Avian Surveys
2021 Final Project Report

SEPTEMBER 2021

PREPARED FOR

Desert Conservation Program
Clark County Department of
Environment and Sustainability

PREPARED BY

SWCA Environmental Consultants

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2021 FINAL PROJECT REPORT

Prepared for

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EXECUTIVE SUMMARY

In 2021, SWCA Environmental Consultants conducted avian surveys at 30 randomly selected sites within Clark County, Nevada. Surveys were conducted with the goal of recording additional detections of seven avian species (herein referred to as 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 suitability models for these target species.

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 two area searches and a 1-hour eagle-use count and were conducted between March 27 and June 11, 2021, by Steve Dougill, Trevor Hinckley, and Justin Streit. Surveyors spent 246.3 hours conducting area searches and 92.6 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. Four of the target species (Arizona Bell's vireo, golden eagle, LeConte's thrasher, and loggerhead shrike) were recorded within the proposed MSHCP Amendment Reserve System. Four of the target species (Arizona Bell's vireo, western burrowing owl, LeConte's thrasher, and loggerhead shrike) were recorded within proposed MSHCP Amendment Impact Areas. In addition to target species, surveyors recorded at least one non-target species at each site. In total, 98 non-target species were recorded. Of these 98 species, 64 were recorded across the MSHCP Amendment Impact Areas and MSHCP Amendment Reserve System.

All detections of LeConte's thrasher and 90% of loggerhead shrike detections were within predicted habitat (i.e., habitat modeled as marginal, suitable, or optimal), and there is no evidence of poor model fit for either species. Detections of Arizona Bell's vireo were limited to areas within the desert riparian ecosystem. Observations of vegetation structure within each site suggest that key habitat requirements were absent from almost all sites (27 of 30), and predicted habitat may be overestimated for Arizona Bell's vireo. Detections of Bendire's thrasher were also limited, but a lack of suitable nesting substrate in some areas of predicted habitat could suggest predicted habitat for the species is overestimated in Clark County. In addition to the Arizona Bell's vireo and Bendire's thrasher, western burrowing owl and gilded flicker were detected in very low numbers, and additional surveys could be warranted for all four species to increase detections and provide more data for additional model refinement. Both western burrowing owl and gilded flicker were detected outside predicted habitat, but data were too sparse to allow a meaningful assessment of model fit. Golden eagles were detected 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 forthcoming amendment to the MSHCP will cover several additional avian species. To better understand and subsequently protect these species, the County commissioned habitat suitability 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 these models, the County is seeking to collect additional occurrence data for seven of the proposed avian species (target 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 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 amended permit would be reduced to 29, including 10 avian species. As part of this process, the County commissioned the development of habitat suitability models for 50 new species to help determine which species should be covered under the proposed amendment (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*], 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) (herein referred to as 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 identified that additional data are needed to refine the models for the target species, especially in areas of high model uncertainty.

1.3 Management Actions, Goals, and Objectives

The goal of this project is to expand upon occurrence data in Clark County for the seven target species. These data may be used to refine species distribution models, which may in turn assist land managers in identifying potentially important areas for conservation. The objective of the project is to conduct surveys for the seven target species across Clark County, particularly within the proposed MSHCP Amendment Impact Areas (Impact Areas), the proposed MSHCP Amendment Reserve System (includes existing MSHCP properties and Special Management Areas being considered for future conservation) (the Reserve System), and other federally managed lands in Clark County.

2 METHODS AND MATERIALS

2.1 Site Selection

Survey sites were randomly selected in 2021 from Impact Areas, the Reserve System, and federally managed lands within Clark County, Nevada. In total, 30 sites were selected following methods detailed in the *Work Plan and Data Management for Avian Surveys* (Streit 2021). Each selected site comprised two 300 × 300–meter (m) subplots and an eagle-use count location (see Sections 2.2.1 and 2.2.2). Each pair of subplots was spaced at least 500 m apart, and sites were spaced at least 2.5 kilometers (km) apart to maximize the number of presence points potentially available for any future modeling efforts (Nussear and Simandle 2020).

Each habitat suitability model identified potentially suitable habitat as optimal, suitable, or marginal (hereafter collectively called predicted habitat) over a county-wide grid of 250 × 250–m cells. In preparation for site selection, the outputs of the target species' habitat suitability models were overlain and then filtered to remove cells within 2.5 km of any previously recorded detection locations used for generating the habitat suitability models (Nussear 2019; Nussear and Simandle 2020; Southwest Ecology 2018). The remaining cells were eligible for selection as a subplot location and were ranked according to the following criteria:

- the number of species with predicted habitat in the cell (≥ 4 species preferred),
- location inside or outside Impact Areas or the Reserve System (inside preferred),
- proximity to a road navigable with a truck (≤ 1.6 km preferred), and
- location on private or public land (public land preferred).

Each prioritization criterion was scored as a '0' or '1', with 1 representing the preferred value for that criterion. The scores were summed, and the cells were split into two categories: high priority with an additive score of 3 or 4, and low priority with a summed score of 2 or less. Cells with a priority score of 3 could have been on private or developed land, more than 1.6 km from a navigable road, or in areas with very steep topography; these location characteristics were considered logistically undesirable.

A random number field was then generated and used to sort the high-priority cells. The initial goal was for each target species to be represented by 30 cells of predicted habitat and for none of these cells to include logistically undesirable location characteristics. This was achieved by selecting the first 100 cells on the list of randomly ordered, high-priority cells and then checking the distribution of predicted habitat among the target species, as well as assessing each cell for the presence of undesirable location characteristics. If a cell contained undesirable location characteristics, it was removed from selection and made unavailable for future selection. Selection then continued down the randomly ordered list of high-priority cells until each species was represented by at least 30 cells of predicted habitat without undesirable location characteristics. In total, the first 454 cells were selected from the randomly ordered, high-priority list, as described above, and the subsequent cell selection included 245 cells following the removal of cells with undesirable location characteristics.

