**PROJECT:** Historical and Current Assessment of Six Covered and Three Evaluation Bird Species

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## EXECUTIVE SUMMARY

- The project reported on herein was developed with goal of providing information towards assessing the status of six 'covered' and 'three' evaluation bird species within Clark County, specifically: Bell's vireo, Bendire's thrasher, blue grosbeak, gray vireo, Le Conte's thrasher, phainopepla, southwestern willow flycatcher, summer tanager, and vermilion flycatcher. This project had two main elements, which are reported on below in two main sections.
- Section I focused on intensive area surveys aimed at habitats thought to be occupied by the targeted species, and 8 intensive area searches were conducted over two seasons. The successful monitoring and habitat measurements at these sites supported regional efforts to assess the status of bird species throughout Clark County and Nevada, and were conducted as a component of the Nevada Bird Count.
- Section II focused on targeted surveys and assessments of historical locations for these species within Clark County. Historical records for each species were compiled from multiple sources and georeferenced. Field surveys were used to assess species presence at 154 of these locations, and to assess site condition in relationship to human disturbance.
- General trends in habitat loss for species resulting from urbanization were estimated from the loss of plant communities in relationship to urban footprint layers for 1985, 1994 and 2006.
- In general, there was insufficient historical data for most of the bird species to draw strong conclusions on the impact of urban development, but trends associated with the data are described for each species.

## INTRODUCTION

Bird species that are rare, or cryptic, often present challenges for conservation assessment and planning. Low densities, cryptic behavior, and temporal variation in habitat occupancy make these species difficult to detect. This in turn tends to confound efforts to understand regional habitat selection and distribution, as well as assessment of population trends. Most of the bird species listed as 'covered' and 'evaluation' under the Clark County Multiple Species Habitat Conservation Plan (MSHCP; Clark County 2000) are rare or cryptic in nature. Some of these species may simply be locally rare because they reach their northern limits for environmental features within the region of the county. Some, however, rely on distinct habitats such as lowland riparian and mesquite-acacia which are not only locally limited, but have also decreased in quality and size because of human activities.

When this project was proposed, regional land managers indicated that there was insufficient information to adequately assess historic and current distributions for most of the bird species targeted by this project. At that time, the MSHCP science advisors (Clark County 2004) reiterated these limitations recommending that a high priority should be placed on filling in the knowledge gaps required to assess the status of the covered species. The project reported on herein was developed in direct response to that recommendation with the goal of providing information towards assessing the status of six covered and three evaluation bird species within Clark County, specifically: Bell's vireo (*Vireo bellii*), Bendire's thrasher (*Toxostoma bendirei*), blue grosbeak (*Passerina caerulea*), gray vireo (*V. vicinior*), Le Conte's thrasher (*T. lecontei*), phainopepla (*Phainopepla nitens*), southwestern willow flycatcher (*Empidonax traillii extimus*), summer tanager (*Piranga rubra*), and vermilion flycatcher (*Pyrocephalus rubinus*). In general, these are passerine birds that are bound to breeding territories during spring or early summer.

Through a process of consultation with MSHCP managers and scientific advisors, this project was developed to consist of two main elements, which are reported on below in two main sections. The first section focuses on intensive area surveys aimed at habitats thought to be occupied by the targeted species and were conducted in support of regional and statewide monitoring efforts. The second section focuses on targeted inventories and assessments of historical locations for these species within Clark County. Associated efforts to develop conceptual and habitat suitability models for these species are covered under a separate project (2005-NPS-609A-P, Conceptual and Habitat Models for Six Covered and Three Evaluation Bird Species) and are reported on separately. The information in this document, along with associated data delivered to Clark County, represent the final report for work performed under the project titled, Historical and Current Assessment of Six Covered and Three Evaluation Bird Species.

## SECTION I – INTENSIVE AREA SEARCHES

### Background

The intensive area searches conducted under this project were intended to support and advance regional efforts to monitor and assess the status of bird species throughout Clark County and Nevada. These searches were specifically designed as a component of the Nevada Bird Count, coordinated by the Great Basin Bird Observatory (GBBO), in response to a statewide initiative by Nevada Partners in Flight to implement an 'all bird' monitoring program (Neel 1999). The approach and protocols implemented were adopted from those used by the GBBO (2005), and the data primarily intended for analysis in the larger Nevada Bird Count program.

The primary purpose of the intensive area searches was to provide an 'unbiased' density estimate that can be used to generate correction factors for estimates obtained over larger areas using more rapid survey approaches, such as point counts (Bart and Earnst 2002). In essence, the intensive areas searches provide detailed species-specific data on the numbers of breeding birds within a particular area and habitat type. More rapid survey approaches (i.e. point counts) can then be conducted within the same areas during the same times. The expectation is that the rapid survey will sample fewer birds, because some birds will be concealed on nests or foraging outside of the sampling range during the survey, and because rapid surveys can be expected to result in biased estimates for more cryptic birds with low detectability. The difference in observations between the intensive and rapid approaches for each species can be used to calculate habitat-specific correction factors for rapid surveys (Bart and Earnst 2002). A second use for the intensive area searches of interest to the NPS was to provide the potential for independent, long-term monitoring of breeding birds at high-priority sites. Repeated surveys can be used to assess changes in breeding bird numbers at important sites through time and in response to site-specific habitat changes. Two of the sites monitored during this project have been similarly monitored in the recent past (see below).

*Objective* – This project was intended to intensively monitor four sites annually during the 2008 and 2009 breeding seasons. The aim was to allocate the intensive area searches among habitat types (vegetation communities) expected to maximize the potential for detecting the targeted bird species indentified for this project.

### Methods

*Intensive area searches* – Field protocols were described in a project-specific Field Protocol document previously (2008) submitted to Clark County. In general, methods for this portion of the project were consistent with protocols established for intensive area searches associated with the Nevada Bird Count program (GBBO 2005, 2009). The intensive area plots varied in size depending on terrain and habitat, but were designed to be surveyed during a single morning (in

this project, plots ranged from 12 to 41 ha). These plots were set up in roughly rectangular grids with flags placed every 50 to 100 m.

Maps were used during searches to plot and record bird observations. These maps, created with the use of a Geographic Information System (v9.2, ESRI Inc. Redlands, California), included aerial images of the plots (NAIP imagery, U.S.D.A. Farm Service Agency 2006), UTM grids, and denotations of boundaries and flagging. Field searches began early in the morning with the surveyor starting from one corner of the plot and progressing systematically through the plot recording all birds present and marking locations on the map. Map information was later transferred into a geospatial database following quality assurance protocols established in a Data Management Plan previously (2007) submitted to Clark County. Partial territories near plot boundaries required efforts outside the plot to provide an estimate of how much of a territory was within the boundary.

In order to adequately determine breeding birds and breeding territories, plots were surveyed once a week for 8-10 weeks. The objective was for the surveyor to be confident that all evidence of nesting had been documented. Searches were conducted between early April and the end of June at most locations with the exception of surveys at a salt desert scrub plot, which targeted Le Conte's thrashers. This species is a permanent resident and breeds early regionally, and surveys at this site began in early March.

After field surveys were completed, species territories overlapping each plot were estimated by the field surveyor following a protocol established by the GBBO. Territories were delineated by confirmation of active nest, nestlings, or dependent young, with boundaries beyond nest sites clarified by territorial behavior or by the locations of the most tightly clustered 90% of the observations of attending adults. In the absence of direct breeding evidence, territory boundaries were determined by at least 3 (when sites were visited 8 times) or 4 detections (when sites were visited 9 or more times) of an adult bird in an area on separate visits. In order to avoid including migrant or transient birds, detections had to be at least 10 days apart.

*Recording of habitat features at monitoring sites* – As part of the intensive area search approach, habitat features were recorded at 3 to 6 points within each plot (number of points surveyed varied based on plot size) following a detailed protocol (GBBO 2008). The following habitat features were measured (at each point): (1) a photograph of the general conditions; (2) categorical variables addressing landscape characteristics and habitat threats; (3) cover and foliage height diversity measured using a point-intercept method; (4) tree density and size; and (5) a summary of vegetation within the plot. Vegetation measurements were made along four 30 m line/belt transects offset randomly from the center point by 5-60 m and established at $90^{o}$ angles from one another with an initial random transect direction.

**Results**

As the primary goal of this effort was to assist with regional bird monitoring, analyses were limited to summaries of bird observations and to estimates of the number and spatial pattern of territories on each plot. Analyses that incorporate the observation and habitat data for determining correction factors for point count surveys are the responsibility of GBBO personnel under a separate project and are reported elsewhere.

*2008 Field Season* – In 2008, four intensive area plots were surveyed (Table 1-1, Figure 1-1). Two of the plots were spring sites (Sacatone and Rogers springs) located within Lake Mead National Recreation Area (LMNRA). Sacatone Spring in the Newberry Mountains at approximately 670 m consisted of 12 ha in a mountainous riparian wash. Following a habitat restoration project in 1992, many native plant species have become established within the plot, including cottonwoods (*Populus fremontii*), willows (*Salix sp*.), and mesquite (*Prosopis sp*.) trees. This riparian wash is heavily used by upland birds, and 1357 observations of 39 species were recorded during the current monitoring effort, including observations of the targeted species, Bell's vireo and phainopepla. A total of 39 territories of 17 different species were documented to overlap the plot (Table 1-2, Figure 1-2).

Rogers Spring was at a lower elevation (approximately 410 m) and was located at the edge of the Muddy Mountains along the north shore of Lake Mead. This 15 ha plot was established approximately 1.5 km from the springhead. Vegetation was dominated by arrowweed (*Pluchea sericea*), common reed (*Phragmites sp*.), seepweed (*Suaeda moquinnii*), and catclaw (*Acacia gregii*). The total number of bird observations was much lower at Rogers Spring than at Sacatone Spring, but still 37 bird species were counted. Only 17 territories of 9 different species were documented to overlap the plot (Table 1-3). Bell's vireo and phainopepla were also seen at this site.

The other two plots were established on Bureau of Land Management (BLM) land, with one plot located in a pinion-juniper woodland and the other plot located in salt desert scrub habitat. The pinion-juniper plot ('South McCullough Mountains') consisted of 15 ha along a lower ridge of the McCullough Mountains at an elevation of 1540 m. The plot contained an upland wash running through its middle. The vegetation community, in addition to pinion (*Pinus monophylla*) and juniper (*Juniperus sp.*), was dominated by Joshua tree (*Yucca brevifolia*), Apache plume (*Fallugia paradoxa*), and desert almond (*Prunus fasiculatum*). During surveys a total of 717 bird observations of 38 different species were recorded, which included observations of the gray vireo, a targeted species for this project. Twenty-five territories of 12 different species were recorded on this plot (Table 1-4).

The salt desert scrub plot ('North Las Vegas Valley') was established at an elevation of 885 m in North Las Vegas Valley just outside Corn Creek and the boundary of the Desert National Wildlife Refuge. This 41 ha plot was dominated by cattle and four-wing saltbush (*Atriplex polycarpa* and *A. canescens*) with a creosote bush (*Larrea tridentata*) component. The

salt desert scrub plot had the fewest bird observations, territories, and species (Table 1-5), but Le Conte's thrasher occurred at high densities in the area and 5 territories of this targeted species were documented on the plot.

*2009 Field Season* – In 2009, the salt desert scrub plot was surveyed again, along with three other plots (Table 1-1). This plot was resurveyed in order to gain better information on Le Conte's thrashers. Again, among all the plots, this site had the fewest number of bird observations, territories, and species, but during this season three breeding territories of the Le Conte's thrasher were documented to overlap the plot (Table 1-5).

A spring site in the Newberry Mountains on LMNRA was also surveyed, this time at Lower Grapevine Spring, a site not far from Sacatone Spring. Lower Grapevine Spring consisted of 18.3 ha along a drainage that had also undergone tamarisk removal treatment as part of a habitat restoration project in 2006. Prior to the habitat treatment, this site was surveyed for birds as part of an intensive area monitoring effort with a major effort in 2004 (see below). During the current survey, much of the native vegetation planted in 2006 had not yet become well established, and the plot was dominated by dead tamarisk stems burned during the restoration effort. A portion of the plot was located in an area that was not part of the restoration project, and this area was dominated by desert willow (*Chilopsis linearis*). Even with the large portion of altered habitat, the plot overlapped 30 territories from 10 different species. Two of the targeted species, Le Conte's thrasher and phainopepla, were observed at the site (Table 1-6).

The two other plots were setup in a catclaw wash and in Mojave mixed scrub on BLM lands. The Mojave mixed scrub plot ('Knob Hill') was located in the Eldorado Mountains at an elevation of 1220 m. Vegetation at this site consisted predominately of creosote bush and bursage (*Ambrosia dumosa*) with components of Mojave yucca (*Y. schidigera*) and cholla (*Opuntia sp*.) (Table 1-1). Thirty different species, including phainopepla, were using this 17 ha plot, which was the highest species diversity recorded among the plots assessed. A total of 27 territories representing 15 different species were recorded to overlap this plot (Table 1-7).

The catclaw wash plot ('West of Cottonwood Cove') was located 14.5 km west from the Cottonwood Cove Marina at an elevation of approximately 900 m. Vegetation at this 25.5 ha plot consisted mostly of catclaw with a substantial components of buckhorn cholla (*O. acanthocarpa*), Mojave yucca, and creosote bush. A total of 1520 bird observations were recorded at this site, along with 26 territories of 12 species, including 3 territories of the phainopepla (Table 1-8).

**Discussion**

As part of the NPS effort to monitor high-priority sites (a secondary objective), three of the intensive monitoring plots were targeted on spring sites within LMNRA – Rogers, Sacatone, and Grapevine springs. All these plots have experienced tamarisk removal activity conducted by the NPS over time, and Sacatone and Grapevine springs plots were at sites on which extensive

restoration efforts had been focused. Habitat restoration at Sacatone Spring began in 1992 and the plot now has well established native riparian vegetation and young trees. The plot was intensively monitored for birds in 2004 as part of a previous project (Fletcher and Barnes 2005). An analysis of habitat development and bird use at this site is outside the scope of this project, and such assessments can be greatly impacted by weather patterns associated with the sampling periods. Nevertheless, in 2004 there were 18 bird territories of 16 species noted to overlap the site, including a phainopepla territory, and in the recent survey, 39 territories of 17 species were documented, including phainopepla and Bell's vireo (Table 1-2).

Grapevine Spring underwent tamarisk removal treatment as part of a habitat restoration project in 2006 and tamarisk at the site was burned and treated with herbicide at that time. Native riparian vegetation at the site has not yet become well established. In 2004, prior to restoration treatment, the site was intensively monitored for birds and at that time there were 19 territories of 15 species at the plot including 2 phainopepla territories (Fetcher and Barnes 2005). Although the site under current conditions has territories of only 10 species, none of which were of the targeted species, a total of 30 individual territories were noted to overlap the plot (Table 1-6). Interestingly, a Le Conte's thrasher was observed on the site at a flat area containing cholla on the edge of the plot.

The intensive area searches were conducted in habitats thought to be occupied by the targeted species (main objective; Table 1-1), and on each site at least one of the targeted species was observed. Observations consisted mainly of the phainopepla which was observed at five of the plots including the Mojave mixed scrub, catclaw and all three spring sites. At the catclaw plot, three breeding territories of this species were documented.

The Le Conte's thrasher was the second most encountered of the targeted species, and it was observed at plots on the salt desert scrub site and at lower Grapevine Spring (a lower elevation spring site). A total of 8 Le Conte's thrasher territories were documented to overlap the salt desert scrub plot over the two years that the site was monitored. The density of Le Conte's thrashers that overlap this plot is comparable to the highest densities recorded for this rare species (Sheppard 1973). Apparently, the cattle saltbush growing in the flats to the east of Corn Creek represents an important breeding habitat for this species within Clark County.

Of the other two species observed during surveys, the Bell's vireo was recorded at Sacatone and Rogers springs, but not at Grapevine Spring which appears to not yet have developed sufficient riparian structure to attract these birds following the recent restoration efforts. The gray vireo was observed on the pinion-juniper site, which was established to target this species, although it was not documented to breed within the plot.

