elevational range: 845 meters (2,773 feet) at the north end down to 841 meters (2,761 feet) at the south end of the grid.

Figure 7. Grid 4: Locations of Special Status Resources



GRID 5

Table 7. Results for Grid 5									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
3/9 (100 traps)	1115	70°F	1 (1?)	0	0	-	100%	-	0-5
	1745 (650)	77°F							
3/10 (100 traps)	0830	61°F	10 (6♂, 3♀, 1?)	0	0	0%	20%	Calm	5-10
	1730 (900)	78°F							
3/11 (100 traps)	0815	61°F	6 (1♂, 5♀)	0	0	75%	95%	0-5	20-25
	1515 (700)	61°F							
3/12 (100 traps)	0800	46°F	9 (5♂, 3♀, 1?)	0	0	0%	5%	10-15	5-10
	1345 (575)	60°F							
3/14 (100 traps)	1215	65°F	6 (4♂, 2♀)	0	0	75%	90%	0-5	5-10
	1815 (600)	69°F							
3/15 (100 traps)	0800	45°F	23 (13♂, 9♀, 1?)	1	1 POMO	75%	50%	Calm	Calm
	1845 (1,075)	74°F							
3/16 (100 traps)	0730	43°F	15 (11♂, 4♀)	0	0	10%	5%	Calm	Calm
	1730 (1,000)	73°F							
100 Traps	**5,500 hrs**	**43-78°F**	**70 (40♂, 26♀, 4?)**	**1 adult**	**1 POMO**	**0-75%**	**5-100%**	**0-15 mph**	**0-25 mph**

Habitat Description: The 3,400-meter grid is vegetated by burrobush scrub (1,935 meters), creosote bush scrub (1,100 meters) to the south, and saltbush scrub (365 meters) in the middle (see Figure 8). With 12 perennial shrub, grass, and succulent species observed, the grid has a relatively high level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "5" in the left margin.

Dominant perennials: Spiny saltbush (*Atriplex spinifera*), winterfat, and spiny hopsage to the north; creosote bush and burrobush to the south.

Other: Cooper's goldenbush, cheesebush, Anderson's boxthorn, Mojave aster, cottonthorn, needlegrass, peach thorn, spiny saltbush (*Atriplex confertifolia*), and desert goldenhead.

Spiny Hopsage & Winterfat: 308 hopsage and 510 winterfat plants.

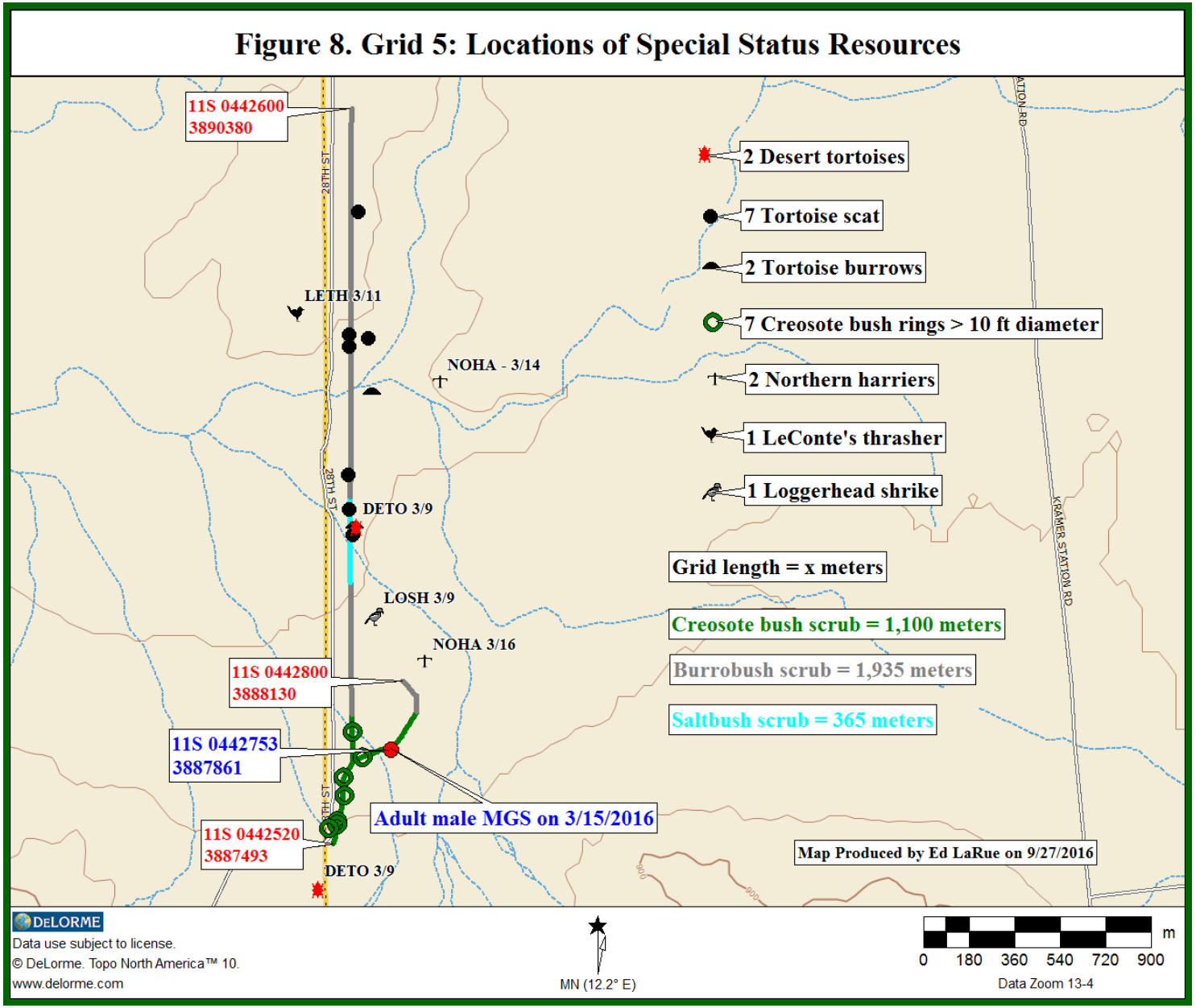
Observable human disturbances: Human disturbances were not tallied in the field but are similar to adjacent grids. Moderate, older sheep scat found throughout.

Land form: Desert plain with a few small hills to the south. **Soil type:** Sandy loam to rocky.

Slope: 0 to 15%. **Aspect:** None to the north; north on southern parts of grid.

Elevational range: 860 meters (2,823 feet) at the south end down to 844 meters (2,769 feet) at the north end of the grid.

Figure 8. Grid 5: Locations of Special Status Resources



GRID 6

Table 8. Results for Grid 6									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
6/13 (100 traps)	0630	59°F	22 (11♂, 11♀)	0	0	0%	2%	0-5	0-5
	1330 (700)	88°F							
6/14 (100 traps)	0600	60°F	47 (20♂, 27♀)	0	0	0%	0%	10-15	10-15
	1445 (875)	90°F							
6/15 (100 traps)	0545	57°F	76 (36♂, 38♀, 2?)	0	0	0%	0%	5-10	20-25
	1645 (1,100)	82°F							
6/16 (100 traps)	0545	51°F	68 (34♂, 31♀, 3?)	0	0	0%	0%	0-5	15-20
	1615 (1,050)	87°F							
6/17 (100 traps)	0545	54°F	52 (22♂, 30♀)	1	2 POMO	0%	0%	0-5	0-5
	1400 (775)	87°F							
100 Traps	**4,500 hours**	**51-90°F**	**265 (117♂, 126♀, 5?)**	**1 juvenile**	**2 POMO**	**0%**	**0-2%**	**0-15 mph**	**0-25 mph**

Habitat Description: The 2,800-meter grid is mostly vegetated by creosote bush scrub (2,120 meters), by saltbush scrub at the north and south ends (360 meters), with burrobush scrub in between (320 meters) (see Figure 9). With 15 perennial shrub, grass, and succulent species observed, the grid has a relatively high level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "6" in the left margin.

Dominant perennials: Creosote bush, burrobush, spiny saltbush (*Atriplex confertifolia*), and Anderson's boxthorn.

Other: Cheesebush, allscale, spiny saltbush (*Atriplex spinifera*), desert needlegrass, Cooper's goldenbush, bush peppergrass, desert aster, cottonthorn, silver cholla, and beavertail cactus.

Spiny Hopsage & Winterfat: 114 spiny hopsage and 294 winterfat plants.

Observable human disturbances: 10 OHV tracks, 5 roads, and 2 pieces of litter. Recent, light sheep grazing to the far south; old sheep scat throughout but not common.

Land form: Plain to low, rolling hills.

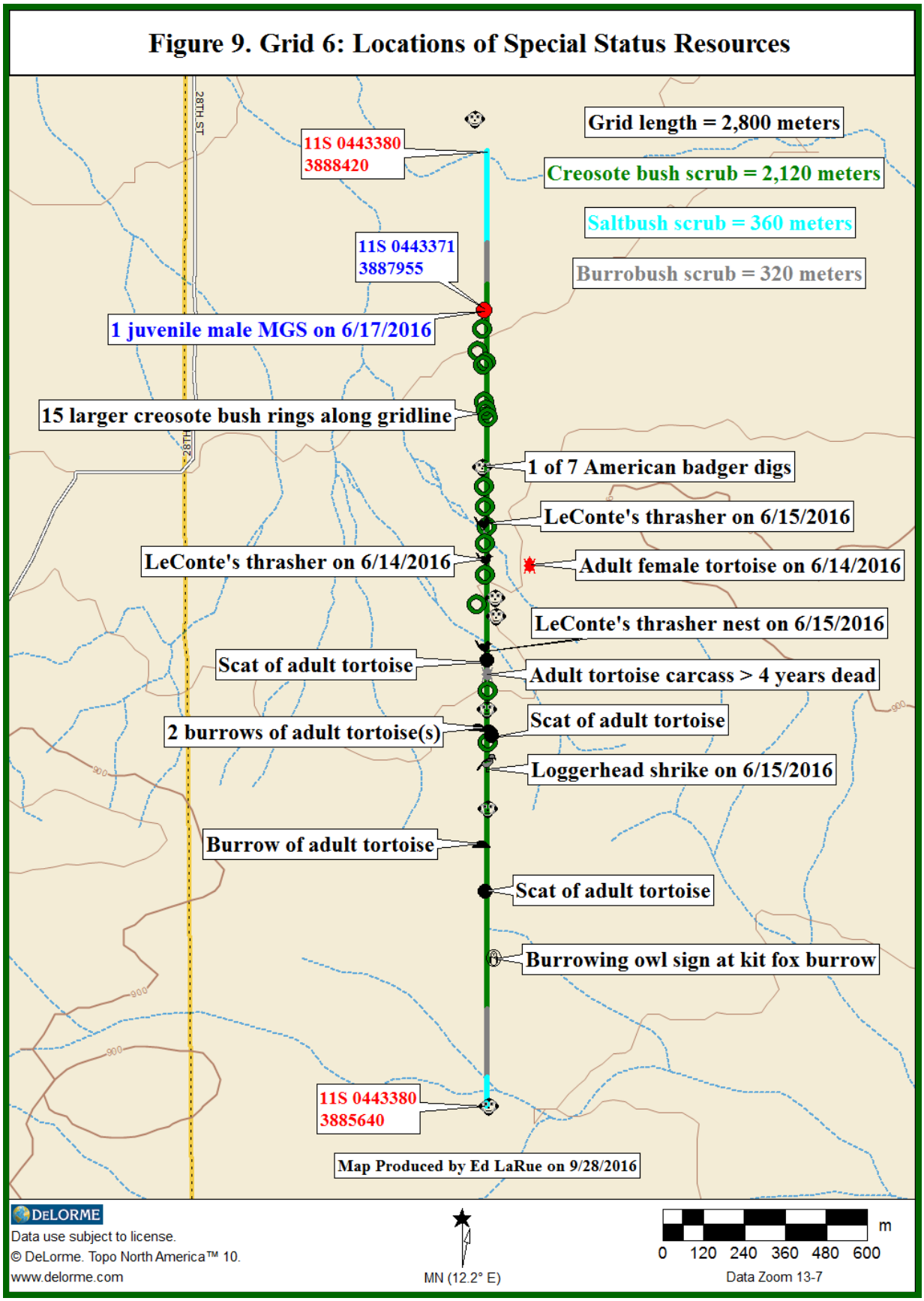
Soil type: Sandy loam to rocky.

Slope: 0 to 10%.

Aspect: Variable near the center of the grid.

Elevational range: 882 meters (2,894 feet) at the north end down to 850 meters (2,789 feet) at the south end of the grid.

Figure 9. Grid 6: Locations of Special Status Resources



GRID 7

Table 9. Results for Grid 7									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
4/4 (100 traps)	0715	55°F	2 (1♀, 1?)	0	0	0%	2%	0-5	10-15
	1815 (1,100)	81°F							
4/5 (100 traps)	0630	47°F	2 (1♂, 1♀)	0	0	0%	0%	Calm	0-5
	1915 (1,175)	82°F							
4/6 (100 traps)	0645	51°F	3 (2♂, 1♀)	0	0	10%	100%	0-5	0-5
	1915 (1,250)	83°F							
4/7 (100 traps)	0645	61°F	3 (2♂, 1♀)	0	0	100%	100% (rain)	10-15	0-5
	1830 (1,175)	67°F							
4/8 (100 traps)	0700	56°F	1 (1♀)	0	0	100% (rain)	100% (rain)	0-5	5-10
	1245 (575)	72°F							
100 Traps	**5,275 hours**	**47-83°F**	**11 (5♂, 5♀, 1?)**	**0**	**0**	**0-100%**	**0-100%**	**0-15 mph**	**0-15 mph**

Habitat Description: The 3,490-meter grid is vegetated by creosote bush scrub (1,400 meters) to the north and south and saltbush scrub (1,190 meters), which is interspersed with burrobush scrub (900 meters) (see Figure 10). With 18 perennial shrub, grass, and succulent species observed, the grid has a relatively high level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "7" in the left margin.