The next step was to use these 245 cells to create 30 sites consisting of paired cells. Within the 245 cells, the species with the fewest cells in predicted habitat were Arizona Bell's vireo, gilded flicker, and western burrowing owl. These three species were prioritized in site creation, and the site creation process started with cells with predicted habitat for any of these three species. Sites were then created as follows:

- If two cells were within a logistically feasible distance from one another (i.e., close enough to allow area searches [see Section 2.2.1] at both cells to be completed by 11 a.m. on a single day, as estimated from nearby road access and terrain), they were grouped as a site.

- If a cell was within 2.5 km of an already selected site, it was not used for new site selection but remained on the alternate list.

- If a cell was in an acceptable area for a unique site and was outside but near an Impact Area or the Reserve System, a replacement was selected from within that Impact Area or the Reserve System. The replacement was the first cell on the randomly ordered high-priority list with at least the same number and composition of species with predicted habitat (e.g., if the cell being replaced included predicted habitat for loggerhead shrike, Bendire's thrasher, LeConte's thrasher, and gilded flicker, the replacement included predicted habitat for at least these four species).

- If a cell with predicted habitat for one of the three prioritized species was in an acceptable area for a unique site (> 2.5 km from another site), but the initial list of 245 cells did not contain a second cell within a logistically feasible distance, a second cell was selected from the randomly ordered high-priority list. All cells on the randomly ordered high-priority list that were within a logistically feasible distance of the first cell were examined. The second cell had to be at least 500 m from the first cell and not on developed land or steep topography (as determined through aerial imagery). If multiple cells met the location criteria, only the cells with the highest number of species with predicted habitat were retained. Of these, the cell with the lowest random number value was selected.

The result of this selection process was 30 sites, each consisting of a pair of cells, and an available set of randomly selected, alternate cells. Selected cells were then converted into subplots by centering a 300 × 300–m subplot boundary over each cell location. During surveys, each surveyor confirmed safe access to and within each subplot and eagle-use count location. If access was deemed unsafe, an alternate subplot was selected as a replacement.

2.2 Surveys

Surveys at each of the 30 sites comprised two area searches, one at each of the two subplots, followed by and eagle-use count at a pre-determined location between the subplots. Three survey rounds were planned at each site between March 25 and June 15, 2021, with consecutive visits 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 21.1.0) (Field Maps) and paired with an external Geode GPS receiver.

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 ID 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 (Desert Thrasher Working

Group [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 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 the six non-eagle target species, the surveyor recorded the highest breeding behavior observed, using standard breeding bird behavior codes (Table 1), 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 1. 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 eagles detected during area searches, the surveyor used a raptor-specific (includes eagles) behavior list (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 eagles (see Section 2.2.2). Species known not to breed in Clark County (e.g., winter residents and seasonal migrants) were not recorded.

Following each area search, the surveyor broadcast from near the center of the plot the primary song of each non-eagle target species that was not detected through passive observation. The broadcast for each species comprised three repetitions of an approximately 30-second broadcast period followed by a 1- minute silent observation period.

2.2.2 Eagle-Use Counts

Following area-search surveys at a site, surveyors conducted an eagle-use count at a pre-determined location between the two 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. Distances of 800 m or less were estimated using a rangefinder, while distances > 800 m 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 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 eagles followed a standardized raptor behavior list (Table 2) (USFWS 2013). For each golden eagle detected during activities other than an eagle-use count, surveyors recorded information as detailed in the Area-Search Survey section (see Section 2.2.1). To document relative positional accuracy, the estimated distance to a golden eagle detected during an area search was measured in ArcGIS Pro version 2.7.1, after surveys were complete, as the minimum distance between the subplot and the detection location.

Table 2. 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.

If a surveyor determined that the initial location of an eagle-use count had a poor viewshed, 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 surveys.

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.

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, average and maximum vegetation height (in meters), and a subjective description of vegetation density (e.g., dense or sparse). Surveyors also noted the presence of trees ≥ 12 centimeters (cm) diameter at breast height (dbh) (minimum size needed for gilded flicker nesting cavities), 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 prey species for golden eagles. 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 in the subplot (e.g., Mojave desert scrub and riparian vegetation). When this was the case, the surveyor recorded habitat info for each distinct habitat type, along with the photograph of that habitat.

3 RESULTS AND EVIDENCE OF THE RESULTS

3.1 Objectives Completed

The objective of conducting surveys for the seven target species within Impact Areas, the Reserve System, and other federally managed lands in Clark County was completed; SWCA conducted three rounds of surveys at 30 sites in 2021. No other objectives were proposed for this project.

3.2 Site Location

The distribution of selected subplots included 16 within Impact Areas and 14 within the Reserve System (Figure 1). The remaining 30 subplots were distributed across federally managed lands. Each selected subplot intersected predicted habitat for at least one target species. The number of selected subplots intersecting predicted habitat for each species ranged from a low of 22 subplots (37%) for Arizona Bell's vireo to a high of 56 (93%) for loggerhead shrike (Table 3). At least one subplot intersected each of the three categories of predicted habitat (i.e., optimal, suitable, and marginal) for each species other than Arizona Bell's vireo, for which no subplots intersected habitat modeled as optimal. Two of the initially selected subplots were replaced after surveys began due to access issues. Twelve eagle-use count locations were micro-sited to locations that had better viewsheds than the originally selected locations.

