Avian Surveys
2022 Final Project Report

SEPTEMBER 2022

PREPARED FOR

Desert Conservation Program
Clark County Department of
Environment and Sustainability

PREPARED BY

SWCA Environmental Consultants

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2022 FINAL PROJECT REPORT

Prepared for

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EXECUTIVE SUMMARY

In 2022, SWCA Environmental Consultants conducted avian surveys at 30 selected sites within Clark County, Nevada. Surveys were conducted with the objective of recording additional detections of seven avian species (target species) that will be covered under a proposed amendment to the Clark County Multiple Species Habitat Conservation Plan (MSHCP): Arizona Bell's vireo (*Vireo bellii arizonae*), Bendire's thrasher (*Toxostoma bendirei*), gilded flicker (*Colaptes chrysoides*), golden eagle (*Aquila chrysaetos*), LeConte's thrasher (*Toxostoma lecontei*), loggerhead shrike (*Lanius ludovicianus*), and western burrowing owl (*Athene cunicularia hypugaea*). These additional detections may be used to refine existing habitat distribution models for these target species.

Survey sites were selected to prioritize opportunities to record detections of four of the seven target species (priority species): Arizona Bell's vireo, Bendire's thrasher, gilded flicker, and western burrowing owl. The survey sites were located within the proposed MSHCP Amendment Impact Areas, the proposed MSHCP Amendment Reserve System, and other federally managed lands in Clark County. Surveys consisted of one or two area searches and a 1-hour eagle-use count or three area searches and no eagle-use count and were conducted between March 23 and June 5, 2022, by Steve Dougill, Trevor Hinckley, and Justin Streit. Surveyors spent 294.4 hours conducting area searches and 67.6 hours conducting eagle-use counts. Surveyors also recorded any incidental detections of the seven target species and survey detections of non-target species.

Surveyors detected all seven target species either during surveys or incidentally, or both. Three of the target species (Arizona Bell's vireo, LeConte's thrasher, and loggerhead shrike) were recorded within both the proposed MSHCP Amendment Reserve System and proposed MSHCP Amendment Impact Areas; western burrowing owl was also recorded within the proposed MSHCP Amendment Reserve System. Each target species was detected in only a small portion of the predicted habitat surveyed for the species, however, and the possible reasons for this varied by species. In addition to target species, surveyors recorded at least one non-target species at each site, totaling 106 non-target species, seven of which were raptor or large bird species, across all sites. Of the 106 species, 22 were recorded across the proposed MSHCP Amendment Impact Areas, and 13 were recorded in the proposed MSHCP Amendment Reserve System.

Survey results supported the models for gilded flicker, LeConte's thrasher, and loggerhead shrike. Arizona Bell's vireo was detected primarily in the largest drainages with the most extensive Desert Riparian habitat, and survey results suggest that the species uses smaller, fragmented patches of habitat in the county during migration. Bendire's thrasher was detected only in southern Clark County; these detections are consistent with the distribution of existing detection locations in the model input dataset. Additional information on specific habitat requirements in Clark County is needed to better understand this species' potential distribution. Western burrowing owl was detected outside but near predicted habitat for a second year in a row. Given the presence of potentially suitable burrows outside predicted habitat, it is possible more usable habitat is available to the species than is currently predicted. Conversely, western burrowing owl was the least abundant target species in 2022, and ongoing drought conditions in Clark County could be affecting species occurrence. Golden eagle detections were within or near predicted foraging habitat, but given their highly mobile nature, it is difficult to fully assess their specific use of the landscape from visual surveys alone. More specific methods such as telemetry could help refine knowledge of golden eagle foraging locations in Clark County.

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1 INTRODUCTION

1.1 Description of the Project

In accordance with the Clark County Multiple Species Habitat Conservation Plan (MSHCP), the Clark County Desert Conservation Program (the County) protects and manages habitat for protected species within its existing MSHCP properties (Riparian Reserve Units and the Boulder City Conservation Easement [BCCE]), including habitat for avian species covered by the MSHCP. A proposed amendment to the MSHCP will include the coverage of several additional species. To better understand and subsequently protect these species, the County commissioned habitat distribution models for 50 species (Nussear 2019; Nussear and Simandle 2020; Southwest Ecology 2018). These models will be used to identify potential areas for conservation and protection from development or disturbance. To better refine some of these models, the County is seeking to collect additional occurrence data for seven of the proposed avian species: Arizona Bell's vireo (*Vireo bellii arizonae*), Bendire's thrasher (*Toxostoma bendirei*), gilded flicker (*Colaptes chrysoides*), golden eagle (*Aquila chrysaetos*), LeConte's thrasher (*Toxostoma lecontei*), loggerhead shrike (*Lanius ludovicianus*), and western burrowing owl (*Athene cunicularia hypugaea*).

1.2 Background and Need

On March 28, 2001, the U.S. Fish and Wildlife Service (USFWS) issued an incidental take permit for the MSHCP, which covered 78 species, including eight avian species (USFWS 2001a). The process of amending the MSHCP began in 2007. One of the goals of the amendment is to minimize the number of species covered by the MSHCP to focus on those most at risk. Through this process, the number of species covered under the proposed amendment would be reduced to 29, including 10 avian species. As part of this process, the County commissioned the development of habitat distribution models for 50 new species to help determine which species should be covered (Nussear 2019; Nussear and Simandle 2020; Southwest Ecology 2018). Distribution is relatively well understood for three of the 10 avian species proposed for coverage under the amendment (Ridgway's rail [*Rallus obsoletus yumanensis*], southwestern willow flycatcher [*Empidonax traillii extimus*], and yellow-billed cuckoo [*Coccyzus americanus*]) but is less clear for the other seven species (Arizona Bell's vireo, Bendire's thrasher, gilded flicker, golden eagle, LeConte's thrasher, loggerhead shrike, and western burrowing owl) (hereafter target species). During the model development process, several areas lacking data were identified for the seven target species, and these areas generally had the greatest model uncertainty. The County determined that additional data are needed to refine the models for the target species, especially in areas of high model uncertainty. SWCA was contracted in 2021 and 2022 to conduct avian surveys to assist in filling in the data gaps.

1.3 Management Actions, Goals, and Objectives

The primary objectives of the avian surveys project are 1) to verify and expand on occurrence records of the seven target species across Clark County, particularly in areas where model uncertainty is high and known target species occurrences are limited, and 2) to build on a dataset of all avian species occurrences within the proposed MSHCP Amendment Reserve System (including existing MSHCP properties and Special Management Areas being considered for future conservation) and proposed MSHCP Amendment Impact Areas. The goal is that data collected for the seven target species may be used to refine habitat distribution models, which may in turn assist land managers in identifying potentially important areas for conservation. The 2021 survey data collected by SWCA supported the models for three of the target species: golden eagle, LeConte's thrasher, and loggerhead shrike. Surveys in 2022 therefore prioritized

opportunities to collect additional occurrence data for the remaining four target species (hereafter priority species): Arizona Bell's vireo, Bendire's thrasher, gilded flicker, and western burrowing owl.

2 Methods and Materials

2.1 Site Selection

In 2022, SWCA selected 30 sites within Clark County on federally managed land and on County property where data gaps existed for the four priority species. Because the primary focus in 2022 was to record additional detection locations for the four priority species, it was less important than it had been in 2021 to prioritize site placement within the proposed MSHCP Amendment Reserve System and proposed MSHCP Amendment Impact Areas.

The habitat distribution models and existing detection location data for the four priority species were used to select 30 sites that fit the prioritization criteria, as described below. In accordance with the geographically weighted resampling procedure described in the generation methods for the species' habitat distribution models (Nussear and Simandle 2020) where a maximum of three detections could be sampled for the model within a 2.5 ×2.5 km area, sites were spaced at least 2.5 kilometers (km) from their nearest neighbor. In 2021, site configuration was based on the methods detailed in the *Work Plan and Data Management for Avian Surveys* (Streit 2021), where each site comprised two 300 × 300–meter (m) square subplots (each spaced at least 500 m apart) and one eagle-use count location. This subplot size is recommended by the Desert Thrasher Working Group (DTWG) (2018) for both LeConte's and Bendire's thrashers as optimal for detecting these secretive species. The site configuration of multiple subplots was chosen because 1) it is possible for a surveyor to survey an area much larger than 300 × 300 m in a morning, 2) having multiple sampling locations within a site provides a greater chance of detecting secretive species, 3) having multiple sampling locations within a site provides flexibility in choosing diverse habitat structure, and 4) detections from each subplot would align with unique 250 × 250–m model cells, minimizing a potential detection clustering effect.

Two modifications were made to this site configuration approach in 2022 to facilitate recording detections for the four priority species. A small subset of sites comprised three 300 × 300–m square subplots and no eagle-use count location; this alternative site configuration was selected wherever it was logistically possible to survey three square subplots before 11 a.m. At a different subset of sites, either one or both square subplots were replaced with either a narrow, linear subplot delineating a segment of vegetation within a drainage or a non-square shape delineating a potential patch of mesquite/acacia habitat. These non-square subplots (hereafter linear subplot) were delineated to target potential Arizona Bell's vireo habitat. If a linear subplot was larger in areal extent than a square subplot, it was either divided into two linear subplots or the site comprised one large, linear subplot. Details of the 2022 site selection process are presented below.

2.1.1 Field Verification Areas

Prior to site selection, each priority species' model and model input dataset were visually examined to determine if there were any areas of predicted optimal habitat where no detections existed in the model input dataset. For each priority species, areas with predicted optimal habitat that were more than 2.5 km from existing detections were identified as needing field verification and were delineated to encompass the predicted optimal habitat and surrounding predicted habitat (i.e., habitat modeled as marginal, suitable, or optimal). Field verification areas do not represent an exhaustive identification of every modeled cell of predicted optimal habitat where no existing detections are located (Figure 1).

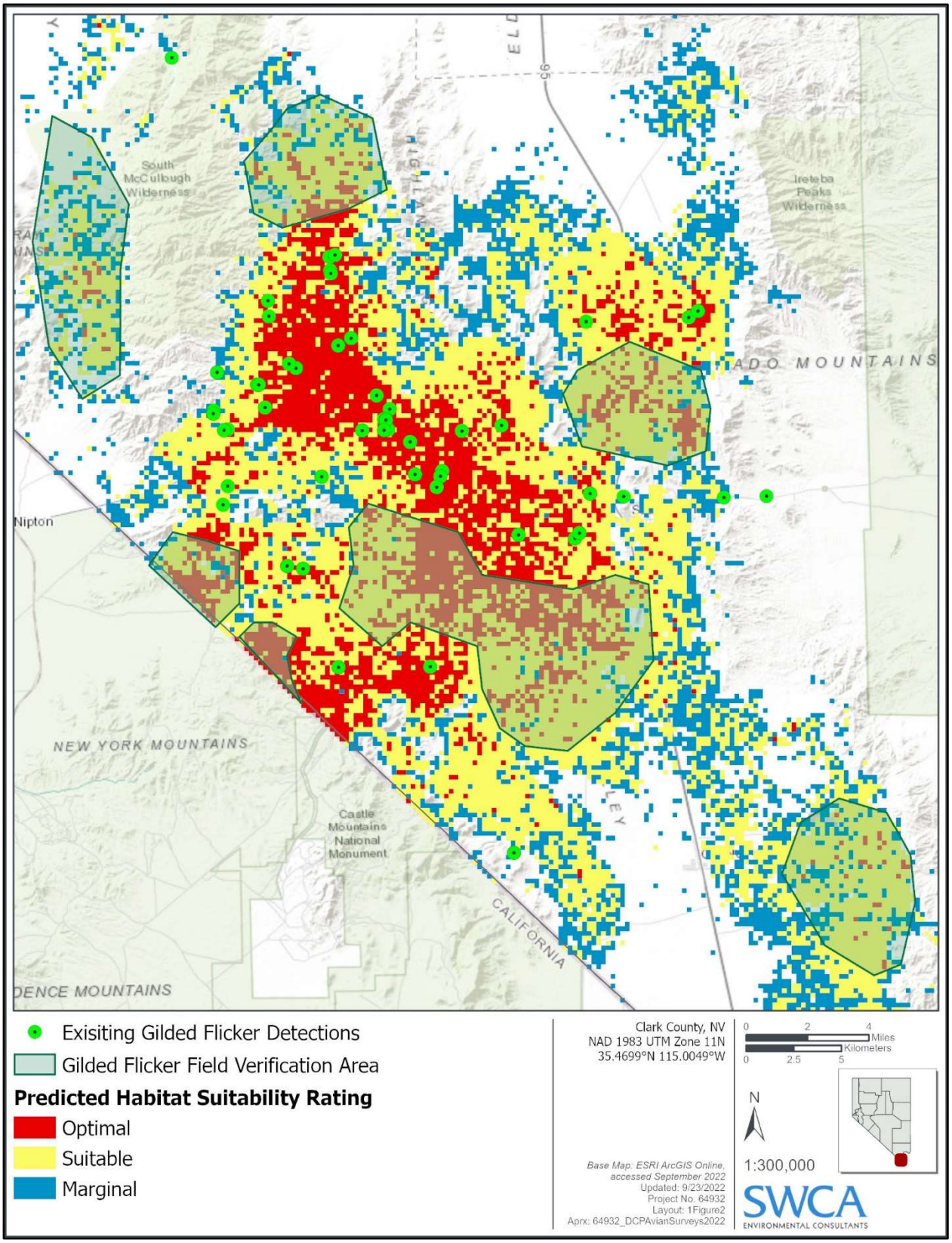

Figure 1. Field verification areas for gilded flicker in a portion of Clark County.

For Bendire's thrasher, gilded flicker, and western burrowing owl, several field verification areas comprising numerous predicted habitat cells were identified, with some overlap among species. Where field verification areas aligned relatively closely, one combined area was delineated for all species. Where field verification areas overlapped but did not align, separate areas were defined for each species. For Arizona Bell's vireo, the only areas of predicted optimal habitat that needed field verification were in relatively inaccessible riparian areas (e.g., the southern stretch of the Virgin River) or in large areas of private land (e.g., the town of Overton, Nevada); neither of these was prioritized for sampling. Site selection for Arizona Bell's vireo instead relied upon careful examination of aerial imagery combined with the existing detections used in the model input dataset to identify areas of potentially suitable vegetation structure and composition. Each area of potentially suitable habitat, regardless of existing detection presence or size, was delineated as a field verification area. Field verification areas were delineated for Arizona Bell's vireo near existing detection locations because desktop review suggested several of these detections were in atypical habitat for the species and warranted field verification.

To increase the sample size of all priority species' field verification areas, all available eBird data (eBird 2022) were visually examined and used to identify additional the field verification areas. For Bendire's thrasher, gilded flicker, and western burrowing owl, this meant looking for observations from eBird lists with relatively high location specificity (based on eBird list comment specificity and lists with small distance coverage) that were outside the delineated field verification areas and away from existing detections. If any eBird observations matching these criteria existed, the nearest field verification area for the corresponding species was expanded to include the eBird detection location. For Arizona Bell's vireo, these data were used to identify new field verification areas, ensuring that no potentially suitable habitat was overlooked. The final count of field verification areas was at least eight for each species plus five combination areas for Bendire's thrasher and gilded flicker (Figure 2).