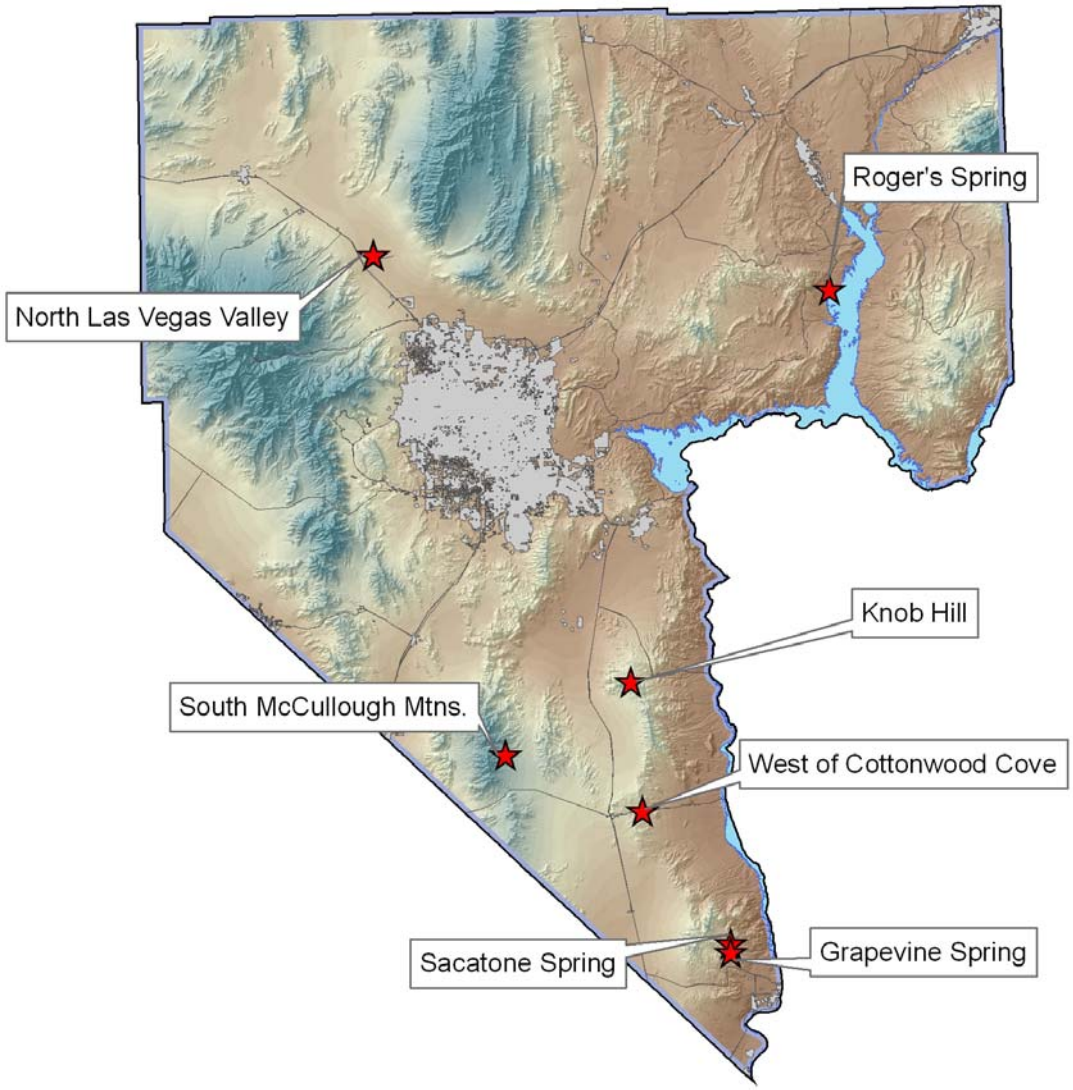


**Figure 1-1**. Map showing intensive area plots surveyed in Clark County during the 2008 and 2009 field seasons. The plot in North Las Vegas Valley targeted salt desert scrub, Knob Hill targeted Mojave mixed scrub, McCullough Mountains targeted pinion-juniper, and West of Cottonwood Cove targeted catclaw vegetation. The other three sites targeted riparian vegetation around springs.

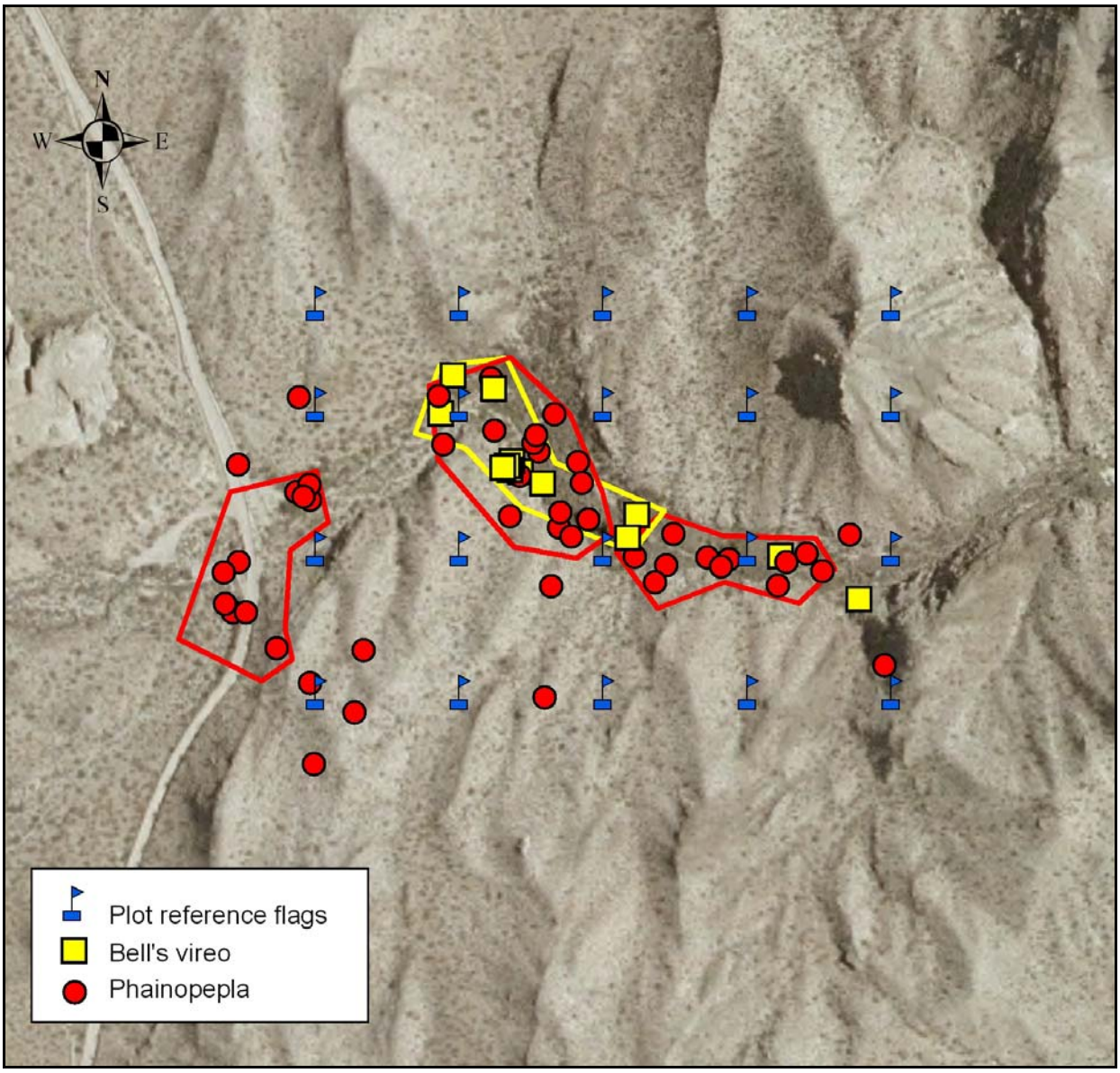


**Figure 1-2**. An example map showing total observations and territories of Bell's vireo (yellow polygon) and phainopepla (red polygons) at the Sacatone Spring in 2008.

**Table 1-1**. Locations of intensive area plots along with land manager (BLM or LMNRA), habitat type, and the targeted bird species expected at each plot. Reference locations (UTM, NAD 83) are of the northwest corner. The species names are abbreviated as follows: Bell's vireo (BEVI), Bendire's thrasher (BETH), blue grosbeak (BLGR), gray vireo (GRVI), Le Conte's thrasher (LCTH), phainopepla (PHAI), southwestern willow flycatcher (WIFL), summer tanager (SUTA), and vermilion flycatcher (VEFL).

| Location | Targeted Species | Habitat Type | Year (No. of Surveys) |
|---|---|---|---|
| Sacatone Spring, Newberry Mountains, LMNRA (711591N, 3902466E) | PHAI, BLGR, BEVI<br>Possible: SUTA, VEFL, WIFL | Upland Spring Riparian | 2008 (9 surveys) |
| Grapevine Spring, New Berry Mountains, LMNRA (711300N, 3900850E) | PHAI, BLGR, BEVI<br>Possible: SUTA, VEFL, WIFL | Upland Spring Riparian | 2009 (9 surveys) |
| North Las Vegas Valley, east of boundary Corn Creek, Desert Wildlife Refuge, BLM (643198N, 4034053E) | LCTH | Salt Desert Scrub | 2008 (8 surveys)<br>2009 (9 surveys) |
| Wee Thump Wilderness, South McCullough Mountains, BLM (668630N, 3938539E) | GRVI, BETH | Pinion/Juniper Woodland | 2008 (9 surveys) |
| Roger Spring, LMNRA (730300N, 4027365E) | PHAI, BLGR, BEVI<br>Possible: SUTA, VEFL, WIFL | Mesquite/Acacia Woodland | 2008 (9 surveys) |
| West of Cottonwood Cove, BLM (694450N, 3927799E) | PHAI, LCTH, BETH<br>Possible: VEFL, WIFL | Mesquite/Acacia Woodland | 2009 (10 surveys) |
| Knob Hill, Eldorado Mountains, BLM (692300N, 3952400E) | PHAI, LCTH, & BETH | Mojave Mixed Scrub | 2009 (9 surveys) |

**Table 1-2**. Number of observations, territories overlapping plot, and territory equivalents by species on the Sacatone Spring plot in 2008.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories | | | |
| Gambel's quail | 403 | 5 | 4.5 |
| Cactus wren | 41 | 4 | 2.3 |
| Black-tailed gnatcatcher | 80 | 3 | 2.3 |
| Black-throated sparrow | 61 | 3 | 3 |
| Costa's hummingbird | 26 | 3 | 3 |
| Mourning dove | 107 | 3 | 3 |
| Phainopepla | 106 | 3 | 2.8 |
| Verdin | 64 | 3 | 2.7 |
| Ash-throated flycatcher | 54 | 2 | 2 |
| House finch | 138 | 2 | 2 |
| Lucy's warbler | 31 | 2 | 1.6 |
| Abert's towhee | 24 | 1 | 1 |
| Bell's vireo | 16 | 1 | 1 |
| Crissal thrasher | 9 | 1 | 1 |
| *Empidonax* unidentified | 10 | 1 | 1 |
| Lesser goldfinch | 12 | 1 | 1 |
| Northern mockingbird | 19 | 1 | 1 |
| Others Observed | | | |
| American kestrel | 1 | 0 | 0 |
| Black-headed grosbeak | 2 | 0 | 0 |
| Black-throated gray warbler | 1 | 0 | 0 |
| Brewer's sparrow | 4 | 0 | 0 |
| Brown-headed cowbird | 22 | 0 | 0 |
| Common raven | 2 | 0 | 0 |
| Grey flycatcher | 12 | 0 | 0 |
| Ladder-backed woodpecker | 2 | 0 | 0 |
| Loggerhead shrike | 8 | 0 | 0 |
| MacGillivray's warbler | 5 | 0 | 0 |
| Orange-crowned warbler | 7 | 0 | 0 |
| Rock wren | 1 | 0 | 0 |
| Sharp-shinned hawk | 2 | 0 | 0 |
| Spotted towhee | 1 | 0 | 0 |
| Turkey vulture | 19 | 0 | 0 |
| Unidentified bird | 21 | 0 | 0 |
| Western kingbird | 4 | 0 | 0 |
| Western wood pee-wee | 3 | 0 | 0 |
| White-throated swift | 8 | 0 | 0 |
| White-winged dove | 12 | 0 | 0 |
| Wilson's warbler | 11 | 0 | 0 |
| Yellow warbler | 5 | 0 | 0 |
| Yellow-rumped warbler | 3 | 0 | 0 |

**Table 1-3**. Number of observations, territories overlapping plot, and territory equivalents by species on the Rogers Spring plot in 2008.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories | | | |
| Horned lark | 55 | 4 | 3.3 |
| Lucy's warbler | 58 | 4 | 4 |
| Common yellowthroat | 26 | 2 | 2 |
| Say's phoebe | 23 | 2 | 1.2 |
| Verdin | 41 | 2 | 2 |
| Ash-throated flycatcher | 12 | 1 | 1 |
| Bell's vireo | 5 | 1 | 1 |
| Mourning dove | 23 | 1 | 1 |
| Others Observed | | | |
| American white pelican | 40 | 0 | 0 |
| Black-tailed gnatcatcher | 2 | 0 | 0 |
| Black-throated sparrow | 6 | 0 | 0 |
| Brewer's sparrow | 2 | 0 | 0 |
| Brown-headed cowbird | 1 | 0 | 0 |
| Bullock's oriole | 8 | 0 | 0 |
| Common raven | 1 | 0 | 0 |
| Crissal thrasher | 4 | 0 | 0 |
| Gambel's quail | 5 | 0 | 0 |
| Grey flycatcher | 1 | 0 | 0 |
| House finch | 22 | 0 | 0 |
| Loggerhead shrike | 1 | 0 | 0 |
| Marsh wren | 4 | 0 | 0 |
| Northern mockingbird | 3 | 0 | 0 |
| Northern rough-winged swallow | 36 | 0 | 0 |
| Osprey | 1 | 0 | 0 |
| Phainopepla | 1 | 0 | 0 |
| Red-tailed hawk | 1 | 0 | 0 |
| Sharp-shinned hawk | 1 | 0 | 0 |
| Turkey vulture | 9 | 0 | 0 |
| Unidentified bird | 36 | 0 | 0 |
| Warbling vireo | 1 | 0 | 0 |
| Western bluebird | 1 | 0 | 0 |
| Western wood pee-wee | 1 | 0 | 0 |
| White-crowned sparrow | 16 | 0 | 0 |
| White-throated swift | 12 | 0 | 0 |
| Wilson's warbler | 8 | 0 | 0 |
| Yellow warbler | 10 | 0 | 0 |
| Yellow-breasted chat | 2 | 0 | 0 |
| Yellow-rumped warbler | 1 | 0 | 0 |

**Table 1-4**. Number of observations, territories overlapping plot, and territory equivalents by species on the Southern McCullough Mountains plot (pinion-juniper) in 2008.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories | | | |
| Black-throated sparrow | 120 | 5 | 4.3 |
| Cactus wren | 29 | 3 | 1.5 |
| Juniper titmouse | 31 | 3 | 2.9 |
| Scott's oriole | 37 | 3 | 2.2 |
| Ash-throated flycatcher | 30 | 2 | 2 |
| Bewick's wren | 27 | 2 | 2 |
| Bushtit | 108 | 2 | 2 |
| Blue-gray gnatcatcher | 30 | 1 | 1 |
| Crissal thrasher | 18 | 1 | 1 |
| Ladder-backed woodpecker | 20 | 1 | 1 |
| Mourning dove | 52 | 1 | 0.8 |
| Western scrub jay | 31 | 1 | 0.9 |
| Others Observed | | | |
| Black-tailed gnatcatcher | 1 | 0 | 0 |
| Black-throated gray warbler | 2 | 0 | 0 |
| Brewer's sparrow | 26 | 0 | 0 |
| Bullock's oriole | 2 | 0 | 0 |
| Clark's nutcracker | 2 | 0 | 0 |
| Common poorwill | 1 | 0 | 0 |
| Common raven | 3 | 0 | 0 |
| Gambel's quail | 8 | 0 | 0 |
| Gray vireo | 2 | 0 | 0 |
| Green-tailed towhee | 1 | 0 | 0 |
| Grey flycatcher | 15 | 0 | 0 |
| House finch | 25 | 0 | 0 |
| Loggerhead shrike | 5 | 0 | 0 |
| MacGillivray's warbler | 1 | 0 | 0 |
| Northern mockingbird | 2 | 0 | 0 |
| Plumbeous vireo | 1 | 0 | 0 |
| Red-tailed hawk | 5 | 0 | 0 |
| Ruby-crowned kinglet | 3 | 0 | 0 |
| Say's phoebe | 3 | 0 | 0 |
| Towsend's solitaire | 1 | 0 | 0 |
| Towsend's warbler | 2 | 0 | 0 |
| Turkey vulture | 5 | 0 | 0 |
| Unidentified bird | 41 | 0 | 0 |
| Western wood pee-wee | 3 | 0 | 0 |
| White-crowned sparrow | 6 | 0 | 0 |
| White-throated swift | 6 | 0 | 0 |
| Wilson's warbler | 12 | 0 | 0 |