Dominant perennials: Creosote bush, burrobush, and spiny saltbush (*Atriplex spinifera*).

Other: Cheesebush, cottonthorn, desert wishbone plant, spiny saltbush (*Atriplex confertifolia*), beavertail cactus, desert aster, Anderson's boxthorn, bush peppergrass, desert needlegrass, silver cholla, Cooper's goldenbush, and cottontop cactus.

Spiny Hopsage & Winterfat: 121 spiny hopsage and 178 winterfat plants.

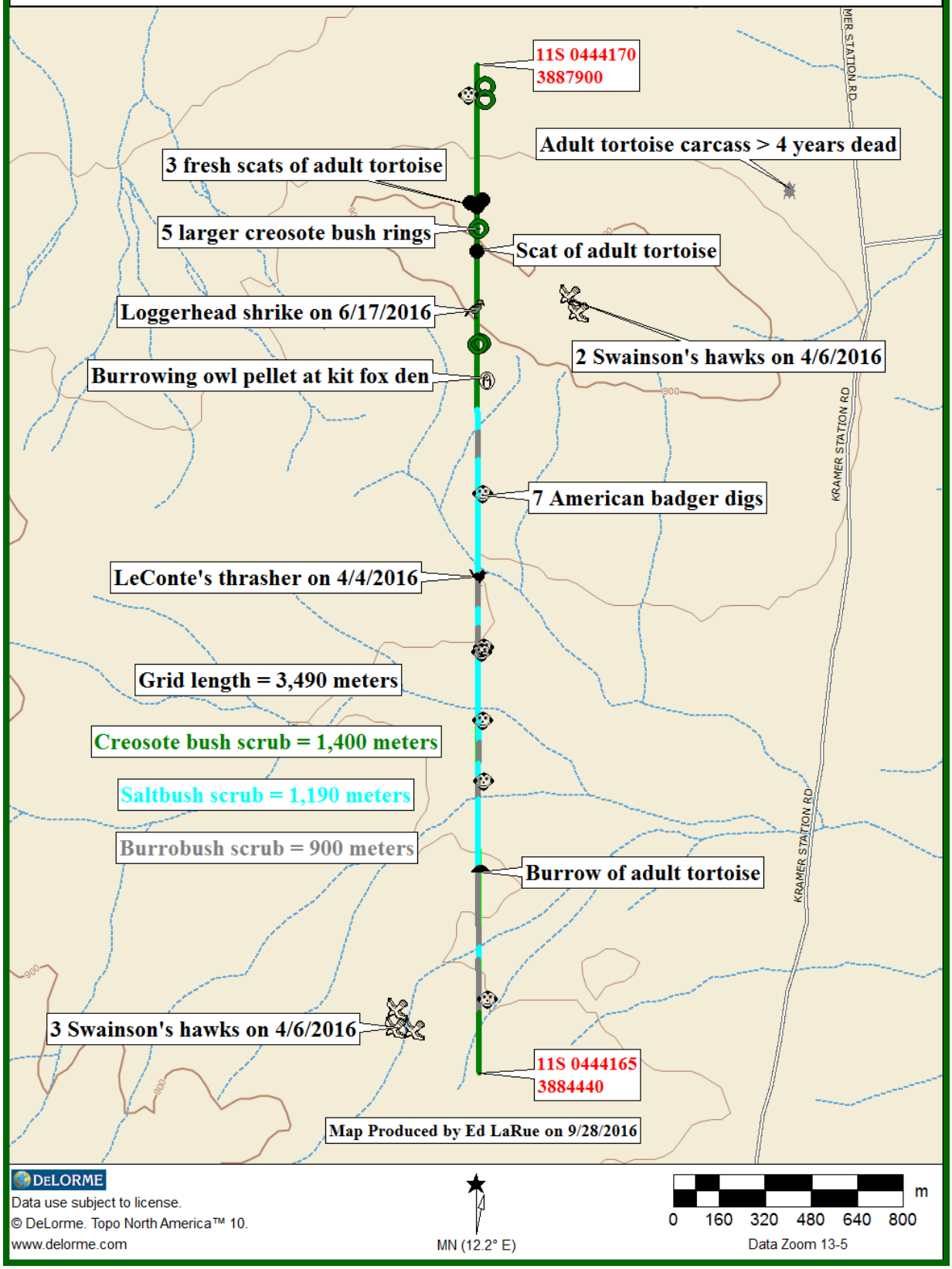
Observable human disturbances: 12 OHV tracks, 5 dirt roads, and moderate levels of older domestic sheet scat in the central, hilly area.

Land form: Desert plain to north and south with central hills. **Soil type:** Sandy to cobbly.

Slope: 0 to 15%. **Aspect:** Variable.

Elevational range: 884 meters (2,900 feet) at the south end down to 869 meters (2,851 feet) at the north end of the grid.

Figure 10. Grid 7: Locations of Special Status Resources



GRID 8

Table 10. Results for Grid 8									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS	MGS	Other	AM	PM	AM	PM
4/3 (100 traps)	0730	64°F	0	0	0	5%	50%	0	5-10
	1415 (675)	82°F							
4/4 (100 traps)	0715	55°F	6 (5♂, 1♀)	0	0	0%	2%	0-5	10-15
	1815 (1,100)	81°F							
4/5 (100 traps)	0630	47°F	3 (2♂, 1♀)	0	0	0%	0%	Calm	0-5
	1915 (1,175)	82°F							
4/6 (100 traps)	0645	51°F	6 (4♂, 1♀, 1?)	0	0	10%	100%	0-5	0-5
	1915 (1,250)	83°F							
4/7 (100 traps)	0645	61°F	6 (5♂, 1♀)	0	0	100%	100% (rain)	10-15	0-5
	1830 (1,175)	67°F							
4/8 (100 traps)	0700	56°F	1 (1♂)	0	1 POMO	100% (rain)	100% (rain)	0-5	5-10
	1245 (575)	72°F							
100 Traps	**5,950 hours**	**47-83°F**	**22 (17♂, 4♀, 1?)**	**0**	**1 POMO**	**0-100%**	**0-100%**	**0-15 mph**	**0-15 mph**

Habitat Description: The 3,490-meter grid is vegetated by creosote bush scrub (2,555 meters) over the northern two-thirds of the site and saltbush scrub (760 meters) over the southern third, with narrow band of burrobush scrub (175 meters) in between (see Figure 11). With 16 perennial shrub, grass, and succulent species observed, the grid has a relatively high level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by an "8" in the left margin.

Dominant perennials: Spiny saltbush (*Atriplex spinifera*), creosote bush, and burrobush.

Other: Spiny saltbush (*Atriplex confertifolia*), silver cholla, bush peppergrass, Anderson's boxthorn, cheesebush, desert aster, allscale, desert goldenhead, beavertail cactus, desert needlegrass, Cooper's goldenbush, desert wishbone plant, and cottonthorn.

Spiny Hopsage & Winterfat: 129 spiny hopsage and 136 winterfat plants.

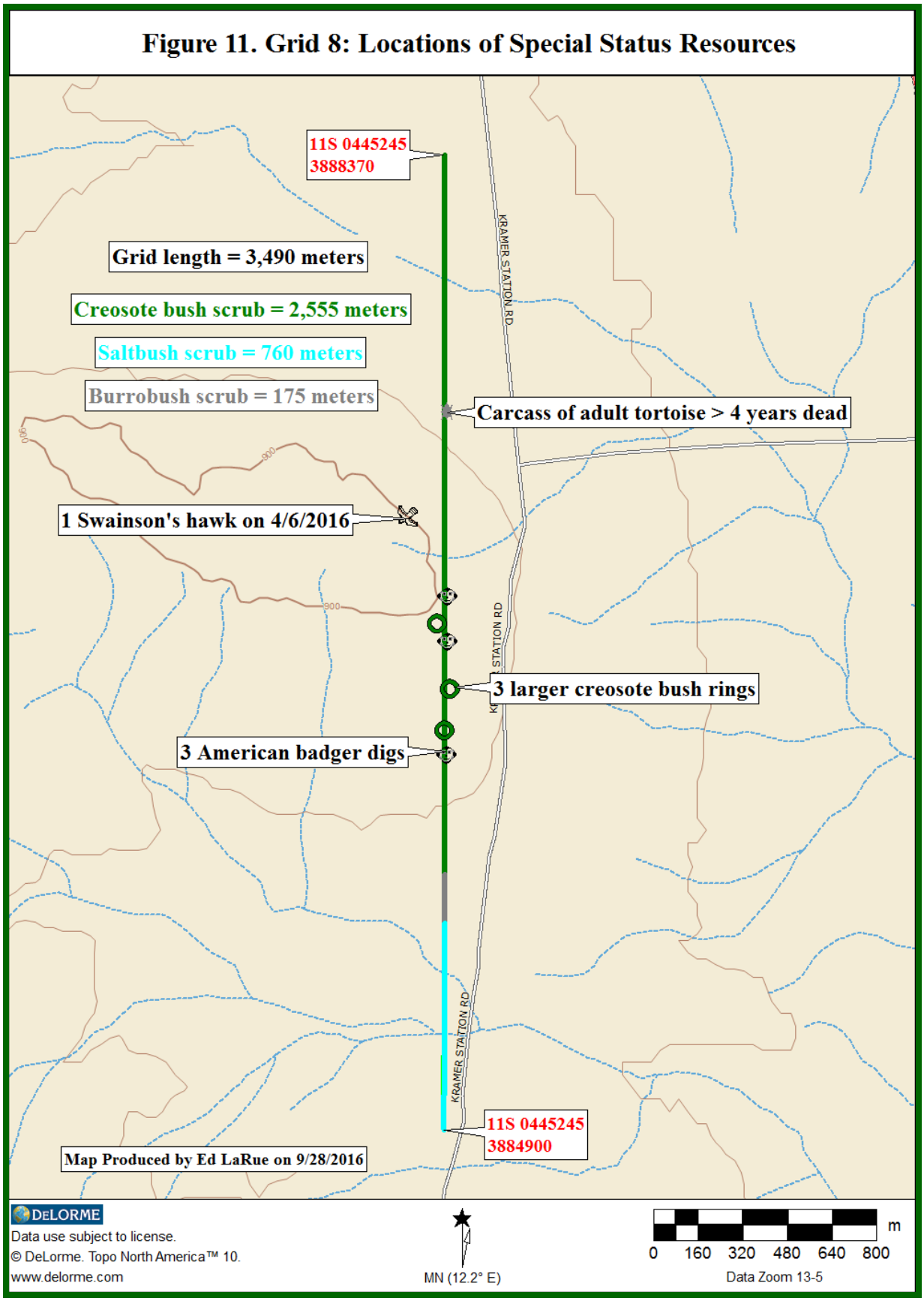
Observable human disturbances: 15 OHV tracks, 2 dirt roads, 1 asphalt driveway, and moderate, older sheep scat north of the paved driveway to the abandoned military house.

Land form: Desert plain to north and south with central hills. **Soil type:** Sandy to cobbly.

Slope: 0 to 15%. **Aspect:** Variable.

Elevational range: 875 meters (2,871 feet) at the south end down to 868 meters (2,848 feet) at the north end of the grid.

Figure 11. Grid 8: Locations of Special Status Resources



GRID 9

Table11. Results for Grid 9									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			*AGS	**MGS	Other	AM	PM	AM	PM
6/13 (100 traps)	0730	68°F	27	1	0	0%	0%	0-5	0-5
	1430 (700)	92°F							
6/14 (100 traps)	0700	65°F	15	2	0	0%	2%	5-10	10-15
	1500 (800)	91°F							
6/15 (100 traps)	0615	59°F	25	3	0	0%	0%	0-5	5-10
	1900 (1,275)	71°F							
6/16 (100 traps)	0715	56°F	28	3	0	0%	0%	5-10	5-10
	1815 (1,100)	84°F							
6/17 (100 traps)	0615	59°F	47	2	0	0%	0%	0-5	10-15
	1415 (800)	89°F							
100 Traps	**4,675 hours**	**56-92°F**	**142**	****6 x 11 = 1 adult 5 juveniles**	**0**	**0%**	**0-2%**	**0-10 mph**	**0-15 mph**

*AGS – Data provided by Lehong Chow did not include sexes of antelope ground squirrels captured.
**MGS – As reported by Lehong Chow and Kathy Simon, 6 different MGS were trapped 11 times, so six captures and five recaptures are reported above. These included 1 adult and 5 juvenile MGS.

Habitat Description: The 3,460-meter grid is vegetated entirely by creosote bush scrub (see Figure 12). With 9 perennial shrub, grass, and succulent species observed, the grid has a moderate level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "9" in the left margin.

Dominant perennials: Burrobush, creosote bush, spiny saltbush (*Atriplex confertifolia*), and bush peppergrass.

Other: Anderson's boxthorn, desert aster, cheesebush, cottonthorn, and indigo bush.

Spiny Hopsage & Winterfat: 14 spiny hopsage and 2 winterfat plants.

Observable human disturbances: 5 OHV tracks, 4 dirt roads, 1 shooting target, 1 old tire, 1 piece of litter, and recent, heavy sheep grazing over the eastern 1/3 of the grid.

Land form: Lower bajada. **Soil type:** Sandy loam.

Slope: 0 to 2%. **Aspect:** Slight southern aspect.

Elevational range: 840 meters (2,756 feet) on the west part of the grid down to 833 meters (2,733 feet) at the southeast corner of the grid.