2.1.2 Site Selection Criteria

The site selection process began by clipping each priority species' habitat suitability layer to the "suitable" and "optimal" habitat classes (collectively referred to as high-quality predicted habitat). Each clipped layer was then converted into a new polygon layer composed of 250 × 250–m cells. These converted polygon layers were then combined to create a single layer that identified high-quality predicted habitat for each species at each cell. Site selection from this combined layer was then guided by scoring each cell according to the following criteria:

- The presence of high-quality predicted habitat within a field verification area for a given species
- The number of species with high-quality predicted habitat within the cell (more than one priority species preferred)
- The proximity of the cell to a road navigable with a truck (≤ 1.6 km preferred)
- Location on private or public land (public land preferred)

Each of these criteria was individually scored. The first prioritization criterion was scored as a 2 for predicted optimal habitat within a field verification area for any species, a 1 for predicted suitable habitat within a field verification area for any species, and a 0 for everything else. The latter three prioritization criteria were scored as a 0 or 1, with 1 representing the preferred value for that criterion. The scores were added across the criteria, and the cells were split into two layers: cumulative scores of 3 or higher were placed into the high-score layer, and total scores of 2 or less were placed into the low-score layer. A random number field was then generated for both the high-score and low-score cells. Cells were filtered to the first 20% in each layer (i.e., random number ≤ 0.2). For Bendire's

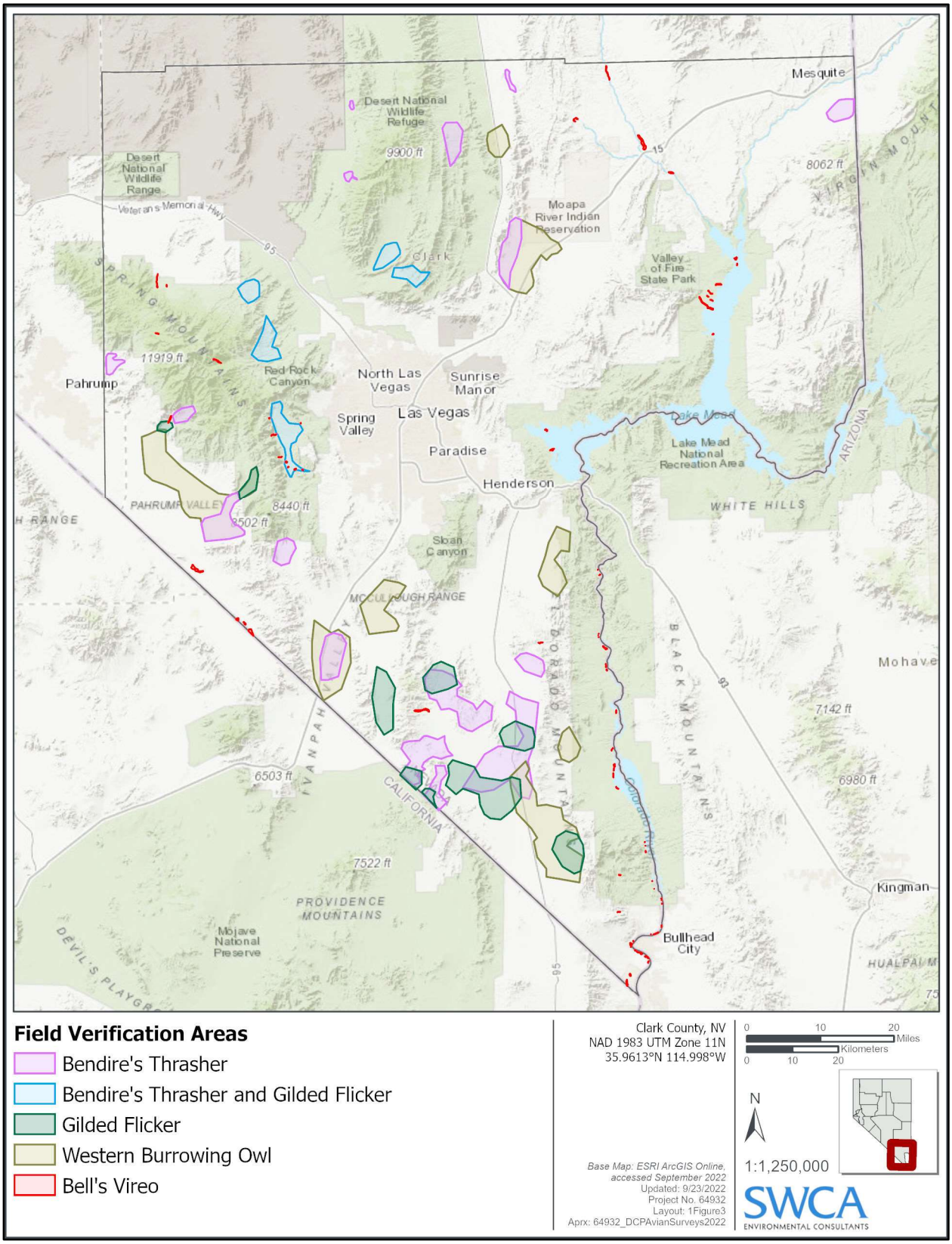

Figure 2. Final field verification area boundaries.

thrasher, gilded flicker, and western burrowing owl, cells could be selected regardless of whether they were in a field verification area. Cells selected for Arizona Bell's vireo were restricted to field verification areas.

Initial cell selection began with the filtered cells in the high-score layer. Examination of aerial imagery proved that the spatial data for presence of roads or private land used to generate the initial prioritization criteria were incomplete. Filtered cells were therefore re-scored after inspecting aerial imagery to confirm whether the cell was accessible (i.e., within logistically feasible walking distance from a road visible in aerial imagery), was not on developed land, and did not include topography that could be too steep to navigate safely. The first cells then selected were those containing optimal habitat for a species within its field verification area with the highest scores. Cells were selected in groups of at least two, with each cell at least 500 m from another cell in the group. Aerial imagery was examined to confirm habitat type.

This process was repeated, species by species, for Bendire's thrasher, gilded flicker, and western burrowing owl. Where field verification areas overlapped or applied to multiple species, cells selected for one species were re-examined to see if they also contained optimal habitat for the second species. If the selected cell contained optimal habitat for both species, no additional cells were added to the group. Some individual field verification areas generated for a species using eBird data did not overlap with the high-score cell layer. The cell selection process was repeated for these areas using the low-score cell layer until at least two cells were selected in each field verification area for Bendire's thrasher, gilded flicker, and western burrowing owl. The result of this cell selection process was 46 pairs or clustered small groups of cells (potential sites) across all field verification areas for Bendire's thrasher, gilded flicker, and western burrowing owl.

The collection of selected cells generated for Bendire's thrasher, gilded flicker, and western burrowing owl was increased using field verification areas identified for Arizona Bell's vireo. If any of the Arizona Bell's vireo field verification areas (see Section 2.1.1) were larger than 9 hectares (ha) (the area covered by a standard 300 × 300–m square subplot), they were divided into sections no larger than 9 ha in size. Some Arizona Bell's vireo field verification areas larger than 9 ha in size were in locations with only one access point. In these cases, dividing the area into smaller sections did not facilitate logistics, and the area was instead limited to no more than 18 ha (the area covered by two standard subplots). The adjusted field verification areas were then selected from using the process for the Bendire's thrasher, gilded flicker, and western burrowing owl selected cells. The selected field verification areas of identified for Arizona Bell's vireo added 38 pairs or clusters, of small habitat patches or singular long, narrow drainage areas to the list of potential subplots within potential sites.

Amongst the potential subplots, there was great overlap between Bendire's thrasher and gilded flicker and some overlap between Bendire's thrasher and western burrowing owl. There was no overlap between Arizona Bell's vireo and any of the other three species. In locations where three subplots were chosen, the third subplot replaced the eagle-use count to keep total sampling effort consistent across sites. To reduce the list to 30 sites, each potential site (i.e., pair or cluster of cells or subplot-sized habitat patches) was evaluated and assigned a priority ranking of low, medium, or high for inclusion in the final site list.
All potential sites within 2.5 km of a site surveyed in 2021 were given a low priority ranking.
For Bendire's thrasher, gilded flicker, and western burrowing owl, all potential sites with predicted habitat for a given species were assessed species by species and any that were within 2.5 km of a detection within the model input file were given a low priority for inclusion for that species (i.e., a site could be low priority for Bendire's thrasher and high priority for gilded flicker). For Arizona Bell's vireo, any potential site on or near a waterway with known species' occurrence in Clark County (i.e., the Virgin and Muddy Rivers and Las Vegas Wash) was given a low priority for inclusion. Potential sites in areas where timely permit acquisition could be an issue (e.g., Lake Mead National Recreation Area) were given a medium priority for inclusion. All other potential sites were given a high priority for inclusion.

The final collection of 30 proposed sites consisted of 20 sites of paired square or linear subplots, nine sites consisting of three square subplots, and one site with one linear subplot. Each site was selected for no more than three of the priority species, and the number of sites with subplots selected for each priority species ranged from eight for burrowing owl to 17 for Bendire's thrasher (Table 1). A set of alternate sites and subplots was also selected in case unforeseen access or navigation issues were identified. The selected alternate subplots had at least the same predicted priority species richness and composition of the selected subplots.

Table 1. Priority Species for Which Each Survey Site Was Selected

Survey Site Name	Arizona Bell's Vireo	Bendire's Thrasher	Gilded Flicker	Burrowing Owl
Arrow Canyon Range				X
Black Butte				X
Black Hills		X		
Boulder City				X
Copper Canyon	X	X		X
Cottonwood Valley				X
Creeks	X			
Crescent Peak		X	X	
Deadman Canyon		X		
Dry Lake Range				X
East Eldorado Valley				X
Elbow Canyon		X		
Fletcher Canyon	X			
Goodsprings		X		
Lee Canyon		X	X	
Lovell Wash				X
Lower Meadow Valley Wash	X			
Lower Sandy Valley	X			
Lucy Gray		X	X	
McCullough Spring		X	X	
Meadow Valley Wash	X			
Middle Piute Valley		X	X	
New York Mountains		X	X	
North Searchlight		X	X	
Pahranagat Wash		X		
Pine Creek	X	X	X	
Red Rock Wash	X	X	X	
Wheeler Camp Spring	X			
Wheeler Wash		X		
Yucca Forest		X	X	

2.1.3 Eagle-use Count Locations

Eagle-use count locations were placed approximately between a pair of subplots (linear or square). If there was only one linear subplot in a site instead of a pair of subplots, the eagle-use count location was near one end of the subplot. During the first survey, the surveyor evaluated the viewshed from the eagle-use count location. If the surveyor determined that the viewshed at the initial location was poor, the surveyor moved the eagle-use count to a nearby location to maximize visibility within an 800-m radius. The new location was recorded and used for all subsequent eagle-use counts. No eagle-use counts were established for the sites with three subplots.

2.2 Surveys

Surveys at each of the 30 sites comprised area searches, one at each of the subplots, followed immediately by an eagle-use count when applicable. Three surveys were planned at each site between March 20 and June 7, 2022, with consecutive surveys to each site separated by at least 10 days. All data were recorded on Samsung tablets (Galaxy Tab Active Pro with Android version 10 or Galaxy Tab Active2 with Android version 9) using ArcGIS Field Maps (version 22.3.0) (Field Maps) and paired with an external Geode GPS receiver to provide sub-meter horizontal accuracy.

At the start of each area search and eagle-use count, surveyors recorded weather data, which comprised cloud cover, wind speed and direction, temperature, and precipitation, on a standardized electronic form in Field Maps. Surveys were not conducted during periods of sustained precipitation or heavy fog, which could interfere with visibility of birds, or when winds reached or exceeded speeds that could interfere with the audibility of bird vocalizations (Ralph et al. 1993). Surveyors also recorded the start time and location, stop time and location, his or her name, and subplot and site name for each area search and eagle-use count in the same standardized electronic form in Field Maps.

2.2.1 Area Search Surveys

Area searches began as early as 30 minutes prior to sunrise and were completed by 11 a.m. or when the ambient temperature reached 100 degrees Fahrenheit, whichever occurred first (DTWG 2018; USFWS 2001b). Surveyors alternated the order in which the subplots were searched so that each subplot was not surveyed at the same time of day for all three survey rounds. Surveyors also varied their starting locations so that each area search began in a different location.

Each area search lasted at least 1 hour and continued until the surveyor thoroughly covered the subplot. The surveyor walked transects so that he or she passed within 50 m or less of all areas of the subplot. The surveyor walked transects slowly and quietly, meandering as necessary to confirm the identity of detected birds or to navigate obstacles in the plot. Additionally, the surveyor lingered, as necessary, in a particular location to confirm the identity of an individual bird.

Whenever the surveyor detected one of the seven target species, he or she recorded the initial location for the individual(s) and the number of individuals by age and gender (if possible). For potential gilded flicker detections, individuals not visually confirmed as gilded flicker were recorded as unknown flicker due to the presence of northern flicker (*Colaptes auratus*) in the county. For the six non-eagle target species, the surveyor recorded the highest breeding behavior observed, using standard breeding bird behavior codes (Table 2), to help determine if the species was breeding in the subplot. The behaviors fall into four categories ranging from “Observed” (i.e., species detected, but no inference on breeding status could be drawn) to “Confirmed” (i.e., direct evidence of current breeding activity observed in site).

Table 2. Standard Breeding Behavior Codes by Breeding Evidence Category

Breeding Evidence Category	Behavior
Observed	perching or foraging
	flyover
	calling
Possible	in appropriate habitat
	singing
Probable	singing bird present 7+ days
	multiple (7+) singing birds
	pair in suitable habitat
	territory defense
	courtship, display, or copulation
	visiting probable nest site
	agitation
Confirmed	carrying nest material
	building nest
	distraction display
	active nest
	incubating / brooding
	eggs in nest
	young in nest
	carrying food
	carrying fecal sac
	family group
	recently fledged or precocial young

For any golden eagle detections recorded during area searches, the surveyor used a raptor-specific (includes eagles) behavior list and estimated the distance to the eagle (see Section 2.2.2). The surveyor also recorded a detection location for at least one individual of any non-target species observed at each subplot and that species' highest breeding behavior, for the purpose of creating a list of species present in the subplot. Additional individual non-target detections were recorded opportunistically, as time allowed. For any non-target raptor species or common ravens (*Corvus corax*) detected, the surveyor used the same raptor-specific behavior list as for golden eagle (see Section 2.2.2). Species known not to breed in Clark County (e.g., winter residents and seasonal migrants) were not recorded as part of area searches, but surveyors opportunistically recorded the species in eBird under their accounts.

Following each area search within a subplot less than 800 m in length, the surveyor broadcast from near the center of the plot the primary song of each of the four priority species that was not detected through passive observation. For subplots that were more than 800 m long, additional broadcast locations were used so that every point within the subplot was within 400 m of a broadcast. The broadcast for each species comprised three repetitions of an approximately 30-second broadcast period followed by a 1-minute silent observation period. For the subplots more than 800 m long, the surveyor limited the broadcast to the primary song of the priority species identified for the survey site (see Table 1).

2.2.2 Eagle-Use Counts

Following area searches at a site, surveyors conducted an eagle-use count for sites comprising less than three subplots. Each count lasted 1 hour, following the recommendation of the USFWS (2013), with no time-of-day limit on when the counts were conducted. Surveyors focused their search within an 800-m radius, where they were able to record the most accurate data on location, age, and potential use of the area, but recorded all detections, regardless of distance to the detected individual. When applicable, a rangefinder was used to estimate distance; otherwise, distances were estimated visually using topographic features and an aerial map. For each golden eagle observed during an eagle-use count, the surveyor recorded the estimated location of the individual onto a digital map and recorded the age of the individual, distance and bearing from the observation point, and the observed behavior onto a standardized electronic form. Behaviors recorded for golden eagle followed a standardized raptor behavior list (Table 3) (USFWS 2013). As a quantitative assessment of positional accuracy is not possible for offset detection locations, a qualitative description of how accurately a surveyor placed a detection location according to their distance and bearing estimates was generated after surveys were complete. This was accomplished by using ArcGIS Pro (version 2.7.1) to measure the distance to a golden eagle as either the distance between the count location and detection location or, for individuals detected during an area search, as the minimum distance between the subplot and the detection location. Any discrepancies between the measured distance and estimated distance recorded by the surveyor were noted in the feature comments.

Table 3. Standard Eagle Behavior List

Behavior
Soaring flight
Unidirectional flapping-gliding
Perched
Kiting-hovering
Stooping/diving at prey
Stooping/diving agonistic
Undulating/territorial flight
Nesting/copulation
Other (explain in comments)

Source: USFWS (2013)

If surveyors detected a non-target raptor species or a common raven during an eagle-use count, they recorded detection locations as detailed in the Area-Search Surveys section (see Section 2.2.1). Common ravens were included with non-target raptor species as they are behaviorally more similar to raptor species than to non-raptor species.

2.2.3 Incidental Detections

Whenever any of the seven target species were detected incidentally (i.e., not during an area search or eagle-use count), the surveyor recorded the detection location and associated information as detailed in the Area-Search Surveys section (see Section 2.2.1). Incidental detections could be recorded whenever surveyors were not conducting an area search or eagle-use count, including when they were conducting other fieldwork in Clark County. Only visually confirmed gilded flickers were recorded incidentally.

2.2.4 Habitat Data

Surveyors recorded data on selected habitat components and structural metrics at least once at each subplot. These data included the dominant vegetation species and average and maximum vegetation height (in meters). Surveyors also noted burrows of a suitable size for burrowing owl, surface water within or immediately adjacent to the subplot, and signs of leporid mammals (e.g., black-tail jackrabbit [*Lepus californicus*] and desert cottontail [*Sylvilagus audubonii*]), which are common golden eagle prey species. For gilded flicker, SWCA reviewed published nest cavity dimensions (Moore et al. 2020) and estimated the minimum size of trees needed to support nesting as ≥ 12 cm diameter at breast height (dbh); surveyors also recorded the presence of trees this size. Additionally, surveyors took at least one representative overview photograph of each subplot. More than one photograph was taken when the surveyor felt that multiple, distinct habitat types were present within a single subplot (e.g., Mojave Desert Scrub and Desert Riparian vegetation). When this was the case, the surveyor recorded habitat information for each distinct habitat type, along with the photograph of that habitat.

2.3 Data Summarization

To summarize each target species' use of a site, both survey and incidental detections were examined. The distance at which each species could be detected varied and was greatest for golden eagle. Individual golden eagles could be detected at distances of more than 2 km; therefore, this species was excluded from the site use summary. For the remaining non-eagle target species, it was assumed that birds detected within a certain distance of a subplot could be using the subplot. This distance was determined by using the published breeding or foraging territory size for each species to calculate the radius of a circular territory. A circular area around the detection location was chosen on the assumption of equal probability of movement in any direction from the detection location. The radius of the circle ranged from 50 m (Arizona Bell's vireo) to 888 m (western burrowing owl) (Table 4). Any detection whose buffer overlapped with a subplot was considered possibly using the subplot and therefore associated with the subplot (associated detection). The amount of surveyed predicted habitat (i.e., predicted habitat within a subplot) that was associated with a detection was calculated as the sum of the amount of predicted habitat within both the subplot and the circular area around each detection.

Table 4. Target Species' Territory Sizes and Subplot Association Distance

Target Species	Territory Size (ha)	Subplot Association Distance (m)
Arizona Bell's vireo	0.8	50
Bendire's thrasher	1.67	73
Gilded flicker	25	282
LeConte's thrasher	7.34	153
Loggerhead Shrike	8.5	164
Western burrowing owl	248	888

Source: Territory size information was obtained from the following sources: Arizona Bell's vireo (Newman 1992), Bendire's thrasher (DTWG 2018), gilded flicker (Elchuk and Wiebe 2003), LeConte's thrasher (Sheppard 2019), loggerhead shrike (Miller 1931), western burrowing owl (Bates 2006).

Note: All territory sizes presented represent the breeding territory size, except for western burrowing owl. For western burrowing owl, unlike the other species, the foraging territory is notably different and larger than the area defended around a nest; the foraging territory size is therefore presented to avoid under-estimating habitat use.