**Table 1-5**. Number of observations, territories overlapping plot, and territory equivalents by species on North Las Vegas Valley plot (salt desert scrub) in 2008 and 2009.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories in 2008 | | | |
| Le Conte's thrasher | 44 | 5 | 3.75 |
| Sage sparrow | 90 | 2 | 2 |
| Horned lark | 21 | 1 | 1 |
| Lesser nighthhawk | 1 | 1 | 1 |
| Mourning dove | 12 | 1 | 1 |
| Others Observed in 2008 | | | |
| Barn swallow | 5 | 0 | 0 |
| Black-headed grosbeak | 2 | 0 | 0 |
| Blue-gray gnatcatcher | 3 | 0 | 0 |
| Brewer's sparrow | 25 | 0 | 0 |
| Cliff swallow | 12 | 0 | 0 |
| Common raven | 10 | 0 | 0 |
| Northern Harrier | 1 | 0 | 0 |
| Red-tailed hawk | 1 | 0 | 0 |
| Say's phoebe | 5 | 0 | 0 |
| Unidentified bird | 13 | 0 | 0 |
| Violet green swallow | 2 | 0 | 0 |
| White-throated swift | 1 | 0 | 0 |
| Yellow warbler | 1 | 0 | 0 |
| With Territories in 2009 | | | |
| Sage sparrow | 86 | 5 | 3.5 |
| Le Conte's thrasher | 32 | 3 | 2.7 |
| Others Observed in 2009 | | | |
| Ash-throated flycatcher | 1 | 0 | 0 |
| Black-throated sparrow | 44 | 0 | 0 |
| Blue-gray gnatcatcher | 1 | 0 | 0 |
| Brewer's sparrow | 25 | 0 | 0 |
| Brown-headed cowbird | 1 | 0 | 0 |
| Common nighthawk | 2 | 0 | 0 |
| Common raven | 1 | 0 | 0 |
| Gambel's quail | 1 | 0 | 0 |
| Gray flycatcher | 1 | 0 | 0 |
| Horned lark | 5 | 0 | 0 |
| House finch | 40 | 0 | 0 |
| Loggerhead shrike | 1 | 0 | 0 |
| Mourning dove | 16 | 0 | 0 |
| Say's phoebe | 3 | 0 | 0 |
| Unidentified bird | 4 | 0 | 0 |
| White-throated swift | 6 | 0 | 0 |
| Yellow warbler | 1 | 0 | 0 |

**Table 1-6**. Number of observations, territories overlapping plot, and territory equivalents by species on the Grapevine Spring plot in 2009.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories | | | |
| Mourning dove | 185 | 6 | 6 |
| Anna's hummingbird | 39 | 4 | 4 |
| Gambel's quail | 275 | 4 | 4 |
| Ash-throated flycatcher | 63 | 3 | 2.9 |
| Black-tailed gnatcatcher | 65 | 3 | 2.8 |
| Black-throated sparrow | 170 | 3 | 2.3 |
| Verdin | 41 | 3 | 2.9 |
| Cactus wren | 81 | 2 | 1.4 |
| Brown-headed cowbird | 11 | 1 | 1 |
| Loggerhead shrike | 40 | 1 | 0.8 |
| Others Observed | | | |
| Brewer's sparrow | 2 | 0 | 0 |
| Bullock's oriole | 3 | 0 | 0 |
| Chipping sparrow | 1 | 0 | 0 |
| Common raven | 2 | 0 | 0 |
| Costa's hummingbird | 4 | 0 | 0 |
| House finch | 87 | 0 | 0 |
| Ladder-backed woodpecker | 1 | 0 | 0 |
| Le Conte's thrasher | 4 | 0 | 0 |
| Northern mockingbird | 4 | 0 | 0 |
| Phainopepla | 3 | 0 | 0 |
| Red-tailed hawk | 1 | 0 | 0 |
| Rock wren | 1 | 0 | 0 |
| Scott's oriole | 1 | 0 | 0 |
| Turkey vulture | 14 | 0 | 0 |
| Unidentified hummingbird | 1 | 0 | 0 |
| Western kingbird | 1 | 0 | 0 |
| Western tanager | 2 | 0 | 0 |
| Western wood pee-wee | 1 | 0 | 0 |
| Wilson's warbler | 3 | 0 | 0 |
| Yellow warbler | 1 | 0 | 0 |

**Table 1-7**. Number of observations, territories overlapping plot, and territory equivalents by species on Knob Hill plot in the Eldorado Mountains (Mojave mixed scrub) in 2009.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories | | | |
| Black-throated Sparrow | 202 | 4 | 3.8 |
| Ash-throated Flycatcher | 103 | 3 | 2.9 |
| Mourning Dove | 83 | 3 | 2.7 |
| Cactus Wren | 45 | 2 | 1.8 |
| Gambel's Quail | 71 | 2 | 1.4 |
| House Finch | 114 | 2 | 2 |
| Loggerhead Shrike | 65 | 2 | 1.9 |
| Verdin | 49 | 2 | 1.9 |
| Anna's Hummingbird | 12 | 1 | 1 |
| Black-tailed Gnatcatcher | 21 | 1 | 1 |
| Ladder-backed Woodpecker | 40 | 1 | 0.8 |
| Red-tailed Hawk | 16 | 1 | 1 |
| Rock Wren | 12 | 1 | 1 |
| Scott's Oriole | 8 | 1 | 1 |
| Western Kingbird | 18 | 1 | 1 |
| Others Observed | | | |
| Black-headed Grosbeak | 1 | 0 | 0 |
| Bullock's Oriole | 1 | 0 | 0 |
| Gray Flycatcher | 10 | 0 | 0 |
| Green-tailed Towhee | 5 | 0 | 0 |
| MacGillivray's Warbler | 2 | 0 | 0 |
| Northern Mockingbird | 13 | 0 | 0 |
| Phainopepla | 7 | 0 | 0 |
| Sage Sparrow | 4 | 0 | 0 |
| Say's Phoebe | 9 | 0 | 0 |
| Townsend's Warbler | 1 | 0 | 0 |
| Turkey Vulture | 2 | 0 | 0 |
| Unidentified Hummingbird | 4 | 0 | 0 |
| Western Bluebird | 1 | 0 | 0 |
| Western Wood Pee-wee | 7 | 0 | 0 |
| White-crowned Sparrow | 3 | 0 | 0 |
| White-throated Swift | 3 | 0 | 0 |
| Wilson's Warbler | 8 | 0 | 0 |

**Table 1-8**. Number of observations, territories overlapping plot, and territory equivalents by species on West of Cottonwood plot (catclaw wash habitat) in 2009.

| Species | No. of Observations | No. of Territories | Territory Equivalents in Plot |
|---|---|---|---|
| With Territories | | | |
| Ash-throated flycatcher | 88 | 3 | 2.9 |
| Black-tailed gnatcatcher | 51 | 3 | 2.6 |
| Black-throated sparrow | 279 | 3 | 2.8 |
| Mourning dove | 222 | 3 | 2.5 |
| Cactus wren | 65 | 2 | 1.9 |
| Gambel's quail | 474 | 2 | 1.5 |
| Loggerhead shrike | 37 | 2 | 1.9 |
| Northern mockingbird | 18 | 2 | 2 |
| Phainopepla | 61 | 2 | 2 |
| Verdin | 55 | 2 | 2 |
| Brown-headed cowbird | 33 | 1 | 1 |
| Ladder-backed woodpecker | 7 | 1 | 0.9 |
| Others Observed | | | |
| Anna's hummingbird | 1 | 0 | 0 |
| Brewer's sparrow | 16 | 0 | 0 |
| Bullock's oriole | 2 | 0 | 0 |
| Common raven | 6 | 0 | 0 |
| Gray flycatcher | 9 | 0 | 0 |
| Great-tailed grackle | 1 | 0 | 0 |
| House finch | 68 | 0 | 0 |
| Prairie falcon | 1 | 0 | 0 |
| Red-tailed hawk | 2 | 0 | 0 |
| Rock wren | 1 | 0 | 0 |
| Say's phoebe | 5 | 0 | 0 |
| Turkey vulture | 6 | 0 | 0 |
| Unidentified Buteo | 1 | 0 | 0 |
| Western kingbird | 4 | 0 | 0 |
| Western wood pee-wee | 1 | 0 | 0 |
| Wilson's warbler | 6 | 0 | 0 |

## SECTION II – HISTORICAL ASSESSMENTS

### Background

A common approach to assessing change in distributions of wild populations in response to human encroachment is to assess current presence of a species at sites of historical observations and to relate these new observations to current habitat conditions at the sites. In general, however, such assessments are mostly hampered by a relative scarcity of historical data (for a local example see Bradford et al. 2003). For assessments of bird species, such approaches are also hampered by records that can represent transient birds observed in non-typical habitat, or observations of birds attracted to generally unsuitable (sink) habitats at urban and suburban margins due to the presence of particularly attractive features such as trees, surface water, and feeders. Regardless of these limitations, a review of historical data and assessments of conditions of the historical sites can be useful for evaluating potential habitat loss for important species.

The project described in this section focused on compiling and assessing the usefulness of historical records for nine targeted bird species (identified in Section I), and conducting targeted surveys at historical locations to determine presence and assess habitat features. Further effort focused on an attempt to evaluate the loss of potential habitat caused by recent urban development within Clark County. The original intent was to use the year 1985 as a cutoff date for historical observations, but following preliminary assessments that showed limited historical records and negotiations with Clark County project managers, the cutoff was shifted to 1994, the year when the population of Clark County reached approximately 1 million.

*Objectives* – The objectives of this portion of the project were to: (1) gather and review available observations on historical (prior to 1994) locations of nine targeted bird species from published literature, museum specimens, and data archives; (2) conduct targeted surveys for each species at historical locations; and (3) identify possible changes in suitable habitat for each species within Clark County.

### Methods

*Compilation and georeferencing of historical observation records* – Prior to compiling historical records of the nine targeted bird species, the taxonomic history of each species was first reviewed using the integrated taxonomic information system (ITIS; retrieved June 17, 2008; http://www.itis.gov). ITIS allowed a quick search of all common and scientific names (including subspecies) associated with each species. The only relevant information from this search was a change in the genus for the blue grosbeak from *Guiraca* to *Passerina*.

Historical records of the target species within Clark County were compiled from 3 major sources: 44 electronic databases available through the web portal Ebird (retrieved November 25,

2008; http://ebird.org) and ORNIS (retrieved June 21, 2008; http://ornisnet.org); requested datasets from 11 different agencies; and observations reported in 26 publications found during literature review (a summary of this search effort was provided to the County in database form). Most of the historic records obtained required georeferencing (Hill 2006) because records were referenced only by location descriptions and lacked spatial coordinates. The program Biogeomancer (http://biogeomancer.org) was used to estimate geographical coordinates associated with location descriptions, as well as estimates of uncertainty buffering the locations. This program follows a specific protocol, and some descriptive information could not be inputted. For example, for a description of a location "12 miles east of Searchlight near the river", the program could not make use of the information "near the river" which then resulted in a rather large error associated with the location. In these cases, appropriate (although subjective) replacement estimates were made of coordinates and errors. Georeferenced records with error estimates > 6 km in radius were not considered accurate enough for surveying. Many of these discarded locations, however, overlapped the error margins of other accepted records. In other instances, closely situated records where errors margins substantially overlapped were treated as a single location during surveys (for an example see Figure 2-1).

*Field surveys at historical locations* – Field protocols were described in detail in a project-specific Field Protocol document previously (2009) submitted to Clark County. In general, surveys at historical observation sites were targeted in areas within 1 km of the georeferenced location, and searches focused on the most suitable habitat for the targeted species in the area. If suitable habitat did not exist in the targeted area, the next most appropriate habitat within the error buffer was searched. The time spent at each historical location varied depending on the patch size of suitable habitat, as well as habitat and terrain conditions. For example, a highly degraded location (such as a lot within an urbanized setting) required little survey time to determine lack of occupancy. Surveys also ended after the first detection of the targeted species. At least 1 hour of search time was allotted at each location, although at many locations several hours were required to provide a thorough documentation of the area.

Surveys for each species occurred during the appropriate season which provided the best opportunity for observing the species of interest (see Field Protocol document for specifics). Surveys were only conducted under favorable weather conditions (no surveys were conducted during rains, high winds, or afternoon heat). At each location, the surveyor searched through the habitat stopping every 150 to 300 m depending on vegetation and terrain conditions to conduct a call-broadcast survey. Call-broadcast has been shown to be an effective tool to census many species of birds, for example Bendire's and Le Conte's thrashers were effectively surveyed locally using this approach (Fletcher 2009). At each call-broadcast point, recorded songs of the targeted species were played for 30 seconds followed by an observation period of 1 minute, repeating the process at least once more before moving to a new point. As the main interest was to document presence, a transect approach was not used, and the surveyor moved through the most appropriate habitat within the targeted area to maximize the potential for detection.

At each point, coordinates were recorded from a handheld GPS (GPSmap76Cx) so that distances between points could be roughly determined and an estimate of the survey area calculated. Estimates of the survey area at each location were derived within GIS to represent the approximate area of coverage assuming a 300 m circular radius for the effectiveness of the call-broadcast, summing the radius around each call-broadcast point, and then subtracting overlap among buffers (Figure 2-2). The effective range of call-broadcast varies depending on several factors of which site conditions, atmospheric conditions, and species are important. The effective range of 300 m assumed here was estimated from observed responses of thrashers to call-broadcasts (Fletcher 2009).

To improve assurances of results at locations where the targeted species were not detected (negative locations), some sites were surveyed twice on different dates. Resurveys were focused on locations that were considered to represent good habitat for the target species during the initial survey. Locations were not revisited if the site was degraded, poorly defined in records, or in some cases extremely difficult and time consuming to reach.

*Habitat assessments of historical locations* – Habitat conditions at survey sites were assessed after species searches had been performed (see Field Protocol document for specifics). Three categories of variables were assessed: (1) vegetation type based on vegetation/habitat categories and presence of dominant plant species; (2) presence of species-specific indicators or elements of suitable habitat for targeted species; and (3) qualitative indicators of human disturbance along with general observations. Questions on the data sheet were predominately categorical (only one answer) or present/absent (yes or no). The habitat assessments were conducted to determine if a location represented typical habitat suitable for the target species or whether the location likely represented a transient record or a site were habitat had changed. Indicators of disturbance were recorded to determine potential impacts on species presence. These included presence/absence of: utility corridors, OHV tracks, major dirt roads, paved roads, buildings or construction, as well as an overall assessment of the level of human disturbance by category (none–light, limited, moderate, disturbed, or heavy). To determine nonrandom associations among variables, where appropriate, a Fisher's exact test was chosen because of small sample sizes for most of the bird species (see Results) and because of the categorical nature of the predictor variables. The statistical package R 2.8.1 (R Development Core Team 2008) was used for data analyses.

To assess potential transitions in disturbance conditions at historical sites between 1994 and 2006 caused by development, surveyed historical locations were overlaid with aerial images (LANDSAT imagery) from these two years and visually assessed (see Figure 2-3 for an example). In this assessment, no effort was made to distinguish between historical records in typical or non-typical habitat for a species, and the points assessed were based on the estimated coordinates for each observation with the associated errors generally ignored. Historical locations were heuristically considered to be in one of three categories: relatively undisturbed areas, disturbed areas, or interface areas. Locations within disturbed areas were mostly within urban or suburban developments, but also occasionally in other types of developed areas; for

example, a historical Le Conte's thrasher observation at a site that is now a solar energy facility. Many locations, however, were situated at the interface between developed and less disturbed natural areas, and these sites were categorized as such because the areas appeared to have some important habitat features.

*Estimating historical urban footprint* – Parcel data from 1985, 1994 and 2006 (Parcel Data; Clark County) were used to develop an index of urban development that could then be used to assess changes in plant communities over these time periods (Figure 2-4). During data validation, the data layers showed clear discrepancies between parcels identified and actual development and construction, generally providing overestimates of impacted areas. To correct for this, parcel data from each year were clipped to a data layer representing the extent of urban development in 2006 (Urban Land Cover Areas in Clark County, NV, 2006; Clark County) with the assumption that areas considered undeveloped in 2006 were undeveloped in the parcel data. The parcel data layers also did not include road coverage, leaving gaps for these developed features. Accordingly, the following protocol was used: (1) from current street coverage data (Street Centerline Database, Clark County; December 2009), roads proximate (within 100 m) to identified parcels for each targeted year were selected; (2) significant roads (interstates, state highways, major roads and rural routes) omitted in the previous step were 'added in' after visual assessment against historical NDOT maps and LANDSAT imagery; and (3) these historical street layers were then buffered (50 m), and merged with parcel data to arrive at an estimate of historical urban footprint. These historical urban footprints were not intended to be detailed representations of development and disturbance, but only intended to provide an index by which habitat loss could be relatively assessed.