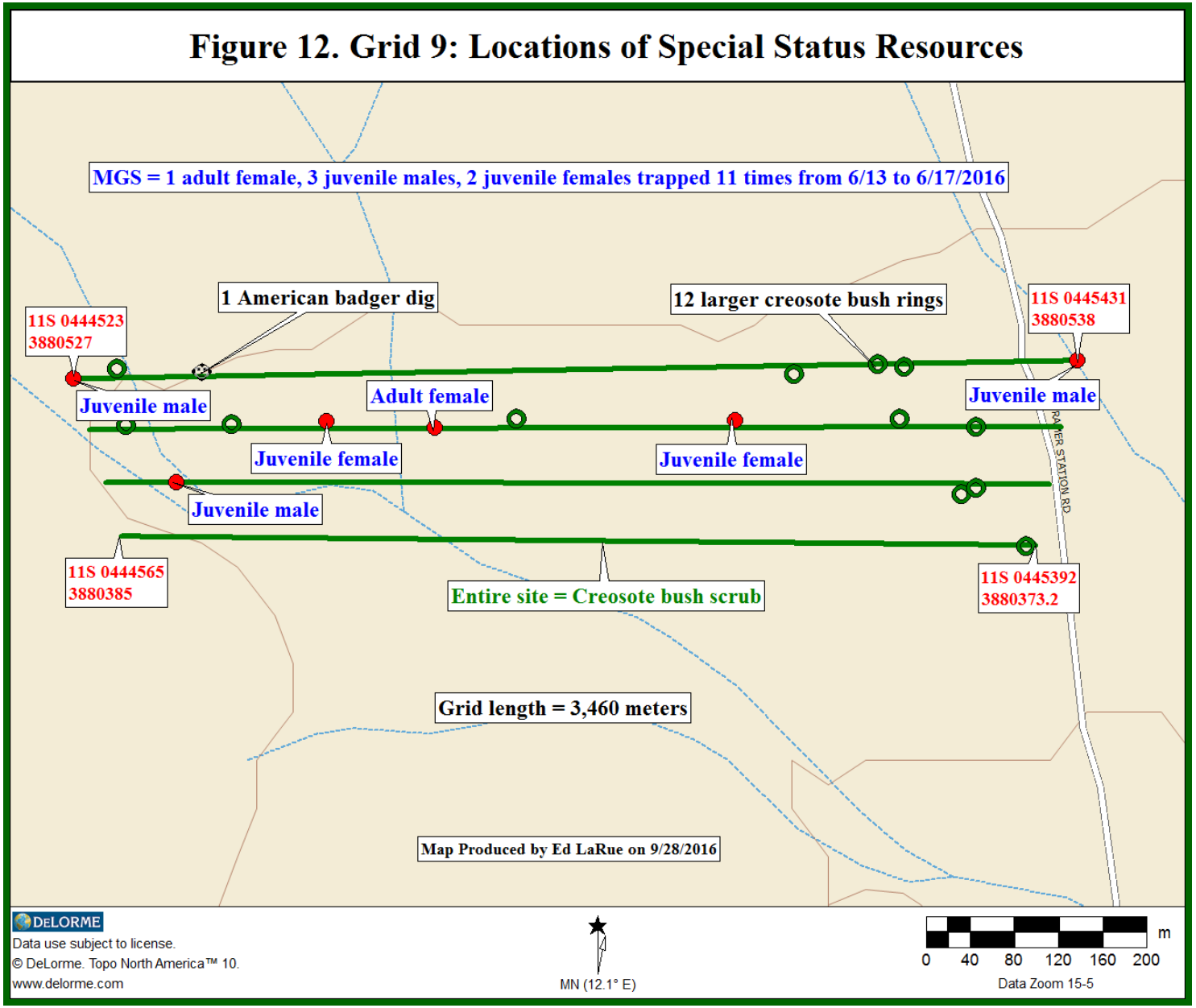


Figure 12. Grid 9: Locations of Special Status Resources
MGS = 1 adult female, 3 juvenile males, 2 juvenile females trapped 11 times from 6/13 to 6/17/2016
1 American badger dig
12 larger creosote bush rings
11S 0444523
3880527
11S 0445431
3880538
Juvenile male
Adult female
Juvenile male
Juvenile female
Juvenile female
Juvenile male
RATTLER STATION RD
11S 0444565
3880385
Entire site = Creosote bush scrub
11S 0445392
3880373.2
Grid length = 3,460 meters
Map Produced by Ed LaRue on 9/28/2016
DeLORME
Data use subject to license.
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www.delorme.com
MN (12.1° E)
0 40 80 120 160 200
m
Data Zoom 15-5

GRID 10

Table 12. Results for Grid 10									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS*	MGS	Other	AM	PM	AM	PM
6/13 (88 traps)	0615	64°F	15	0	0	0%	0%	0-5	0-5
	1315 (616)	91°F							
6/14 (88 traps)	0615	64°F	35	1	0	0%	0%	0-5	5-10
	1545 (836)	91°F							
6/15 (88 traps)	0615	62°F	42	0	0	0%	0%	10-15	5-10
	1930 (1,166)	68°F							
6/16 (88 traps)	0800	60°F	25	0	0	0%	0%	5-10	5-10
	1715 (814)	81°F							
6/17 (88 traps)	0630	65°F	23	0	0	0%	0%	0-5	5-10
	1245 (550)	88°F							
88 Traps	**3,982 hours**	**60-91°F**	**140**	**1 adult**	**0**	**0%**	**0%**	**0-15 mph**	**0-10 mph**

*AGS – Data provided by Lehong Chow did not include sexes of antelope ground squirrels captured.

Habitat Description: The 2,985-meter grid is predominantly vegetated by creosote bush scrub (2,435 meters) with some saltbush scrub (550 meters) on the eastern end of the grid lines (see Figure 13). With 11 perennial shrub, grass, and succulent species observed, the grid has a relatively moderate level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by a "10" in the left margin.

Dominant perennials: Creosote bush, spiny saltbush (*Atriplex confertifolia*), spiny saltbush (*Atriplex spinifera*), bush peppergrass, and allscale.

Other: Burrobush, desert aster, Anderson's boxthorn, cheesebush, desert goldenhead, and cottonthorn.

Spiny Hopsage & Winterfat: 6 spiny hopsage and 13 winterfat plants.

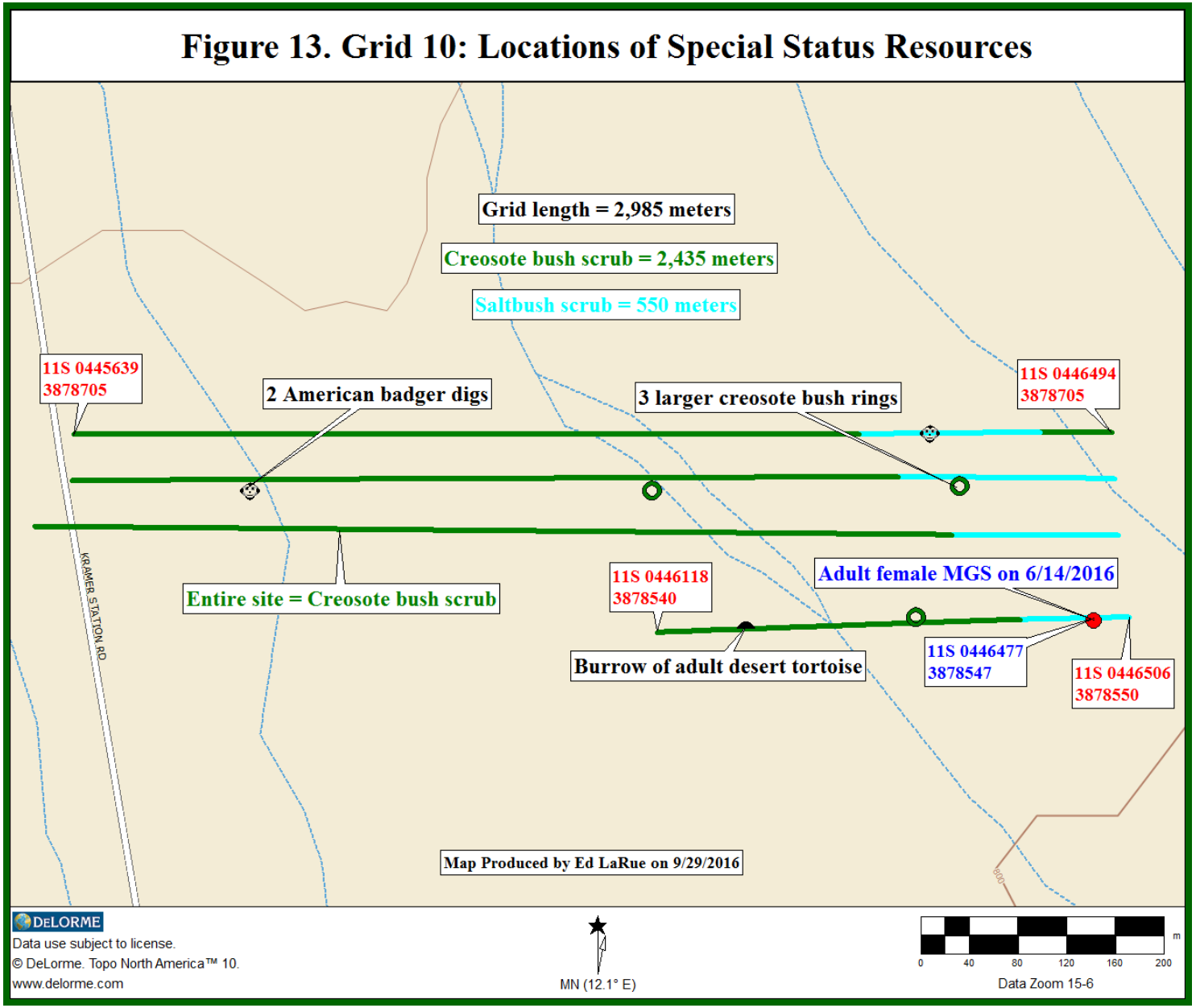
Observable human disturbances: 15 mine pits, 3 dirt roads, 2 pieces of litter, and 2 OHV tracks, with recent, moderate levels of sheep scat throughout the parcel.

Land form: Desert plain. **Soil type:** Sandy loam.

Slope: 0%. **Aspect:** None.

Elevational range: 809 meters (2,654 feet) along the western boundary down to 801 meters (2,628 feet) at the southeast corner of the grid.

Figure 13. Grid 10: Locations of Special Status Resources



GRID 11

Table 13. Results for Grid 11									
DATE 2016	TIME	TEMP °F	CAPTURES			Cloud Cover		Max Wind speed (mi/hr)	
			AGS*	**MGS	Other	AM	PM	AM	PM
6/19 (100 traps)	0530	61°F	12	1	0	0%	0%	0-5	Calm
	1100 (550)	92°F							
6/20 (100 traps)	0530	71°F	9	0	0	0%	0%	Calm	0-5
	0945 (425)	92°F							
6/21 (100 traps)	0530	69°F	11	1	0	-	0%	-	5-15
	1000 (450)	87°F							
6/22 (100 traps)	0530	70°F	12	2	0	-	1%	-	5-15
	1100 (550)	87°F							
100 Traps	**1,975 hours**	**61-92°F**	**44**	****3 x 4 = 3 juveniles**	**0**	**-%**	**0-1%**	**0-5 mph**	**0-15 mph**

*AGS – Data provided by Adam Walters and Erin Whitfield did not include sexes of antelope ground squirrels captured.
**MGS – Data indicate that three different juvenile MGS – 2 females and 1 male – were captured four times, so three original captures plus one recapture are reported above. All three MGS were juveniles.

Habitat Description: The 3,320-meter grid is vegetated entirely by creosote bush scrub (see Figure 14). With 10 perennial shrub, grass, and succulent species observed, the grid has a relatively high level of perennial diversity. See Appendix C for all plants identified during the survey, which are indicated by an "11" in the left margin.

Dominant perennials: Creosote bush and spiny saltbush (*Atriplex spinifera*).

Other: Burrobush, desert goldenhead, spiny saltbush (*Atriplex confertifolia*), Cooper's goldenbush, desert aster, Anderson's boxthorn, and rubber rabbitbrush.

Spiny Hopsage & Winterfat: 2 spiny hopsage plants and no winterfat plants (only site among 11 sites where winterfat was not observed).

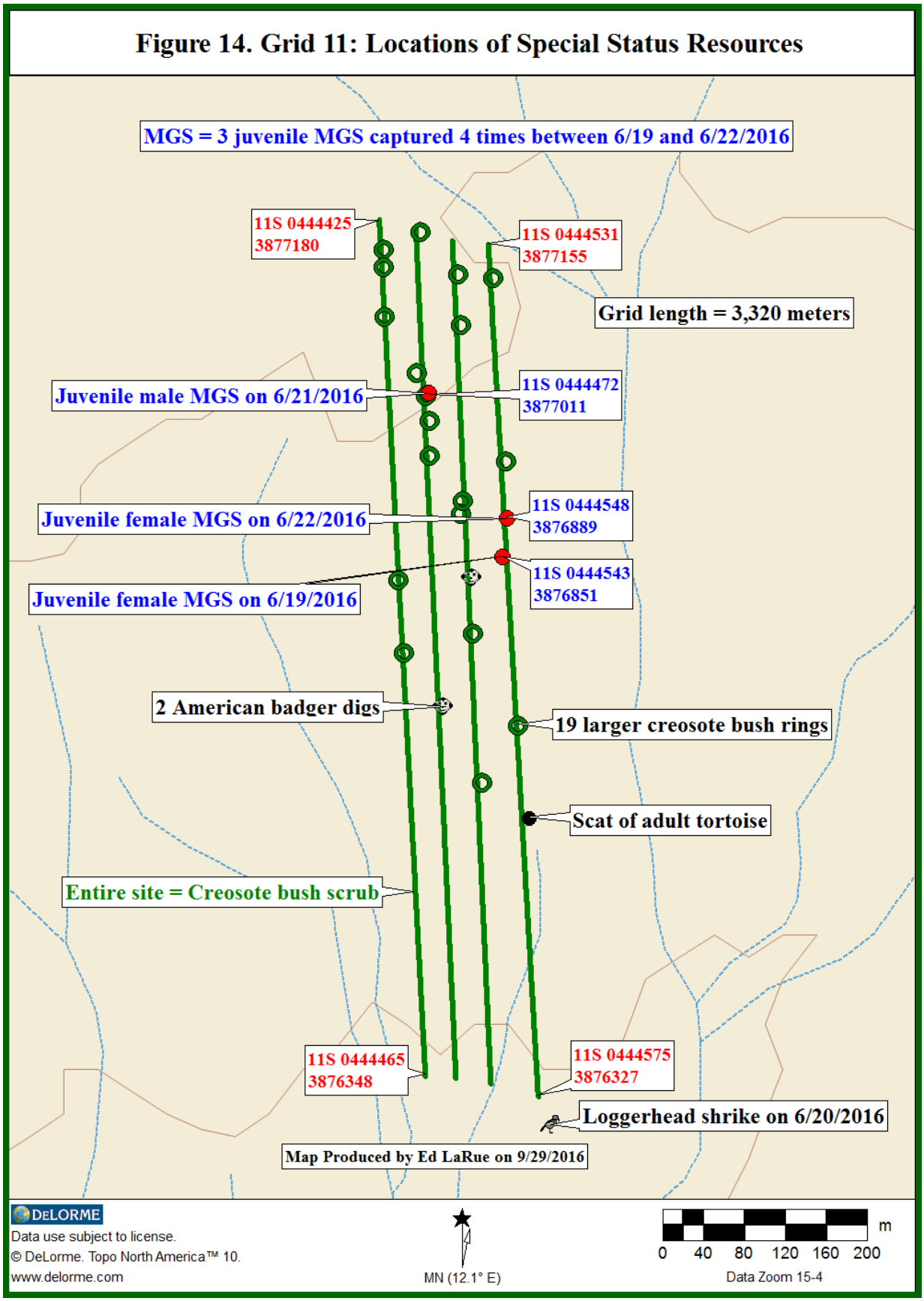
Observable human disturbances: 6 OHV tracks, 4 dirt roads, 2 mining pits, 1 piece of litter, and sparse, older sheep scat spread throughout the site; no fresh sheep scat.