3 RESULTS AND EVIDENCE OF THE RESULTS

3.1 Objectives Completed

The objective of verifying and expanding on occurrence data for the seven target species, with particular focus on four priority species, was completed; SWCA recorded all seven target species in 2022. Additionally, the objective of building on a dataset of all avian species occurrences within the proposed MSHCP Amendment Reserve System and proposed MSHCP Amendment Impact Areas was also completed; SWCA recorded 22 species across the proposed MSHCP Amendment Impact Areas and 13 species in the proposed MSHCP Amendment Reserve System.

3.2 Site Location and Survey Effort

Access or logistics issues were identified after surveys began for two of the initially selected 68 subplots. Both subplots were dropped from surveys. One of these two subplots was at the Creeks site, where surveyors were not able to access the eastern subplot due to private land; to compensate for lost effort, the western (linear) subplot was extended north to include more riparian habitat. The second dropped subplot was in the Lovell Wash site, where surveyors detected an active red-tailed hawk (*Buteo jamaicensis*) nest near the center of the middle subplot during the second survey; to avoid disturbance to the nest, which still contained two young during the final survey, this subplot was replaced with an eagle-use count location. Each eagle-use count location was relocated during the first survey to a position with a better view shed; two eagle-use counts were relocated a second time during the second survey.

Following adjustments for logistics, there were 66 subplots totaling 569.3 ha across 30 sites. Twenty sites had paired square or linear subplots and an eagle-use count location, two sites had one linear subplot and an eagle-use count location, and eight sites had three square subplots. The 66 subplots included eight within the MSHCP Amendment Reserve System and three within the MSHCP Amendment Impact Areas (Figure 3). All sites were on federally owned land (Bureau of Land Management, U.S. Forest Service, and USFWS) except for one site on County property near Boulder City. Each subplot intersected predicted habitat (i.e., habitat modeled as optimal, suitable, or marginal) for at least three target species. The surveyed area comprising predicted habitat for each target species ranged from 163 ha (29% of the total area surveyed) for Arizona Bell's vireo to 519 ha (91%) for loggerhead shrike (Table 5). The surveyed plots included each predicted habitat classification for each species except Arizona Bell's vireo, where no area was surveyed within predicted optimal habitat.

Surveys were conducted between March 23 and June 5, 2022, by Steve Dougill, Trevor Hinckley, and Justin Streit. Consecutive surveys to each site were separated by at least 11 days. Surveyors spent 294.4 hours conducting area searches at the 66 subplots covering 569.3 ha (Table 6). An additional 1.5 hours were spent conducting area searches at the Lovell Wash subplot that was dropped. Surveyors also spent 67.6 hours conducting eagle-use counts at 22 eagle-use count locations. Survey site size ranged from 7.6 ha at a site with only one linear subplot to 27.0 ha at sites with three square subplots. Mean subplot elevation ranged from 470 to 2,245 m above mean sea level (amsl). Several high-wind days occurred throughout the survey period, which caused surveys to be postponed; otherwise, weather conditions were favorable during surveys. No precipitation was observed during any survey, and temperatures during area searches did not exceed 98 degrees Fahrenheit. Wind speeds ranged from 0 to 15.5 km per hour during area searches and up to 41.8 km per hour during eagle-use counts.

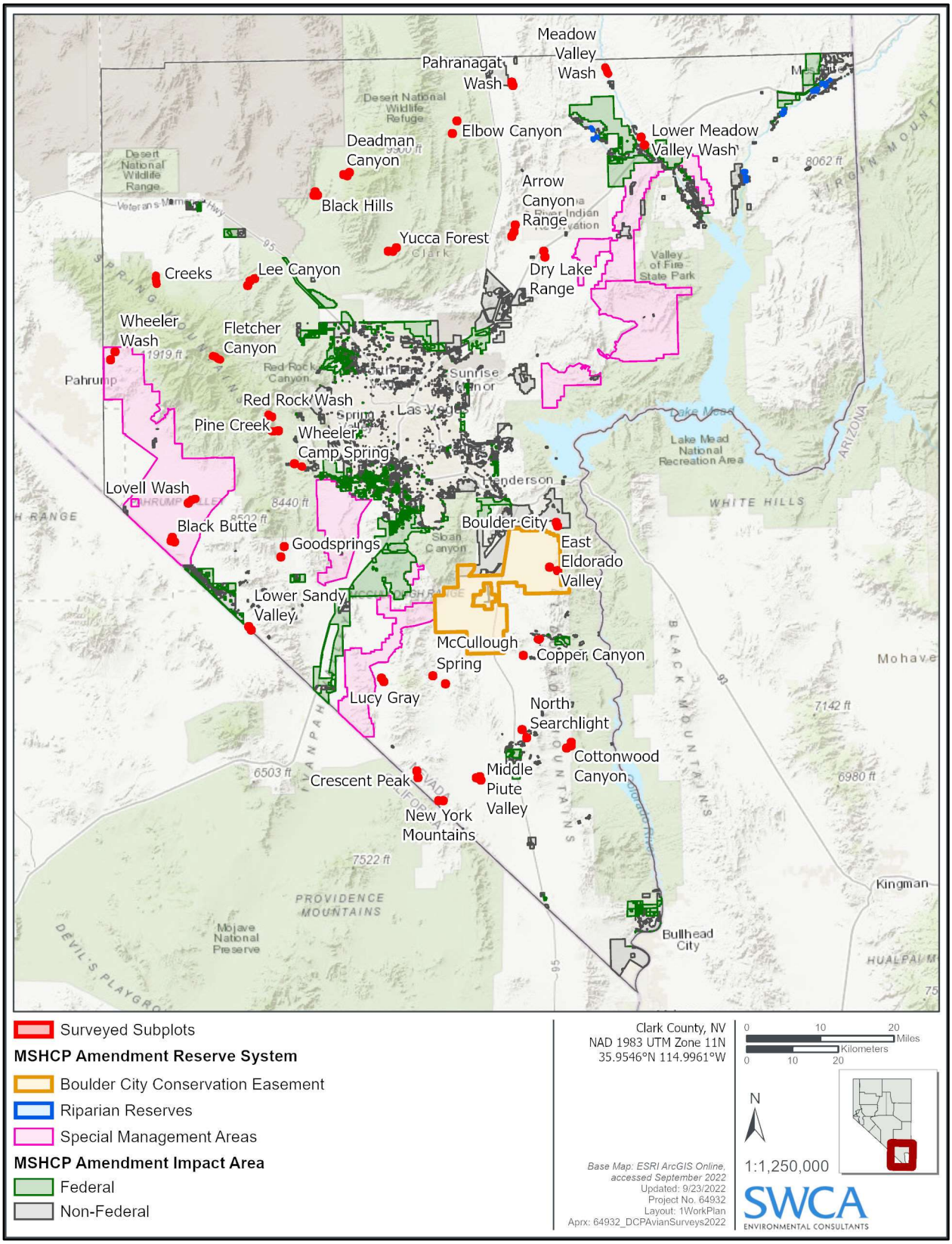

Figure 3. Location of sites selected for avian surveys in Clark County, 2022.

Table 5. Total Area (ha) Surveyed by Habitat Suitability Classifications and Species, Clark County, 2022.

Species	Optimal Habitat	Suitable Habitat	Marginal Habitat	Total Predicted Habitat*
Arizona Bell's vireo	0	74	89	163 (29%)
Bendire's thrasher	180	225	42	447 (78%)
Gilded flicker	108	86	35	229 (40%)
Golden eagle	57	171	96	324 (57%)
LeConte's thrasher	143	252	47	442 (78%)
Loggerhead shrike	191	283	47	519 (91%)
Western burrowing owl	65	76	44	185 (33%)

Source: Data on predicted suitable habitat were obtained from models developed by Nussear and Simandle (2020) and Nussear (2019).

* Numbers in parentheses represent the percentage of the total area (569.3 ha) of the 66 surveyed subplots.

Table 6. Survey Dates and Effort by Survey Type and Site, Clark County, 2022

Site	Survey Dates	Total Area (ha)	Total Area-Search Survey Hours	Total Eagle-Use Count Hours
Arrow Canyon Range	March 24, April 18, May 16	27.0	10.2	–
Black Butte	March 21, April 18, May 10	27.0	10.0	–
Black Hills	April 7, April 30, May 22	27.0	10.2	–
Boulder City	March 23, April 17, May 17	18.0	7.3	3.0
Copper Canyon	April 2, May 1, May13	14.0	8.3	3.2
Cottonwood Valley	April 4, May 9, May 29	27.0	10.0	–
Creeks – Willow	April 10, April 27, May 8	7.6	12.0	3.2
Crescent Peak	March 30, May 2, May 27	18.0	9.8	3.0
Deadman Canyon	April 8, April 28, May 11	27.0	11.4	–
Dry Lake Range	March 25, April 20, May12	18.0	7.3	3.1
East Eldorado Valley	March 26, April 25, May 18	18.0	7.3	3.1
Elbow Canyon	April 5, May 6, May 21	18.0	6.9	3.1
Fletcher Canyon	April 15, May 3, May 23	13.2	14.1	3.1
Goodsprings	March 31, April 23, May 15	18.0	10.2	3.1
Lee Canyon SW	April 9, April 27, May 28	27.0	11.3	–
Lovell Wash*	March 28, April 14, May 10	18.0	7.5	2.1
Lower Meadow Valley Wash	March 26, April 11, May 6	18.0	10.7	3.1
Lower Sandy Valley	March 27, April 17, May 11	18.0	9.8	3.2
Lucy Gray	April 4, May 14, May 26	18.0	8.9	3.1
McCullough Spring	April 1, May 2, May 31	18.0	8.8	3.1
Meadow Valley Wash	March 27, April 26, May 19	8.2	13.0	3.1
Middle Piute Valley	April 3, May 5, June 5	27.0	10.1	–
New York Mountains	April 2, May 13, May 30	18.0	9.2	3.2
North Searchlight	April 3, May 14, June 2	17.9	8.2	3.1
Pahranagat Wash	March 29, April 19, May 4	17.7	7.4	3.3

Site	Survey Dates	Total Area (ha)	Total Area-Search Survey Hours	Total Eagle-Use Count Hours
Pine Creek	March 31, May 5, May 25	16.2	13.9	3.2
Red Rock Wash	April 1, May 5, May 24	12.2	11.5	3.2
Wheeler Camp Spring	March 30, April 20, May12	12.2	10.1	3.1
Wheeler Wash	March 29, April 13, May 7	18.0	8.0	3.1
Yucca Forest	April 6, April 29, May 20	27.0	10.7	–
Total		**569.3**	**294.4**	**67.6**

Note: Any discrepancy between the sum of the individual numbers presented in the table and the totals is the result of rounding.

* Area-search survey effort at Lovell Wash includes only the effort for the two subplots surveyed throughout the season.

3.3 Findings

3.3.1 Target Species Detections

At least one detection of each of the seven target species was recorded during surveys (Table 7; see Sections 3.4.1.1 through 3.4.1.7). At least 40% of survey detections for each species were associated with a subplot except golden eagle, for which subplot association was not determined. At least one incidental detection was also recorded for each target species under one or more of the following circumstances: being on-site but not during an area search, traveling to or from a site, camping or looking for a camping spot near a site, conducting southwestern willow flycatcher and yellow-billed cuckoo surveys along the Muddy River or Virgin River, conducting point-count surveys at the BCCE or Riparian Reserve Units, and completing other fieldwork in the Pahrump Valley. Though some incidental detections were near to and associated with a subplot, the majority were not (see Appendix A). Three of the target species (Arizona Bell's vireo, LeConte's thrasher, and loggerhead shrike) were recorded within both the proposed MSHCP Amendment Reserve System and proposed MSHCP Amendment Impact Areas; western burrowing owl was also recorded within the proposed MSHCP Amendment Reserve System.

At least one subplot at 21 of the 30 sites had at least one associated detection. Detections were recorded across multiple surveys or incidentally, or both, within at least one site for Arizona Bell's vireo, gilded flicker, and loggerhead shrike. Breeding was confirmed within Clark County in 2022 for three of the target species: gilded flicker (nest with young), LeConte's thrasher (nest with young), and loggerhead shrike (active nest) (see Table B-1 in Appendix B).

The percentage of detections associated with subplots and within predicted habitat ranged from 25% for LeConte's thrasher to 77% for Arizona Bell's vireo (Figure 4). Of the detections not associated with a subplot, the percentage associated with predicted habitat ranged from 23% for Arizona Bell's vireo to 82% for golden eagle. For five of the target species, at least one detection was recorded outside predicted habitat. The percentage of surveyed predicted habitat associated with detections ranged from 0.4% (2 ha) for Bendire's thrasher to 24% (55 ha) for gilded flicker (Figure 5).

Table 7. Survey Results and Incidental Detections by Target Species, Clark County, 2022

	No. Sites (No. Subplots)	Associated with Subplots		Not Associated with Subplots		Total No. of Detections
		No. Survey Detections	No. Incidental Detections	No. Survey Detections	No. Incidental Detections	
Arizona Bell's vireo	3 (4)	30	0	2	8	40
Bendire's thrasher	2 (2)	2	0	0	4	6
Gilded flicker	4 (8)	20	8	1	15	44
Golden eagle	0	–	–	6	6	12
LeConte's thrasher	4 (4)	3	1	4	8	16
Loggerhead shrike	13 (15)	22	5	4	31	62
Western burrowing owl	1 (1)	1	1	0	0	2

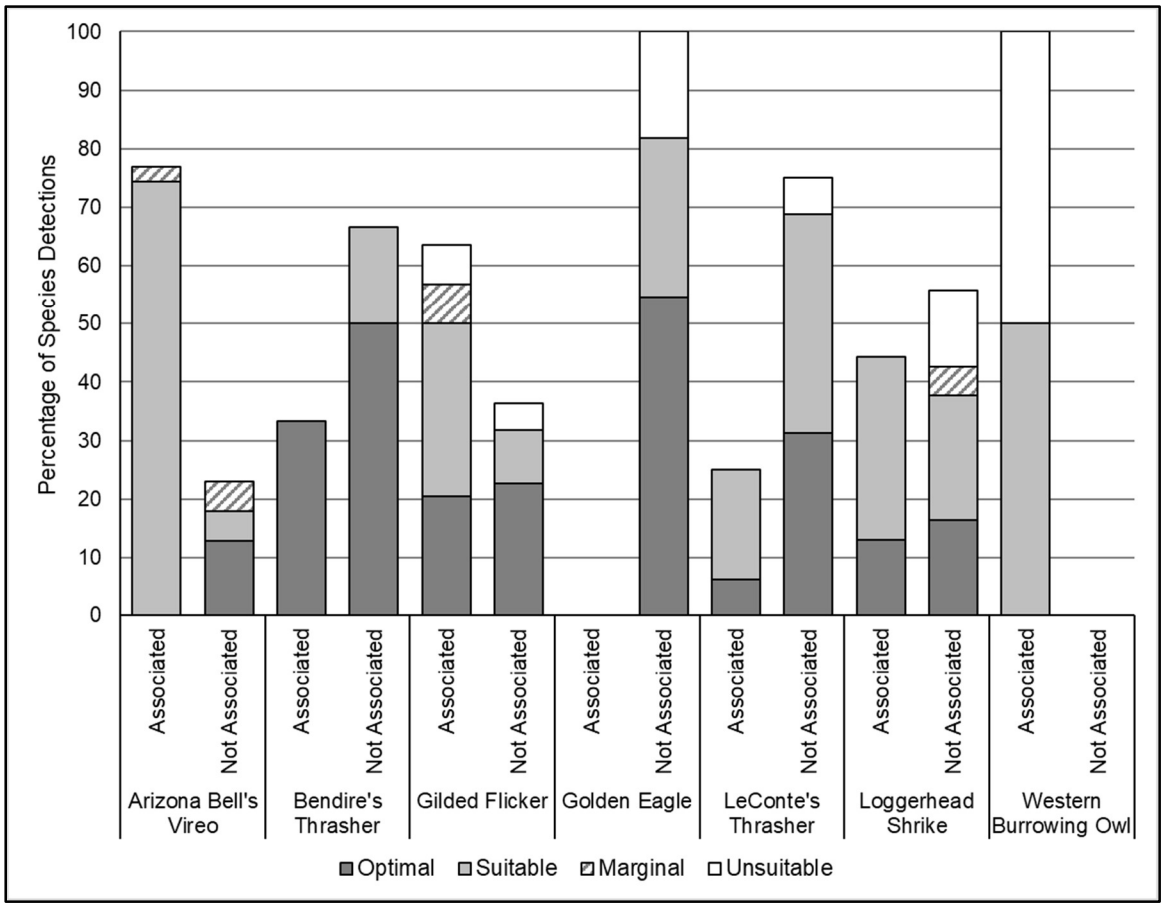

Figure 4. Percentage of detections by species, subplot association, and habitat suitability classification, Clark County, 2022.