*Assessment of historical habitat loss* – Plant communities that existed prior to urban development were estimated using soil data layers derived from the Soils Survey of Clark County (Natural Resource Conservation Service, U.S. Department of Agriculture, 2007). Soil map unit polygons that under-laid urban footprint layers from 1985, 1994, and 2006 were identified in ArcGIS and the associated soil types determined. 'Ecological site descriptions' for the soil types were used to identify potential natural vegetation likely to have occurred with each soil type under pristine conditions; as such, these descriptions may not necessarily be those associated with a given map unit under current conditions (see http://esis.sc.egov.usda.gov/ESIS/About.aspx). Dominant and minor component plant species identified in the ecological site descriptions were then used to assign soil map unit polygons to particular plant communities described for the Mojave Desert (e.g., Sawyer and Keeler-Wolf 1995). Relative estimates of the area lost for each plant community were then derived by comparisons against the urban footprint index layers for 1985, 1994 and 2006 in ArcGIS. For comparison, estimates of the area lost for each plant community were also calculated using the 2006 urban footprint from the Urban Land Cover Areas layer.

**Results**

*Field surveys at historical locations* – From data sources, a total of 214 historical records were compiled for the targeted species within Clark County; however, 60 of these records were discarded because the margin of error was too large or the record fell well within the error margin of another record. In general, there were very few useable historic records obtained for most of the bird species (< 15) with the exceptions of the phainopepla and Le Conte's thrasher (Table 2-1). The level of survey effort at sites was strenuous and on average about 1.5 hours was spent on the ground at each historical location, ranging from 10 minutes (where the bird was observed quickly) to 4.25 hours. On average, at each historical location an estimated 0.74 $km^2$ was surveyed. The following provides a summary of survey results with analyses focused on those species where sample sizes and observations permitted meaningful interpretations.

*Phainopepla* – The phainopepla had the largest number of historical records complied for species in this project, and surveys were conducted at 53 historical locations. A total of 153 call-broadcasts were conducted at these locations, covering an estimated area of 34.9 $km^2$ (Table 2-1). Three locations thought to have highly suitable habitat were resurveyed after initial negative detections, and at one of these sites a phainopepla was observed on the second visit. Presence of phainopepla was documented at 25 of the historical locations (Figure 2-5).

Not surprisingly, this species was found to be highly associated with desert mistletoe (*Phoradendron californicum*), and all 25 locations where phainopepla were observed had this parasitic plant. Mistletoe berries are the main food source for this species from October to May (Chu and Walsberg 1999). Many of the historical records for the phainopepla were in disturbed areas (Table 2-2), but there did not appear to be a statistically significant negative effect from human disturbance on species presence ($p = 0.656$; Figure 2-6). The presence of major and minor dirt roads even showed a significantly positive relationship with this species (p-values = 0.004 and 0.026 respectively; Table 2-3). Controlling for mistletoe, disturbance continued to show no negative effect ($p = 0.598$), and there was no significant relationship between phainopepla presence and any of the other disturbance variables (all p-values > 0.05). Visual assessments on aerial images of the 53 historical records for this species indicated that in 1994 about a third of the records were in areas with some level of disturbance (disturbed or interface) and that by 2006 this proportion had jumped to 43% (Table 2-4).

*Le Conte's thrasher* – Surveys were conducted at 37 historical locations for the Le Conte's thrasher (Figure 2-7). A total of 101 call-broadcasts were performed at these sites covering an estimated area of 20.4 $km^2$. Five locations where the species was not initially observed but where habitat was considered favorable were resurveyed, but the species was not detected at any of these revisited locations. Many of the historical locations for this species were in disturbed areas, and the species was detected at only 7 locations.

The presence of Le Conte's thrasher appears to be significantly affected by human disturbance ($p = 0.017$), and as the overall measure of disturbance increased, the chance of observing a Le Conte's thrasher substantially decreased (Figure 2-8). Sample size was low, however, and there did not appear to be significant relationships with any of the other disturbance categories (all p-values > 0.5). The noted sensitivity of this species to disturbance suggests that any site close to developed areas probably has decreased suitability as habitat. By 1994, roughly a third of the historical locations were already found occurring in disturbed areas (developed or interface), and by 2006 this had jumped to 40% suggesting further substantial degradation of suitable habitat for this species over that period.

*Bendire's thrasher* – The Bendire's thrasher had the most limited historical record of the species targeted in this project. Only 7 records were found and 1 of these records was not surveyed because of a large associated error. At the 6 historical locations surveyed, 35 call-broadcasts were performed covering an estimated 1.43 $km^2$ of area. Two of the locations were resurveyed. All of these sites were in areas that had very little disturbance and were considered to be in habitats used by this species, a pattern confirmed from inspections of the locations on aerial images. This thrasher, however, was observed only once and that only after a repeated survey (Figure 2-9).

*Gray vireo* – There were limited historical records for the gray vireo, and only 14 records met the criteria for surveying. Forty-nine call-broadcasts were performed at these sites covering an estimated area of 10.6 $km^2$. Based on habitat assessments, 9 of the locations were in areas not considered to be typical habitat for this species (e.g. Creosote-Bursage community), and one of these was in a neighborhood of Boulder City. These records likely represented observations of transient birds, and the species was not recorded at any of these sites. The 5 detections of this species were all located in typical pinion-juniper woodland habitat with little disturbance (Figure 2-10).

The historical records for this species remained in relatively undisturbed areas, and visual assessments of historical locations on aerial images showed no change in disturbance at sites from 1994 to 2006. The 5 records within disturbed areas were already disturbed when the observation was recorded, and likely represented observations of transient birds. No significant effect of human disturbance was detected for the gray vireo, but after removing records in areas not considered habitat the dataset for this species was too small for assessment.

*Blue grosbeak* – Surveys were conducted at only 12 historical locations for the blue grosbeak. One of these sites was in habitat not considered typical for the species. A total of 55 call-broadcasts were performed at these sites and an estimated area of 9.9 $km^2$ was surveyed. Resurveys were conducted at 4 locations in areas consider good habitat following initial negative responses, and at one of these locations the species was observed. All told, blue grosbeaks were observed at only 4 of the historical locations (Figure 2-11), of which 2were in suburban interface

along the Muddy River and the others were in non-native riparian areas (including at Corn Creek).

Although data were limited, human disturbance did not appear to affect the presence of blue grosbeak, as long as important habitat features were present; in general the disturbance variables were non-significant. Two undisturbed sites in 1994 did become more disturbed, but these were changes along suburban-agricultural interface, which represent habitat conditions readily utilized by this species.

*Bell's vireo* – Historical records of the Bell's vireo were limited and surveys were conducted at only 10 locations. A total of 38 call-broadcasts were conducted at these sites covering an estimated area of 8.12 $km^2$, although 2 of these locations were not considered typical habitat for the species. This bird was observed at only 2 locations, both considered suitable habitat for this species (Table 2-2; Figure 2-12). It was observed on a golf course near Laughlin at a site considered disturbed but that contained many natural features, and at Rogers Spring in relatively undisturbed habitat within LMNRA. The extremely small sample size precludes any meaningful assessment of human disturbance. Visual assessments using aerial images showed that in 1994, 4 of the 10 historical locations for this species were in areas with some level of disturbance, and from 1994 to 2006, 1 undisturbed site showed evidence of increased disturbance.

*Summer tanager* – Historical records for the summer tanager were limited and only 9 locations were surveyed. The species was not detected at any of these sites (Figure 2-13), although 30 call-broadcasts were performed covering a total estimated area of 6.08 $km^2$. Seven of the 9 historical locations were in disturbed habitats, and the other 2 locations were in areas of limited disturbance but considered to be only marginal habitat likely representing transient birds. From 1994 to 2006, assessment from aerial images showed that half the sites considered undisturbed in 1994 became highly disturbed by 2006. Although the overall level of disturbance appears high, the limited sample size and lack of presence data precludes any statistical analysis.

*Vermilion flycatcher* – Surveys for the vermilion flycatcher were conducted at 15 historical locations. At these locations, 81 call-broadcasts were conducted covering an estimated 15.1 $km^2$ of area, but the species was not detected (Figure 2-14). From field assessments, 12 of these sites were in areas considered to be disturbed, but based on aerial assessment many of these were in transitional (interface) areas. Although the overall level of disturbance appears high, the limited sample size and lack of presence data precludes any statistical analysis, and further this species often utilizes transitional habitat at the interface between natural and suburban-agricultural areas.

*Southwestern willow flycatcher* – Historical records for the southwestern willow flycatcher were also very limited, and surveys were conducted at only 9 locations. Thirty-three call-broadcasts were conducted, covering an estimated area of 7.1 $km^2$. Two of the locations were not considered to be in typical habitat for this species based on site conditions, and the other 7

locations, all had conditions considered moderately to heavily disturbed from field assessments. The species was not observed at any of the sites (Figure 2-15). Changes in site conditions were difficult to assess from aerial images based on the general categories used, but some degradation of sites was noted between 1994 and 2006. Although the level of disturbance was high at sites where this species was likely to have occurred, the limited sample size and lack of presence data precludes any meaningful analysis.

*Estimating conditional change from historical urban footprints* – There were several recognized problems with using ecological site descriptions from the soil survey to estimate the distribution of plant communities that existed prior to urban development. A limitation of the approach was that the plant communities assigned to map units (polygons) were based on the dominant vegetation identified for the major soil type within the units, and thus minor soil types and associated vegetation within units were simply not counted. For example, the assessment herein does not include any cottonwood-willow dominated riparian community, a known component of the early Las Vegas Valley, although areas identified as 'water' in this assessment were assumed to be associated with such habitat. The result is that certain geographically limited, although biologically important vegetation communities were under-represented. Another problem was the difficulty in distinguishing between Mojave mixed scrub and creosote-bursage communities, which were the major vegetation types lost to development in Las Vegas Valley; this problem also appears to be pervasive in vegetation layers commonly used for Clark County. Further, a small area of the county was too disturbed for assessment at the time the soil survey was conducted (see Figure 2-16).

The assessment of change in historical urban footprint incorporated a 50 m buffer around selected roads. This buffer may be excessive for roads in rural areas and likely inflated estimates of habitat loss. Similarly, the use of a roads layer representing 2009 conditions to identify roads proximate to historical parcels, likely resulted in the selection of some roads that were not present historically. Where this was observed in the data, however, was in areas where road density was high (i.e. high-density urban areas), thus the affect on assessments related to habitat loss for the targeted bird species was likely minimal. Given these limitations, the representations of urban footprints might provide over-estimates of vegetation community loss. A relative assessment of this impact is possible by comparing estimates of area lost from the 2006 index and the values from the 2006 Urban Land Cover Areas layer (Table 2-5). The over inflation of these estimates was counter-balanced by the knowledge that the selection of roads was an imprecise technique and that not all roads observed in historical satellite images were included in the analysis. Further, these estimates of habitat loss were intended for use as an index of change and not as an absolute representation of impacted habitat.

Assessments of change from the historical urban footprints revealed easily apparent trends in the losses of vegetation communities. These losses were expectedly anisotropic, with extensive area loss at lower elevations (e.g. creosote-bursage and Mojave mixed shrub; see Figure 2-17) and markedly less loss at higher elevations (e.g. pinion-juniper). Losses in plant

communities have also shifted through time towards those at higher elevations. This is particularly noticeable for Joshua tree habitat, with marginal increase in lost habitat (7%) from 1985 to 1994, and a significantly higher loss from 1994 to 2006 (52%). Proportional losses of important vegetation communities for Le Conte's and Bendire's thrashers were substantially higher than that of the gray vireo simply because of elevational differences in where associated plant communities occurred (see Discussion below). In general, there was a 131% increase in impacted vegetation communities from 1985 to 2006, as would be expected by the large increase in human population during that time. With the approximate doubling of population since 1994, a whopping 80% of this change in habitat occurred in the 11 years between1994 and 2006.

**Discussion**

There was insufficient historical data for most of these bird species to draw strong conclusions on the impact of urban development, but there are some trends associated with the data. Levels of current disturbance did not appear to strongly affect the presence of phainopepla or blue grosbeak at historical locations as long as important components of habitat for these species remained. For the phainopepla this meant predominately mesquite and other plants with berry-bearing mistletoe (Chu and Walsberg 1999; Crampton 2004). If enough mistletoe was present, this bird was recorded at the location even in highly disturbed areas. Although there was a significant association between phainopepla and roads, teasing out the relationship is difficult because in desert areas, roads often follow washes, and the phainopepla was strongly associated with wash vegetation. For the blue grosbeak, rural and suburban development associated with agriculture appears to have little effect on this species and may actually represent preferred habitats; increases in number for this species in northeastern regions has been linked with forest fragmentation (White 1998).

Although the phainopepla and blue grosbeak show little sensitivity to habitat disturbance, this was not a demographic study and the impact of development on reproduction and survivorship of these birds was not assessed. As opposed to disturbance, habitat loss for both species, and in particular the phainopepla, may have been substantial in Clark County with loss of preferred habitats such as mesquite and other vegetation types associated with washes and water. In essence the loss since 1985 represents an increase of more than a 28% over that period (Table 2-5).

The two thrasher species showed similar overall losses of habitat from urbanization, but very different patterns for current impacts of disturbance. For Bendire's thrasher, historical observations in typical habitats for this species remained within relatively undisturbed areas. Conversely, the Le Conte's thrasher showed an expectedly strong negative association between its current presence at historical locations and current levels of human disturbance. This species is known to be very sensitive to disturbance (Sheppard 1996).

Both species share some general similarities in habitat associations, and important vegetation communities for both species have been greatly impacted by urbanization. The Le

Conte's thrasher in particular was associated with low slope areas – an environmental feature apparently favored for development. Both species show associations with Mojave mixed shrub, which was the vegetation community that experienced the greatest loss to urbanization (just about half of all habitat lost). The preference of these thrashers appears to be for Mojave yucca and cylindrical cholla species (England and Laudenslayer 1989; Fletcher 2009) which are often components of the Mojave mixed shrub community, although not always dominant features. As such, the impact of the loss of this vegetation community on these thrashers is not likely a linear function. Both species are also associated with Joshua tree, although this appears to be stronger for Bendire's thrashers. The loss of Joshua tree habitat has more than doubled since 1985. The lack of development noted at historical locations for the Bendire's thrasher, likely reflect the fact that large tracts of Joshua trees, as well as preferred components of Mojave mixed shrub, remain currently intact across Clark County.

The Le Conte's thrasher, however, could be particularly vulnerable to habitat degradation and fragmentation because of its low population density, patchy population structure, and likely stepping-stone dispersal (Laudenslyayer et al. 1992). Within Clark County, high-quality habitat for this species is mostly scattered in small, disconnected patches (Fletcher 2009). Large areas of potential historical habitat for this bird have clearly been lost to urbanization. In particular, this species appears strongly associated with saltbush communities (Fletcher 2009) which are patchy and rare across the county, and extensive areas of this habitat type appear to have been lost to urbanization. Even without direct habitat loss, edge effects from disturbance have likely degraded conditions within many of the remaining patches, and degradation and loss of intervening areas among patches has likely increased isolation.

The gray vireo showed little impact from disturbance at historical locations within sites that represent typical habitat for the species. In the Mojave Desert, the gray vireo is associated with pinion-juniper woodlands from 1,646 to 2,012 m in elevation (Barlow et al 1999), and the few historic locations surveyed within this habitat association all had gray vireos present. Within Clark County, most of the pinion-juniper woodlands have not been directly impacted by development.

Several of the targeted species, Bell's vireo, summer tanager, vermilion flycatcher, southwestern willow flycatcher, as well as the blue grosbeak, are associated with riparian and mesquite woodland habitats. Historically these species were reported to be relatively common in cottonwoods, willows, and mesquites along the lower Colorado River (Linsdale 1936). For example, Grinnell (1914) described the vermilion flycatcher as numerous along the river in the early 1900s, but its abundance and distribution has been drastically reduced because of habitat changes caused by water management practices (Rosenberg et al. 1991). Further, the southwestern willow flycatcher was thought to have suffered substantial regional declines as a result of the same habitat loss and fragmentation (Rosenberg et al. 1991; Dobkin and Sauder 2004). Actual historical records, however, were few (Table 2-1) and only the Bell's vireo and blue grosbeak were detected during surveys. Currently, Bell's vireo and blue grosbeak are

considered relativity numerous in southern Nevada, compared to the relative rarity of the other three species (Floyd et al 2007).

The total amount of riparian and mesquite woodlands lost to urbanization was difficult to determine, because in soil survey maps many of the soil types associated with these plants represented minor components of map units, and therefore were likely underestimated. Furthermore, only parts of the areas for wash and water (Table 2-5) identified in the analysis can be reasonably assumed to be associated with these plant types. Nevertheless, losses of such habitat and mesquite woodlands appeared to be substantial, especially given the regional rarity of these habitats, and the obvious degradation of much of what remains.