Land form: Desert plain. **Soil type:** Sandy loam.

Slope: 0%. **Aspect:** None.

Elevational range: 792 meters (2,598 feet) along the north boundary down to 779 meters (2,556 feet) along the southern boundary of the grid.

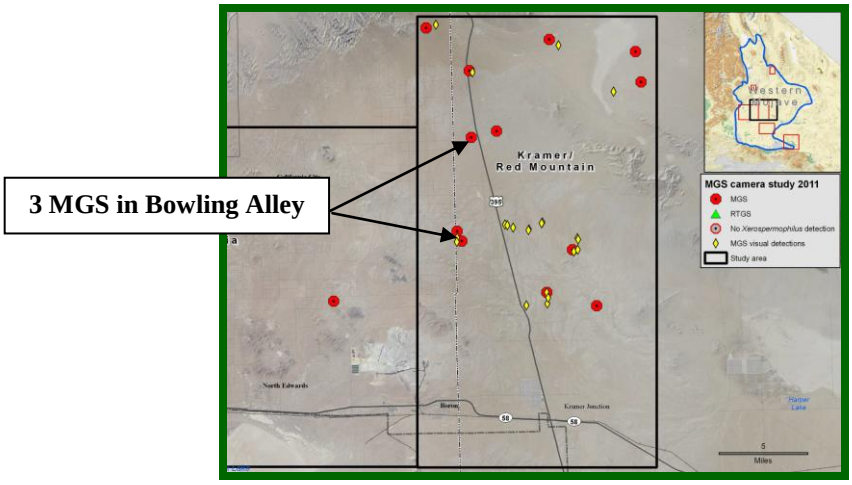
Figure 14. Grid 11: Locations of Special Status Resources



3.2. Relative Occurrence of MGS in the Bowling Alley. There are two main considerations presented in this subsection: 3.2.1 known occurrence of MGS in the Bowling Alley compared to other recent occurrences within the known range of the species; and, 3.2.2 trapping success of MGS in 2016 compared to other trapping efforts in recent years.

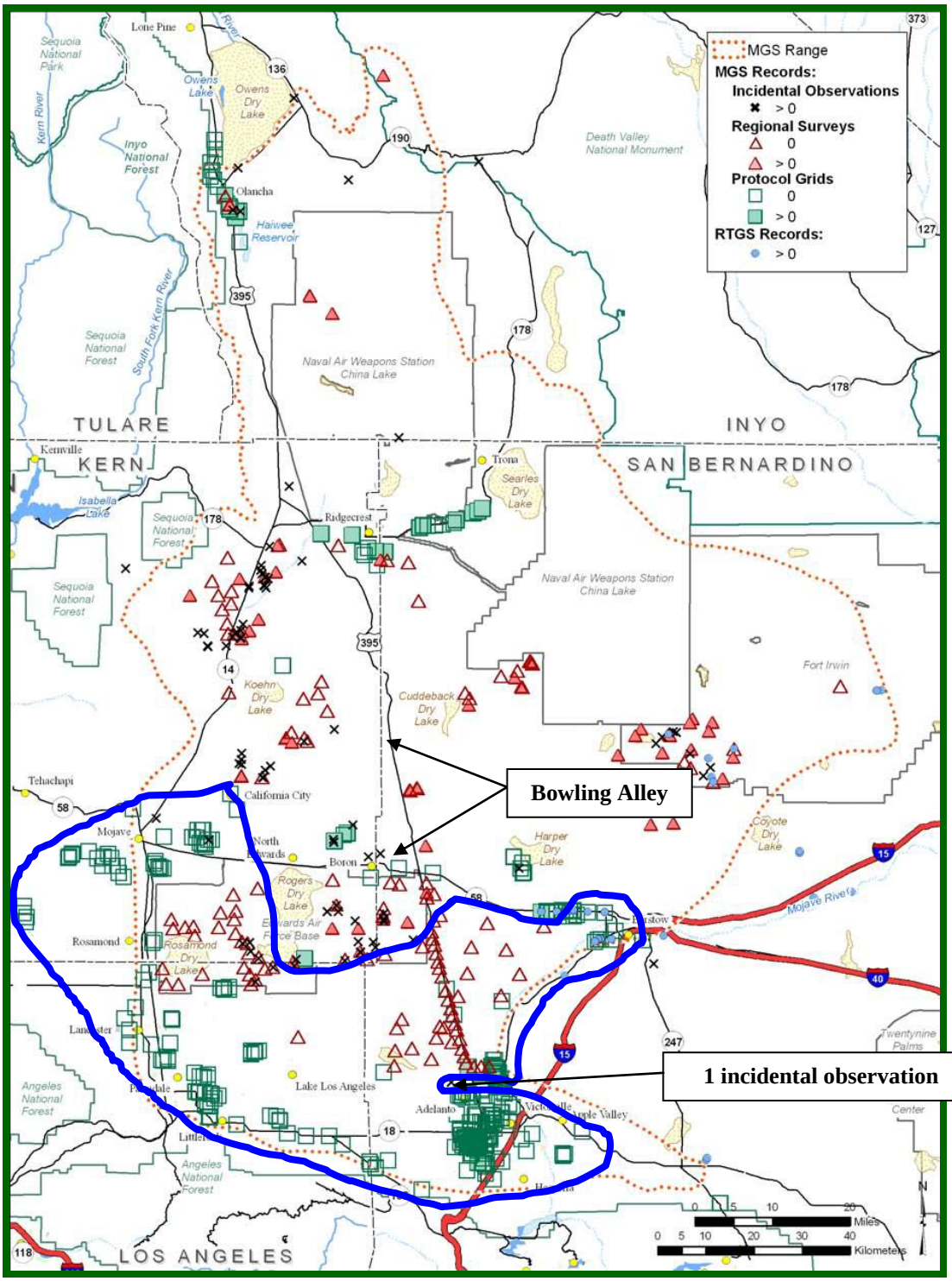
3.2.1. Known Occurrences of MGS in the Bowling Alley. One of the primary reasons for conducting these 2016 trapping studies is to supplement a relative lack of trapping data in the Bowling Alley area. Although there have been a few visual surveys by consultants in the southern portion of the Bowling Alley (Kathy Simon, Leo Simone, and Erin Whitfield personal communication to LaRue in 2016), Leitner and Delaney (2013) performed the only known trapping studies to detect MGS in the Bowling Alley prior to 2016. In 2011, they placed three camera stations in the Bowling Alley and photographed images of MGS at all three stations (see Figure 18 for the 2011 locations relative to the 2016 locations). In Figure 15 (from Leitner 2015), one can see that there have been incidental observations of MGS immediately east and west of the Bowling Alley, which are signified by the "◊" symbol in Figure 15. The three red circles in the Bowling Alley show the locations of the three camera stations that detected MGS. So, importantly, of the 123 study sites sampled by Leitner and Delaney (2013) in 2011 and 2012, three were placed in the Bowling Alley, and all three of the stations in the Bowling Alley had positive detections of MGS.

Figure 15. Previous MGS Trapping Studies in the Bowling Alley.



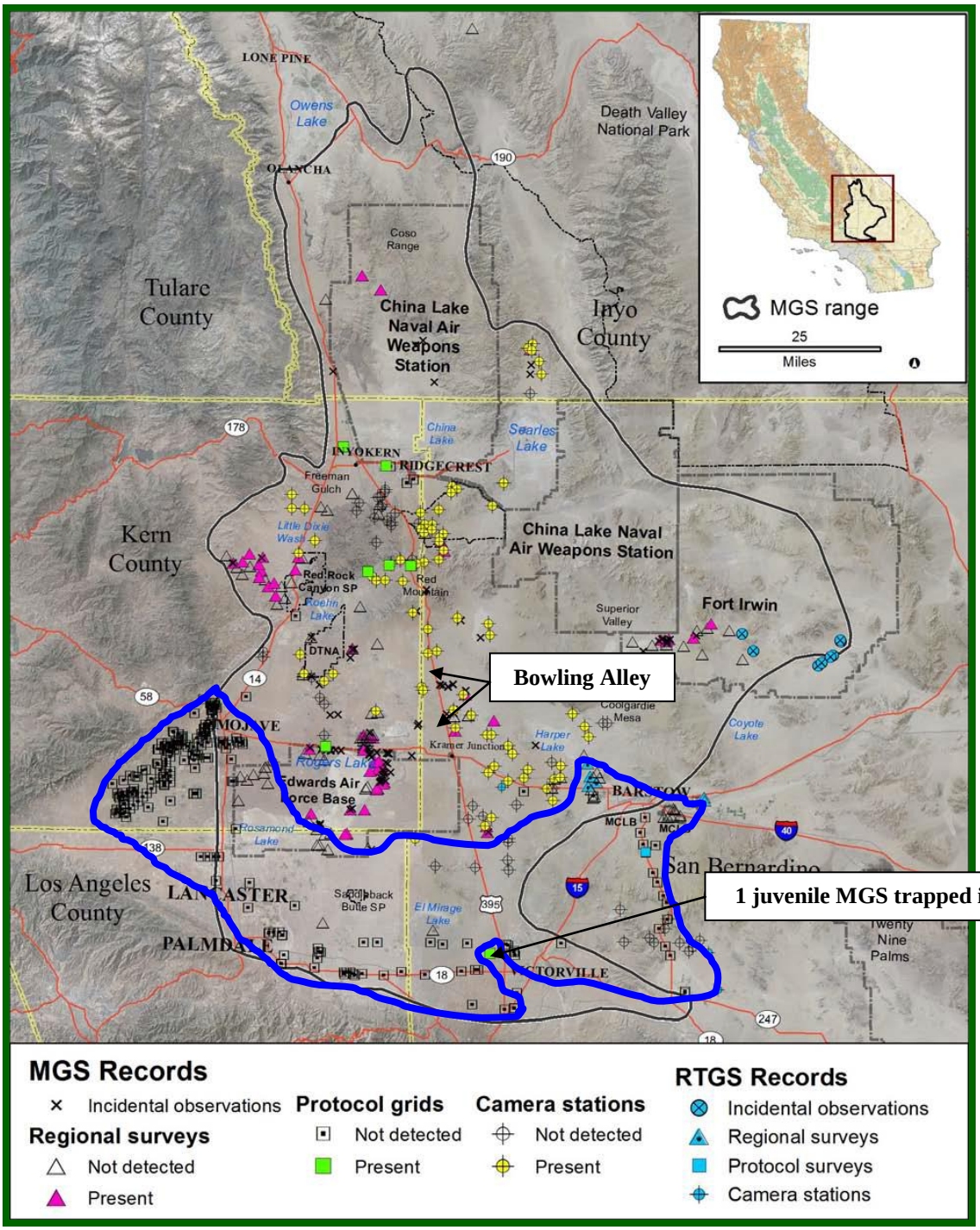
Another pertinent factor to consider is the relative success of detecting MGS in the Bowling Alley compared to success and failure in other regions. Leitner (2008) reviewed the data for every live trapping effort performed between 1998 and 2007 and reported trapping success and failures among those "protocol" and "regional" trapping studies. Unless MGS were captured, *protocol* grids were trapped over a 15-day period and *regional* grids (like those conducted in 2016 in the Bowling Alley) were trapped over a 5-day period even if MGS were captured. Leitner (2015) performed the same analysis for all live trapping and camera trapping studies between 2008 and 2012. So between these two studies (Leitner 2008 and 2015), the success and failure of every live trapping effort and camera study occurring between 1998 and 2012 are reported. The results of these two studies are depicted on the following two pages for the period between 1998 and 2007 (Figure 16) and between 2008 and 2012 (Figure 17).

Figure 16. Results of MGS Trapping Studies between 1998 and 2007



In Figure 16, one can see that there were no studies in the Bowling Alley between 1998 and 2007, there was one incidental MGS observation near the southwest corner, and that no MGS were captured inside the **thick blue line**, which encompasses most of the southern and western portions of the historic range of the species.

Figure 17. Results of MGS Trapping Studies between 2008 and 2012



In Figure 17, one can see that no MGS were captured inside the **thick blue line**, which encompasses most of the southern and western portions of the historic range of the species. Importantly, this shows that, except for the two MGS occurrences labeled in these two maps, no MGS were trapped or observed in the southern or western extents of the historic range between 1998 and 2012.