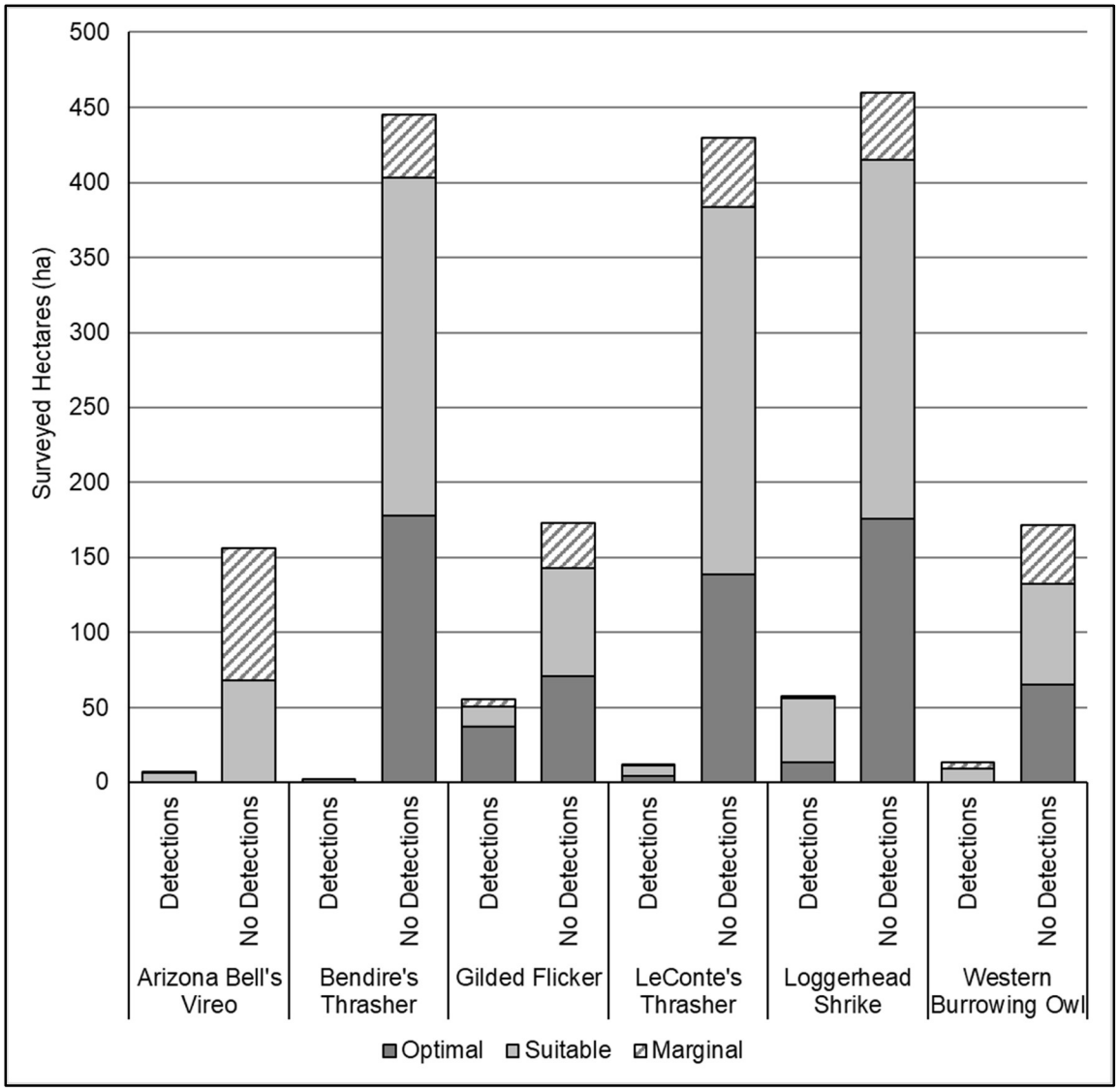

Figure 5. Areal extent of surveyed predicted habitat with and without associated target species detections, Clark County, 2022.

3.3.1.1 ARIZONA BELL'S VIREO

Surveyors recorded 32 Arizona Bell's vireo detections during area searches and recorded eight incidental detections (Figure 6; see Table 7). Thirty of these detections were associated with a subplot in one of three sites. One of the incidental detections was just north of the county line along the Meadow Valley Wash and is not included in predicted habitat summaries. One Arizona Bell's vireo detection in the southern end of the Meadow Valley Wash site was greater than 2.5 km from any existing detections in the model input data set.

All 39 detections within the county were in predicted habitat with 79% of detections in predicted suitable habitat, most of which were associated with subplots, and 13% of detections associated with predicted optimal habitat, none of which were associated with subplots(see Figure 4). Nine sites were selected for Arizona Bell's vireo (see Table 1), and detections were associated with subplots in three of these sites. Of the area surveyed in 2022, 29% (163 ha across 26 subplots) was predicted Arizona Bell's vireo habitat of

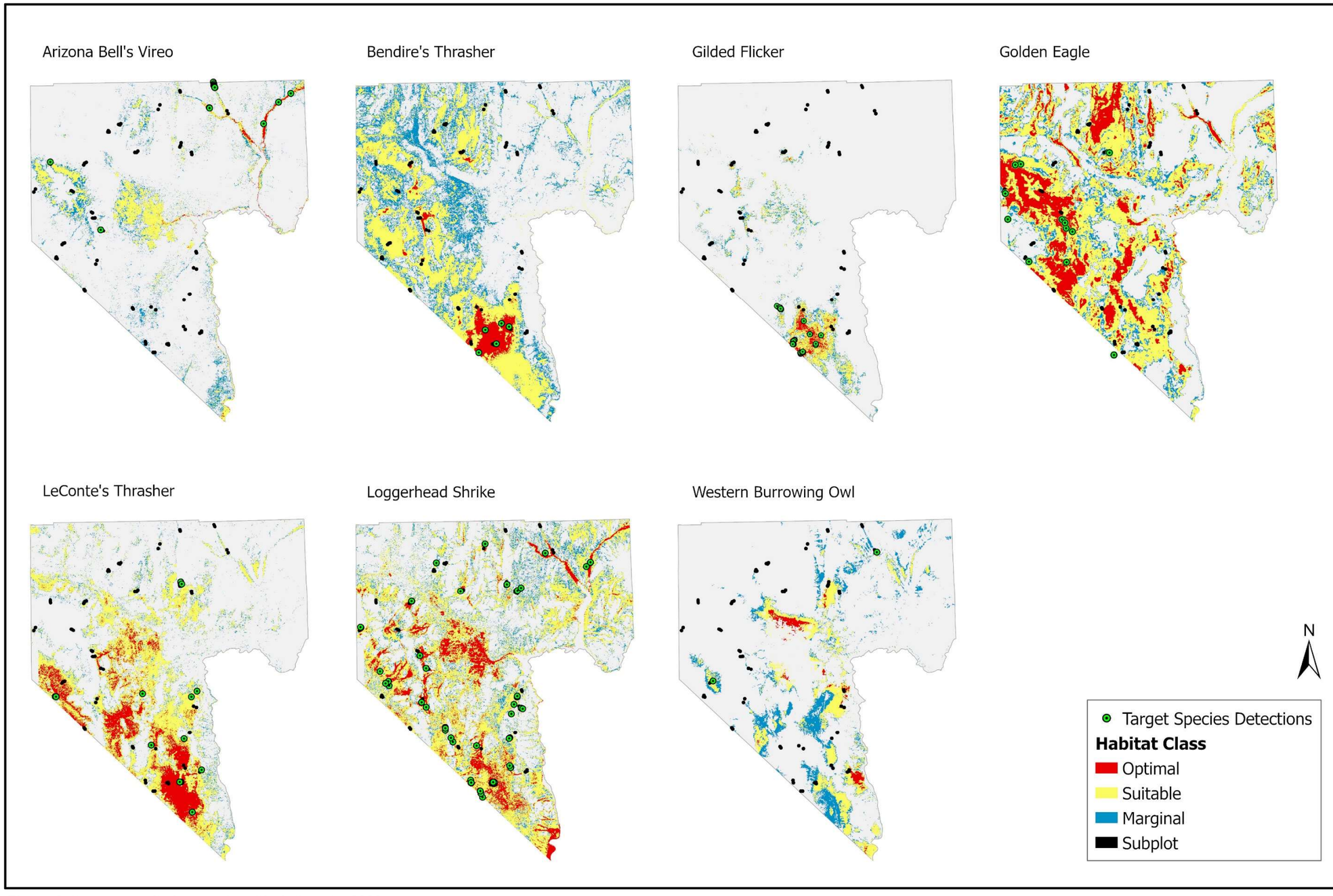

Figure 6. Survey results by species, Clark County, 2022.

either suitable or marginal classifications (see Table 5). Of the surveyed predicted habitat, 4% (6 ha) were associated with detections (see Figure 5). Mean elevation within subplots with predicted habitat was 470 to 2,245 m (average 1,071 m) amsl. Mean elevation within subplots with detections was 534 to 1,799 m (average 989 m) amsl.

Within the three sites with Arizona Bell's vireo detections, single detections of single individuals were recorded in late April at two sites (Wheeler Camp Spring and Creeks); these detections were of a singing individual and a silent individual briefly appearing during playback broadcast, respectively. At the third site (Meadow Valley Wash), detections were recorded on all three surveys, with up to 17 detections recorded during one survey. The highest observed breeding evidence associated with any detection was "singing," but the pattern of detections in both subplots represented "singing birds present 7+ days," and the number of detections in the northern subplot represented "multiple (7+) singing birds," which both indicate probable breeding within the site (see Table 2).

3.3.1.2 BENDIRE'S THRASHER

Surveyors recorded two detections of Bendire's thrasher during area searches and recorded four incidental detections (see Table 7, Figure 6). Both survey detections were associated with a subplot, each in a different site. All detections were concentrated in southern Clark County within a 220-km^2 area close to the community of Searchlight. Three Bendire's thrasher detections were greater than 2.5 km from existing detection locations in the model input dataset and were within the New York Mountains and North Searchlight sites and in the approximate vicinity of the Middle Piute Valley site.

All Bendire's thrasher detections were in predicted habitat, with 83% of detections in the optimal habitat classification and 17% of detections (none of which were associated with subplots) in the suitable habitat classification (see Figure 4). The single detection associated with predicted suitable habitat was an incidental detection not associated with a subplot. In total, 17 sites were selected for Bendire's thrasher (see Table 1), and detections were associated with subplots in two of these sites. Of the area surveyed in 2022, 78% (447 ha across 57 subplots) was predicted Bendire's thrasher habitat (see Table 5).
The percentage of surveyed predicted habitat associated with detections was 0.4% (2 ha) (see Figure 5). Mean elevation within subplots with predicted habitat ranged from 470 to 2,245 m (average 1,193 m) amsl. For subplots with detections, mean elevation was 1,084 and 1,385 m (average 1235 m) amsl.

Both survey detections were of non-singing individuals, denoting observation only of the species in the respective sites (New York Mountains and North Searchlight) and no evidence of breeding (see Table 2). One of the incidental detections consisted of a pair in suitable habitat, indicating probable breeding in the area.

3.3.1.3 GILDED FLICKER

Surveyors recorded 21 detections of gilded flicker during area searches and recorded 23 incidental detections (see Table 7, Figure 6). Three detections of unknown flicker were also recorded during surveys. Twenty-eight of the confirmed gilded flicker detections were associated with a subplot in one of four sites. Twenty-five gilded flicker detections were greater than 2.5 km from existing detections in the model input dataset and were clustered near the Lucy Gray, Crescent Peak, and Middle Piute Valley sites.

Of the 44 gilded flicker detections, 39 (89%) were in predicted habitat. Of the detections in predicted habitat, 43% were in predicted optimal habitat, 39% were in predicted suitable habitat, and 7% were in predicted marginal habitat (see Figure 4). A total of 11% of detections (5 of 44) were in habitat classified as unsuitable and four of these were close enough (≤ 112 m) to be associated with predicted habitat somewhere in the model. The fifth detection in unsuitable habitat was 365 m from predicted habitat.

Ten sites were selected for gilded flicker (see Table 1), and detections were associated with subplots in four of these sites. Of the area surveyed in 2022, 40% (229 ha across 29 subplots) was predicted gilded flicker habitat (see Table 5). The percentage of surveyed predicted habitat associated with detections was 24% (55 ha) (see Figure 5). Mean elevation within the subplots with predicted habitat ranged from 1,044 to 1,531 m (average 1,277 m) amsl. Mean elevation within subplots with detections ranged from 1,062 to 1,431 m (average 1,309 m) amsl.

Within the four sites with associated detections, gilded flicker detections were recorded during one survey in early June at the Middle Piute Valley site. Detections were recorded on two visits, one in mid-May and one in late May, at the New York Mountains and Lucy Gray sites. At the Crescent Peak site, detections were recorded during three visits in late March, early May, and late May. Detections at all sites consisted primarily of individuals seen perched, foraging, calling, or flying (i.e., observed at site) (see Table 2). At the New York Mountains site, an active nest with young and an adult seen carrying food near the nest were observed incidentally near a subplot in the site. At the Crescent Peak site, an adult was observed visiting a probable nest cavity. In addition to the activity listed above, an old nest cavity about 15 cm in diameter with chipping marks around the hole that would be suitable for a flicker species was found in a Joshua tree (*Yucca brevifolia*) just outside the southeast McCullough Springs subplot.

3.3.1.4 GOLDEN EAGLE

Surveyors recorded 12 detections of golden eagle, four of which involved two individuals soaring together (see Table 7, Figure 6). One of the detections was outside Clark County (south of the Crescent Peak site) and is not included in predicted habitat summaries. The distance estimated by the surveyor from their location to the eagle ranged from 150 to 10,000 m (average = 2,693 m, standard deviation = 2,852 m). Six golden eagle detections were greater than 2.5 km away from existing detections in the model input dataset; five of these were in the vicinity of the Spring Mountains and the sixth was over the Sheep Mountains.

Due to the distance at which a golden eagle can be visually detected, sampling was not strictly limited to the immediate search area within or around a site (i.e., the subplots and the 800-m-radius count circle). All survey sites were within 1.5 km of predicted foraging habitat, and 44 of 66 subplots (67%) and 14 of 22 eagle-use count locations (64%) were in predicted foraging habitat. Conversely, 42 of 66 subplots (64%) and 10 of 22 eagle-use count locations (45%) were in or within 1.5 km of habitat modeled as unsuitable, resulting in relatively even sampling of both predicted and unsuitable habitat.

All 12 eagle detections were of individuals in flight; no specific foraging behavior (e.g., active hunting) was observed for any detection. Nine of the 11 detections within the county (82%) were within predicted foraging habitat, with six detections (55%) within habitat modeled as optimal for foraging and three (27%) within habitat modeled as suitable. Two detections were outside predicted foraging habitat by an estimated 70 and 2,460 m. No direct breeding evidence was observed, but one individual golden eagle was observed to the east of the Creeks site performing undulating/territorial flight within habitat modeled as suitable for foraging.

3.3.1.5 LECONTE'S THRASHER

Surveyors recorded 16 detections of LeConte's thrasher: seven were recorded during area-search surveys, and nine were incidental detections (see Table 7, Figure 6). Four of the detections were associated with a subplot, each in a different site (see Table 5). Thirteen LeConte's thrasher detections were greater than 2.5 km from existing detection locations in the model input dataset.

Fifteen of the 16 detections (94%) were in predicted habitat, with 38% in predicted optimal habitat and 56% in predicted suitable habitat (see Figure 4); the other detection was in habitat modeled as unsuitable but was 65 m from predicted habitat. Of the area surveyed in 2022, 78% (442 ha across 62 subplots) was predicted LeConte's thrasher habitat (see Table 5). The percentage of surveyed predicted habitat associated with detections was 2% (11 ha) (see Figure 5). Mean elevation at subplots with predicted habitat and no detections ranged from 470 to 1,749 m (average 1,080 m) amsl. Mean elevation at each subplot with detections ranged from 593 to 1,145 m (average 818 m) amsl.

At each of the four sites with subplots with associated detections, detections were recorded during one visit between late March and early May. Two detections consisted of silent individuals running on the ground, one detection was of a calling individual, and one detection was of a singing individual. The detections of silent or calling individuals denote only observation of the species in the respective sites (see Table 2). The detection of a singing individual denotes possible breeding at the site (Black Butte). Breeding activity was confirmed in other locations within the county, as surveyors observed one individual carrying food and, in a separate location, observed an active nest with young.

3.3.1.6 LOGGERHEAD SHRIKE

Surveyors recorded 62 detections of loggerhead shrike; 26 were recorded during surveys, and 36 were incidental detections (see Table 7, Figure 6). Twenty-seven of the detections were associated with a subplot in one of 13 sites. One of the incidental detections was just south of the county line near the New York Mountains and is not included in predicted habitat summaries. Twenty-seven loggerhead shrike detections were greater than 2.5 km from existing detection locations in the model input dataset.

In total, 54 detections (87%) were in predicted habitat, with 30% in predicted optimal habitat, 52% in predicted suitable habitat, and 5% in predicted marginal habitat (see Figure 4). The eight detections in habitat classified as unsuitable were between 58 and 215 m from predicted habitat. Of the area surveyed in 2022, 91% (519 ha) was predicted loggerhead shrike habitat (see Table 5), with some predicted habitat in each subplot. The percentage of surveyed predicted habitat with associated detections was 11% (58 ha) (see Figure 5).

Of the 13 sites with detections, detections were recorded on only one visit at eight sites, during two visits for three sites, and during all three visits for two sites. Detections primarily consisted of individuals perching, foraging, or calling (i.e., "observed at the site) (see Table 2). Singing individuals (i.e., possible breeding) were observed at three sites, agitation (i.e., probable breeding) was observed at one site, and nest building (i.e., confirmed breeding) was observed at one site. Within detections not associated with a subplot, confirmed breeding behavior (i.e., carrying food, family groups, and recently fledged young) were observed in four different locations.

3.3.1.7 WESTERN BURROWING OWL

Surveyors recorded one survey detection and one incidental detection of western burrowing owl (see Table 7, Figure 6). Both detections involved calling individuals. One of the detections was greater than 2.5 km from existing detections in the model input dataset.

One of the detections was in predicted suitable habitat, while the other was in habitat classified as unsuitable but was 217 m from predicted marginal habitat (see Figure 4). Eight sites were selected for western burrowing owl (see Table 1), and detections were associated with subplots in two of these sites. Of the area surveyed in 2022, 33% (185 ha across 25 subplots) was predicted western burrowing owl habitat (see Table 5). The percentage of surveyed predicted habitat associated with detections was

7% (13 ha) (see Figure 5). Mean elevation for subplots with predicted habitat ranged from 470 to 1,214 m (average 761 m) amsl.