**Table 2-1**. Number of historical records compiled for each targeted species within Clark County, Nevada, number of historical locations surveyed and estimated total area surveyed.

| Species | Total Records Clark County | Records Surveyed | Surveyed Area ($km^2$) |
|---|---|---|---|
| Bell's vireo | 15 | 10 | 8.1 |
| Bendire's thrasher | 7 | 6 | 1.4 |
| Blue Grosbeak | 18 | 12 | 9.9 |
| Gray vireo | 16 | 14 | 10.6 |
| Le Conte's thrasher | 37 | 25 | 20.4 |
| Phainopepla | 75 | 53 | 34.9 |
| SW Willow Flycatcher | 12 | 9 | 7.1 |
| Summer Tanager | 13 | 9 | 6.1 |
| Vermilion Flycatcher | 20 | 16 | 15.1 |

**Table 2-2.** Number of historical survey locations (first values) and number of locations with detections of targeted species (second value) by human disturbance categories and typical (type) or non-typical (non) habitat determined from field assessments.

| | Heavy | | Disturbed | | Moderate | | Limited | | Light/None | |
|---|---|---|---|---|---|---|---|---|---|---|
| Species | type | non | Type | non | type | non | type | non | type | non |
| Bell's vireo | 3/1 | 0/- | 1/0 | 1/0 | 2/0 | 0/- | 2/1 | 1/0 | 0/- | 0/- |
| Bendire's thrasher | 0/- | 0/- | 0/- | 0/- | 1/0 | 0/- | 4/1 | 0/- | 1/0 | 0/- |
| Blue Grosbeak | 5/0 | 0/- | 5/3 | 0/- | 0/- | 0/- | 1/1 | 0/- | 0/- | 1/0 |
| Gray vireo | 0/- | 3/0 | 0/- | 2/0 | 0/- | 2/0 | 4/4 | 1/0 | 1/1 | 1/0 |
| Le Conte's thrasher | 8/0 | 0/- | 3/0 | 0/- | 6/2 | 0/- | 6/3 | 0/- | 2/2 | 0/- |
| Phainopepla | 15/5 | 0/- | 18/11 | 0/- | 7/4 | 0/- | 6/2 | 1/0 | 6/3 | 0/- |
| SW Willow Flycatcher | 3/0 | 0/- | 2/0 | 0/- | 2/0 | 0/- | 0/- | 0/- | 0/- | 2/0 |
| Summer Tanager | 4/0 | 0/- | 3/0 | 0/- | 0/- | 0/- | 2/0 | 0/- | 0/- | 0/- |
| Vermilion Flycatcher | 6/0 | 0/- | 6/0 | 0/- | 0/- | 0/- | 2/0 | 0/- | 1/0 | 0/- |

**Table 2-3**. Results (p-values) from statistical assessments for 6 measures of human disturbance at historic locations considered to be in typical habitat for the bird species. Statistical assessments of data for the gray vireo, summer tanager, vermilion flycatcher and southwestern willow flycatcher were not possible because none of these birds were detected during field surveys of historical locations.

| Species | Human Disturbance | Utility Corridor | OHV Road | Major Dirt Road | Paved Road | Structures |
|---|---|---|---|---|---|---|
| Phainopepla | 0.656 | 0.402 | 0.004 | 0.0263 | 1.000 | 0.762 |
| Le Conte's Thrasher | 0.017 | 1.000 | 0.378 | 0.673 | 0.178 | 0.178 |
| Blue Grosbeak | 0.091 | 1.000 | 0.236 | 0.236 | 0.024 | 1.000 |
| Bell's Vireo | 0.679 | 1.000 | 1.000 | 0.464 | 1.000 | 1.000 |
| Bendire's Thrasher | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |

**Table 2-4**. Assessment of disturbance conditions (based on aerial imagery) at sites of historical records for targeted species within Clark County, Nevada between 1994 and 2006.

| | 1994 | | | 2006 | | |
|---|---|---|---|---|---|---|
| Species | Disturbed | Interface | Undisturbed | Disturbed | Interface | Undisturbed |
| Bell's vireo | 2 | 2 | 6 | 2 | 3 | 5 |
| Bendire's thrasher | - | - | 6 | - | - | 6 |
| Blue Grosbeak | 3 | 3 | 6 | 3 | 5 | 4 |
| Gray vireo | 5 | - | 9 | 5 | - | 9 |
| Le Conte's thrasher | 7 | 1 | 17 | 10 | - | 15 |
| Phainopepla | 6 | 13 | 34 | 9 | 14 | 30 |
| Summer Tanager | 3 | 1 | 5 | 6 | 1 | 2 |
| SW Willow Flycatcher | 1 | 3 | 5 | 3 | 2 | 4 |
| Vermilion Flycatcher | 2 | 11 | 2 | 2 | 11 | 2 |

**Table 2-5**. Area estimates (ha) of plant communities under urban layers within Clark County derived in this project (index layers) for years 1985, 1994, and 2006. Also provided is an area estimate for plant communities under an existing data layer representing the extent of urban development in 2006 (Urban Land Cover Areas in Clark County, NV, 2006; Clark County). Targeted species that may have been affected by the loss of each habitat type are identified using standard abbreviates as follows: Bell's vireo (BEVI), Bendire's thrasher (BETH), Blue grosbeak (BLGR), Gray vireo (GRVI), Le Conte's thrasher (LCTH), Phainopepla (PHAI), Southwestern willow flycatcher (WIFL), Summer tanager (SUTA), and Vermilion flycatcher (VEFL).

| Habitat Type | 1985 Index | 1994 Index | 2006 Index | 2006 | Species Affected |
|---|---|---|---|---|---|
| Mojave Mixed Scrub | 23164.1 | 32520.0 | 78825.0 | 54765.3 | BETH, LCTH |
| Creosote Bur Sage | 8862.9 | 10681.2 | 16105.1 | 14979.4 | LCTH |
| Mesquite | 5810.8 | 6342.2 | 7138.4 | 8412.9 | BLGR, BEVI, PHAI, VEFL, SUTA |
| Shadscale* | 6296.4 | 6940.5 | 7529.4 | 8012.2 | LCTH |
| Saltbush** | 6492.7 | 7870.7 | 9053.8 | 9377.0 | LCTH |
| Black Brush | 887.4 | 1202.8 | 1786.8 | 2059.6 | BETH |
| Wash Vegetation | 645.5 | 792.0 | 1135.2 | 1240.3 | BETH, LCTH, PHAI, |
| Joshua Tree | 507.1 | 544.4 | 829.5 | 644.1 | BETH, LCTH |
| Pinion Juniper | 257.2 | 258.4 | 262.5 | 60.4 | GRVI |
| Mixed Woodland | 134.7 | 134.7 | 135.6 | 35.0 | GRVI |
| Water | 51.4 | 66.5 | 74.6 | 299.4 | BLGR, BEVI, PHAI, SUTA WIFL, VEFL |
| Rock (no vegetation) | 3644.0 | 4859.4 | 7715.2 | 8225.1 | |
| Disturbed | 2670.7 | 3113.7 | 3456.6 | 4492.9 | |
| Total | 59424.9 | 75326.5 | 134047.7 | 112603.6 | |

**Mostly Atriplex confertifolia, ** Mostly A. polycarpa & A. canescens*

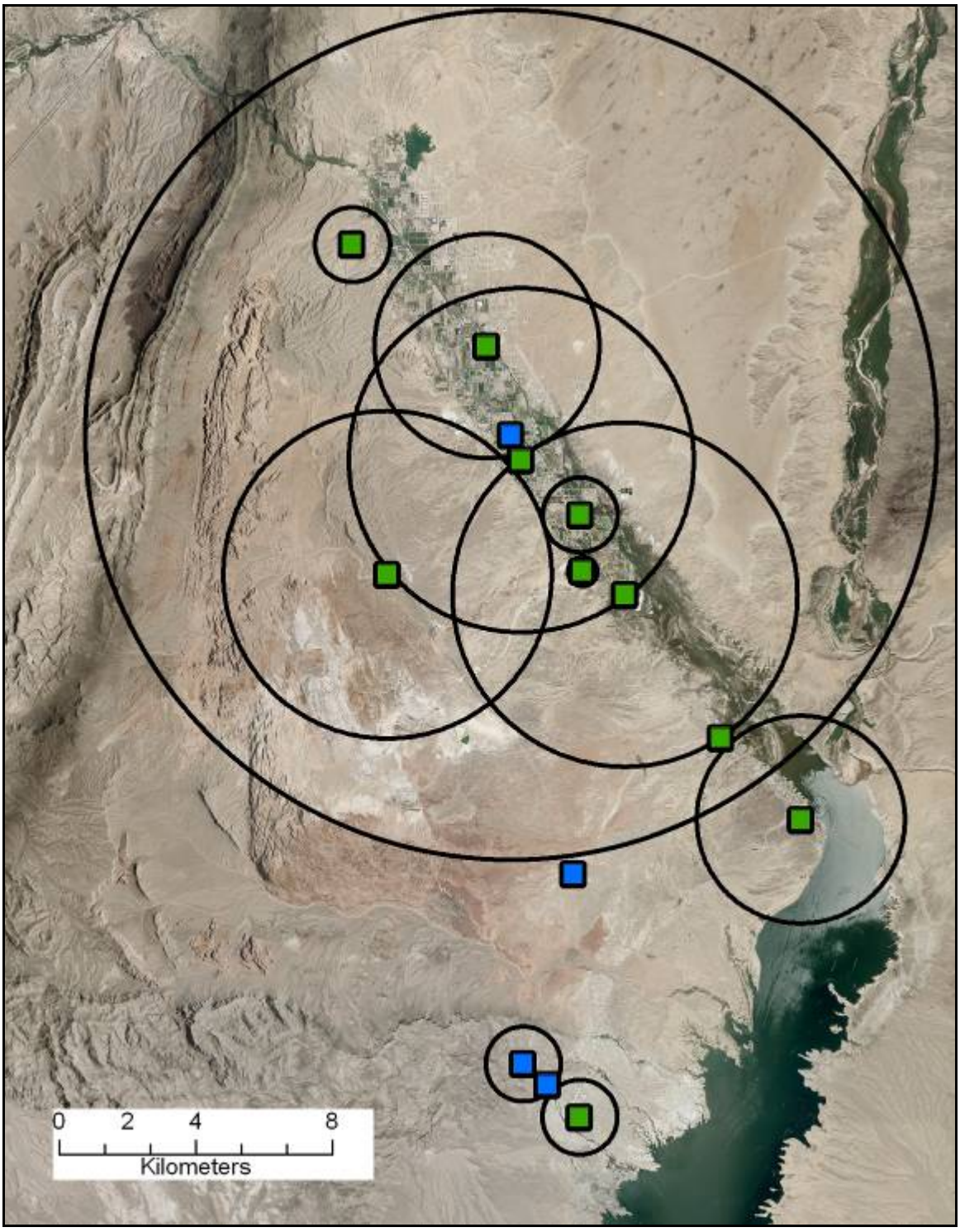


**Figure 2-1**. Map showing historical records. Green squares indicate locations surveyed. Blue squares depict historical locations not surveyed because either the error margin associated with the record was too large or the site was within the error margin of another record. The black circles show the error buffers associated with the record.

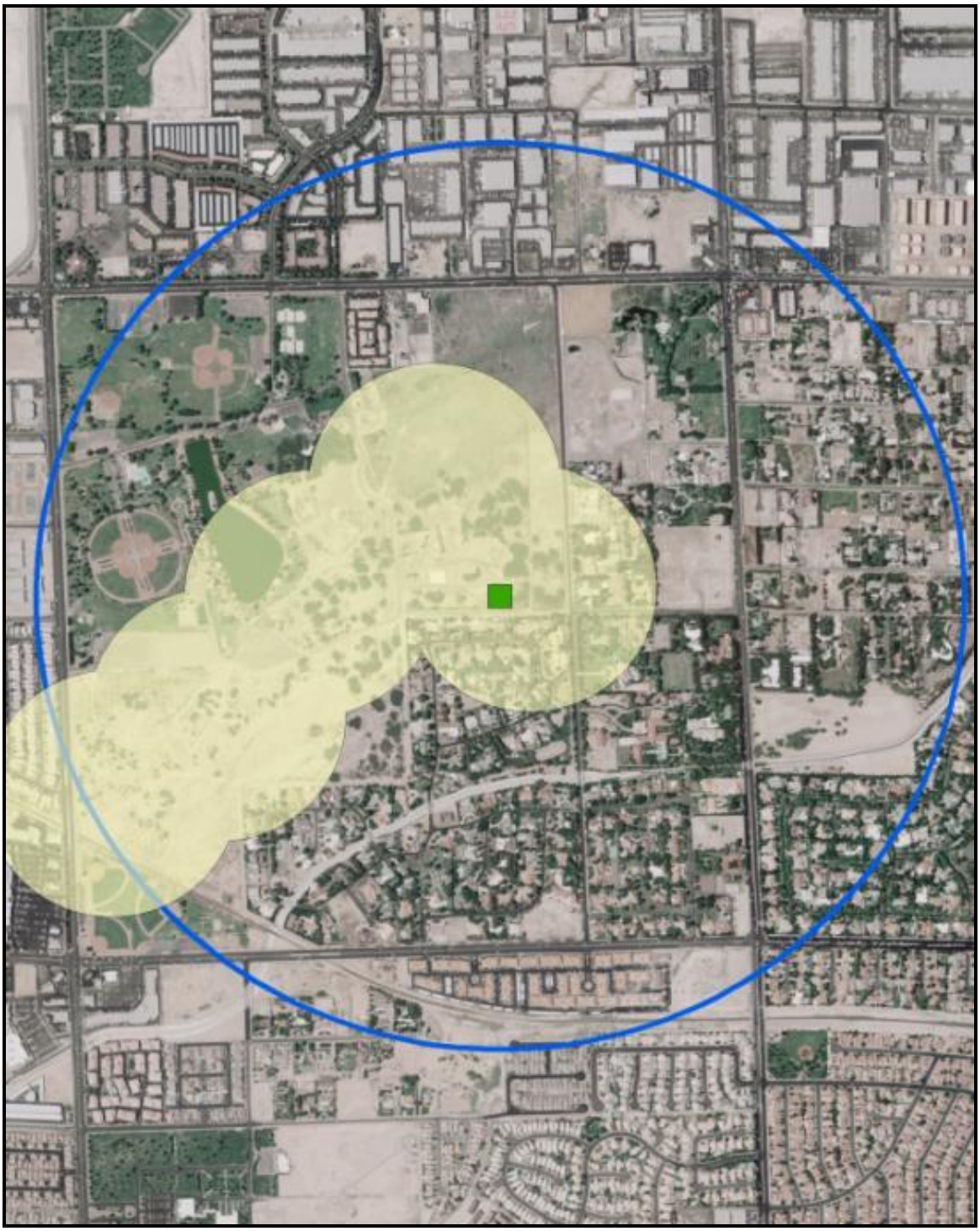

**Figure 2-2**. Map showing error buffer (in blue) associated with historical record and area surveyed shown in yellow. The green square indicates where a phainopepla was observed.


**Figure 2-3**. Example of aerial images from 1994 and 2006 showing changes in conditions around a historical location for phainopepla with northwestern Las Vegas Valley.

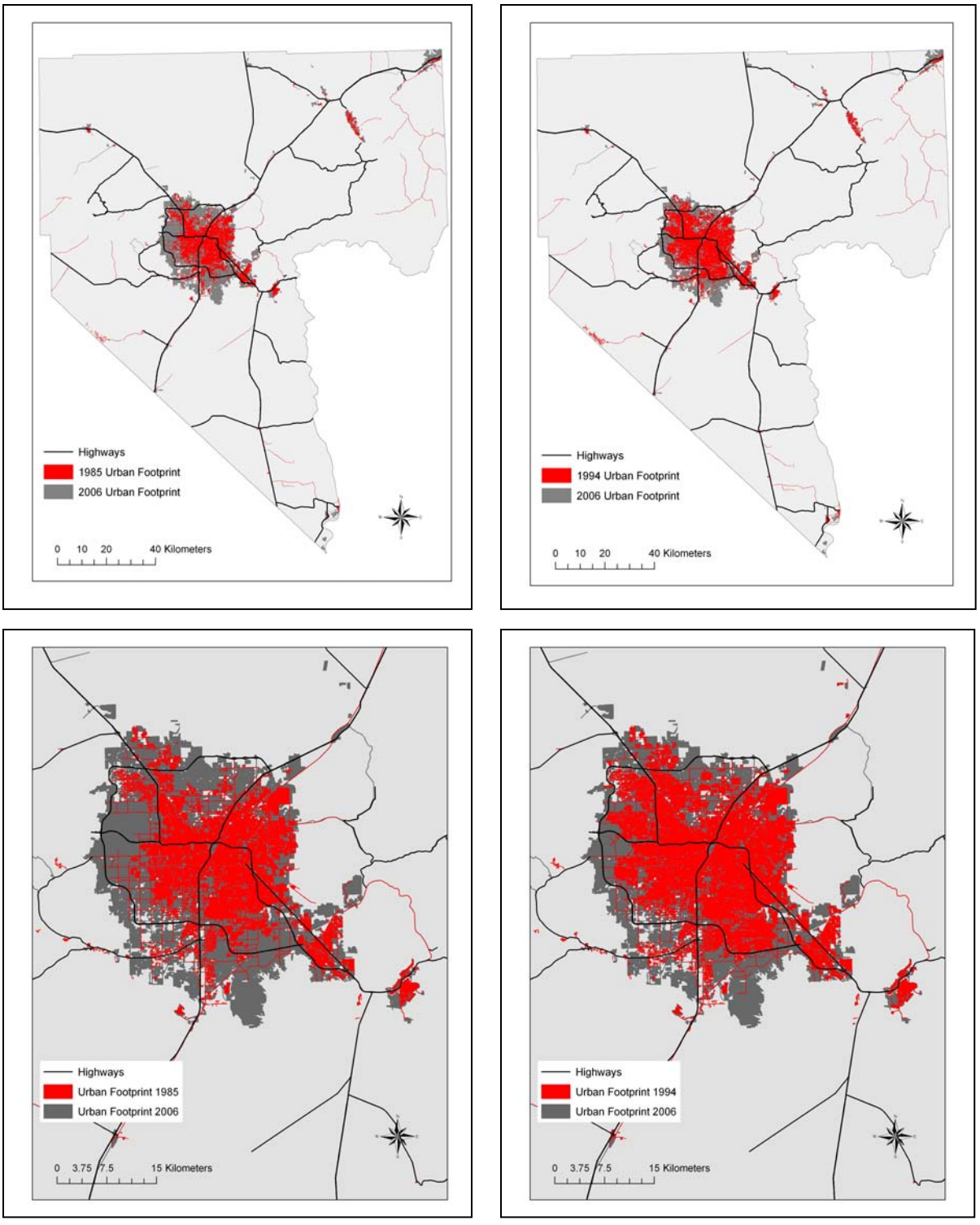


**Figure 2-4**. Example images of urban development used to assess changes in plant communities developed from parcel data (see text).