3.2.2. Relative Trapping Success in the Bowling Alley in 2016. There are no available baseline data to determine the relative occurrence of MGS in the Bowling Alley because there has been only one previous trapping effort (in 2011) and the current one (in 2016). However, there are trapping studies, some of which are long-term, with which we can compare relative trapping success on those plots in previous years to trapping success in 2016. Two such areas for which we have data are the long-term trapping studies of Phil and Barbara Leitner at the Freeman Gulch site located about 25 miles northwest of the Bowling Alley and the Coso study sites located about 65 miles north, which includes two separate sites, including Coso Basin and Cactus Peak. Leitner provided the following data showing recent and historical trapping success for MGS at these three sites.

Table 14. Results of MGS Trapping at Three Long-term Study Sites

Freeman Gulch		**Coso Basin**		**Cactus Peak**	
Year	**Number of MGS**	**Year**	**Number of MGS**	**Year**	**Number of MGS**
1994	9	2011	3	2011	27
2002	5	2012	27	2012	67
2005	15	2013	6	2013	19
2006	9	2014	1	2014	9
2007	5	2015	0	2015	4
2016	**1**	**2016**	**1**	**2016**	**7**

Multi-year data from these three sites provide an excellent opportunity to compare trends in previous MGS trapping success with trapping success in 2016. To compare relative trapping effort to Leitner's efforts in Table 14, note that the Bowling Alley effort ranged from 1,975 trap-hours in late June up to 5,950 hours in early April. In an email dated 13 October 2016, Leitner indicated that for the Freeman Gulch site, there were 6,050 trap-hours in 1994, 5,000 trap-hours for the years between 2002 and 2007, and 11,250 trap-hours in 2016. It is significant that for Freeman Gulch although the 2016 level of trapping effort was double that of 2002-2007 and nearly so for 1994, the lowest trapping success rate occurred there in 2016. There were always 22,050 trap days at the Coso Basin and Cactus Peak sites, so the downward trend in trap success at those two sites can be compared to one another. And, among all the sites, trapping success was substantially lower in 2015 and 2016 than in all other years for these three long-term studies.

There is one important consideration in terms of timing that affects this discussion. For Leitner's trapping efforts at the Coso Basin, Cactus Peak, and Freeman Gulch sites, only adult MGS are reported in Table 14. Each of these surveys occurred early enough in the season that only adult MGS were trapped. So, this indicates that the data in Table 14 are readily comparable among Leitner's grids and less so compared to our effort, where juvenile MGS were captured from mid- to late-June.

One can see that more squirrels were trapped in 2012 at both the Coso Basin and Cactus Peak grids than any other year, which is a reflection of several excellent reproductive years, particularly 2010. One can also see a downward trend in capture success among these two grids from 2012 to 2015. In fact, 2015 was the only year since Leitner's studies began in the late 1980's that no MGS were trapped on the Coso Basin grid (Leitner personal communication to LaRue in September 2016). Although 2016 numbers showed a slight increase over 2015 numbers, they are still as low as or lower than any of the other years reported.

For Freeman Gulch, MGS numbers seemed to have been relatively steady between 1994 and 2007. We would also add that LaRue performed a five-day regional trapping survey with 100 traps on the Freeman Gulch site in May 2010 and did not capture any MGS. So, sometime between 2007 and 2010 MGS numbers decreased at the long-term study site at Freeman Gulch and have not regained previous levels as of 2016. At another site on Coolgardie Mesa where Leitner had captured seven MGS in 2002 using only 100 traps, no MGS were captured during a 2016 regional survey of that same grid where he used 225 traps (Leitner personal communication to LaRue on 26 April 2016).

So, one can see that MGS capture success in 2016 was among the lowest for the three grids where we have long-term data. That 13 MGS were captured at 6 of the 11 grids trapped in 2016 in the Bowling Alley demonstrates that MGS are persisting there in spite of lowered rainfall and concomitant lower reproductive success over the past four years. It may also suggest that the MGS numbers in 2016 in the Bowling Alley were depressed like at the other three sites (and the Coolgardie Mesa site), and that there may have been higher numbers in recent years.

Whereas creosote bush scrub occupied approximately 52% of the grid length, 85% of the MGS (11 of 13) were trapped in that community, with the other two MGS caught in saltbush scrub communities, and none caught in burrobush scrub. Given the mosaic of the three plant communities; the proximity of the trapped animals to other nearby communities; the mobility of MGS, particularly juveniles and adult males, which may have been dispersing when trapped; etc., it is difficult to draw any firm conclusions about the prevalence of *resident* MGS in one plant community versus another.

One potential reason for lower capture success in saltbush and burrobush scrub is that Grids 3 and 4, which are comprised entirely of these two communities, were trapped in early March for a total of 3,925 and 3,825 trap-hours, respectively, over a period of five days each. Grid 5, which is comprised of 68% saltbush and burrobush scrub, was trapped a total of 5,500 trap-hours, over a seven-day period at the same time in early March. It may be noteworthy that the adult MGS male on Grid 5 was caught on day-six and that neither of the two pure saltbush-burrobush scrub grids (3 and 4) was trapped beyond five days. In any case, more data need to be collected to determine the extent of MGS residency and dispersal in saltbush and burrobush scrub communities in the Bowling Alley.

On page 3-156 of the Final Impact Report for the West Mojave Plan (BLM 2005), there is a table that compares the then-known occurrences of 252 MGS records with the prevalence of plant communities in the West Mojave Desert, based on a 1996 vegetation map prepared by Debi Clark of the BLM Barstow Field Office. The interesting result of that analysis is that the prevalence of known MGS records corresponded perfectly with the prevalence of plant communities within the West Mojave planning area. BLM (2005) reported that 53.97% of the planning area is vegetated by creosote bush scrub and that 53.96% of the 252 MGS records occurred in creosote bush scrub. And, importantly, 19.84% of the planning area is vegetated by saltbush scrub and exactly 19.84% of the 252 MGS records occurred in saltbush scrub. So, these data clearly show that MGS have been and continue to be in saltbush scrub communities (e.g., most of the red dots and yellow triangles located east of Highway 395 in Figure 15 are in saltbush scrub communities).

Although only 2 of 13 MGS were trapped in saltbush scrub in 2016 in the Bowling Alley, saltbush scrub is still considered to be suitable and likely occupied. As described above, none of the grids in pure saltbush-burrobush scrub communities (Grids 2, 3, and 4) were trapped when juvenile MGS would have been actively dispersing; only adult MGS could have been captured on Grids 3 and 4. One possibility is that if MGS were in a depressed part of their boom-and-bust cycle in 2016, creosote bush scrub communities with their relatively higher incidence of perennial plant diversity may serve as refugia until which time the regional population rebounds after several years of reproductive success. If so, even if saltbush-burrobush scrub communities are not occupied at the same elevated levels as creosote bush scrub, they would be important for dispersing juveniles and wide-ranging adult males.

3.3. Genetics Considerations. Importantly, tissue samples were collected from 12 of the 13 MGS captured during this study. On 26 October 2016, Dr. Marjorie Matocq indicated that these and 488 other MGS tissue samples are being genetically analyzed using an advanced technique called "Single Nucleotide Polymorphisms (SNP)." She expects results by the end of 2016. These results will answer some very important questions about the genetics of MGS in the Bowling Alley. For example, we will be able to determine how related these animals are to one another; e.g., are the five juveniles on Grid 9 and three juveniles on Grid 11 respective litter mates or from multiple litters? If the male at the north end of the Bowling Alley is related to those at the middle and/or south ends, we will know that MGS are dispersing through the centrally-located saltbush-burrobush scrub communities. We will also know if these 12 animals are pure MGS or if any has hybridized with round-tailed ground squirrels. Importantly, we will be able to determine how closely related these animals are to others found throughout the range and how important the Bowling Alley is as a Key Population Area and linkage to MGS occurring north and south of the region.

3.4. Observable Human Impacts. By segregating and combining the human disturbance data presented above in Table 2 for the 11 grids into one table, we are able to readily compare the data among the 11 grids. Table 15 lists disturbances in descending order of prevalence.

Table 15. Summary of Observable Human Disturbances on the 11 Grids

Disturbance	Grid Numbers											
	1	**2***	**3***	**4***	**5***	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
OHV tracks	13	-	-	-	-	10	12	15	5	2	6	50
Dirt Roads	1	-	-	-	-	5	5	2	4	3	4	23
Mine Pits	0	-	-	-	-	0	0	0	0	15	2	17
Litter	0	0	0	0	0	0	0	0	1	2	1	4
Rifle shells	1	-	-	-	-	0	0	0	0	0	0	1
Paved road	0	0	0	0	0	0	0	1	0	0	0	1
Targets	0	0	0	0	0	0	0	0	1	0	0	1
Old tire	0	0	0	0	0	0	0	0	1	0	0	1
Sheep grazing**	M-H Fresh	M Older	M Older	M Older	M Older	L Fresh	M Older	M Older	H Fresh	M Fresh	L Older	

*For Grids 2, 3, 4, and 5 the observable human disturbances were not tallied, which is indicated by "-," but an indication of sheep grazing was recorded. For those grids where a particular disturbance was not observed, a "0" rather than a "-" is used.
**Sheep grazing – L = Light; M = Moderate; H = Heavy with an indication of freshness following.

Although disturbances were not tallied for Grids 2 through 5, the types and prevalence of disturbances observed on the other seven grids is indicative of these grids as well (LaRue, personal observation). As such, OHV tracks on these four grids would likely have fallen in between 2 and 15 tracks per grid, with as few as 1 and as many as 5 dirt roads, but not likely more. Except for mine pits, which were only observed in the southern part of the Bowling Alley alongside Grids 10 and 11, and sheep grazing, which is described below, cross country vehicle travel and dirt roads are the two main types of human disturbances observed along the 11 grids trapped in 2016.

The northern portions of the Bowling Alley are found within the Monolith-Cantil sheep allotment and the southern half in the Boron sheep allotment. In 2016, sheep grazing ranged from being light in the hilly (Grid 6) and far southern portions (Grid 11) of the Bowling Alley to heavy in areas to the far north (Grid 1) and east of Saddleback Mountain (Grid 9). "Fresh" versus "older" is entirely dependent on the time a given grid was trapped. For example, those grids listed as having fresh sheep scat included Grid 1 that was trapped May 5-9 and Grids 6, 9, and 10, which were each trapped June 13-17. So, the grids trapped before early May did not have fresh sheep scat presumably because sheep were not released until mid-May.

Robert Pawelek, Chief - Multi-Resources, Wild Horse & Bureau in the Ridgecrest Field Office of the BLM indicated to LaRue in an email on 24 August 2016 that a single band of 800 ewe pairs were turned out for a 30-day period in 2016 and that no other sheep grazing has been authorized on BLM lands in the Bowling Alley since 2012. Given that fresh sheep scat were found as far north as Grid 1 and as far south as Grid 10, sheep can cover a fairly large area in 30 days, in this case a linear distance of approximately 12 miles.

Excluding sheep grazing, these impact levels are NOT considered to be high or prevalent. Based on 27 years of tallying human disturbances in the Mojave Desert, LaRue concludes that these disturbance levels are much lower than most regions in the West Mojave. To the far east, in the Morongo Basin, which encompasses the area between Yucca Valley and Twentynine Palms, LaRue has not observed evidence of any domestic sheep grazing in the past 27 years. In areas to the south around Lake Los Angeles, to the southeast in the Brisbane Valley, and to the northwest outside the Desert Tortoise Research Natural Area sheep grazing is prevalent and very heavy. Within the Bowling Alley, sheep grazing is judged to be moderate-to-heavy compared to other grazed portions of the West Mojave. Among the observable human disturbances tallied in 2016, sheep grazing is, by far, the most prevalent and adverse impact occurring in the Bowling Alley.

3.5. Other Special Status Species. Although the primary focus of this report is to assess the importance of the Bowling Alley for MGS conservation, it is equally important that the BLM and County recognize that there are other DRECP-Covered Species that would be adversely affected if the Bowling Alley is designated as a DFA. The presence of many of these species, such as desert tortoise (*Gopherus agassizii*), American badger (*Taxidea taxus*), and resident bird species [e.g., burrowing owl (*Athene cunicularia*), LeConte's thrasher (*Toxostoma lecontei*), and loggerhead shrike (*Lanius ludovicianus*)] is considered to be an indicator of habitat quality and the general ecological health and importance of the region. As such, throughout the 2016 effort, biologists were asked to record the incidences of special status species, as identified by USFWS (2008), CDFW (2016a, 2016b, 2016c), BLM (2008, 2010), and/or CNPS (2016).

As tabulated on page 9 and mapped in Figures 4 through 14, nine different special status species and one special status resource (creosote rings larger than 10 feet in diameter) were either observed or detected along the 11 trapping grids between March 9 and June 22, 2016. Some of these species including desert tortoise, burrowing owl, LeConte's thrasher, loggerhead shrike, and American badger are resident animals that could have been observed or detected throughout the survey effort. Other species, including desert cymopterus (*Cymopterus deserticola*), Swainson's hawk (*Buteo swainsoni*), Vaux's swift (*Chaetura vauxi*), and northern harrier (*Circus cyaneus*), are only detectable at certain times of year. For these species, and especially the birds, they would be expected to occur on all 11 sites and not just the few sites where they were incidentally observed during their migration or germination periods.

Importantly, observations of many of the species along the grids represent a miniscule portion of what is actually present in the Bowling Alley in unsurveyed areas. Since most species like desert tortoise, desert cymopterus, burrowing owl, and the larger creosote bush rings were observed or detected within 16 feet either side of a given transect, imagine how many more of these species occur than were observed. In fact, only about 1.2% of an entire square mile is sampled along a two-mile long trapping grid.[1]

4.0. CONCLUSIONS

The BLM, County, and CDFW are tasked with considering the relative importance of the Bowling Alley to the regional conservation of the Mohave ground squirrel and other Covered Species in the DRECP. During The Wildlife Society meetings in Pomona, CA in February 2016, BLM biologist, Amy Fesnock, briefed the MGS TAG on the DRECP. Fesnock indicated that the public lands managed by the BLM in the Bowling Alley would be designated as Development Focused Areas (DFAs) unless the "importance" of this area could be demonstrated.