3.3.2 Non-target Species

Surveyors recorded at least one non-target species at each site, totaling 106 non-target species, seven of which were raptor or large bird species, across all sites. Thirteen of these species were recorded in the proposed MSHCP Amendment Reserve System, and 22 were in the proposed MSHCP Amendment Impact Areas. These species are known to breed in Clark County, although not necessarily in the sites where they were observed. Fourteen additional bird species known to be winter visitors or migrants passing through Clark County were recorded during surveys. Migrating raptors and vultures were observed but not recorded, and strong movements of Swainson's hawks (*Buteo swainsoni*) and turkey vultures (*Cathartes aura*) were observed from the Lower Meadow Valley Wash near Moapa and the Dry Lake Range sites during April. The three most abundant non-target species across all sites combined were black-throated sparrow (*Amphispiza bilineata*), ash-throated flycatcher (*Myiarchus cinerascens*), and house finch (*Haemorhous mexicanus*). Breeding was confirmed for 30 non-target species. A full list of the bird species detected during surveys and their highest breeding evidence is outlined in Table B-2 in Appendix B.

3.3.3 Habitat Data

In total, 67 photographs (one from each subplot including the Lovell Wash subplot that was dropped mid-season) and associated habitat data were recorded. Average vegetation height within each subplot ranged from 0.4 to 4.0 m (average = 1.4 m, standard deviation = 0.9 m). Maximum vegetation height within each subplot ranged from 1.4 to 20 m (average = 4.6 m, standard deviation = 3.5 m). The most reported species of vegetation were creosote bush (*Larrea tridentata*), burrobush (*Ambrosia* spp.), and blackbrush (*Coleogyne ramosissima*). Large trees (≥ 12 cm dbh) were reported for 34 (51%) subplots; 16 of the subplots with large trees were in predicted gilded flicker habitat. Burrows of a suitable size for burrowing owl were reported for 38 subplots covering 328 ha (58% of subplots and surveyed area); 15 of the subplots with burrows (121 ha) were in predicted western burrowing owl habitat. Signs of leporid mammals were reported for 37 (55%) subplots; 25 of the subplots with signs of leporid mammals were in predicted golden eagle foraging habitat. Surface water was present during surveys within five (7%) of the subplots; three of the subplots with surface water were in predicted Arizona Bell's vireo habitat.

4 EVALUATION/DISCUSSION OF RESULTS

Many factors (e.g., breeding season phenology, level of breeding activity, territory size, and local population size) can influence detection probability, and low detection probability can result in species not being detected despite being present. Survey methods and timing were selected to be the most applicable across the suite of target species, but each species has different typical breeding phenology. Detection probability could be lower in the latter portion of a breeding season (e.g., for gilded flicker and LeConte's thrasher) or at the very beginning (e.g., for Bendire's thrasher and Arizona Bell's vireo).

Breeding activity can be influenced by various factors such as food availability, which can be directly related to local rainfall. In years of below-average rainfall, a species' occurrence within habitat normally considered suitable might be limited to areas with only the highest food availability. Clark County and the greater southwest have been experiencing prolonged drought (Environmental Protection Agency 2021), and the 2-year period between July 2020 and June 2022 is the driest on record for Clark County (National Oceanic and Atmospheric Administration 2022). Over this 2-year period, 12.8 cm of precipitation fell on

Clark County, which is only about one-third of the mean 2-year precipitation amount (38.1 cm) recorded from 1901 through 2000.

Detection probability of a species within a given sampling unit (i.e., subplot) can also be influenced by typical territory size. For species with small territories, such as Arizona Bell's vireo (0.8 ha), multiple territories could exist wholly within any subplot (3.1–13.2 ha in size), thereby increasing detection probability for the species. For species with large territories, such as western burrowing owl (248 ha), a subplot might encompass only a very small portion of the territory. In these cases, there is less than 100% probability that the individual territory holder is in that portion of the territory and available for detection when the subplot is sampled by a surveyor.

Lastly, local population sizes or distributions within Clark County are likely not static. Dramatic decreases in North American bird populations have been recently reported (Rosenberg et al. 2019), and it is possible that one or more of the target species have experienced this trend within Clark County. The dataset used in generating the target species distribution models includes detections spanning several decades but sourced from various research projects and agency databases. These data are therefore not sufficient for determining population trends within Clark County for any of the target species.

As noted above, there are several factors that could influence detection probability, making determination of true absence difficult to prove. Discussions for each of the target species below will therefore focus on patterns of detections.

4.1 Arizona Bell's Vireo

Bell's vireo breeds in habitat that includes dense, low, shrubby vegetation characteristic of early successional stages in riparian areas, brushy fields, young second-growth forest or woodland, scrub oak, coastal chaparral, and mesquite brushlands (Kus et al. 2020). Habitat is often near surface water (Barlow 1962), but the species can also use drier thickets (Averill-Murray and Corman 2005). Bell's vireo uses habitat with a well-developed to dense shrub layer or understory in both California and Arizona (Averill-Murray and Corman 2005; Franzreb 1989; Goldwasser 1981). In California, a dense shrub layer 0.6 to 3 m in height was the most important habitat structure component (Franzreb 1989; Goldwasser 1981). Understory species included mule-fat (*Baccharis salicifolia*), arrowweed (*Pluchea sericea*), mesquite (*Prosopis* spp.), and tamarisk (*Tamarix* spp.). In Arizona, Bell's vireo is also readily found in mesquite bosque and heavily wooded desert washes with dense stands of palo verde (*Parkinsonia* spp.), desert ironwood (*Olneya tesota*), mesquite, and/or netleaf hackberry (*Celtis reticulata*) (Averill-Murray and Corman 2005). Lotebush (*Ziziphus obtusifolia*) is another commonly used nest substrate in Arizona, and the use of juniper (*Juniperus* spp.) has also been also documented. The best MSHCP ecosystem analogues to these habitat types are Desert Riparian and Mesquite/Acacia (Clark County Department of Comprehensive Planning and USFWS 2000). Bell's vireo is primarily found below 1,300 m amsl in the United States (Kus et al. 2020) but has been found nesting as high as 1,560 m amsl in Arizona (Averill-Murray and Corman 2005).

Nearly two-thirds of the existing detection locations in the model input dataset were concentrated along the Muddy and Virgin Rivers in the northeast corner of the county. These two rivers support the most extensive contiguous Desert Riparian habitat in the county and notable occurrences of Mesquite/Acacia habitat. Additional patches of suitable habitat are found along the lower Colorado River and tributaries such as Las Vegas Wash, and the 2021 detections away from the Muddy and Virgin Rivers were along these drainages. Due to the known occurrence of both the species and suitable habitat along these two rivers and along the lower Colorado River, no surveys were conducted along these rivers in 2022. Six of the eight incidental Arizona Bell's vireo detections recorded in 2022 were on these two rivers, confirming continued presence of the species.

Existing detection locations in the model input dataset in the remainder of the county were mostly associated with isolated and fragmented riparian habitat bordering dry washes and smaller creeks or other areas where dense, shrubby vegetation might exist. Of the subplots selected for Arizona Bell's vireo, just over half (seven of 13) were within 1.2 km of existing detections. The only occupied habitat identified in any of these areas, as determined through observed behavior and pattern of detections, was in the Meadow Valley Wash site. Meadow Valley Wash was the widest of the drainages surveyed in 2022, and it contained the largest patch of Desert Riparian habitat, which was adjacent to surface water. The site was within a stand of Desert Riparian habitat extensive enough to be mapped as a separate ecosystem (Clark County Department of Comprehensive Planning and USFWS 2000). Given the amount of observed available habitat, it is not surprising that almost all the 2022 detections (95%) were at this site and that the pattern of observed behavior in the site suggested the presence of occupied territories.

Of the remaining 11 subplots selected for Arizona Bell's vireo outside the Meadow Valley Wash site, six were within 1.2 km of existing detections, and two of the six near existing detections had associated survey detections. Detections in both subplots were likely of migrants but did verify the existing detections. Given that Arizona Bell's vireo territories average less than 1 ha in size and territorial males sing persistently from pre-dawn with no noticeable decrease in vocalization rate until afternoon (Kus et al. 2020), detection probability of territorial, resident individuals is likely higher with this species than some other target species. For subplots lacking detections, the species was likely absent in those locations.

Almost all the subplots selected for Arizona Bell's vireo and outside the Meadow Valley Wash site contained either riparian vegetation or mesquite habitat. Subplots in the Lower Meadow Valley Wash and Lower Sandy Valley sites were the only ones in patches of vegetation extensive enough to be mapped as a separate ecosystem (Mesquite/Acacia) (Clark County Department of Comprehensive Planning and USFWS 2000). Vegetation in the rest of the subplots was too limited in areal extent to be mapped as separate ecosystems and represents isolated and fragmented stands of potentially suitable habitat. While most of these subplots contained little suitable habitat, two subplots—within the Creeks and Fletcher Canyon sites (1,799 m and 2,137 m amsl, respectively)—were also above the elevational range known to be used by the species. The highest subplot, in the Fletcher Canyon site, was immediately surrounded by habitat not known to be used by the species (mixed conifer forest). Another subplot (in Copper Canyon) had no components of suitable habitat, only vegetation typical of Mojave Desert Scrub that was slightly denser than the surrounding habitat. Despite the apparent mismatch in habitat characteristics for these three subplots, all three had existing detections within 500 m, and one was associated with a 2022 survey detection (Creeks site). The species is known to use riparian and woodland habitats and Sonoran Desertscrub during migration (Kus et al. 2020), and although migrants in some parts of the range have been shown to be more abundant in larger patches of riparian vegetation (Skagen et al. 1998), it is likely that Arizona Bell's vireo uses smaller, fragmented habitat patches in Clark County for migration. As the detection at the Creeks site was likely of a migrant, presence of the species in the site does not represent an expansion of the known elevation range for breeding for the species.

There was some predicted habitat, mostly in the marginal habitat classification, in subplots not specifically selected for Arizona Bell's vireo. None of these subplots contained suitable habitat components, and the vegetation within each was typical of either the Mojave Desert Scrub or the Blackbrush ecosystems (Figure 7). Predicted habitat around each of these subplots was sparse and patchy, but these observations suggest that some predicted habitat might be misclassified.

Figure 7. Subplots with predicted Arizona Bell's vireo habitat: northern subplot at Arrow Canyon Range (left) and southeastern subplot at McCullough Spring (right).

4.2 Bendire's Thrasher

Bendire's thrasher occurs within a range of different habitat types, including pinyon-juniper woodland, the edges of mesquite patches within grassland, and semi-desert and desert areas scattered with large shrubs and open ground (DTWG 2018). It may also occur in sagebrush (*Artemisia* spp.) with scattered junipers at higher elevations and latitudes (England and Laudenslayer 2020). Habitat heterogeneity at both the territory and the landscape scale have been shown to be important in territory selection, with increased heterogeneity associated with species occurrence (Desmond and Sutton 2017). This study noted that within a territory, Bendire's thrashers selected for habitat with taller shrubs, greater density within vegetation patches, and expanses of barer ground. Additionally, at the landscape scale, the habitat Bendire's thrashers selected for was surrounded by smaller, disjunct habitat patches that consisted of a variety of habitat types. Lastly, Desmond and Sutton (2017) noted that habitat selected by Bendire's thrashers tended to have more edge than did other habitat, and, when considered in context of greater habitat heterogeneity, they concluded that this species is edge-adapted.

Predicted Bendire's thrasher habitat is widespread in the western half of the county, and three-quarters of the 2022 surveyed area was predicted habitat. Despite the widespread distribution of predicted habitat, existing detections in the model input dataset were concentrated (71 of 120) in the large patch of predicted optimal habitat, which is in the south part of the county close to the community of Searchlight. The 2021 and 2022 survey results are consistent with this distribution as of the six locations documented across both 2021 (SWCA 2021) and 2022, all concentrated in or near the largest patch of predicted optimal habitat. The concentrated distribution of detections in 2022 was associated with only 0.4% of surveyed predicted Bendire's thrasher habitat.

Bendire's thrasher is known to be secretive and difficult to detect (England and Laudenslayer 2020), but survey methods were selected specifically to maximize detection probability of both this species and LeConte's thrasher (DTWG 2018). The average territory size for this species is smaller than a subplot; therefore, the territory holder should be available for detection if a territory overlapped a subplot. What is unknown in 2022 is the actual detection probability, and while it certainly contributes to the low abundance of detections, it is likely not the only factor influencing survey results. Bendire's thrasher is one of several fast-declining avian species in North America with an estimated population decline of 87% over the last 45 years (Rosenberg et al. 2016). It is possible that the species now occurs in Nevada at lower densities than historically present, which would be consistent with the relative lack of detections during surveys.

The species' breeding ecology is not well understood, and recent research efforts have focused on developing a better understanding of habitat associations. Of the sites surveyed in 2022 with predicted habitat but no detections, several appeared to be lacking one or more potential habitat components identified for territories in Arizona and New Mexico by Desmond and Sutton (2017). One component was slope, with habitat in Arizona and New Mexico being less likely to be occupied as slope increased. Fletcher (2009) found that LeConte's and Crissal thrashers avoided habitat with slope exceeding 6%. Five of the subplots with predicted habitat but no detections had slope exceeding 6%, with mean slope ranging from 8% to 20%.

Elevation was also identified as a factor by Desmond and Sutton (2017), with the odds of a territory being present decreasing as elevation increased. The maximum observed elevation for a territory in the Desmond and Sutton study was over 2000 m, similar to the highest mean elevation of 2,245 m amsl for surveyed subplots in Clark County in 2022. The subplots with detections were at elevations below 1,400 m, as were three-quarters of the subplots with predicted habitat but no detections. Ammon et al. (2020) found that Bendire's thrasher territories were similarly distributed across the species' range, with a decreased probability of presence as elevation increased. There was therefore likely a reduced probability that the higher-elevation subplots would be occupied compared to the lower-elevation subplots.

No specific data on the habitat structure components important to Bendire's thrasher were collected in 2021 or 2022, but review of habitat photos revealed that some subplots without detections lacked the structural heterogeneity preferred by the species. Subplots in both the Black Butte and Pahranagat Wash sites consisted of homogenous creosote-bursage flats and lacked any of the taller shrubs or denser vegetation patches preferred by the species (Figure 8). Subplots in the Creeks, Fletcher Canyon, Pine Creek, and Red Rock Wash sites all had taller shrubs and dense vegetation but lacked expanses of bare ground (Figure 9).

Figure 8. Habitat in the Black Butte site, 2022.

Figure 9. Habitat in the Red Rock Wash site, 2022.

4.3 Gilded Flicker

Gilded flicker is most frequently associated with saguaros (*Carnegiea gigantea*) in Arizona but can also use riparian woodland when trees of sufficient size are present (Moore et al. 2020). Where it uses saguaros, the stands tend to be dense (Moore et al. 2020), and stem dbh is ≥ 30 cm, as estimated from published observations for northern flicker (Moore et al. 2020). In Arizona, the species is primarily found at elevations ranging from 61 to 975 m amsl, although it has been recorded up to 1,402 m amsl (Corman 2005a). In southern Nevada, where saguaros are absent, gilded flickers are associated with Joshua trees and other tall yuccas of sufficient size to provide a substrate for nest cavities (Great Basin Bird Observatory 2010).

As in 2021, survey results supported the model as almost all detections were in or near predicted habitat, and many of these detections were in areas of predicted habitat more than 2.5 km from existing detections. All the 2022 detections were consistent with the known gilded flicker population at the southern end of Clark County near the Highland and Eldorado Ranges, and all but two detections in the model input dataset (near the Bird Springs Range and Henderson) were within the known population extent. All detections in the model input dataset, as well as the 2021 and 2022 detections, were associated with Joshua trees. The densest Joshua tree forests in Clark County (e.g., within the Wee Thump Joshua Tree Wilderness), which presumably provide the highest quality habitat, are in the same area as the known gilded flicker population. Although Joshua trees are clearly important to gilded flickers, the stand structural characteristics required for suitable habitat are unknown, and the presence of Joshua trees alone is not a predictor for species occurrence or suitable habitat. Of the 29 subplots with predicted habitat, 24 had Joshua trees, but detections were associated with only eight of these subplots. Joshua trees of sufficient size to support breeding were also noted in eight subplots outside predicted habitat. Likewise, the presence of Joshua trees large enough to support breeding is not a requirement for species occurrence as only half of the subplots with detections in 2022 had sufficiently large Joshua trees. For the subplots

with associated detections that lacked large Joshua trees, detections indicated either foraging within a home range, based on repeated detections across multiple surveys, or post-breeding dispersal, based on single detections in June.

In both 2021 and 2022, predicted habitat around the Spring Mountains and the Sheep Range was surveyed. In both years, habitat that appeared to be structurally similar to habitat in the known population range was seen in these sites, but no gilded flickers were detected. Conspecific vocalizations were broadcast at the end of each area search in both years, and since gilded flickers are a conspicuous and noisy species that readily responds to broadcast calls during the breeding season, it is likely that the species was absent from these areas. One factor that could affect habitat suitability in some of these sites is elevation. Five of the subplots surveyed in 2022 were above the maximum elevation (1,402 m amsl) at which the species has been observed (Corman 2005a). These were in the Lee Canyon and Yucca Forest sites on the north side of the Spring Mountains and in the Sheep Range; each subplot had Joshua trees large enough to support nesting cavities, and mean elevations ranged between 1,463 and 1,531 m amsl. Surveyors noted that although the Joshua trees were of large enough diameter for nesting and the trees occurred in apparently sufficient density at these sites, the trees were shorter than in lower elevation sites, with less vertical trunk available for nesting.