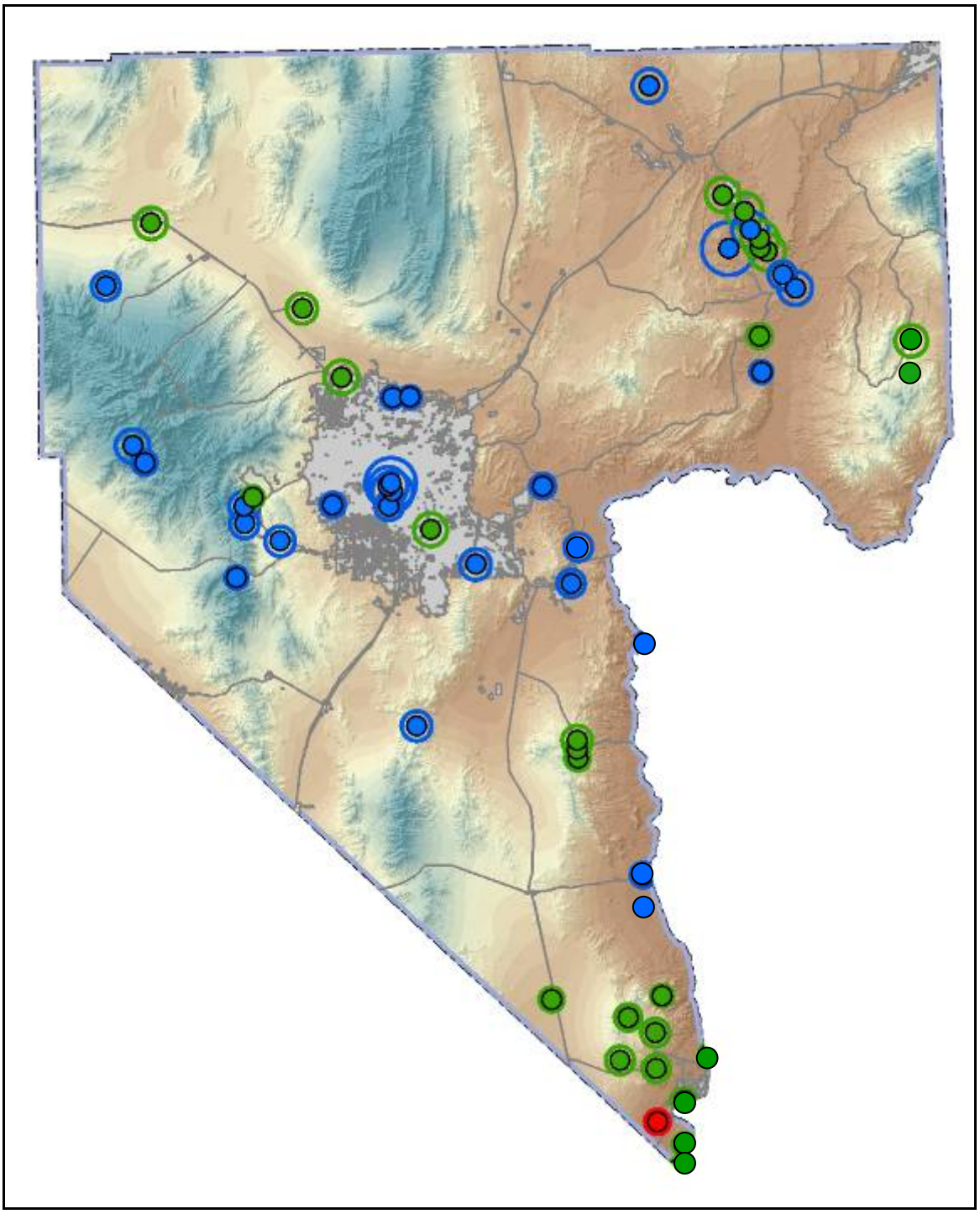

**Figure 2-5**. Map of phainopepla historical records and associated error buffers. Green circles depict locations where the species was present, blue circles depict absence locations, and red circles depict sites not considered to be suitable breeding habitat.

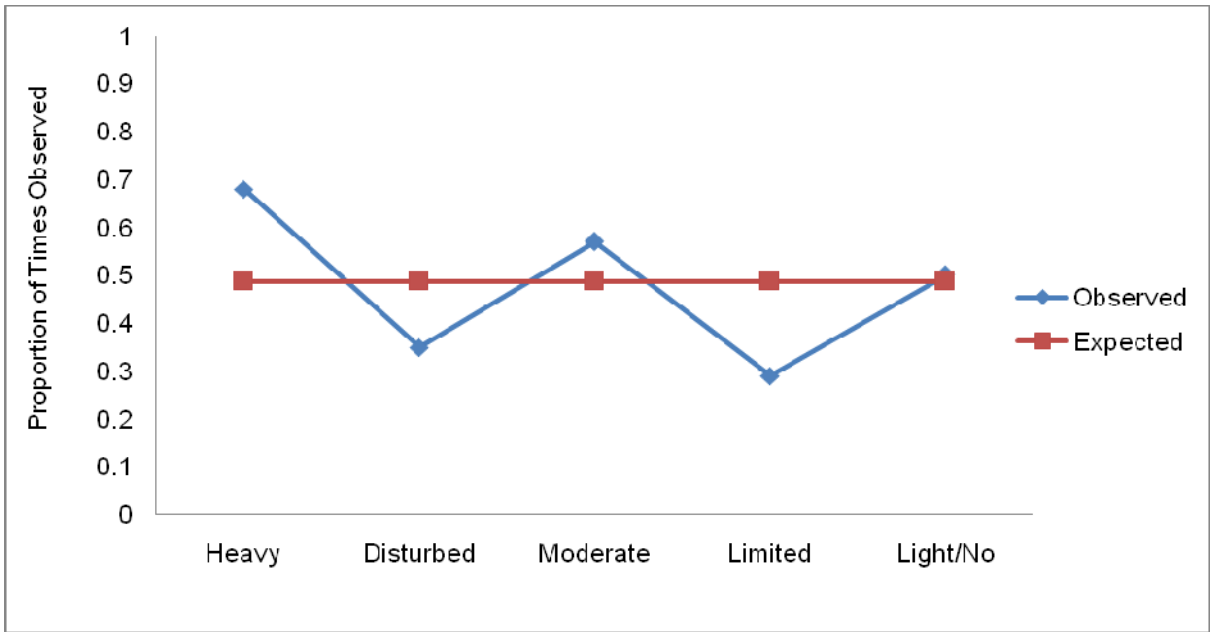


**Figure 2-6**. Line graph showing the proportion of times phainopeplas were observed within each disturbance category, plotted with the expected proportion of times within the category by chance alone.

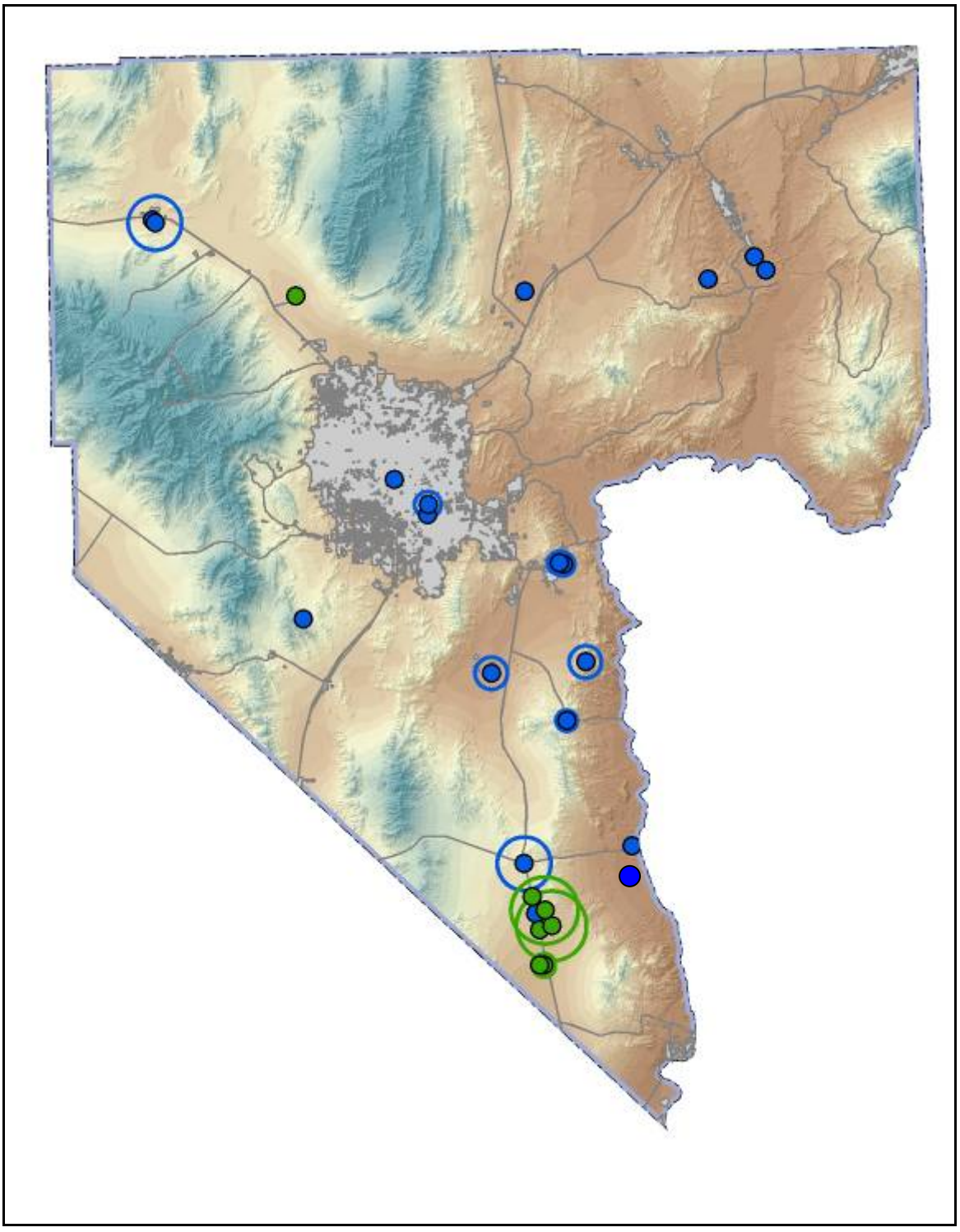

**Figure 2-7**. Map of Le Conte's thrasher historical records and associated error buffers. Green circles depict locations where the species was present and blue circles depict absence locations.

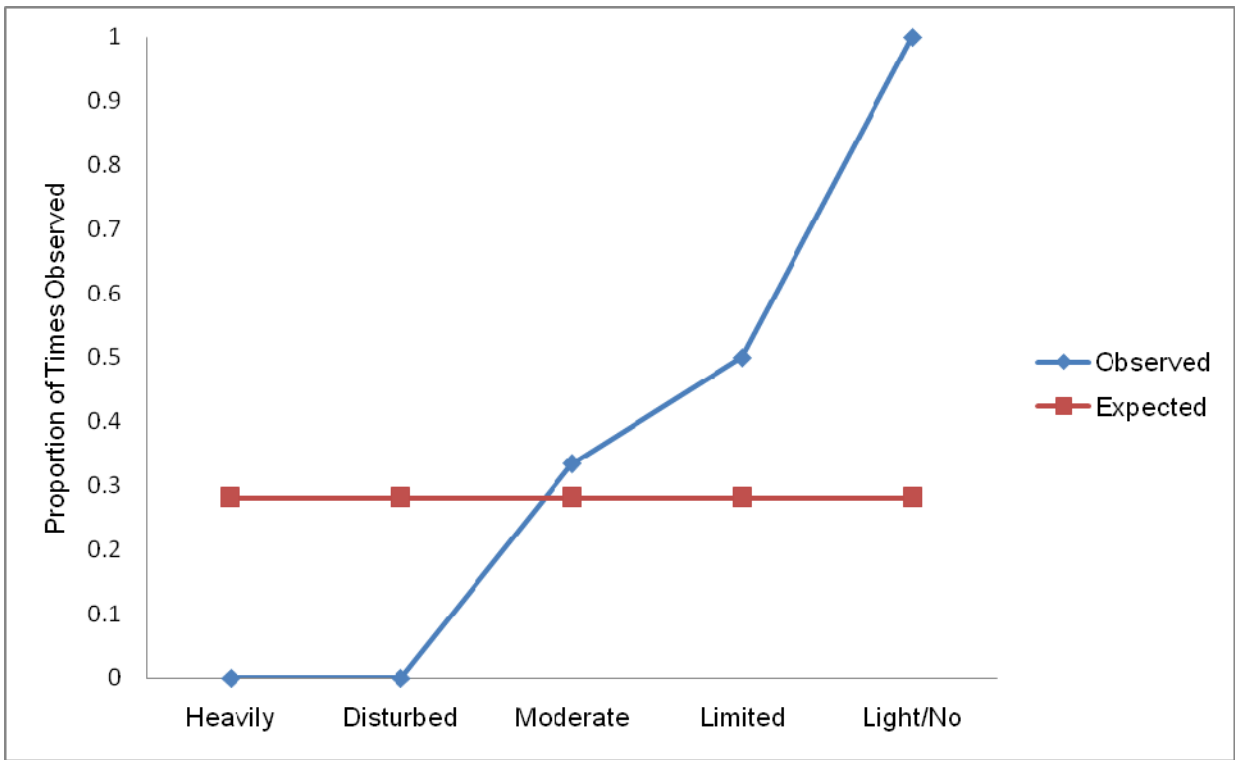


**Figure 2-8**. Line graph showing the proportion of times Le Conte's thrashers were observed within each disturbance category, plotted with the expected proportion of times within category by chance alone.