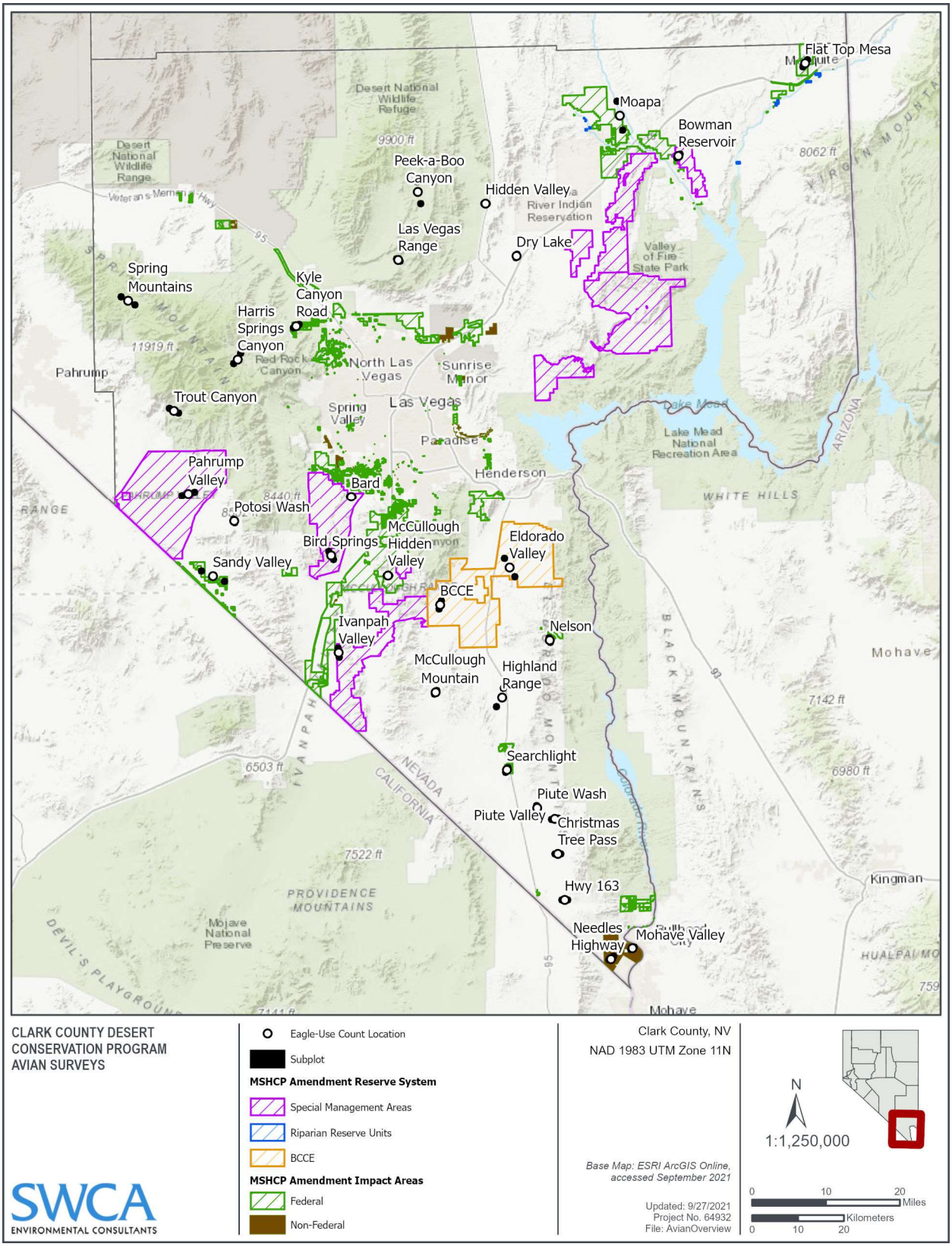

Figure 1. Location of sites selected for avian surveys in Clark County, 2021.

Table 3. Number of Subplots Intersecting Predicted Suitable Habitat by Species

Species	Total (%)	# Intersecting Optimal Habitat (%)	# Intersecting Suitable Habitat (%)	# Intersecting Marginal Habitat (%)
Arizona Bell's vireo	22 (37)	0	18 (30)	4 (7)
Bendire's thrasher	46 (77)	10 (17)	27 (45)	9 (15)
Gilded flicker	23 (38)	4 (7)	16 (27)	3 (5)
Golden eagle	40 (67)	5 (8)	29 (48)	6 (10)
LeConte's thrasher	50 (83)	16 (27)	33 (55)	1 (2)
Loggerhead shrike	56 (93)	20 (33)	34 (57)	2 (3)
Western burrowing owl	31 (52)	1 (2)	22 (37)	8 (13)

Note: Data on predicted suitable habitat were obtained from models developed by Nussear and Simandle (2020) and Nussear (2019). Percentages represent percentage of the 60 selected subplots.

3.3 Survey Effort

Surveys were conducted between March 27 and June 11, 2021, by Steve Dougill, Trevor Hinckley, and Justin Streit. Survey rounds did not overlap. The three survey rounds were completed on March 27 – April 17, April 21 – May 18, and May 22 – June 11, respectively. Consecutive visits to each site were separated by at least 10 days. One extra visit to the Harris Springs Canyon site was made in the first survey round to conduct an area search in a replacement subplot after the surveyor deemed one of the original subplots unsafe for future surveys. The original subplot was surveyed only once, and results from this survey are not included in any analysis. Surveyors spent 246.3 hours conducting area searches and 92.6 hours conducting eagle-use counts (Table 4). Incidental detections were recorded under the following circumstances: on-site, but not during an area search, traveling to or from a site, camping or looking for a camping spot near a site, during southwestern willow flycatcher and yellow-billed cuckoo surveys along the Virgin River and in Lower Las Vegas Wash, conducting point-count surveys at the BCCE, and during other fieldwork in the Pahrump Valley.