Another factor that could affect species occurrence in Clark County is the overall species' range. The known gilded flicker population in Clark County is at the northern extent of the species' range (Moore et al. 2020). The species has been documented as experiencing a long-term population decline of 54% over the last 45 years (Rosenberg et al. 2016). It is possible that suitable habitat does exist outside the known population extent in the county, but that the species' range has contracted. Of the sites surveyed in 2022, three (McCullough Spring, North Searchlight, and Copper Canyon) were at the northern edge of the known population extent. Although no gilded flickers were detected at any of these sites, Joshua trees large enough to support breeding were present within two (McCullough Spring and North Searchlight), and an old nest cavity of a size suitable for flickers was observed near the McCullough Spring site. This old nest cavity indicates that gilded flickers once occupied the McCullough Spring site, which is slightly farther north than the detections in the model input dataset.

4.4 Golden Eagle

Golden eagle is a highly mobile species capable of wide-ranging movements that allow the species to find and exploit a wide variety of food resources, including small to large-sized mammals, birds, reptiles, fish, and carrion (Katzner et al. 2020; Southwest Ecology 2018). Golden eagles in Clark County have been documented foraging in most of the county's habitat types, with most food deliveries to nests consisting of black-tailed jackrabbits, rock squirrels (*Otospermophilus variegatus*), and desert cottontail (Southwest Ecology 2018).

Golden eagles use flight as both a means of travel and a method of foraging. Golden eagles can forage when soaring or in low contoured flight, or from a perch (Katzner et al. 2020), and the 11 detections of individuals not exhibiting a territorial defense flight may have been of foraging individuals. Survey results support the model as most detections were of individuals over predicted foraging habitat. Food resources may exist outside predicted foraging habitat as signs of leporid mammals were detected in 12 subplots in habitat modeled as unsuitable. Given the infrequency with which golden eagles are observed actively hunting (e.g., actively chasing prey) or consuming prey, refinement of foraging habitat models could be furthered through more targeted methods, such as telemetry and/or prey resource surveys.

4.5 LeConte's Thrasher

LeConte's thrasher is a year-round resident in Clark County that occupies sparsely vegetated desert flats, dunes, alluvial fans, or gently rolling hills between 80 and 1,600 m amsl (Sheppard 2020). Most occurrences of LeConte's thrasher are below 1,150 m amsl with a mean elevation of 500 m amsl. Vegetation composition often, but not always, consists of a high proportion of *Atriplex* spp. and cholla cactus (*Cylindropuntia* spp.), with most shrubs rarely exceeding 2.5 m in height, and contiguous or closed cover in a patch of vegetation not larger than 30 m in diameter. LeConte's thrasher also commonly use small arroyos, depressions, or streambeds with larger desert shrubs.

Survey results support the model as nearly all the detections were in predicted habitat, and the detection that was not within predicted habitat was close enough to be associated with predicted habitat. Additionally, most (81%) of the 2022 detections were in predicted habitat more than 2.5 km from existing detections. These results mirror the 2021 results where all 49 detections were in predicted habitat.

Although no sites were selected for LeConte's thrasher, most (78%) of the area surveyed in 2022, associated with 62 subplots, was predicted habitat. Detections were associated with only a small fraction (2%) of the surveyed predicted habitat. Since the surveys in 2022 did not use playback to elicit responses from LeConte's thrashers, it is hard to assess the species' apparent absences as it is known to be secretive and difficult to detect. The actual detection probability in 2022 is unknown, and while it certainly contributes to the abundance of detections, it is likely not the only factor influencing survey results. In Arizona, LeConte's thrashers are more likely to nest in years with above average fall and winter precipitation; in years with little precipitation, they may delay nesting until habitat conditions improve (Corman 2005b). Nesting individuals are more likely to sing and therefore be detected. Given the drought conditions under which surveys occurred in 2022, it is possible that LeConte's thrasher breeding activity was reduced, and detection probability was lower than normal. Additionally, like many other species in North America, LeConte's thrasher populations have been documented in recent years as declining, likely due to habitat loss (Sheppard 2020).

It is possible that some habitat is erroneously classified as predicted habitat. Habitat descriptions recorded by surveyors suggest that a few subplots that were classified as predicted habitat consisted of habitat types not known to be used by LeConte's thrasher. Subplots in Meadow Valley Wash and on the east side of the Spring Mountains contained dense, woody vegetation that was taller (averaging 3.5–4 m in height) than the maximum height (2.5 m) of vegetation typically used by LeConte's thrasher (Figure 10).

Figure 10. Habitat in the Meadow Valley Wash site, 2022.

4.6 Loggerhead Shrike

As in 2021, loggerhead shrike was the most abundant of the target species, with 62 detections. These detections were associated with the most sites (13) of any of the target species, making loggerhead shrike also the most widespread species in 2022. Although none of the sites were selected for loggerhead shrike, 91% of the area surveyed in 2022 was predicted habitat, and predicted habitat was present in all 30 sites, reflecting the widespread presence of predicted habitat in the county. Survey results supported the model as most detections (58 of 62) were within or near (≤ 164 m) predicted habitat, and nearly half of the detections (27 of 62) were in predicted habitat in areas more than 2.5 km from existing detections.

Despite the widespread presence of both the species and predicted habitat in the county, detections were only associated with 11% (58 ha) of the area surveyed in 2022. Given that the average estimated loggerhead shrike territory size in California (8.5 ha) is approximately the same size as a square subplot (9 ha), if the species were present in the vicinity of a subplot, it should be available for detection. This suggests that loggerhead shrike was not present where it was not detected. Food availability could be a factor affecting overall species abundance in the county. The loggerhead shrike is a predatory species that feeds on smaller vertebrates and arthropods (Yosef 2020), and populations of prey species could be sensitive to drought conditions. The presence of the species in the county could be influenced by prey availability, which could be patchy during drought years. Loggerhead shrike populations have also been declining range wide (Yosef 2020), and it is possible that the population is declining in Clark County.

4.7 Western Burrowing Owl

Burrowing owls tend to inhabit gently sloping areas characterized by low, sparse vegetation (Poulin et al. 2020). The western subspecies does not excavate its own burrows and needs potential nest burrows created by other species. In Clark County, the most common type of burrow used by western

burrowing owl is that of Mojave desert tortoise (*Gopherus agassizii*) (Southwest Ecology 2018). Of the area surveyed in 2022 (569 ha), the area of subplots with burrows of a suitable size for western burrowing owl inside the subplot boundary covered a greater areal extent (328 ha; 58%) than the area of predicted habitat (185 ha; 33%). This does not necessarily reflect an under-identification of predicted habitat, as no description of vegetation density or slope near potential burrows was recorded; habitat suitability in areas with potential burrows cannot, therefore, be assessed. The pattern of western burrowing owl detections in both 2021 and 2022, however, suggests that the species may use more habitat in Clark County than is currently modeled as predicted habitat. In both years, half of the detections were in predicted habitat and half were in habitat modeled as unsuitable that was near predicted habitat (SWCA 2021).

Although potential burrows were present outside surveyed predicted habitat, they were not present in all surveyed predicted habitat, and only 121 ha (21%) of the surveyed area had both predicted western burrowing owl habitat and potential burrows. Given the average size of a burrowing owl's foraging territory (248 ha), the scale at which a burrow might be considered "absent" from an area is larger than the model resolution of 6.25-ha cells at which burrow presence was evaluated. The absence of a potential burrow in a subplot therefore cannot be used to assess habitat suitability. This is supported by the survey results as of the two sites with associated burrowing owl detections, each of the four subplots had predicted habitat, but potential burrows were found only in one site (both subplots). The presence of burrows in the vicinity of the other site that lacked them is unknown.

Although one-third of the area surveyed in 2022 contained predicted western burrowing owl habitat and at least one subplot was selected for western burrowing owl in eight of 30 sites, detections were associated with only two sites (7% of surveyed predicted habitat). Multiple factors could contribute to the lack of detections. First, even though burrowing owls can be quite conspicuous and easily seen and identified at a distance, burrowing owls in areas away from human development are not habituated to human presence and can be very secretive, disappearing into their burrow before a surveyor detects them. It is therefore possible that detection probability in the surveyed area is not as high as expected. Secondly, both winter and summer precipitation have been shown to be directly related to the probability of occurrence for western burrowing owl in Clark County (Crowe and Longshore 2010). Given the recent period of drought in Clark County, western burrowing owl occurrence could be lower in 2021 and 2022 than in previous, wetter years.

5 CONCLUSION

Detections of all seven target species were recorded as part of this project, with four of the target species (Arizona Bell's vireo, LeConte's thrasher, loggerhead shrike, and western burrowing owl) recorded within the proposed MSHCP Amendment Reserve System and three (Arizona Bell's vireo, LeConte's thrasher, and loggerhead shrike) within the proposed MSHCP Amendment Impact Areas. The majority of all target species detections (91%) were associated with predicted habitat for the respective species, and survey results supported the models for several species. Each target species was detected in only a small portion of the predicted habitat surveyed for the species, however, and the possible reasons for this varied by species. Additional species-specific conclusions are listed below.

- Survey efforts for Arizona Bell's vireo in 2022 focused on potential habitat fragments away from the three main rivers in Clark County (i.e., lower Colorado, Muddy, and Virgin Rivers). Occupied territories were documented in the Meadow Valley Wash site, which was in the largest drainage surveyed in 2022 and contained the most extensive Desert Riparian habitat of any site surveyed in 2022. Survey results suggest that Arizona Bell's vireo likely uses smaller, more isolated, and more fragmented patches of habitat in the county for migration than it does for breeding. Some habitat misclassification was identified in scattered, low-density predicted

marginal habitat, where observed vegetation was typical of an ecosystem not used by Arizona Bell's vireo. A better understanding of the characteristics of breeding versus migration habitat characteristics is needed, and additional species-specific presence/absence surveys combined with quantitative vegetation descriptions would provide the necessary data.

- Despite the presence of predicted Bendire's thrasher habitat in more than three-quarters of the 2022 survey area, only two individuals were detected during surveys. All detections recorded in 2021 and 2022 have been in the large area of predicted optimal habitat in the southern end of the County, which is consistent with the distribution of detections in the model input dataset. Bendire's thrasher is estimated to have experienced a substantial population decline over the last several decades, and species occurrence in the county may be more restricted than its historical distribution in terms of both geographic extent and density. The breeding ecology of this species is not well understood, and additional studies on species distribution and habitat associations in Clark County, to complement those already underway, are needed to fully understand and predict species occurrence in the county.

- Gilded flicker survey results support the model as nearly all detections were in or near predicted habitat. Almost all gilded flicker detections in the model input dataset, as well as those recorded by SWCA in 2021 and 2022, were within the known population extent in areas dominated by open Joshua tree forests in southern Clark County. Predicted habitat around the Spring Mountains and in the Sheep Range that contains Joshua trees was surveyed in both 2021 and 2022 with no detections. It is possible that additional structural components need to be identified to accurately assess gilded flicker habitat suitability. Elevation could also be an important variable for species occurrence. Lastly, the gilded flicker population in Clark County is at the northern extent of the species' range, and the species has experienced an estimated 54% decline over the last several decades. It is possible that suitable habitat exists outside the known population extent in Clark County, but that the overall species range has contracted.

- All golden eagle detections were relatively distant from each surveyor (0.15–10 km, average 2.7 km), which likely decreased the accuracy of the detection locations. Although all observed individuals were in flight, no active hunting behavior (e.g., chasing or catching prey) was observed, which limits the ability to infer actual use of foraging habitat by detected golden eagles. Signs of potential prey items were observed outside predicted habitat, suggesting that foraging could occur over habitat classified as unsuitable. Telemetry to determine specific foraging patterns of adult eagles and prey-base studies could help refine the understanding of habitat use and help identify available foraging habitat in the county.

- LeConte's thrasher survey results support the model in that all detections but one in the last 2 years have been in predicted habitat. However, detections in 2022 were associated with only a small percentage (2%) of surveyed predicted habitat. As surveyors did not broadcast vocalizations to solicit responses, it is difficult to determine if the lack of detections was due to true absence or very low detection probability. The overall number of detections within surveyed predicted habitat could be influenced by drought conditions which could result in less breeding activity. It is also possible that some predicted habitat was misclassified, and the amount of suitable habitat is smaller than the model suggests.

- Loggerhead shrike survey results support the model in that almost all detections over the last 2 years were in or near predicted habitat. However, detections in 2022 were associated with only 11% of surveyed predicted habitat. Possible explanations for a lack of detections in nearly three-quarters of the surveyed predicted habitat include reduced food availability due to drought conditions limiting territory establishment and range-wide population declines.

- Given the presence of potential burrows and the occurrence in both 2021 and 2022 of western burrowing owl detections in habitat modeled as unsuitable, it is possible that habitat use by western burrowing owl is more extensive than what is currently modeled as predicted habitat. In both 2021 and 2022, western burrowing owl detections were in only a small fraction of surveyed predicted habitat. The lack of detections could be related to recent drought conditions. Additional species-specific surveys could help inform the current extent of western burrowing owl in Clark County.

6 RECOMMENDATIONS

The following recommendations are based on observations from the 2022 avian surveys and factors discussed in this report. These actions would support the County's goal for refining the target species' distribution models.

- Arizona Bell's vireo use of small and fragmented habitat patches in Clark County is not well understood. Additional species-specific surveys would improve understanding of this part of the species' natural history.

- Additional information on specific habitat requirements within Clark County is needed for Bendire's thrasher and gilded flicker. Species-specific surveys paired with vegetation sampling would improve understanding of these requirements. Efforts focused on Bendire's thrasher should complement those of the DTWG. These efforts could also consider the use of temporary transmitters on Bendire's thrashers to document their movements and habitat use.

- The use of telemetry for gathering specific data on golden eagle foraging behavior and distribution should be considered for inclusion in any future efforts for this species.

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APPENDIX A

Species-Specific Survey Results Figures

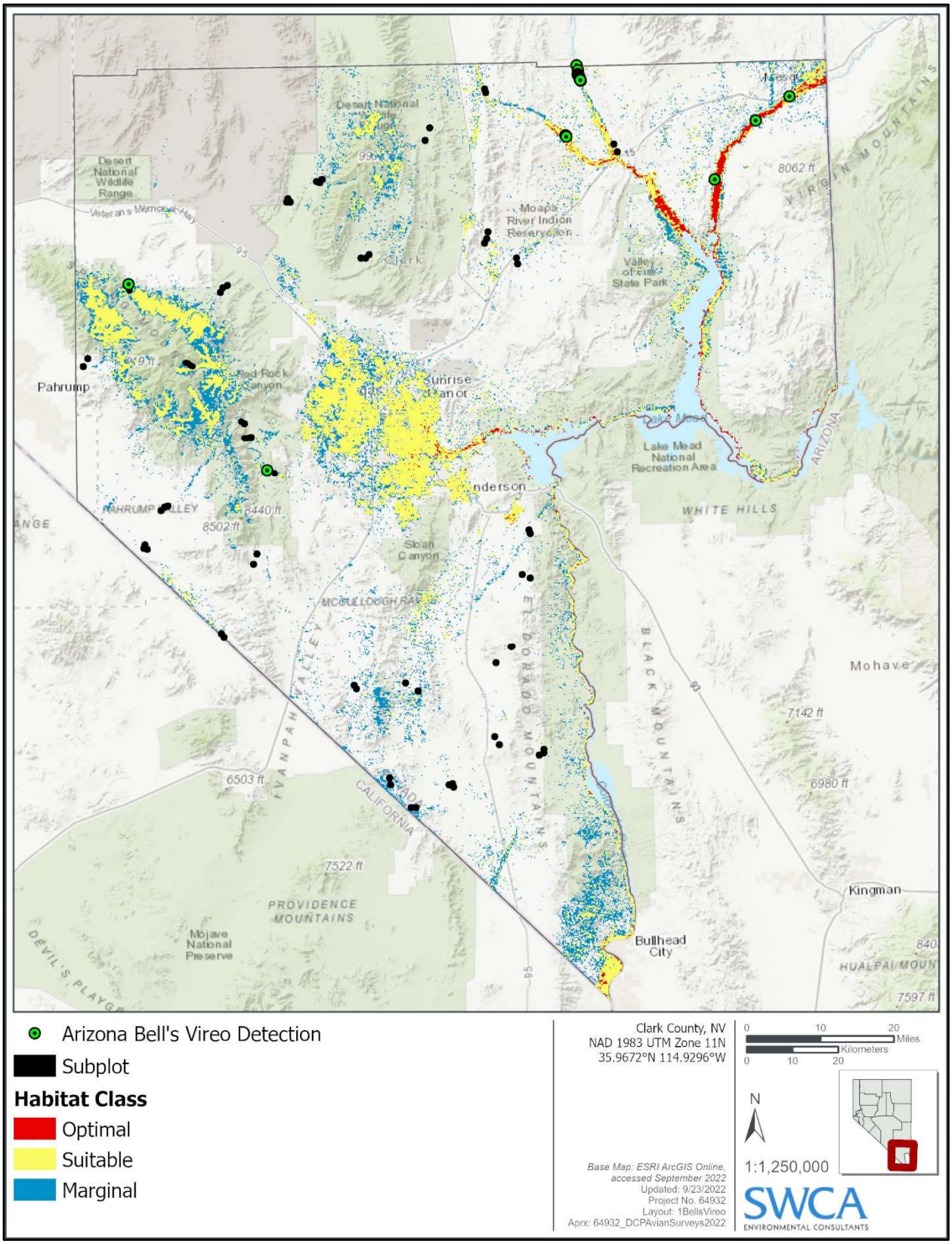

Figure A-1. Arizona Bell's vireo survey and incidental detections, Clark County, 2022.