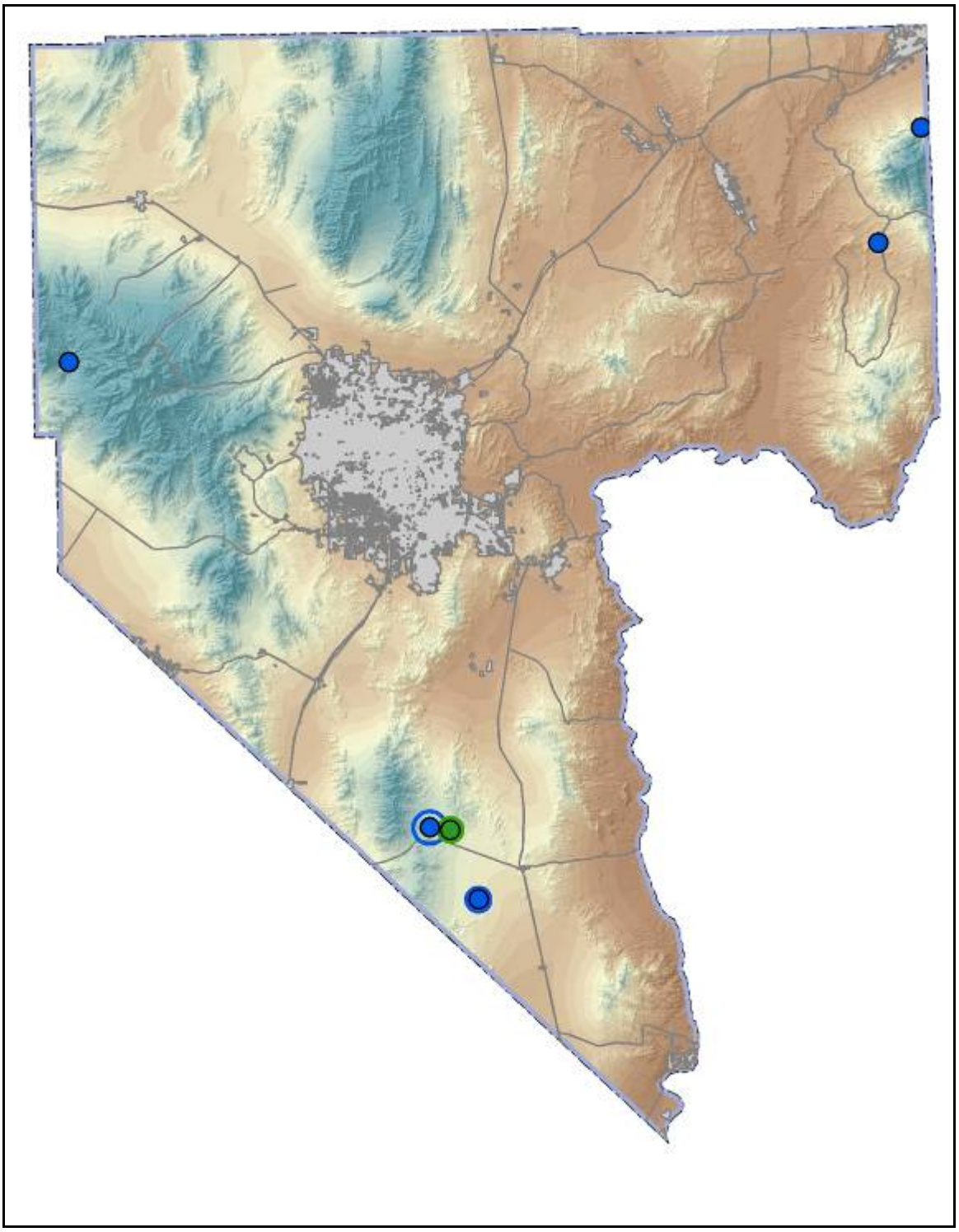

**Figure 2-9**. Map of Bendire's thrasher historical records and associated error buffers. Green circles depict locations where the species was present and blue circles depict absence locations.

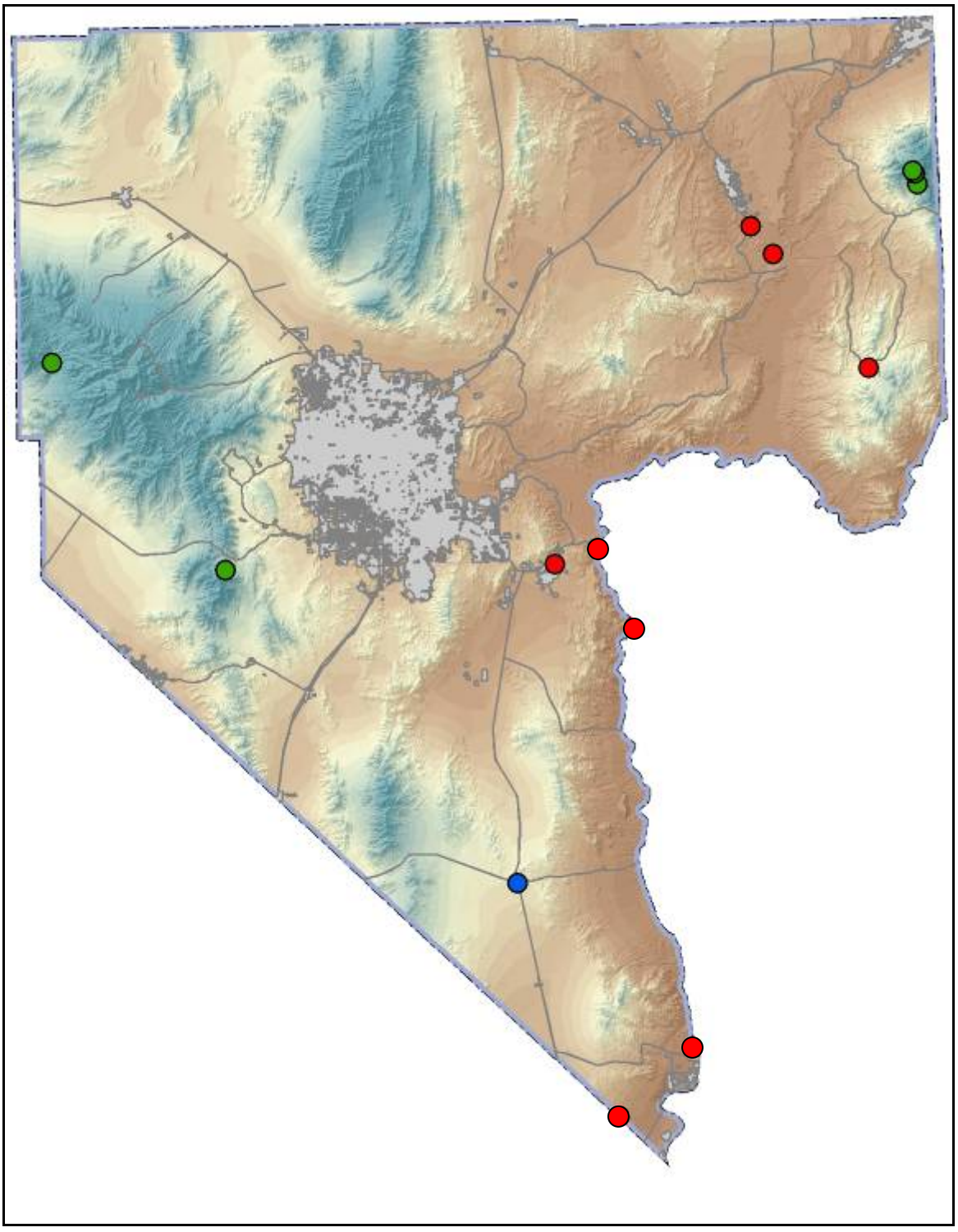

**Figure 2-10**. Map of gray vireo historical records and associated error buffers. Green circles depict locations where the species was present, blue circles depict absence locations, and red circles depict sites not considered to be suitable breeding habitat.

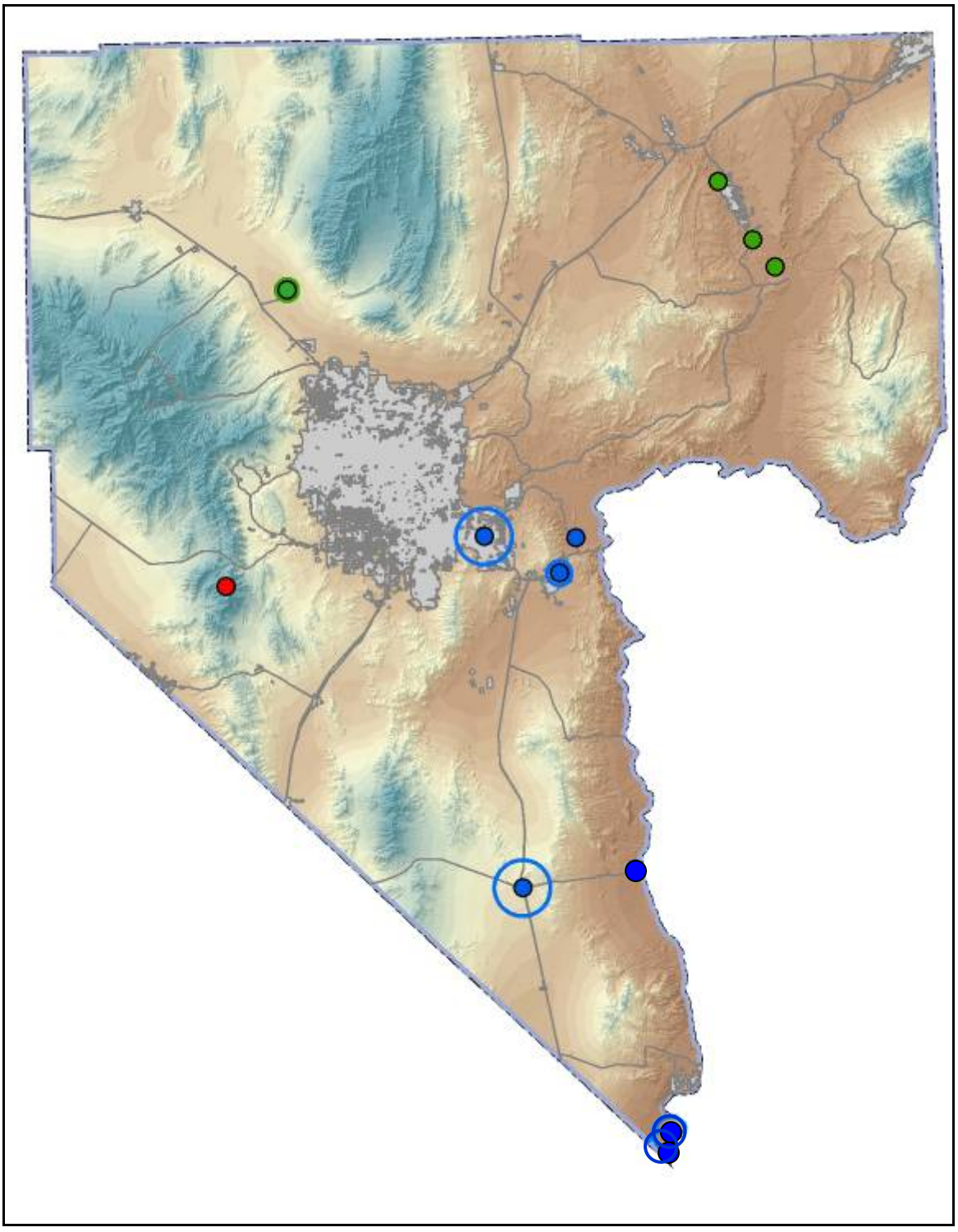

**Figure 2-11**. Map of blue grosbeak historical records and associated error buffers. Green circles depict locations where the species was present, blue circles depict absence locations, and red circles depict sites not considered to be suitable breeding habitat.

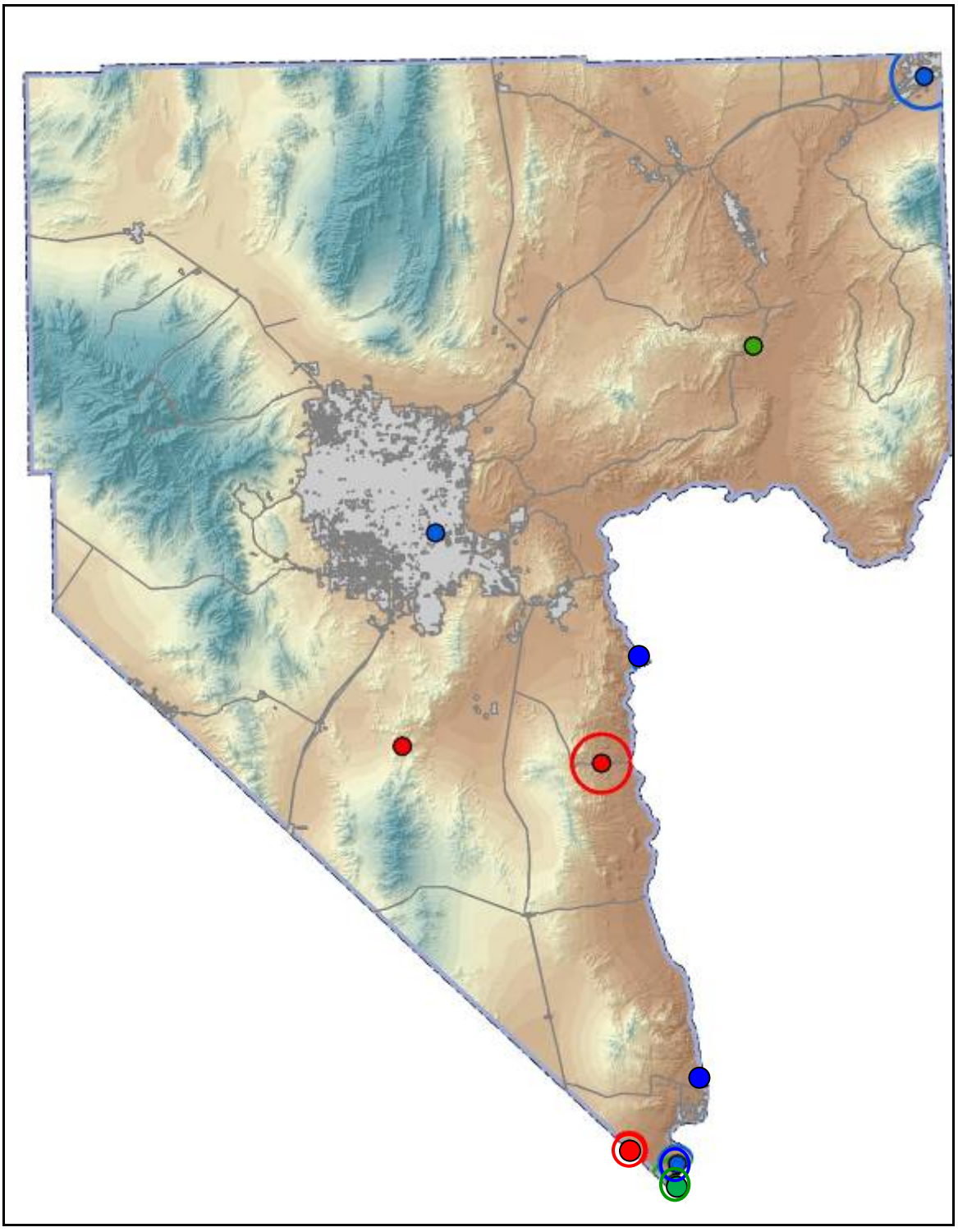

**Figure 2-12**. Map of Bell's vireo historical records and associated error buffers. Green circles depict locations where the species was present, blue circles depict absence locations, and red circles depict sites not considered to be suitable breeding habitat.

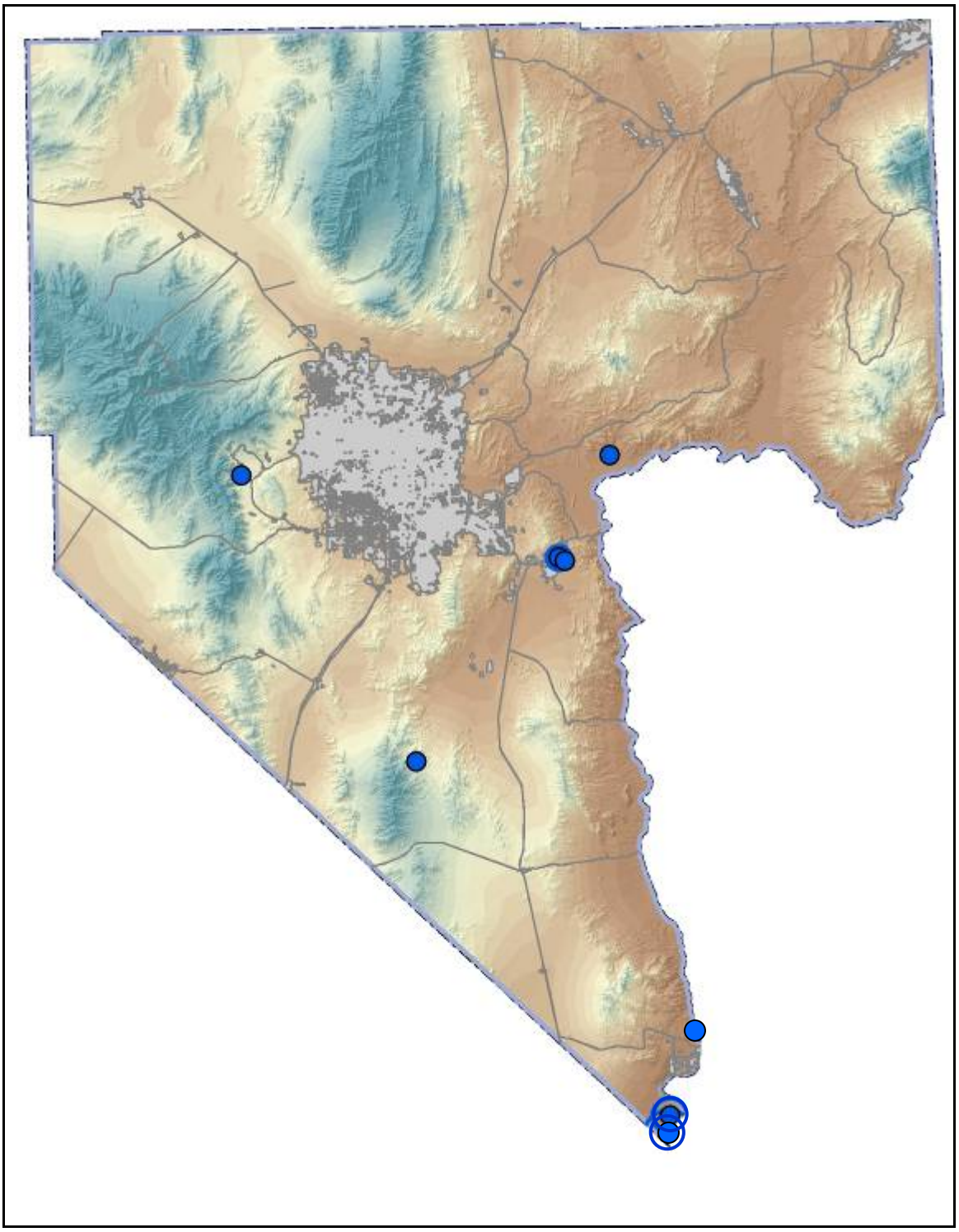

**Figure 2-13**. Map of summer tanager historical records and associated error buffers. Blue circles depict absence locations.