Table 4. Survey Dates and Effort by Survey Type and Site, 2021

Site	Survey Dates	Total Area-Search Survey Hours	Total Eagle-Use Count Hours
Bard	April 10, May 18, June 3	6.5	3.0
BCCE	March 31, May 7, May 24	7.8	3.1
Bird Springs	March 28, April 30, May 22	8.3	3.1
Bowman Reservoir	April 4, April 22, May 26	9.0	3.0
Christmas Tree Pass	April 15, May 17, May 27	8.7	3.2
Dry Lake	April 3, May 2, May 29	7.6	3.1
Eldorado Valley	April 1, May 9, May 29	7.3	3.1
Flat Top Mesa	April 5, April 21, May 27	6.8	3.1
Harris Springs Canyon	April 2, April 17,* May 14, May 31	10.7	3.0
Hidden Valley	April 7, May 6, June 4	6.3	3.1
Highland Range	April 3, May 13, June 1	8.4	3.1
Hwy 163	April 15, May 5, May 28	7.6	3.1
Ivanpah Valley	March 29, May 4, May 23	8.1	3.1

Site	Survey Dates	Total Area-Search Survey Hours	Total Eagle-Use Count Hours
Kyle Canyon Road	April 1, May 12, May 30	7.4	3.1
Las Vegas Range	April 9, May 13, June 1	7.7	3.1
McCullough Hidden Valley	March 27, April 27, June 4	7.7	3.3
McCullough Mountain	April 4, May 12, June 3	9.0	3.1
Moapa	April 6, April 23, May 28	8.1	3.1
Mohave Valley	April 11, May 2, May 25	11.1	3.1
Needles Highway	April 12, May 6, May 26	7.8	3.2
Nelson	April 2, May 10, June 5	8.4	3.0
Pahrump Valley	March 29, April 26, May 24	7.7	3.1
Peek-a-boo Canyon	April 8, May 5, June 2	8.4	3.1
Piute Valley	April 8, May 8, May 30	7.7	3.1
Piute Wash	April 10, May 18, June 2	8.1	3.2
Potosi Wash	March 27, May 4, May 22	8.1	3.0
Sandy Valley	March 28, April 27, May 23	8.0	3.0
Searchlight	April 7, May 14, May 31	8.4	3.1
Spring Mountains	March 31, April 30, June 11	9.8	3.1
Trout Canyon	March 30, April 24, May 25	9.6	3.0
TOTAL		**246.3**	**92.6**

Note: Total hours differ slightly (± 0.2 hour) from the sums of the hours for each site due to rounding.

* The replacement subplot at Harris Springs Canyon was surveyed on April 17 as part of the first survey round.

Several high-wind days in April and early May forced surveys to be rescheduled; otherwise, weather conditions were favorable during surveys. No precipitation was observed during any survey, and temperatures during area searches did not exceed 99 degrees Fahrenheit. Wind speeds ranged from 0 to 14.5 km per hour during area searches and up to 20.9 km per hour during eagle-use counts.

3.4 Findings

3.4.1 Species Detections

At least one detection was recorded during area searches for each of the seven target species (Table 5). Incidental detections were recorded for five of the target species. Detections for each of the target species are detailed below.

Surveyors recorded at least one non-target species at each site. In total, 98 non-target species were recorded. Of these 98 species, 64 were recorded across the Impact Areas and Reserve System. Breeding was confirmed for eight non-target species, including black-tailed gnatcatcher (*Polioptila melanura*), black-throated sparrow (*Amphispiza bilineata*), chipping sparrow (*Spizella passerina*), Lucy's warbler (*Leiothlypis luciae*), mourning dove (*Zenaida macroura*), pinyon jay (*Gymnorhinus cyanocephalus*), red- tailed hawk (*Buteo jamaicensis*), and Scott's oriole (*Icterus parisorum*). The three most abundant non-target species across all sites combined were black-throated sparrow, horned lark (*Eremophila alpestris*), and house finch (*Haemorhous mexicanus*).

Table 5. Survey Results by Target Species

Species	Total # of Detections	# Area Search Detections	# Incidental Detections	# Sites (# Subplots)	# Detections Within Predicted Habitat (%)	# Detections Outside Predicted Habitat (%)
Arizona Bell's vireo	12	1	11	1 (1)	11 (92)	1 (8)
Bendire's thrasher	3	3	0	1 (1)	3 (100)	0 (0)
Gilded flicker	6	6	0	3 (4)	5 (83)	1 (17)
Golden eagle	18	14	4	10 (–)	12 (67)	6 (33)
LeConte's thrasher	49	26	23	11 (16)	49 (100)	0 (0)
Loggerhead shrike	62	31	31	18 (23)	56 (90)	6 (10)
Western burrowing owl	4	2	2	1 (1)	2 (50)	2 (50)

3.4.1.1 ARIZONA BELL'S VIREO

Surveyors detected Arizona Bell's vireo once during an area-search survey and recorded 11 incidental detections (Figure 2; see Table 5). All detections but one were within predicted habitat. Of the 11 detections within predicted habitat, eight were within habitat modeled as optimal and three were within habitat modeled as suitable. The survey detection was within an Impact Area, and seven of the incidental detections were within the Reserve System. The single detection located outside predicted habitat was 318 m from the nearest predicted habitat. The highest observed breeding evidence associated with any of the detections was a "singing bird present 7+ days" (see Table 1), which was noted within one of the County's existing Riparian Reserve Units and within habitat modeled as optimal.

3.4.1.2 BENDIRE'S THRASHER

Surveyors recorded three detections of Bendire's thrasher during area-search surveys and had no incidental detections (Figure 3; see Table 5). All three detections were recorded at the same subplot at the Highland Range site, with one detection per survey. The subplot was within predicted habitat and specifically within habitat modeled as optimal. This subplot was not within an Impact Area or the Reserve System. The highest observed breeding evidence associated with any of the detections was "singing," but the pattern of detections represents a "singing bird present 7+ days," which indicates probable breeding at this subplot (see Table 1).