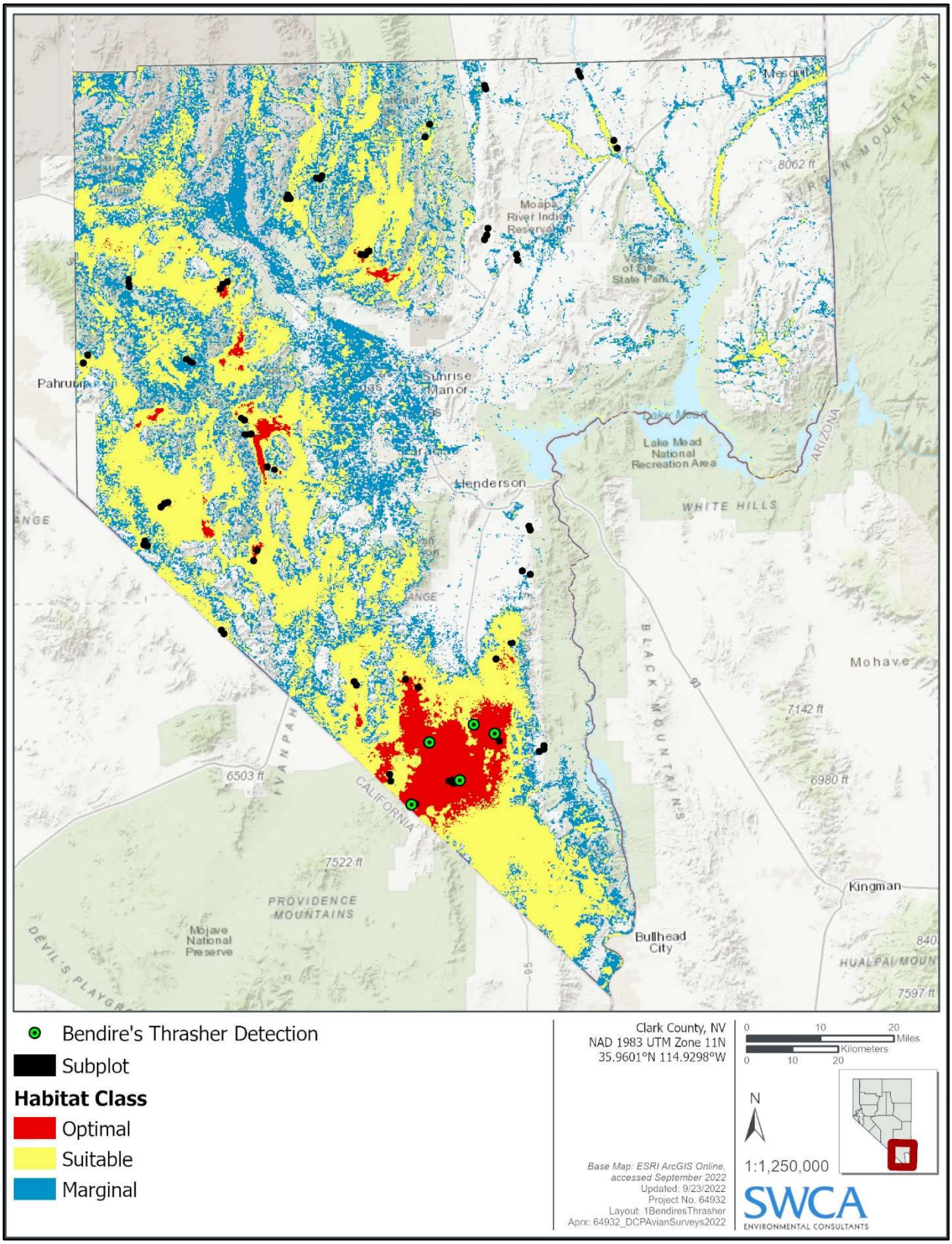

Figure A-2. Bendire's thrasher survey and incidental detections, Clark County, 2022.

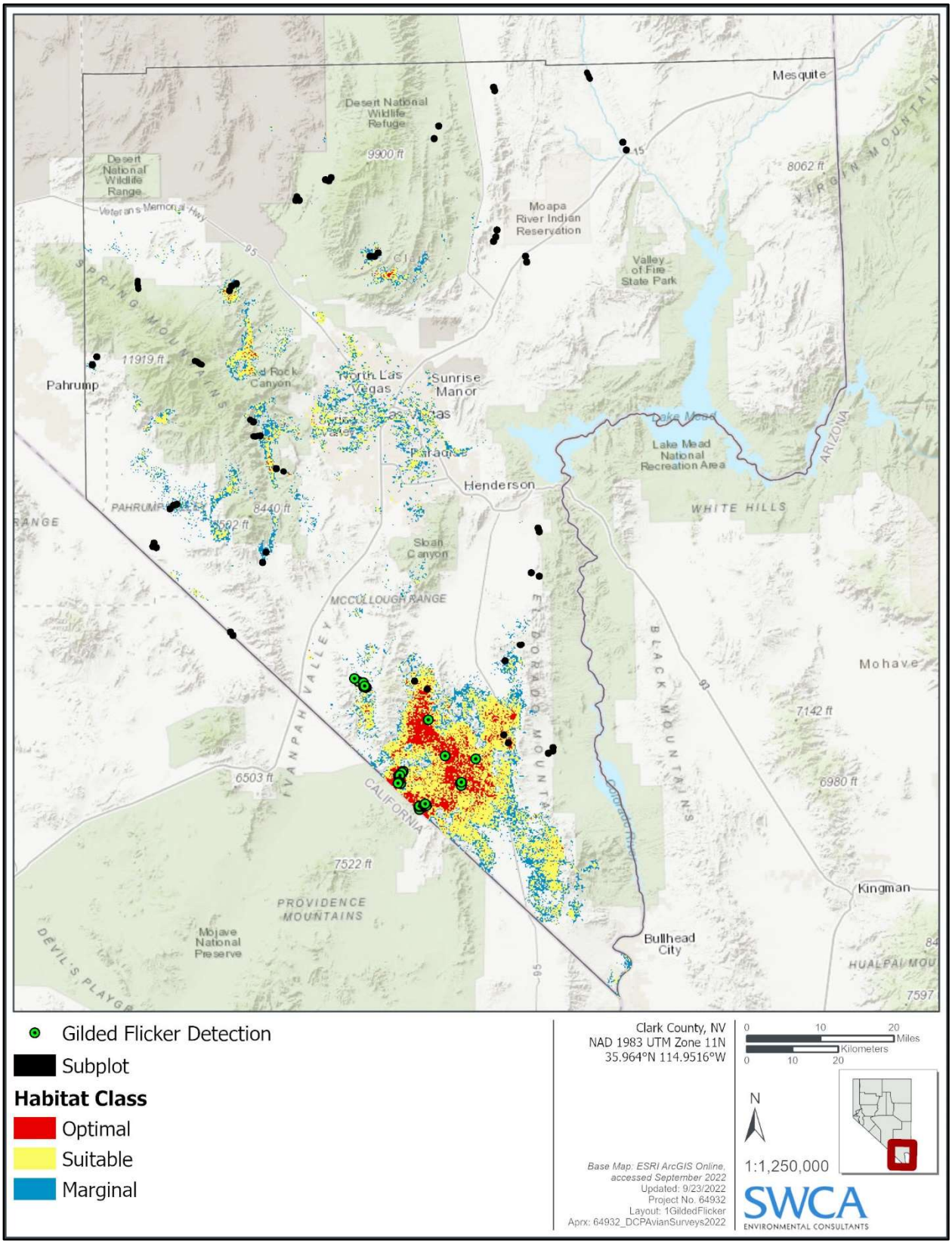

Figure A-3. Gilded flicker survey and incidental detections, Clark County, 2022.

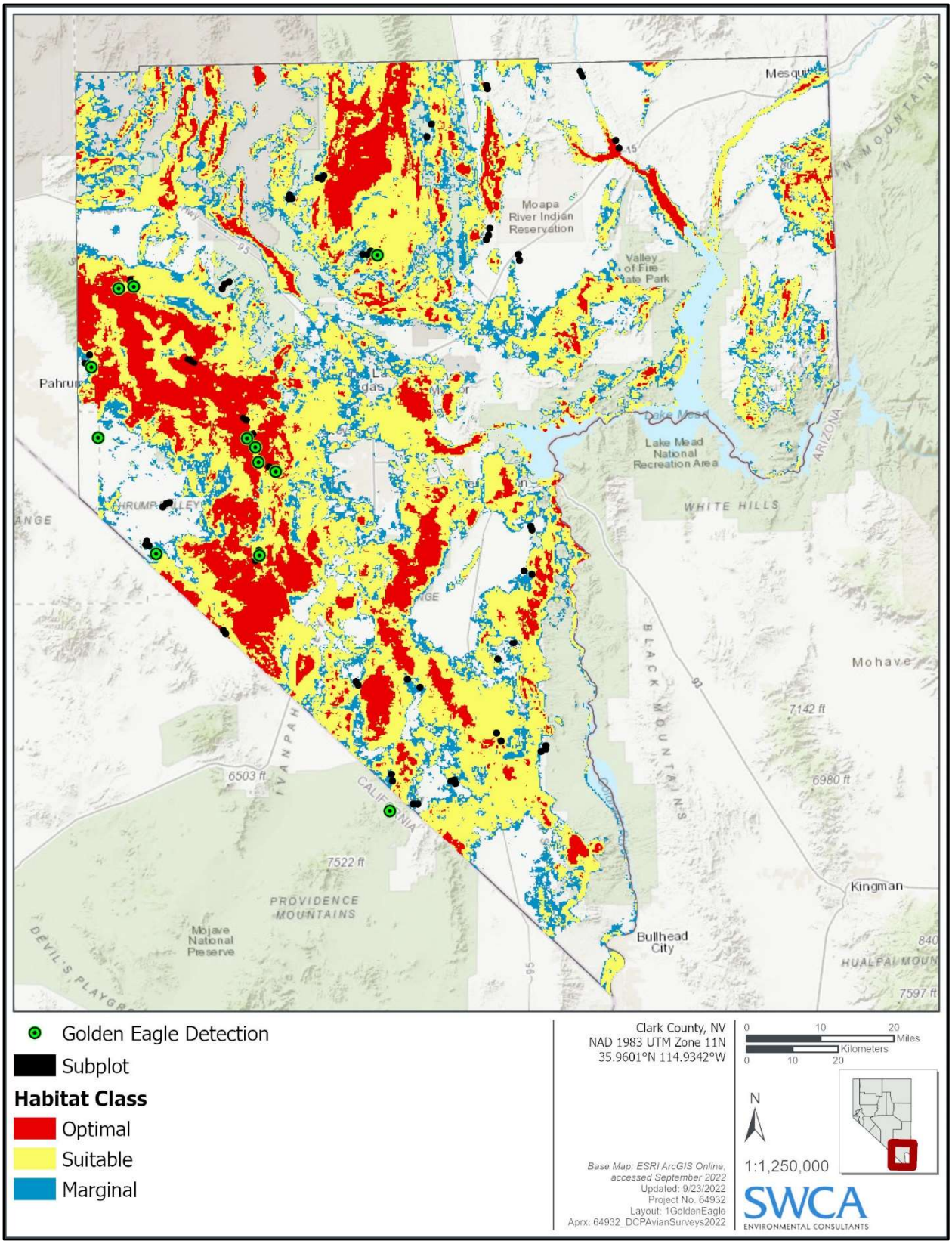

Figure A-4. Golden eagle survey and incidental detections, Clark County, 2022.

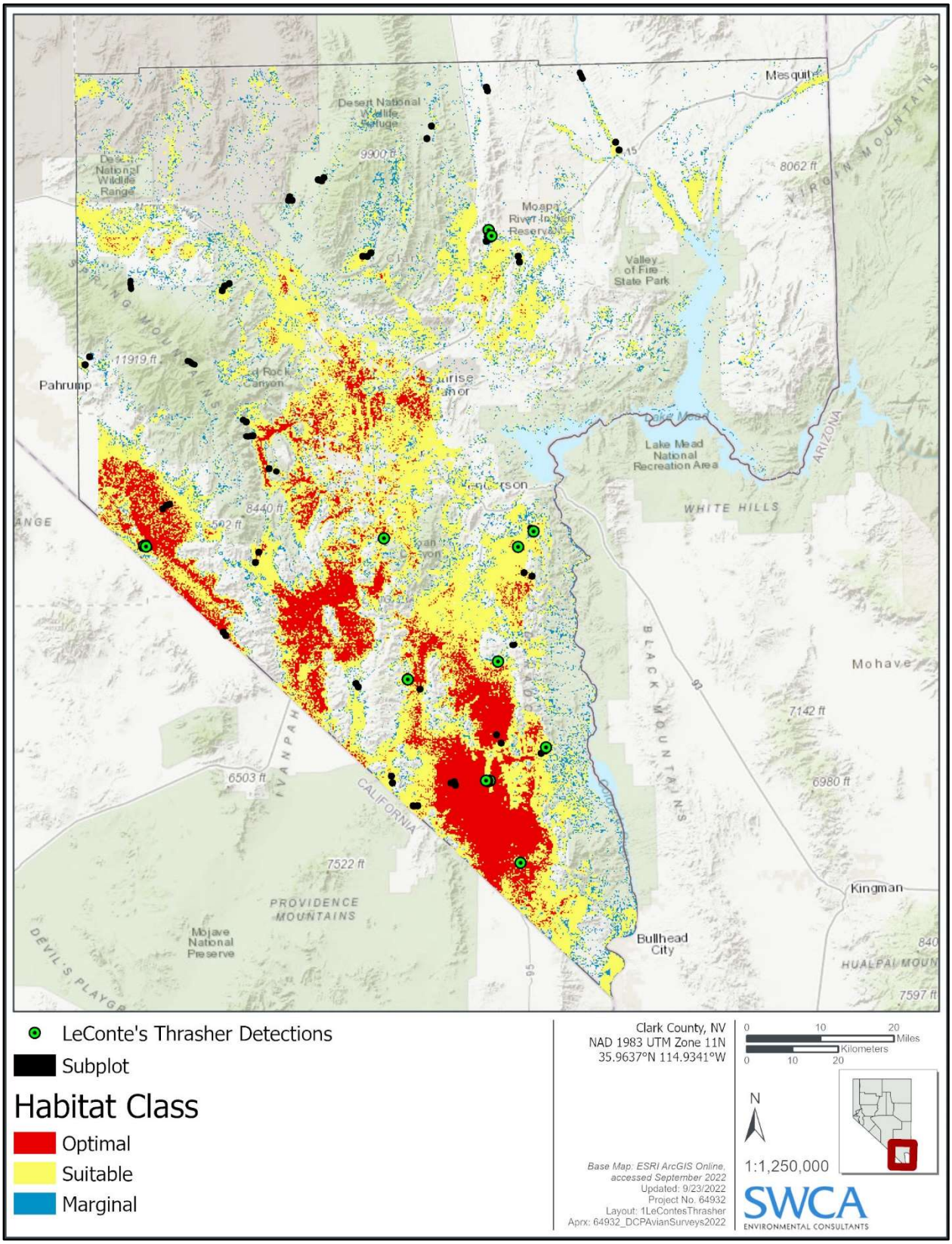

Figure A-5. LeConte's thrasher survey and incidental detections, Clark County, 2022.

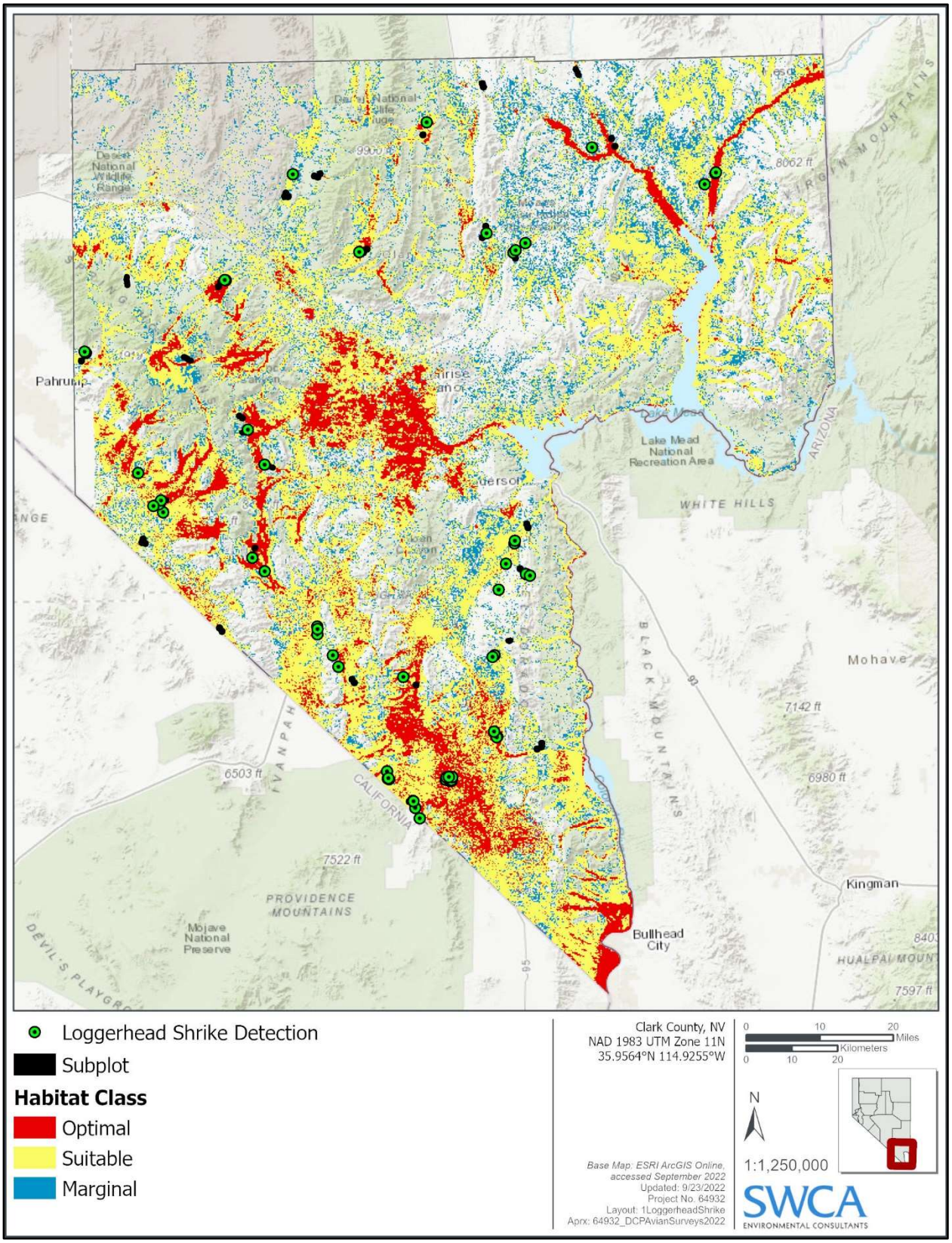

Figure A-6. Loggerhead shrike survey and incidental detections, Clark County, 2022.