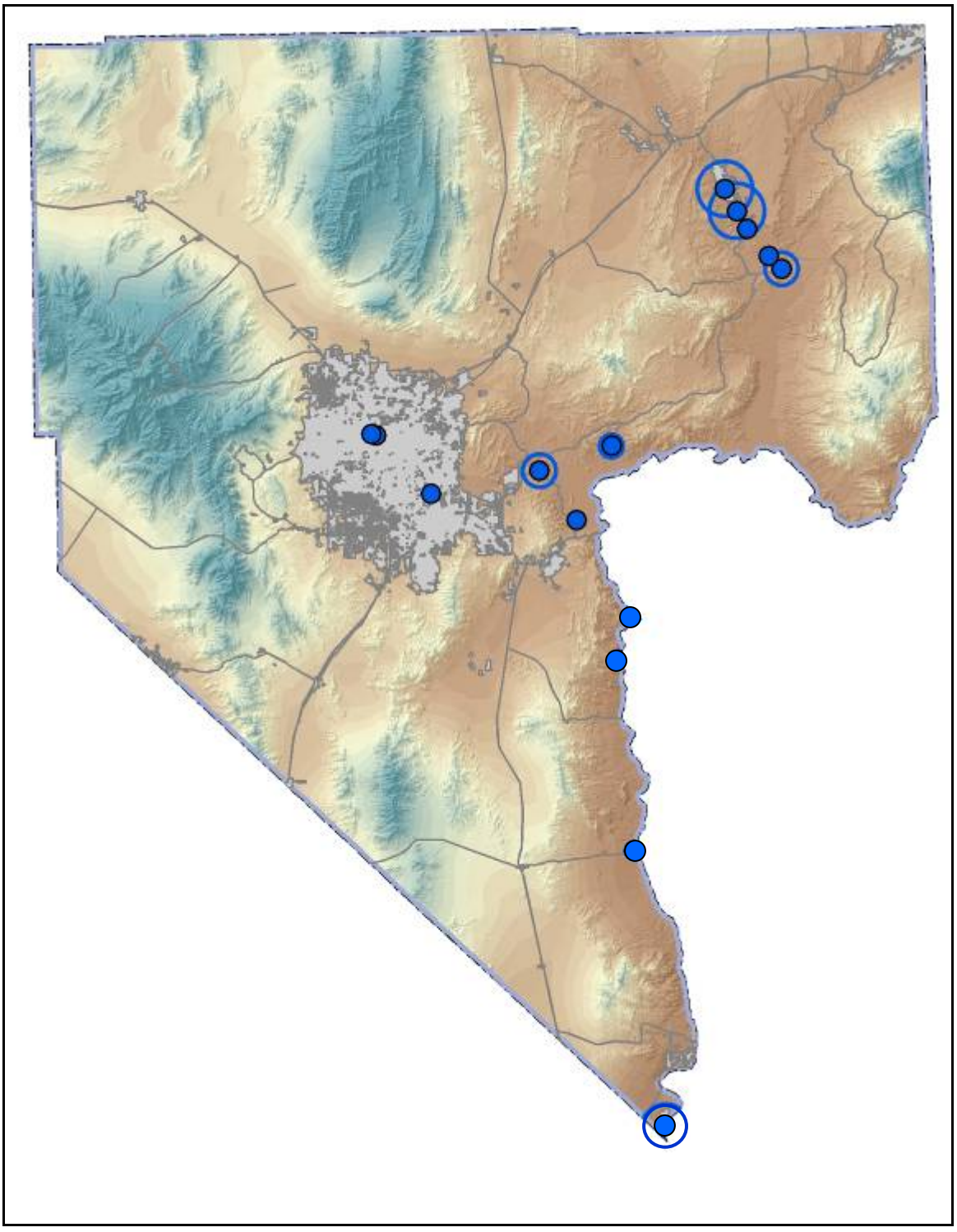

**Figure 2-14**. Map of vermilion flycatcher historical records and associated error buffers. Blue circles depict absence locations.

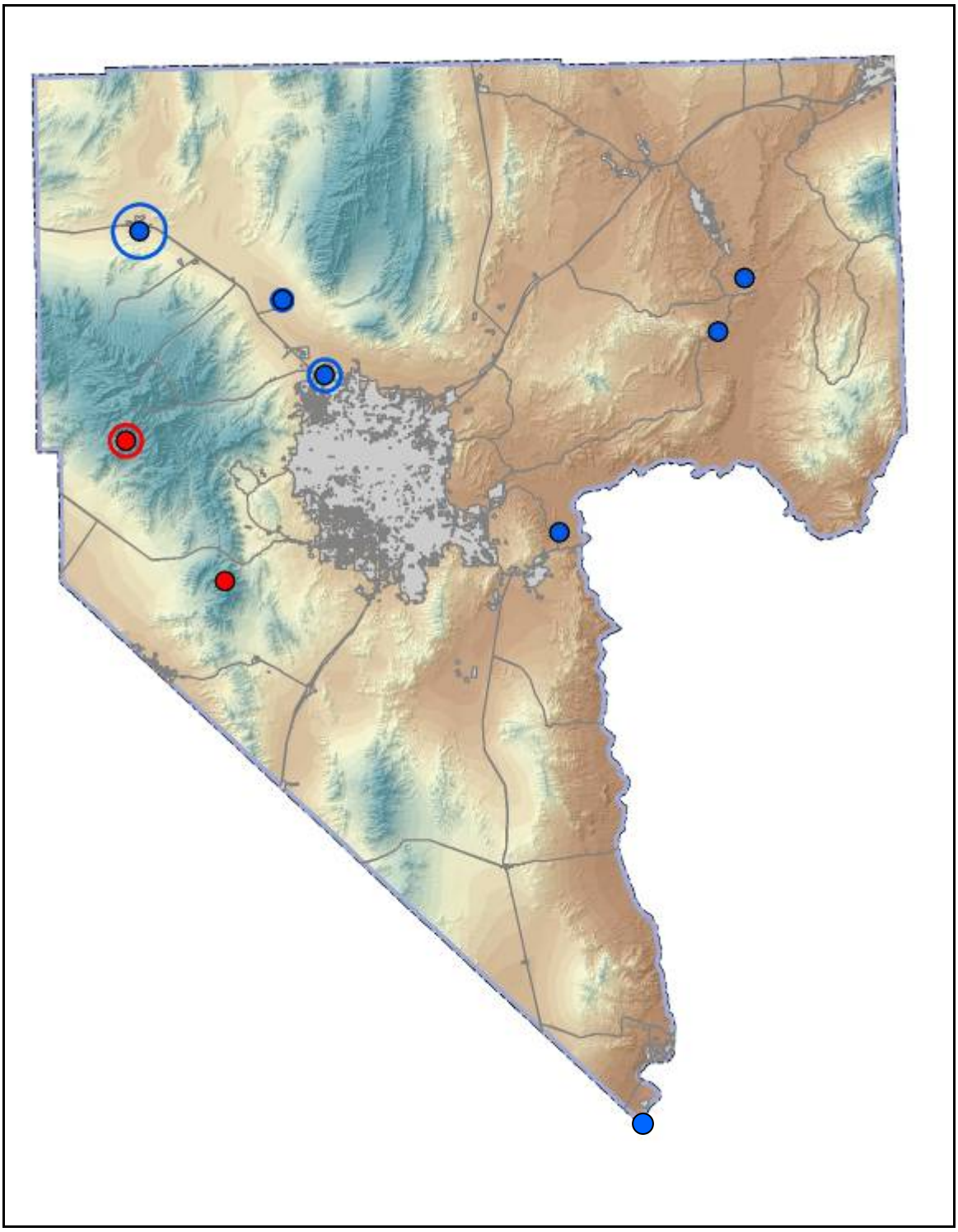

**Figure 2-15**. Map of southwestern willow flycatcher historical records and associated error buffers. Blue circles represent absence locations and red circles are not considered suitable breeding habitat.

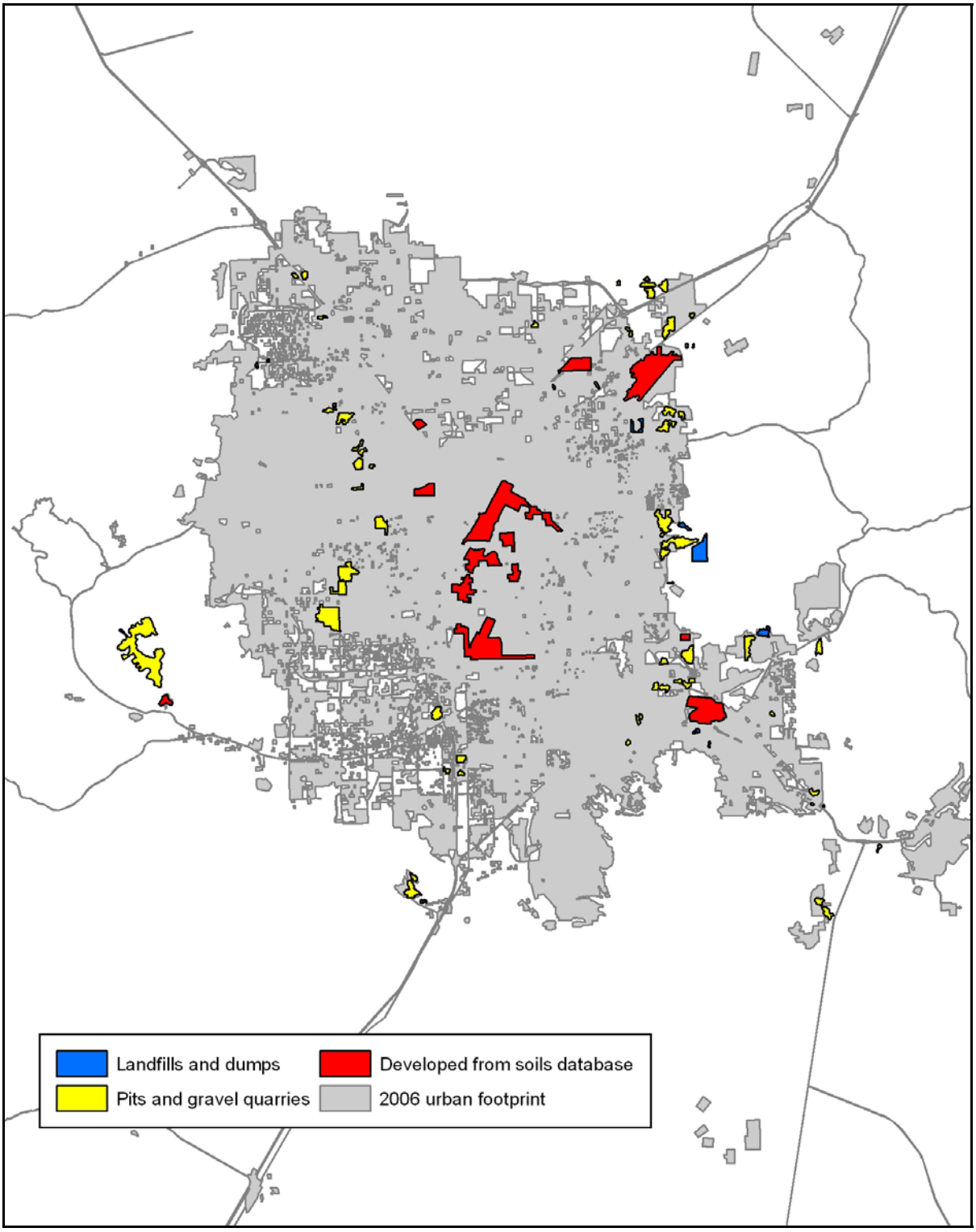


**Figure 2-16**. Map of Las Vegas Valley showing areas of high soil disturbance that could not be assessed to natural condition during the soils survey.

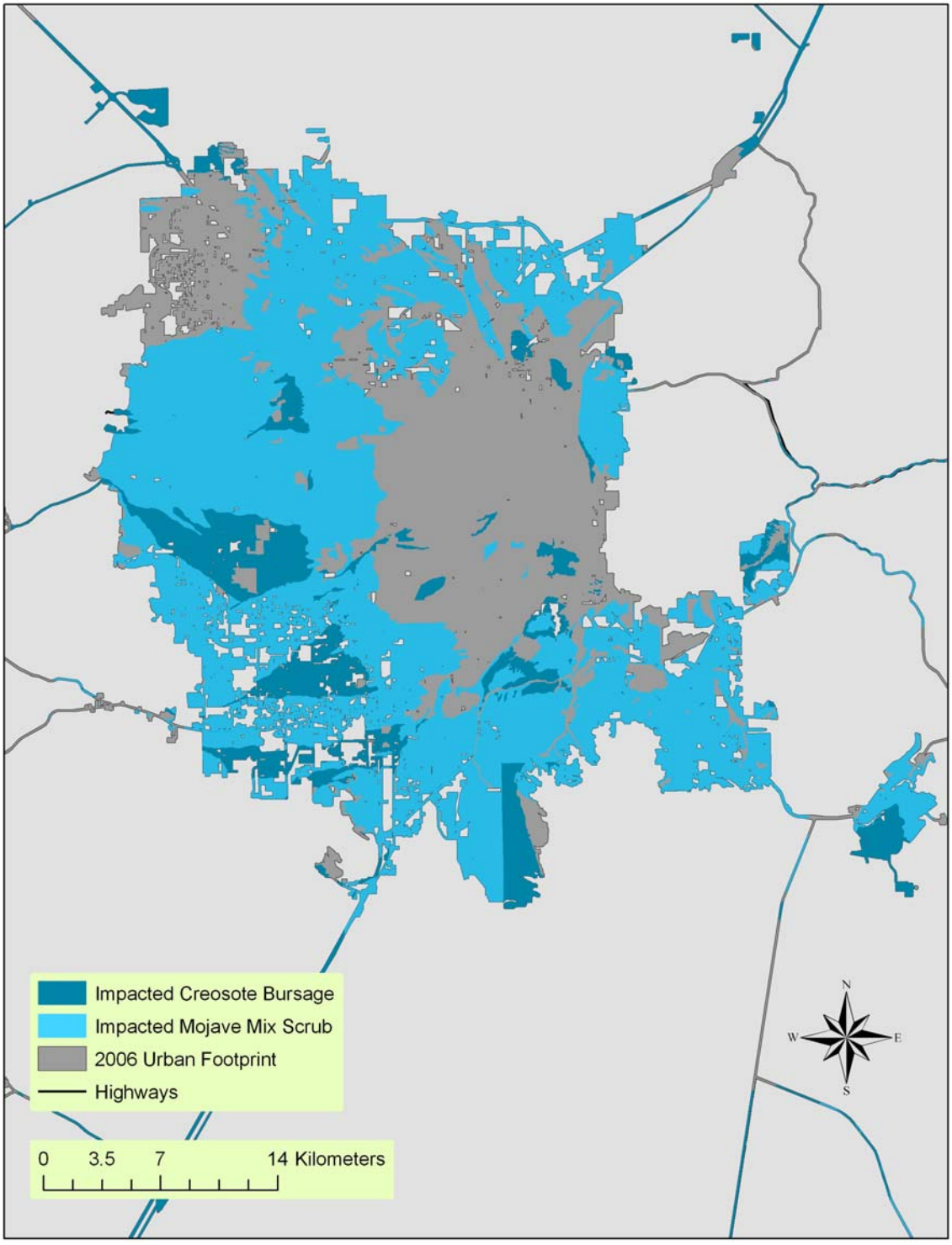


**Figure 2-17**. Estimated areas of creosote-bursage and Mojave mixed shrub lost to urbanization within Las Vegas Valley. Note the straight line between areas in the lower center of the image which is an artifact that reflects differences in the vegetation described for the soil type in different surveys.

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