3.4.1.3 GILDED FLICKER

Surveyors recorded six detections of gilded flicker during area-search surveys; no incidental detections were recorded (Figure 4; see Table 5). The detections were recorded within four subplots of three sites. One detection was recorded during each of two separate surveys in one of the subplots, while detections were recorded during only one survey in each of the other subplots. Five of the detections were within predicted habitat, with four detections in habitat modeled as optimal and one detection in habitat modeled as suitable. The sixth detection was outside predicted habitat by 3,492 m and was the only detection within the Reserve System (in a Special Management Area). No detections were within Impact Areas. The highest observed breeding evidence associated with any of the detections was "pair in suitable habitat" (see Table 1). This detection was in habitat modeled as suitable, on the edge of habitat modeled as optimal.

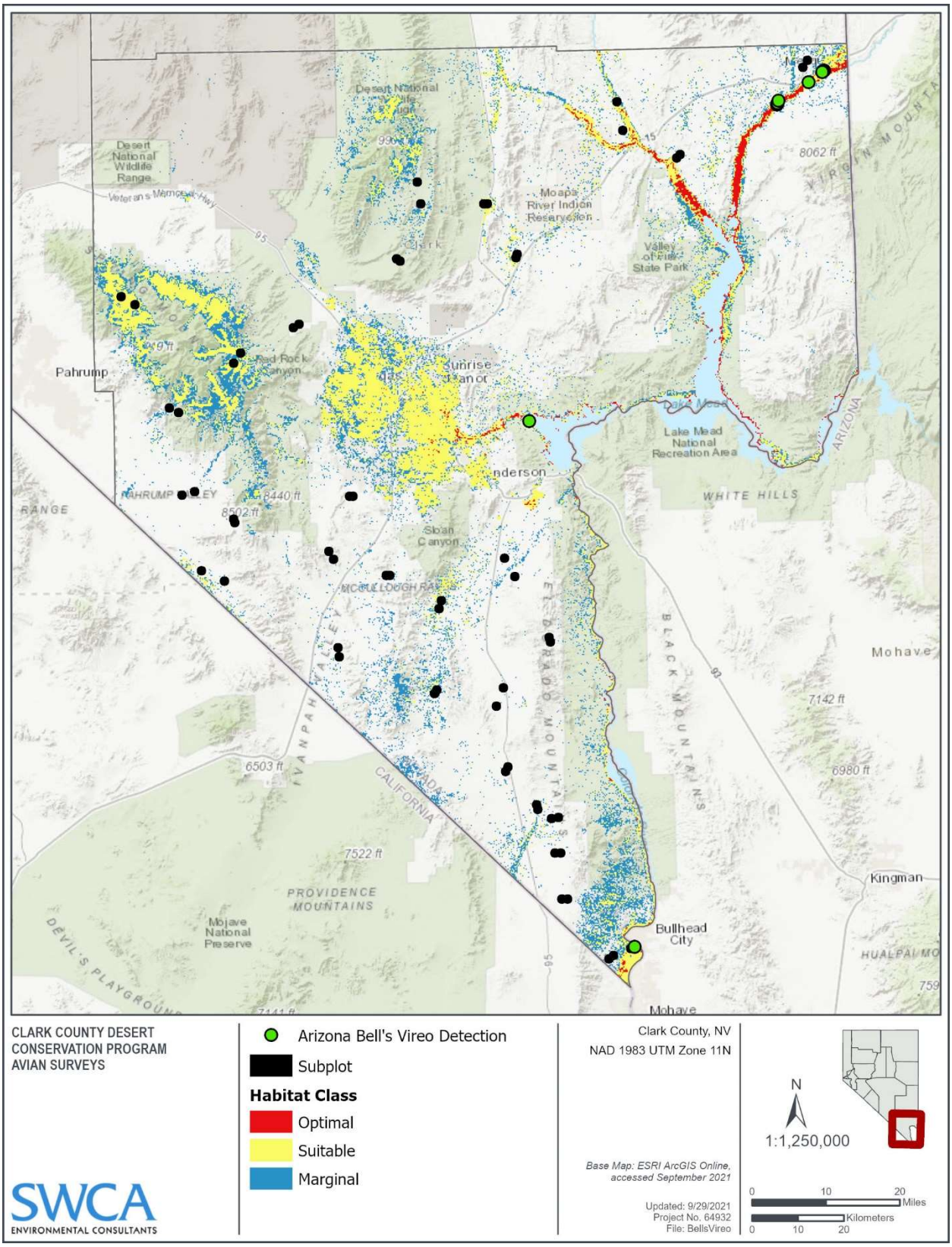

Figure 2. Arizona Bell's vireo survey and incidental detections, Clark County, 2021.