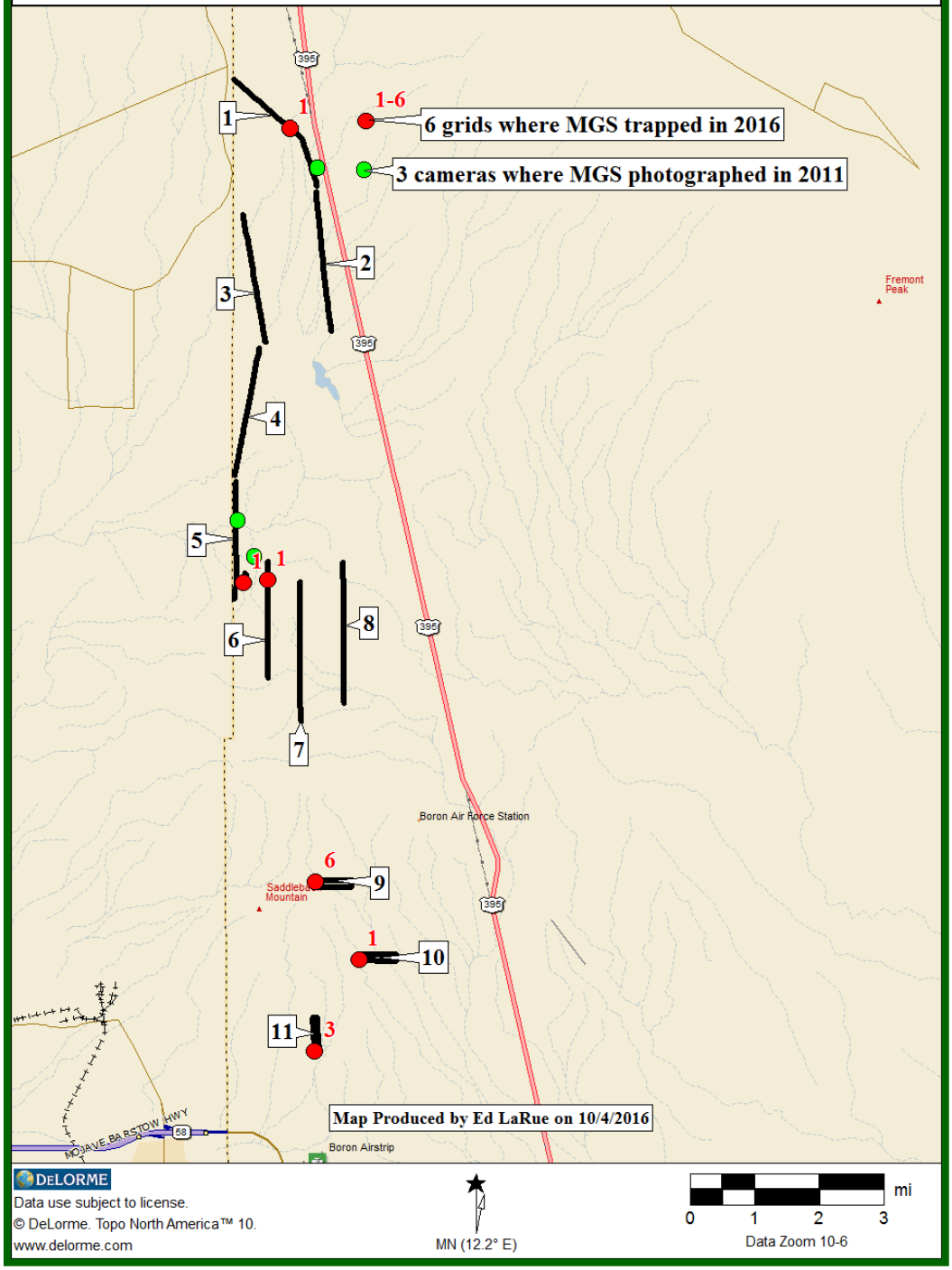
In the absence of any stated criteria as to what constitutes "importance," the MGS TAG considered the question and indicated that the relative importance of the Bowling Alley should be considered in the context of the following factors, which are discussed in subsequent subsections.

A. Include recent or historical records of MGS occurrence.
B. Comprise suitable habitats, including:
    1. Substrates should be more sandy than rocky;
    2. There should be a relatively high diversity of perennial shrubs;
    3. There should be stands of winterfat and/or spiny hopsage; and
    4. Habitats should be relatively intact and not degraded by human uses.
C. Be genetically important to conservation of the species.

[1] 5,280 feet x 2 = 10,560 linear feet x 32 feet wide (16 feet either side of the transect) = 337,920 square feet. There are 43,560 square feet in an acre and 640 acres in a square mile, so there are 27,878,400 square feet in a square mile. Given that we surveyed only about 337,920 square feet along any one of the transects, 337,920 divided by 27,878,400 = 0.012, which is about 1.2% of the surface area in a square mile.

4.1. Recent and Historical Records of MGS Occurrence. It is noteworthy, as shown in Figure 18, that the three MGS detected by Leitner and Delaney (2013) in 2011 were on Grid 5 in burrobush scrub, near the north end of Grid 6 in saltbush scrub, and near the south end of Grid 1 in creosote bush scrub. These data confirm two additional MGS occurrences (e.g., now 4 of 16 animals) in saltbush-burrobush scrub, and MGS persistence in the Bowling Alley even during recent drought episodes.

Figure 18. Locations of 13 MGS Trapped in 2016 and 3 Photographed in 2011



As reported herein, the Bowling Alley has not been systematically sampled since MGS was first discovered in 1886. The only sampling that has occurred was in 2011 when there was a 100% success rate and MGS images were captured at the only three camera stations placed in the Bowling Alley (see Figure 18 above). As reported in Table 14, we note that 2011 was the year before record numbers of MGS were observed at Leitner's Coso Study sites, so there may have also been elevated numbers in the Bowling Alley. Given the present study, we determined that MGS occur from the north end to the south end of the Bowling Alley and under current conditions appear to be more common in creosote bush scrub and to the south than in saltbush-burrobush scrub and to the north.

Given that trapping success at three long-term study plots has consistently declined over the past five to six years, it is noteworthy that MGS were caught on 6 of the 11 grids trapped in the Bowling Alley in 2016. If like the other areas, numbers were depressed in the Bowling Alley in 2016, we may assume that more MGS would have occurred and therefore been trapped in previous years and future years of sufficient rainfall to support reproduction (i.e., 3 inches or 76 millimeters in the winter preceding the trapping effort).

MGS are persisting in the Bowling Alley during several decades of depressed capture rates particularly in the southern and western portions of the range (as depicted in Figures 16 and 17) and during recent drought years that have reduced MGS capture success throughout its range as suggested by the data in Table 14. When one considers all of the trapping studies by both live traps between 1998 and 2012 (Figures 16 and 17) and by cameras between 2008 and 2012 (Figure 17), one finds that only several MGS have been found in the southern part of the range since 1998, located north and south of Adelanto. The last MGS trapped on the western part of Edwards Air Force Base was in 1994 despite numerous trapping surveys in that area. That MGS are persisting from the north end to the south end of the Bowling Alley as of 2016 is evidence of the importance of this area to MGS conservation.

4.2. Suitable Habitats.

4.2.1. Substrates should be more sandy than rocky. Given the absence of any major mountainous areas within the Bowling Alley and observations of suitably sandy substrates in 2016, we conclude that substrates throughout the Bowling Alley, which range from being relatively sandy in saltbush scrub and level areas to being rocky with boulder outcrops in central hilly areas and areas associated with Saddleback Mountain, are considered to be ideally suitable for MGS.

4.2.2. There should be a relatively high diversity of perennial shrubs. Whereas there is no universally accepted measure of what constitutes "high" versus "low" perennial diversity, our experience has been that there may be as few as 3 perennial species and as many as 20 along a given trapping grid. As reported in Table 2, tallies of perennial shrub species occurring along each of the 11 grids ranged from a low of 5 species (which may have resulted from sampling error, as it was the only grid where perennial species were not tallied by LaRue) up to 18 species. There is a clear correlation between heightened perennial species diversity in creosote bush scrub communities in areas of topographical relief compared to relatively lower species diversity in saltbush scrub in desert plain areas.

As such, the highest perennial species counts occur in creosote bush scrub in the central hilly areas of the Bowling Alley (18 perennial species on Grid 7; 16 species on Grid 8; 15 species on Grid 6; and 12 species on Grid 5) compared to the lower counts in desert plain areas vegetated by saltbush-burrobush scrub (9 species on both Grids 3 and 4). Even so, it is noteworthy that 10 of the 13 MGS trapped were caught in creosote bush scrub communities to the south where, relative to the other sites, perennial plant diversity was judged to be low to moderate: 9 species on Grid 9; 10 species on Grid 11; and 11 species on Grid 10.

4.2.3. There should be stands of winterfat and/or spiny hopsage. Leitner has found that the heightened incidence of winterfat and spiny hopsage corresponds to a heightened likelihood of occurrence of MGS. In an email to LaRue on 9 April 2016, Leitner indicated that based on trapping at 68 sites over the period 2002 to 2010, he found that MGS were detected at 77.4% of the sites with ≥300 combined spiny hopsage and winterfat plants per hectare. On those 31 sites, a total of 75 MGS were captured for 2.42 MGS per site. Only 16% of the 37 sites with <300/ha had MGS. A total of 16 MGS were caught at those sites for an average of 0.43 MGS per site. So not only were MGS present at over three-quarters of the grids with ≥300 spiny hopsage and winterfat per hectare, but MGS abundance was higher.

For the current study, spiny hopsage and winterfat plants were tallied within 5 meters± of the grid line. Given an approximate grid length of 10,560 linear feet (3,219 meters) and a width of 16 feet (5 meters), a total of 3.9 acres (1.6 hectares) was surveyed along each grid. Given Leitner's observation, there would need to be 480 combined hopsage and winterfat plants along a given grid to have a 75% predictability of MGS occurrence. In fact, Grid 1 with 776 combined hopsage and winterfat plants, Grid 4 with 634 plants, and Grid 5 with 818 plants are the only three grids with more than 480 plants. And, MGS were trapped on Grids 1 and 5 in 2016, thus supporting Leitner's observations. However, in 2016, 10 of the 13 MGS were trapped on grids having the absolute lowest combined spiny hopsage and winterfat counts: Grid 9 with 16 combined plants and 6 MGS; Grid 10 with 19 plants and 1 MGS; and Grid 10 with only 2 spiny hopsage plants, no winterfat plants, and 3 MGS. Given that 8 of the 10 MGS were juveniles, it is possible pending genetics results that they may have been dispersing through the area. MGS do occur in areas of the Bowling Alley where winterfat and spiny hopsage are not abundant.

4.2.4. Habitats should be relatively intact and not degraded by human uses. Excluding sheep grazing, the human impact levels observed in the Bowling Alley are NOT considered to be high or prevalent. Based on 27 years of tallying human disturbances in the Mojave Desert, LaRue concludes that these disturbance levels are much lower than most regions in the West Mojave. As such, habitats throughout the Bowling Alley (with the possible exception of sheep grazing in some areas) have not been significantly compromised by observable human impacts such as those associated with vehicle travel and casual recreational use in the region.

4.3. Genetic Importance. Leitner and Delaney (2013) concluded that the "Ridgecrest to Kramer Junction Corridor" that they identified in their 2011 to 2012 studies, "…is particularly valuable for connectivity and gene flow between the southernmost core area at EAFB [Edwards Air Force Base] and populations in the central part of the range." In its draft Conservation Strategy, CDFW (2016d) identifies the area as the "North of Edwards Key Population Center," which includes the Bowling Alley (see first map in Appendix C). Measure A2.1 states "Identify and secure acquisition of private lands (*e.g.*, fee title acquisition, conservation easements) or designation of public lands for long-term conservation of habitat within population centers. Known population centers at the time of this document's finalization are listed below and are mapped in Appendix C.," which include the North of Edwards Key Population Center. The relative importance of MGS in the Bowling may be further ascertained when Dr. Matocq's studies become available.

5.0. RECOMMENDATIONS

Based on the positive MGS trapping results given herein, the presence of requisite suitable habitat components as identified by the MGS TAG, two decades of programmatic failure to trap MGS populations in the southern and western portions of its range, and confirmation of MGS' persisting presence in the Bowling Alley over the past five years in spite of drought, we recommend that:

● The BLM withdraw the Bowling Alley area from further consideration as a Development Focus Area under the Desert Renewable Energy Conservation Plan; and

● The San Bernardino County Board of Supervisors no longer consider this as one of the five Development Focus Areas identified for energy development in their 17 February 2016 Resolution.