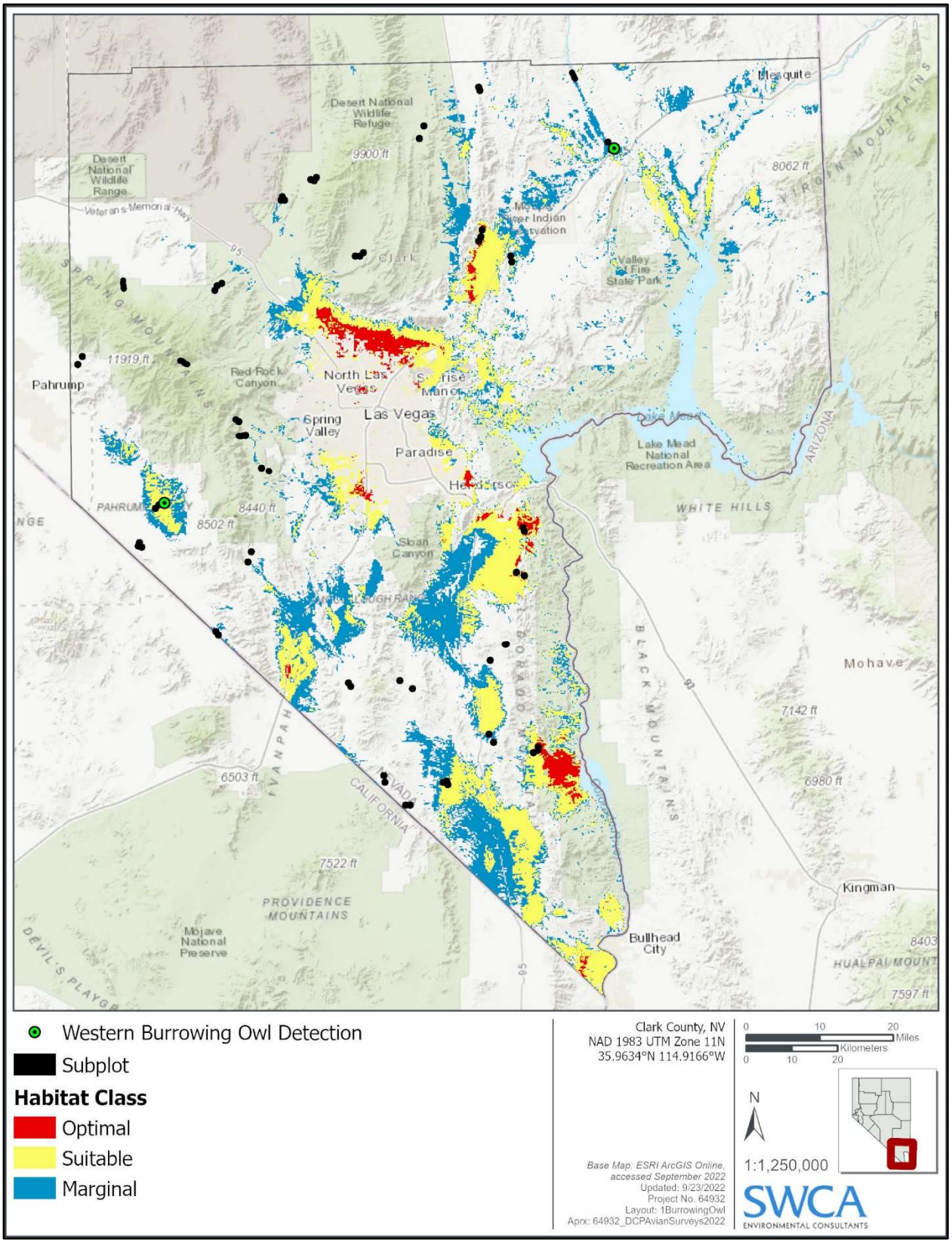

Figure A-7. Western burrowing owl survey and incidental detections, Clark County, 2022.

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APPENDIX B

Target and Non-Target Species Detection Details

Table B-1. Number of Visits with Detections Associated with a Subplot and Observed Breeding Evidence by Target Species and Site, Clark County, 2022

Site	Arizona Bell's Vireo	Bendire's Thrasher	Gilded Flicker	LeConte's Thrasher	Loggerhead Shrike	Western Burrowing Owl
Arrow Canyon Range	0	0	0	**1**	0	0
Black Butte	0	0	0	**1**	0	0
Black Hills	0	0	0	0	0	0
Boulder City	0	0	0	0	0	0
Copper Canyon	0	0	0	**1**	**1**	0
Cottonwood Valley	0	0	0	**1**	0	0
Creeks	**1**	0	0	0	0	0
Crescent Peak	0	0	**3, PN**	0	**2, BN**	0
Deadman Canyon	0	0	0	0	0	0
Dry Lake Range	0	0	0	0	**1**	0
East Eldorado Valley	0	0	0	0	0	0
Elbow Canyon	0	0	0	0	**1**	0
Fletcher Canyon	0	0	0	0	0	0
Goodsprings	0	0	0	0	**1**	0
Lee Canyon SW	0	0	0	0	**2**	0
Lovell Wash	0	0	0	0	**3**	**1**
Lower Meadow Valley Wash	0	0	0	0	0	**1**
Lower Sandy Valley	0	0	0	0	0	0
Lucy Gray	0	0	**2**	0	0	0
McCullough Spring	0	0	0	0	**1**	0
Meadow Valley Wash	**3**	0	0	0	0	0
Middle Piute Valley	0	0	**1**	0	**3**	0
New York Mountains	0	**1**	**2, Y, CF**	0	**2**	0
North Searchlight	0	**1**	0	0	0	0
Pahranagat Wash	0	0	0	0	0	0
Pine Creek	0	0	0	0	0	0
Red Rock Wash	0	0	0	0	0	0
Wheeler Camp Spring	**1**	0	0	0	**1**	0
Wheeler Wash	0	0	0	0	**1**	0
Yucca Forest	0	0	0	0	**1**	0
Not Associated with a Subplot	–	**–, P**	–	**–, Y, CF**	**–, CF, F, RF**	–

Note: Breeding codes are ordered from left to right with increasing evidence of a successful breeding outcome: pair in suitable habitat (P); building nest (BN); distraction display (DD); visiting probable nest site (PN); young in nest (Y); carrying food (CF); family group (F); and recently fledged young (RF).

Table B-2. Non-target Species Recorded During Area-Search Surveys and Eagle-Use Counts, Clark County, 2022

Species Common Name	Species Scientific Name	Number of Subplots*	Breeding codes†
Abert's towhee	*Melozone aberti*	5	PF, C, S, P, A
American kestrel	*Falco sparverius*	3	
American robin	*Turdus migratorius*	1	C, S
Anna's hummingbird	*Calypte anna*	6	PF, C, H, S, P, TD, CC
Ash-throated flycatcher	*Myiarchus cinerascens*	24	PF, FO, C, H, S, P, TD, CC, PN, CF
Bank swallow	*Riparia riparia*	1	FO
Barn swallow	*Hirundo rustica*	1	PF
Bell's sparrow	*Artemisiospiza belli*	--	
Bewick's wren	*Thryomanes bewickii*	6	C, S, P, A, CF
Black-chinned hummingbird	*Archilochus alexandri*	5	PF, C, TD, CC
Black-chinned sparrow	*Spizella atrogularis*	2	S
Black-headed grosbeak	*Pheucticus melanocephalus*	6	PF, C, S
Black-throated gray warbler	*Setophaga nigrescens*	6	PF, S
Black-throated sparrow	*Amphispiza bilineata*	27	PF, C, H, S, P, TD, CC, PN, A, CNM, E, Y, CF, F, RF
Blue grosbeak	*Passerina caerulea*	2	FO, S
Blue-gray gnatcatcher	*Polioptila caerulea*	15	PF, FO, C, S, P, TD, DD, Y
Brewer's sparrow	*Spizella breweri*	17	PF, C, S, P
Brown creeper	*Certhia americana*	1	PF
Brown-headed cowbird	*Molothrus ater*	4	PF, FO, C, S
Black-tailed gnatcatcher	*Polioptila melanura*	4	PF, C, P, A, CF, RF
Broad-tailed hummingbird	*Selasphorus platycercus*	4	PF, C, S, TD, CC
Bullock's oriole	*Icterus bullockii*	7	PF, FO, C, S
Bushtit	*Psaltriparus minimus*	4	PF, C, P, Y
Cactus wren	*Campylorhynchus brunneicapillus*	11	PF, C, S, A, CNM, BN, CF
Calliope hummingbird	*Selasphorus calliope*	--	
Cassin's finch	*Haemorhous cassinii*	1	PF, FO, S, P
Cassin's Vireo	*Vireo cassinii*	3	PF, S
Chipping sparrow	*Spizella passerina*	9	PF, FO, C, S, P, CNM, DD
Cinnamon teal	*Spatula cyanoptera*	--	
Clay-colored sparrow	*Spizella pallida*	--	
Cliff swallow	*Petrochelidon pyrrhonota*	3	PF, FO
Common gallinule	*Gallinula galeata*	1	C
Common nighthawk	*Chordeiles minor*	--	
Common poorwill	*Phalaenoptilus nuttallii*	5	PF, DD
Common raven	*Corvus corax*	50	AN, CF
Common yellowthroat	*Geothlypis trichas*	3	PF, C, S, P, RF

Species Common Name	Species Scientific Name	Number of Subplots*	Breeding codes†
Cooper's hawk	*Accipiter cooperii*	10	AN
Cordilleran flycatcher	*Empidonax occidentalis*	3	PF, C, S
Costa's hummingbird	*Calypte costae*	4	PF, CC
Crissal thrasher	*Toxostoma crissale*	6	PF, C, S, P, A, CF
Dark-eyed junco	*Junco hyemalis*	1	PF, C, S, P
Dusky flycatcher	*Empidonax oberholseri*	11	PF, C, S
Empidonax flycatcher	*Empidonax* spp.‡	3	C
Eurasian collared-dove	*Streptopelia decaocto*	1	FO
Gambel's quail	*Callipepla gambelii*	8	PF, C, H, S, P, A
Gray catbird	*Dumetella carolinensis*	1	S
Gray flycatcher	*Empidonax wrightii*	11	PF, C, S, P
Gray vireo	*Vireo vicinior*	1	S
Great blue heron	*Ardea herodias*	1	PF
Greater roadrunner	*Geococcyx californianus*	2	PF, S
Green heron	*Butorides virescens*	1	C
Green-tailed towhee	*Pipilo chlorurus*	9	PF, C, S
Hairy woodpecker	*Dryobates villosus*	1	PF, PN
Hammond's flycatcher	*Empidonax hammondii*	4	PF, C, S, P, TD, BN
Hermit thrush	*Catharus guttatus*	3	PF
Hooded oriole	*Icterus cucullatus*	1	S
Horned lark	*Eremophila alpestris*	9	PF, FO, C, S, P, CC
House finch	*Haemorhous mexicanus*	26	PF, FO, C, H, S, P, F
House wren	*Troglodytes aedon*	6	PF, C, S, PN, A
Indigo bunting	*Passerina cyanea*	1	C
Juniper titmouse	*Baeolophus ridgwayi*	4	PF, C, S, P, CC
Ladderback woodpecker	*Dryobates scalaris*	15	PF, FO, C, H, S, P, CC, PN, AN, CF
Lark sparrow	*Chondestes grammacus*	3	PF, S, P
Lazuli bunting	*Passerina amoena*	11	PF, FO, C, S, P
Lesser goldfinch	*Spinus psaltria*	7	PF, FO, C, H, S, P
Lesser nighthawk	*Chordeiles acutipennis*	5	PF, S
Lincoln's sparrow	*Melospiza lincolnii*	–	
Lucy's warbler	*Leiothlypis luciae*	8	PF, C, S, P, BN, F
MacGillivray's warbler	*Geothlypis tolmiei*	6	PF, C, S
Mallard	*Anas platyrhynchos*	2	FO, P, RF
Marsh wren	*Cistothorus palustris*	1	PF, C, S
Mountain bluebird	*Sialia currucoides*	3	FO
Mountain chickadee	*Poecile gambeli*	1	PF, C, S, P, CNM
Mourning dove	*Zenaida macroura*	14	PF, FO, S
Nashville warbler	*Leiothlypis ruficapilla*	–	

Species Common Name	Species Scientific Name	Number of Subplots*	Breeding codes†
Northern mockingbird	*Mimus polyglottos*	4	PF, S, CC, PN
Northern rough-winged swallow	*Stelgidopteryx serripennis*	5	PF, FO
Orange-crowned warbler	*Leiothlypis celata*	--	
Peregrine falcon	*Falco peregrinus*	1	P
Phainopepla	*Phainopepla nitens*	8	PF, FO, C, H, S, P, DD, F
Pine siskin	*Spinus pinus*	2	PF, FO, C, S, CC
Pinyon jay	*Gymnorhinus cyanocephalus*	3	PF, FO, C, S
Plumbeous vireo	*Vireo plumbeus*	3	S, BN
Prairie falcon	*Falco mexicanus*	6	
Pygmy nuthatch	*Sitta pygmaea*	1	PF, C, P
Red-naped sapsucker	*Sphyrapicus nuchalis*	1	PF
Red-tailed hawk	*Buteo jamaicensis*	30	Y
Rock wren	*Salpinctes obsoletus*	2	C, S
Ruby-crowned kinglet	*Corthylio calendula*	8	PF, C, S
Rufous hummingbird	*Selasphorus rufus*	--	
Sage thrasher	*Oreoscoptes montanus*	2	PF, S
Say's phoebe	*Sayornis saya*	6	PF, FO, S, TD, CC
Scott's oriole	*Icterus parisorum*	11	PF, H, S, P, BN
Solitary sandpiper	*Tringa solitaria*	--	
Song sparrow	*Melospiza melodia*	2	PF, S
Spotted towhee	*Pipilo maculatus*	5	PF, FO, C, H, S, CF, RF
Summer tanager	*Piranga rubra*	4	PF, C, S, P
Townsend’s solitaire	*Myadestes townsendi*	1	PF
Townsend’s warbler	*Setophaga townsendi*	--	
Tree swallow	*Tachycineta bicolor*	2	FO
Turkey vulture	*Cathartes aura*	7	
Verdin	*Auriparus flaviceps*	9	PF, C, H, S, PN, CNM, CF
Vesper sparrow	*Pooecetes gramineus*	--	
Violet-green swallow	*Tachycineta thalassina*	8	PF, FO
Virginia rail	*Rallus limicola*	1	PF, C, S
Virginia’s warbler	*Leiothlypis virginiae*	3	PF, C, S, P, TD, A, CNM, CF
Warbling vireo	*Vireo gilvus*	5	PF, S, P
Western kingbird	*Tyrannus verticalis*	3	PF, FO, S
Western meadowlark	*Sturnella neglecta*	3	PF, FO, S
Western tanager	*Piranga ludoviciana*	5	PF, C, S
Western wood-pewee	*Contopus sordidulus*	2	PF, S
White-breasted nuthatch	*Sitta carolinensis*	1	C, S, P
White-crowned sparrow	*Zonotrichia leucophrys*	--	
White-throated swift	*Aeronautes saxatalis*	4	PF, S, CC

Species Common Name	Species Scientific Name	Number of Subplots*	Breeding codes†
White-winged dove	*Zenaida asiatica*	1	FO
Wilson's warbler	*Cardellina pusilla*	--	
Woodhouse's scrub-jay	*Aphelocoma woodhouseii*	5	PF, FO, C, H, P, F
Yellow warbler	*Setophaga petechia*	5	PF, C, S, CF
Yellow-billed cuckoo	*Coccyzus americanus*	1	S
Yellow-breasted chat	*Icteria virens*	3	PF, S, P
Yellow-rumped warbler	*Setophaga coronata*	6	PF, FO, C, S, P

* Species with no number of count locations are either migrants or winter residents and do not breed in southern Nevada.

† Breeding codes are ordered from left to right with increasing evidence of a successful breeding outcome in a particular location: Perched or foraging (PF); flyover (FO); calling (C); in appropriate habitat (H); singing (S); pair in suitable habitat (P); territory defense (TD); courtship, display, or copulation (CC); visiting probable nest site (PN); agitation (A); carrying nest material (CNM); building nest (BN); distraction display (DD); active nest (AN); eggs in nest (E); young in nest (Y); carrying food (CF); family group (F); recently fledged or precocial young (RF).

‡ *Empidonax* flycatcher species that could not be identified.

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