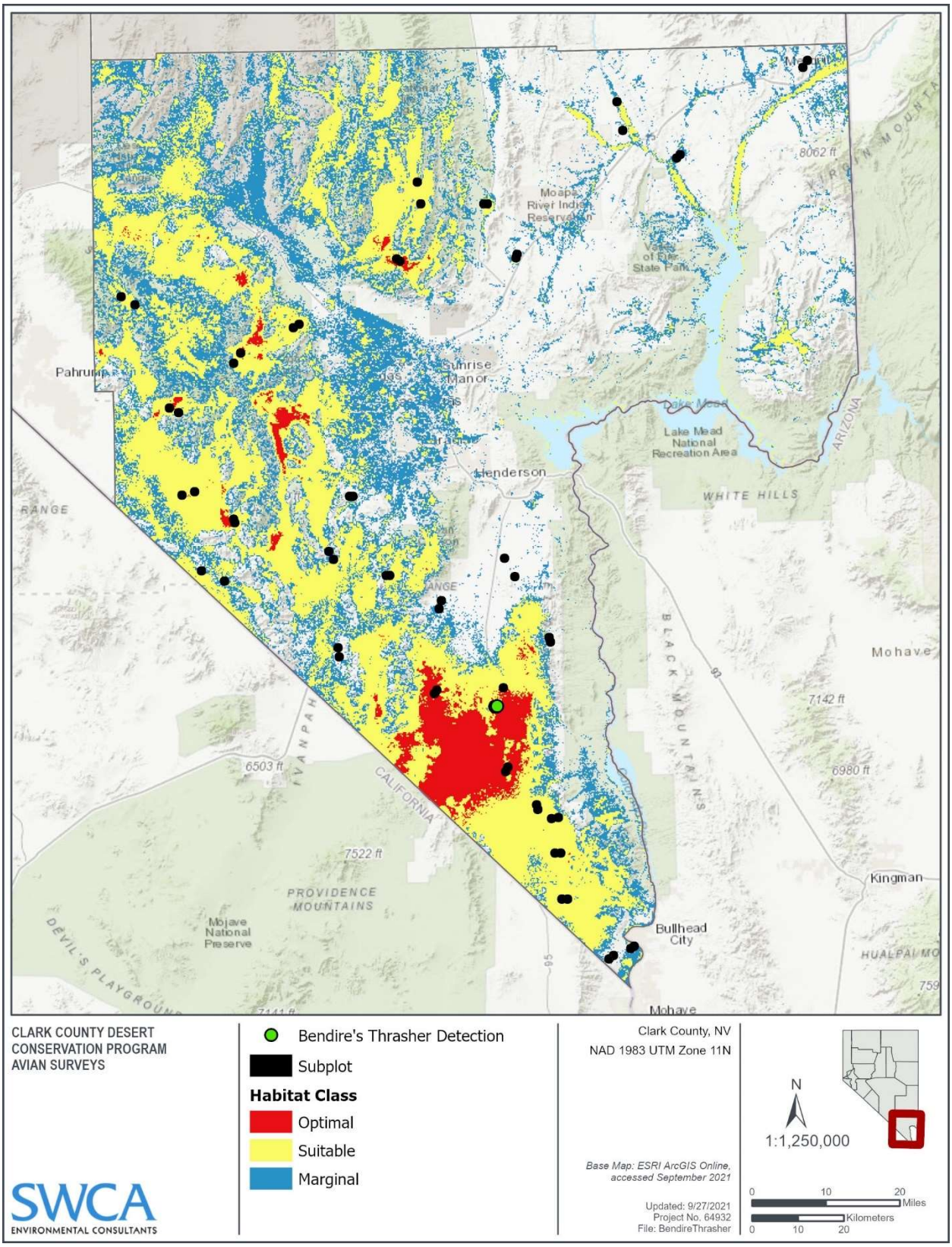

Figure 3. Bendire's thrasher survey and incidental detections, Clark County, 2021.

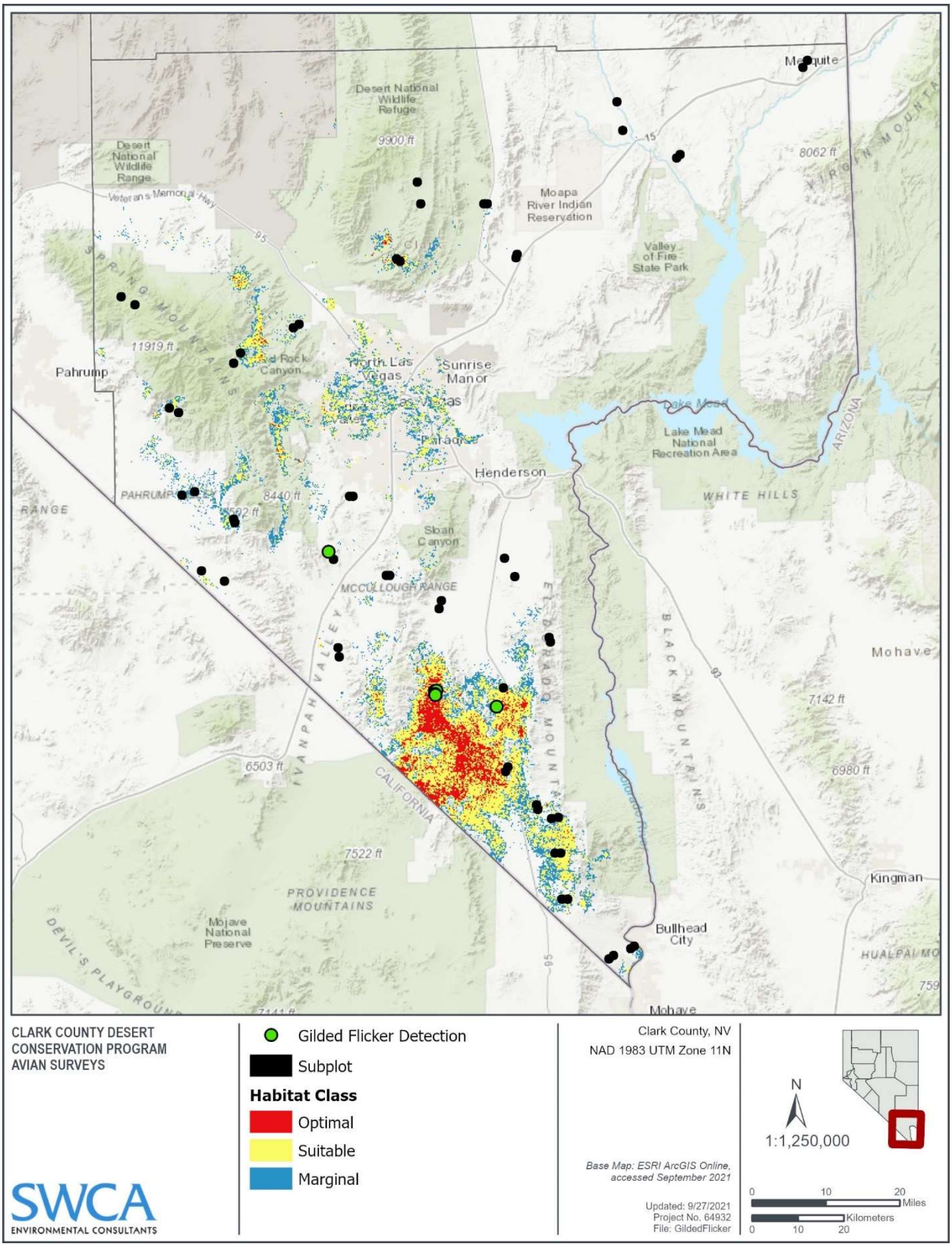

Figure 4. Gilded flicker survey and incidental detections, Clark County, 2021.