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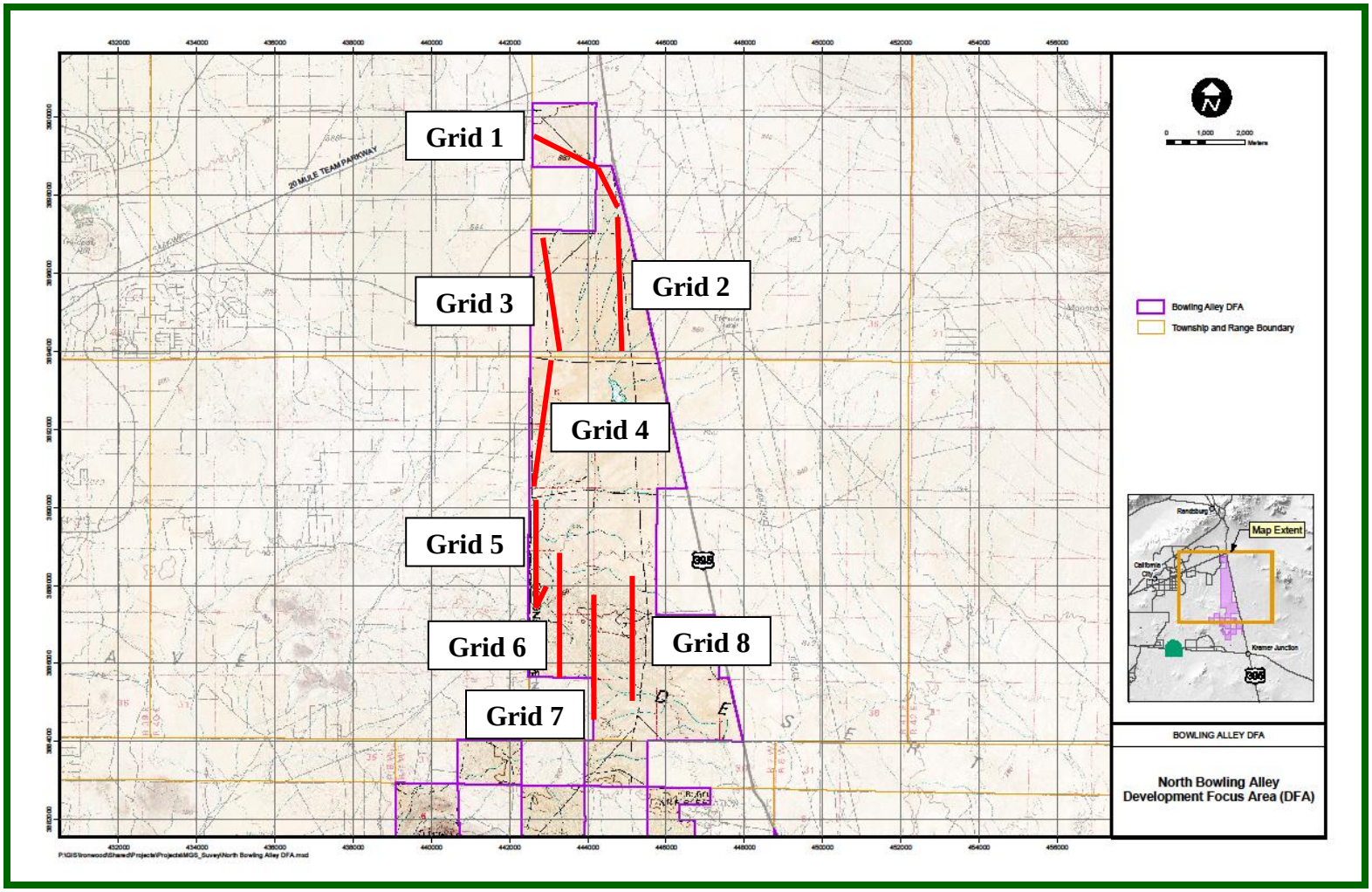
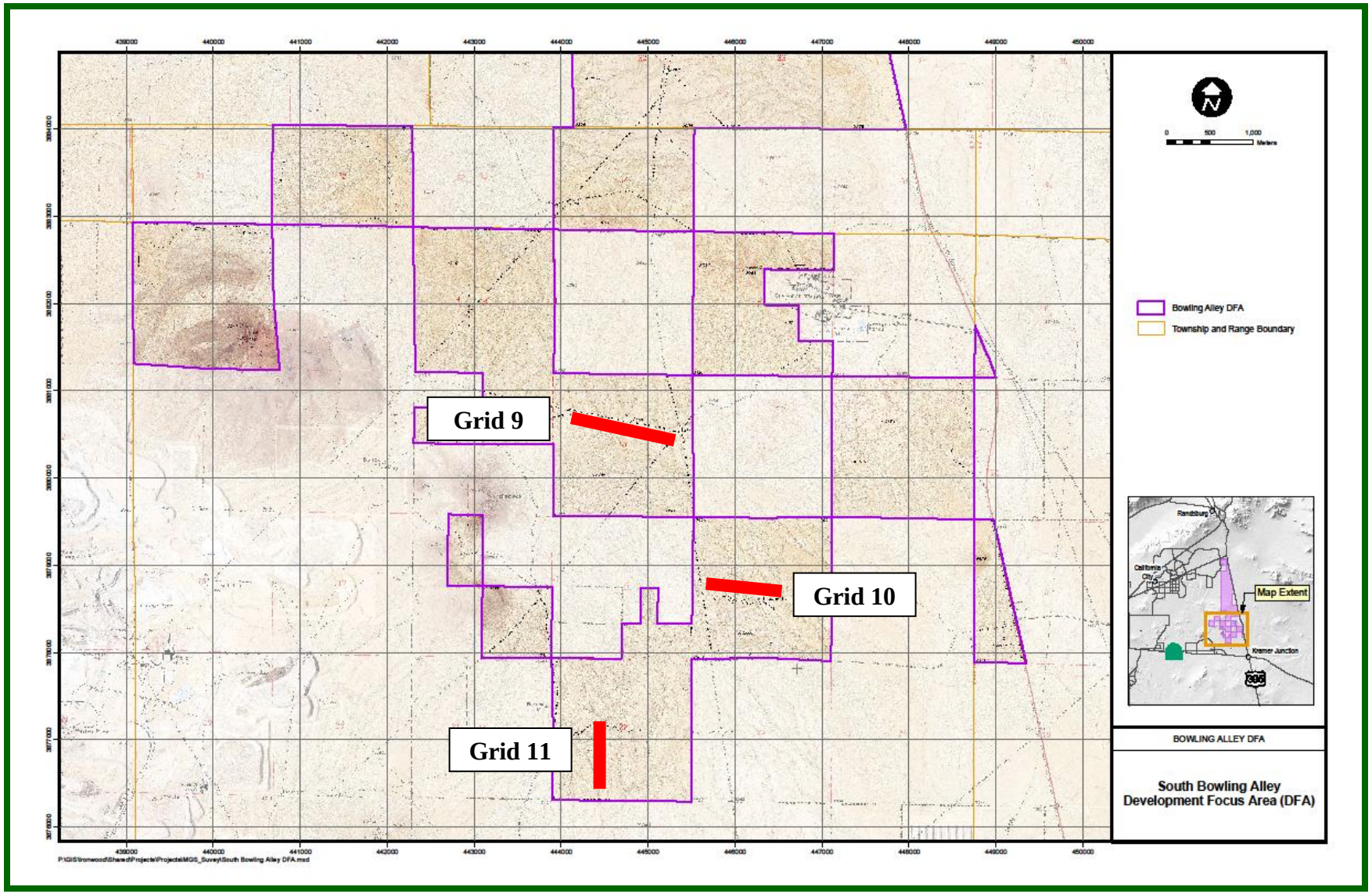
7.0. ACKNOWLEDGEMENTS

This was a volunteer effort supported by many individuals. Key personnel who either hold Memoranda of Understanding (MOU) with the CDFW or are Principal Investigators on those MOUs included Kathy Simon, Lehong Chow, Adam Walters, Leo Simone, Aga Napiatek, and Erin Whitfield. We appreciate assistance from Dr. Scott Osborn of the CDFW, who provided provisional authorization to biologists who were not identified as Independent Researchers or Field Assistants on the various MOUs. Dr. Phil Leitner was instrumental in helping to decide the best placement of trapping grids based on previous grid locations, served as liaison to forward collected tissue samples to Dr. Marjorie Matocq for genetics analysis, and provided insightful review and comment on earlier drafts of this report. In addition to the six biologists listed above, the following personnel (listed in alphabetical order) assisted in trapping: Margaret Adam, Sarah Barrera, Claudia Bauer, Chris Bedwell, Crystal Bedwell, Corey Chan, Chris Fabry, Kelly Hunt, Gabriella Machal, Erin Martinelli, Julie McNamara, Porfirio Pacheco, Nicolena vonHedemann, Denise Woodard, and Rachel Woodard.

APPENDIX A. USGS-Based Maps of the Bowling Alley

The following series of maps was provided by Kathy Simon. LaRue placed the grid locations on the maps, which are considered approximations. Figures 4 through 14 in the text are accurate depictions of grid locations, and provide the NAD 83 UTM coordinates for each grid and the special status resources detected.




Grid 9
Grid 10
Grid 11
Bowling Alley DFA
Township and Range Boundary
Map Extent
BOWLING ALLEY DFA
South Bowling Alley
Development Focus Area (DFA)

Appendix B. Plant Species Detected

The following plant species were identified along the indicated grid lines, where "1" = Grid 1 and "11" = Grid 11. Those plant species that are protected by pertinent State ordinances are highlighted in red and signified by "(SC)" following the common name.

ANGIOSPERMAE: DICOTYLEDONES	DICOT FLOWERING PLANTS
Asteraceae	**Sunflower family**
1, 4, 5, 6, 7, 8, 10, 11 *Acamptopappus sphaerocephalus*	Desert goldenhead
1, 3, 4, 5, 6, 7, 8, 9, 10, 11 *Ambrosia dumosa*	Burrobush
1, 2, 4, 5, 6, 7, 8, 9, 10 *Ambrosia salsola*	Cheesebush
4 *Artemisia spinescens*	Budsage
11 *Chrysothamnus nauseosus*	Rubber rabbitbrush
1, 2, 3, 4, 5, 6, 7, 8, 11 *Ericameria cooperi*	Cooper's goldenbush
1, 3, 4, 5, 6, 7, 8, 9, 10 *Tetradymia* sp.	Cottonthorn
1, 5, 6, 7, 8, 9, 10, 11 *Xylorhiza tortifolia*	Desert aster
Brassicaceae	**Mustard family**
6, 7, 8, 9, 10 *Lepidium fremontii*	Bush peppergrass
Cactaceae	**Cactus family**
6, 7, 8 *Cylindropuntia echinocarpa*	Silver cholla (SC)
7 *Echinocactus polycephalus*	Cottontop cactus (SC)
6, 7, 8 *Opuntia basilaris*	Beavertail cactus (SC)
Chenopodiaceae	**Goosefoot family**
1, 3, 4, 5, 6, 7, 8, 9, 10, 11 *Atriplex confertifolia*	Spiny saltbush
3, 6, 8, 10 *Atriplex polycarpa*	Allscale
1, 2, 3, 4, 5, 6, 7, 8, 10, 11 *Atriplex spinifera*	Spiny saltbush
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 *Grayia spinosa*	Spiny hopsage
1, 2, 3, 4, 5, 6, 7, 8, 9, 10 *Krascheninnikovia lanata*	Winterfat
Fabaceae	**Pea family**
9 *Psorothamnus arborescens*	Indigo bush
Nyctaginaceae	**Four o'clock family**
7, 8 *Mirabilis bigelovii*	Desert wishbone plant
Solanaceae	**Nightshade family**
1, 3, 4, 5, 6, 7, 8, 9, 10, 11 *Lycium andersonii*	Anderson's box-thorn
1, 3, 5 *Lycium cooperi*	Peach thorn
Zygophyllaceae	**Caltrop family**
1, 5, 6, 7, 8, 9, 10, 11 *Larrea tridentata*	Creosote bush

ANGIOSPERMAE: MONOCOTYLEDONES	MONOCOT FLOWERING PLANTS
Poaceae	**Grass family**
3, 4, 5, 6, 7, 8 *Achnatherum speciosum*	Desert needlegrass

Some species may not have been detected because of the seasonal nature of their occurrence. Common names are taken from Beauchamp (1986), Hickman (1993), Jaeger (1969), and Munz (1974).

Appendix C. Photographic Exhibits of Grids

Locations of 10 photographic exhibits on next five pages are shown below in Figure 19:

Figure 19. Bowling Alley: Locations of Photographic Exhibits

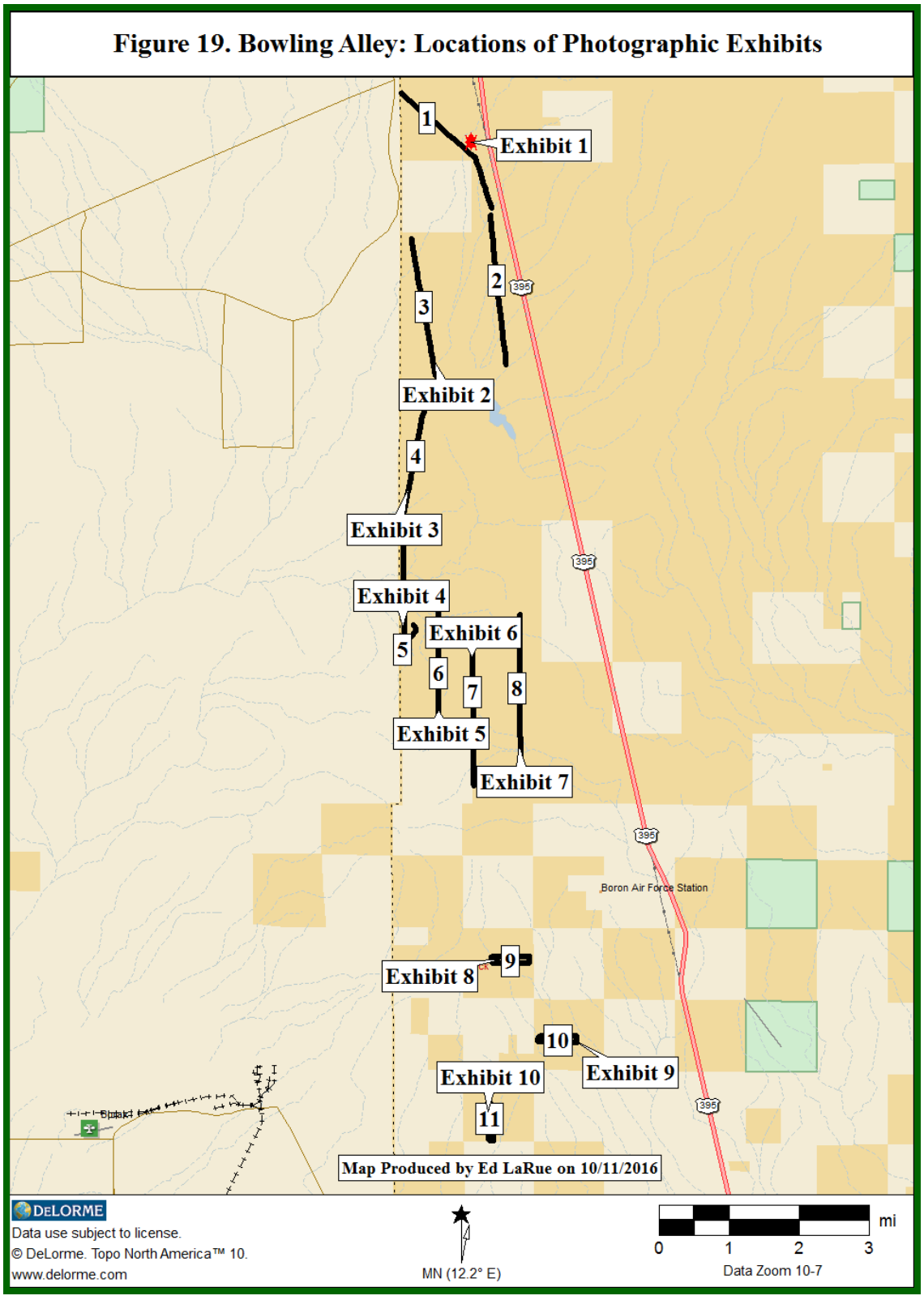


Exhibit 1. Grid 1: View of desert tortoise near the center of grid.