3.4.1.4 GOLDEN EAGLE

Surveyors recorded 14 detections of golden eagle during area-search surveys or eagle-use counts at 10 sites (Figure 5; see Table 5). The estimated distance from the surveyor to the eagle for the 14 detections ranged from 138 to 6,880 m (average = 1,976 m). Detections were recorded during only one of the survey rounds at each of the 10 sites. Four incidental detections were also recorded. Twelve of the 18 detections were within predicted foraging habitat, with one detection within habitat modeled as optimal for foraging, nine within habitat modeled as suitable, and two within habitat modeled as marginal. Six detections were outside predicted foraging habitat by an estimated 31 to 5,205 m (average = 2,574 m). Four detections were within the Reserve System, with two detections within the BCCE and two detections in Special Management Areas. All other detections were within other federally managed lands. No direct breeding evidence was observed, but two golden eagles were observed perched near each other at one site within habitat modeled as suitable for foraging.

3.4.1.5 LECONTE'S THRASHER

Surveyors recorded 49 detections of LeConte's thrasher: 26 were recorded during area-search surveys, and 23 were incidental detections (Figure 6; see Table 5). Detections were recorded at 16 subplots of 11 sites. Detections were recorded during two different surveys in three of the subplots. All 49 detections were within predicted habitat, with 34 within habitat modeled as optimal and 15 within habitat modeled as suitable. Twelve detections were recorded within Impact Areas, and four detections were recorded within the Reserve System (all within the BCCE). All other detections were on federally managed lands. The highest observed breeding evidence associated with any of the detections was "family group" (see Table 1). This detection was in habitat modeled as optimal.

3.4.1.6 LOGGERHEAD SHRIKE

Surveyors recorded 62 detections of loggerhead shrike: 31 were recorded during surveys, and 31 were incidental detections (Figure 7; see Table 5). Detections were recorded at 23 subplots of 18 sites. Detections were recorded during two different surveys in five of the subplots. Six of the 62 detections were outside predicted habitat by 54 to 565 m (average = 163 m). Of the 56 detections within predicted habitat, 18 were within habitat modeled as optimal, 36 were within habitat modeled as suitable, and two were within habitat modeled as marginal. Eleven detections were in Impact Areas, and 17 detections were within the Reserve System, with two in Riparian Reserve Units, two in the BCCE, and 13 in Special Management Areas. The highest observed breeding evidence associated with any of the detections was "recently fledged young" (see Table 1). This detection was in habitat modeled as suitable, on the edge of habitat modeled as optimal.

3.4.1.7 WESTERN BURROWING OWL

Surveyors recorded two western burrowing owls during one area-search survey within a single subplot at the Needles Highway site and recorded two incidental detections (Figure 8; see Table 5). A possibly occupied burrow was also found during surveys at the Sandy Valley site, but no western burrowing owls were ever observed at this burrow. This burrow had whitewash and a pellet near the entrance but was filled with spiderwebs on both the first and second surveys; the burrow was not checked on the third survey. The two survey detections were within the only survey subplot that intersected habitat modeled as optimal for western burrowing owl. The two incidental detections were outside predicted habitat by 10 m and 815 m. The possible burrow was outside predicted habitat by > 9 km. Three of the detections were in Impact Areas. The highest observed breeding evidence associated with any of the detections was "pair in suitable habitat" (see Table 1), which was associated with one of the incidental detections.