Exhibit 2. Grid 3: View from south end of grid, facing north into typical saltbush scrub.

Exhibit 3. Grid 4: View from south end of grid, facing north into typical saltbush scrub.

Exhibit 4. Grid 5: View from near south end of grid, facing south into creosote bush scrub, very near where MGS was captured, so view of occupied habitat.

Exhibit 5. Grid 6: View from near south end of grid, facing north into rocky, low rolling hills.

Exhibit 6. Grid 7: Creosote bush scrub at north end of grid, facing south towards low hills.

Exhibit 7. Grid 8: Saltbush in foreground, creosote bush in background, from south end of grid.

Exhibit 8. Grid 9: View from southwest corner of grid, facing northeast.

Exhibit 9. Grid 10: View from northeast corner of grid, facing southwest.

Exhibit 10. Grid 11: View from northeast corner of grid, facing southwest.

Appendix D. DRECP Vegetation Maps and Locations of 13 MGS Trapped in 2016

The following series of maps are enlargements of the DRECP vegetation map shown in Figure 3. The mapping tool allowed GPS (NAD 83) coordinates to be superimposed on the vegetation layer, revealing the plant communities in which each of the 13 MGS was trapped.

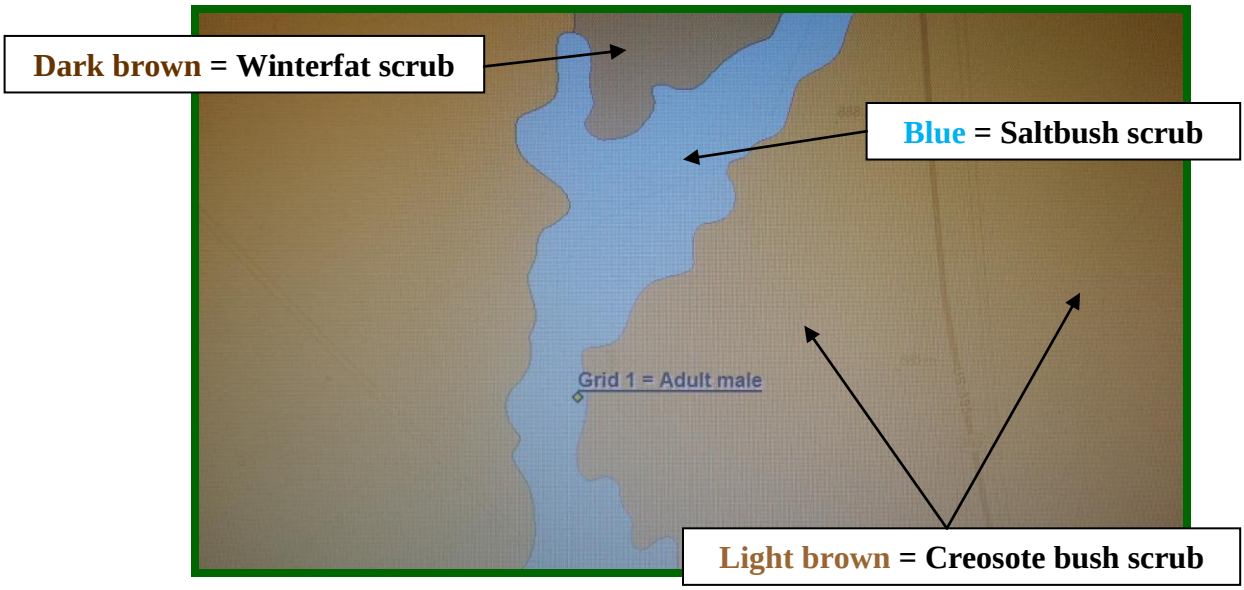


Figure D1. The adult male MGS caught on three occasions on May 6, 8, and 9, 2016 on Grid 1 occurred in saltbush scrub, which is depicted in blue in the above figure. Shown in dark brown at the top of the figure, winterfat scrub located north of Grid 1, was found only in this location in the Bowling Alley.

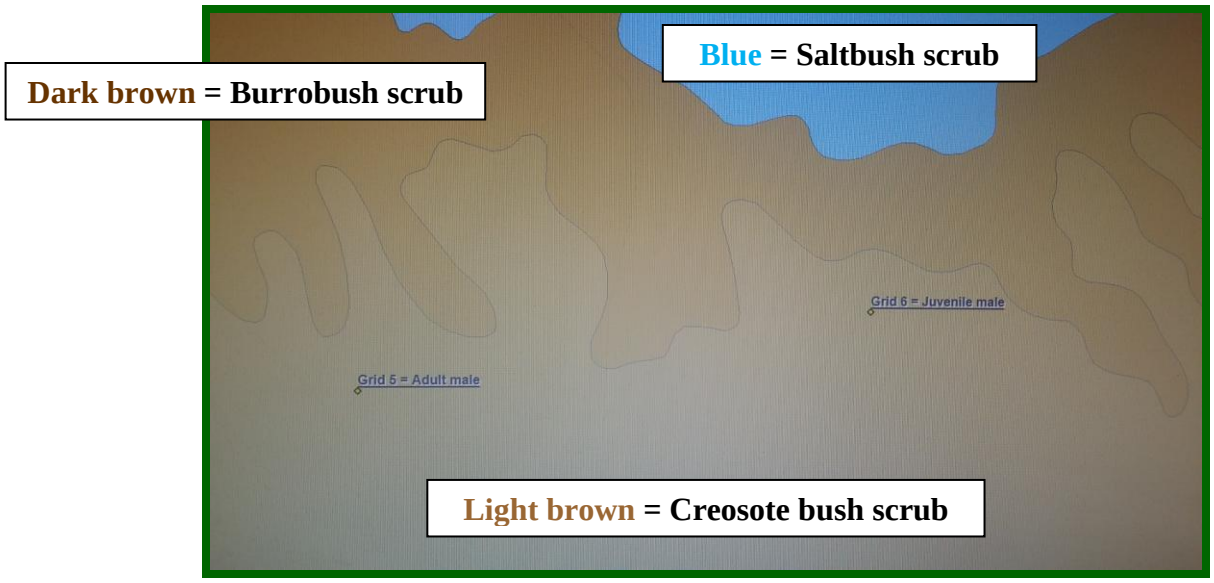


Figure D2. The adult male MGS caught on March 15, 2016 on Grid 5 and the juvenile male caught on June 17, 2016 were both in creosote bush scrub, with burrobush scrub found just north of the two captures.

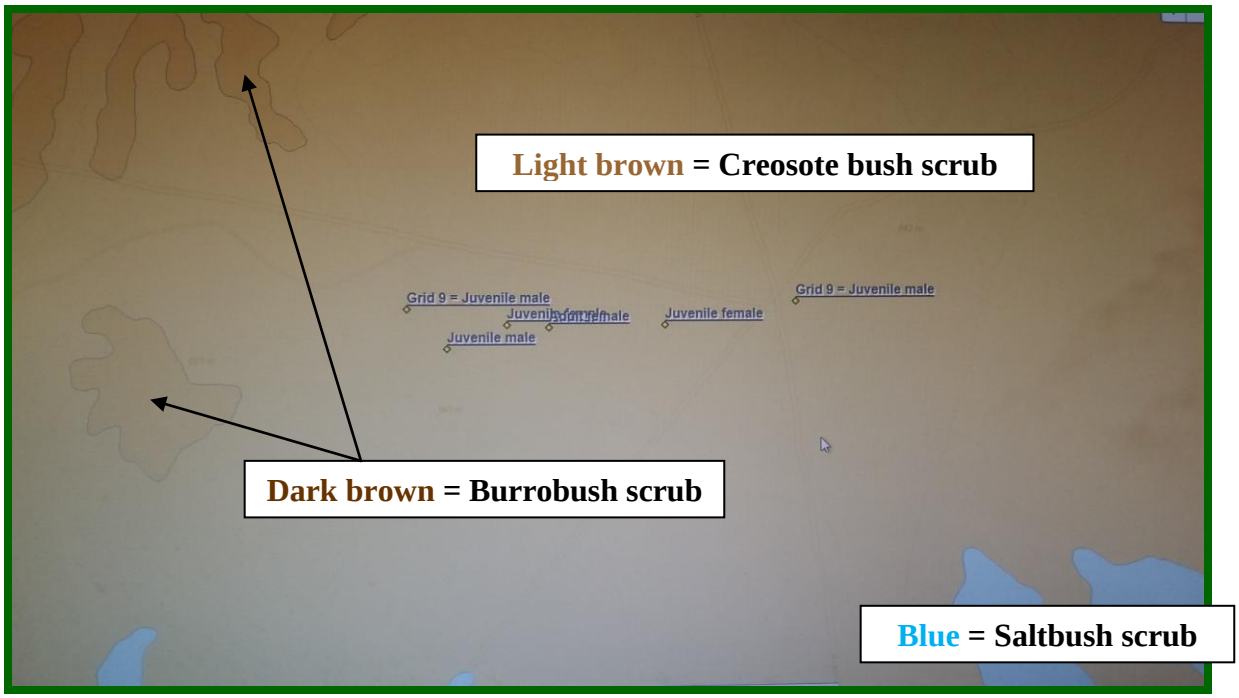


Figure D3. The adult female, three juvenile male, and two juvenile female MGS caught between June 13 and 19, 2016 on Grid 9 were all found in creosote bush scrub, with burrobush scrub and saltbush scrub nearby.

Figure D4. The adult female MGS caught on Grid 10 on June 14, 2016 was found in saltbush scrub, which is surrounded by creosote bush scrub and no burrobush scrub component.

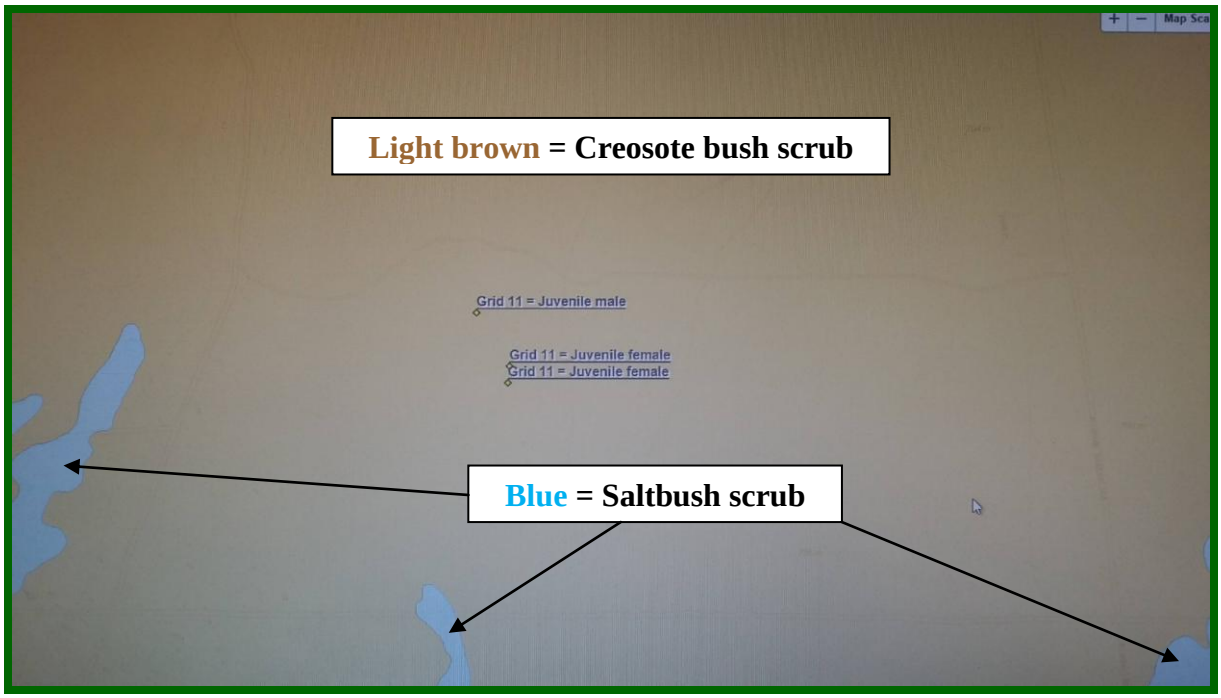


Figure D5. The three juvenile MGS caught on Grid 11 between June 19 and 22, 2016 were each found in creosote bush scrub with small islands of saltbush scrub nearby.