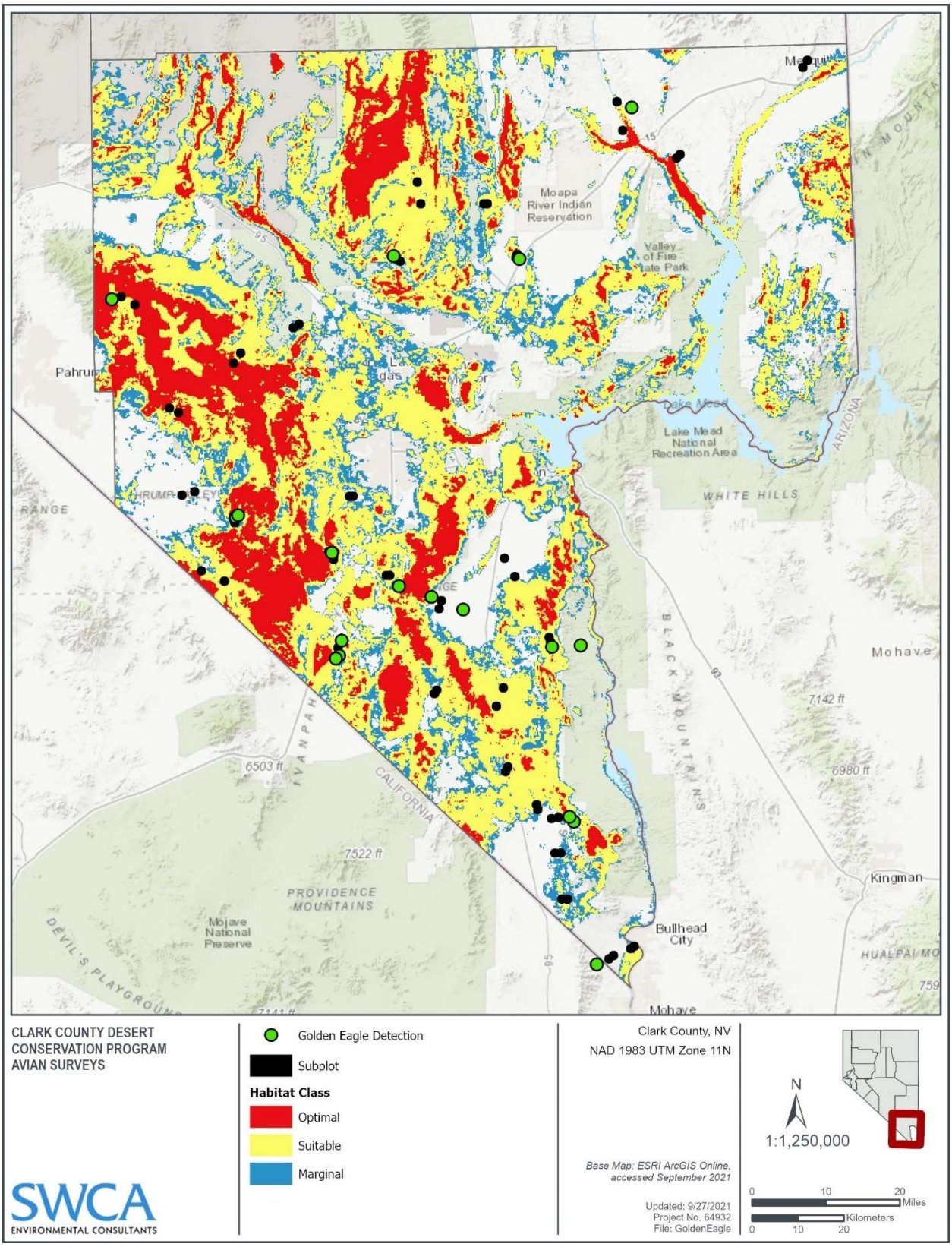

Figure 5. Golden eagle survey and incidental detections, Clark County, 2021.

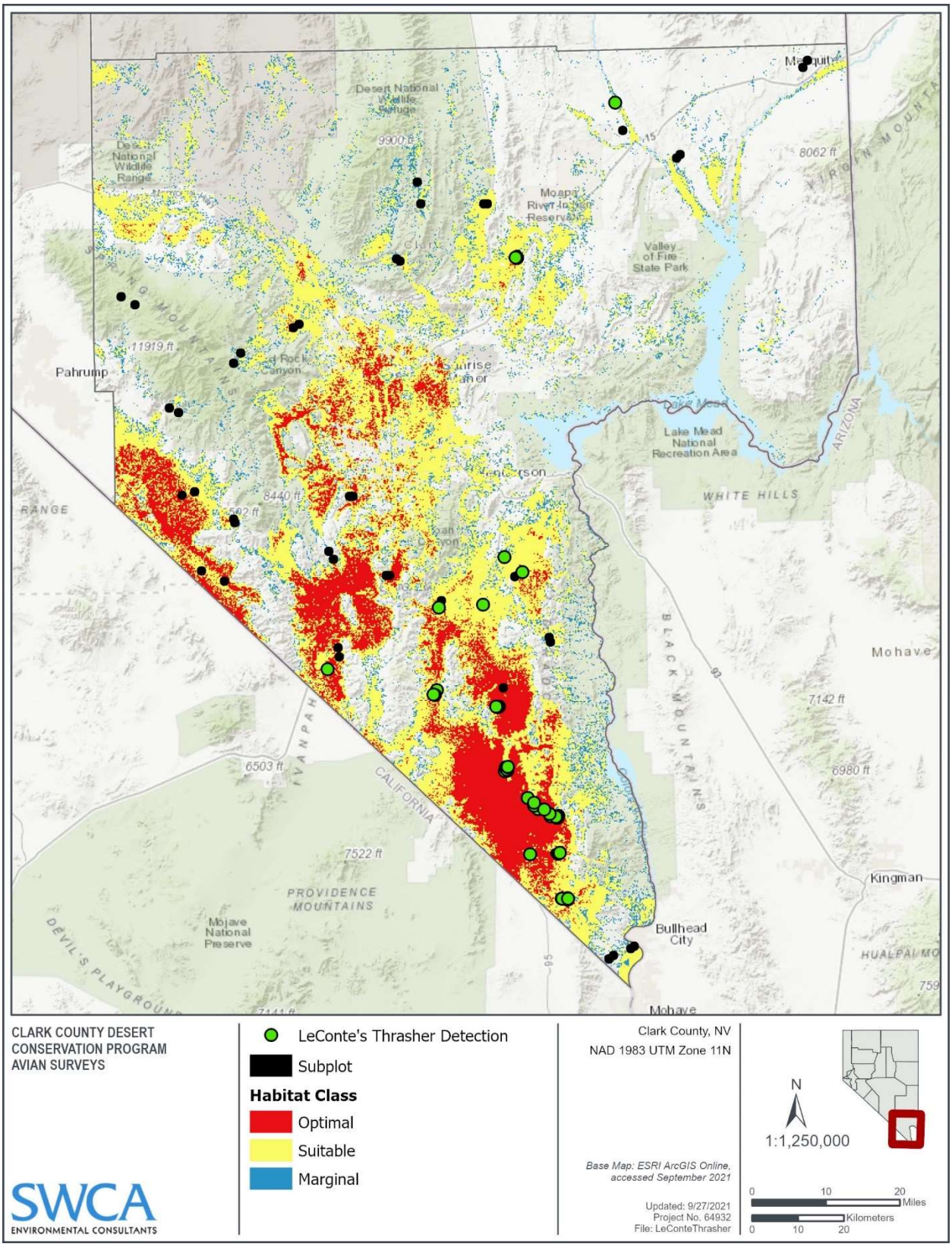

Figure 6. LeConte's thrasher survey and incidental detections, Clark County, 2021.

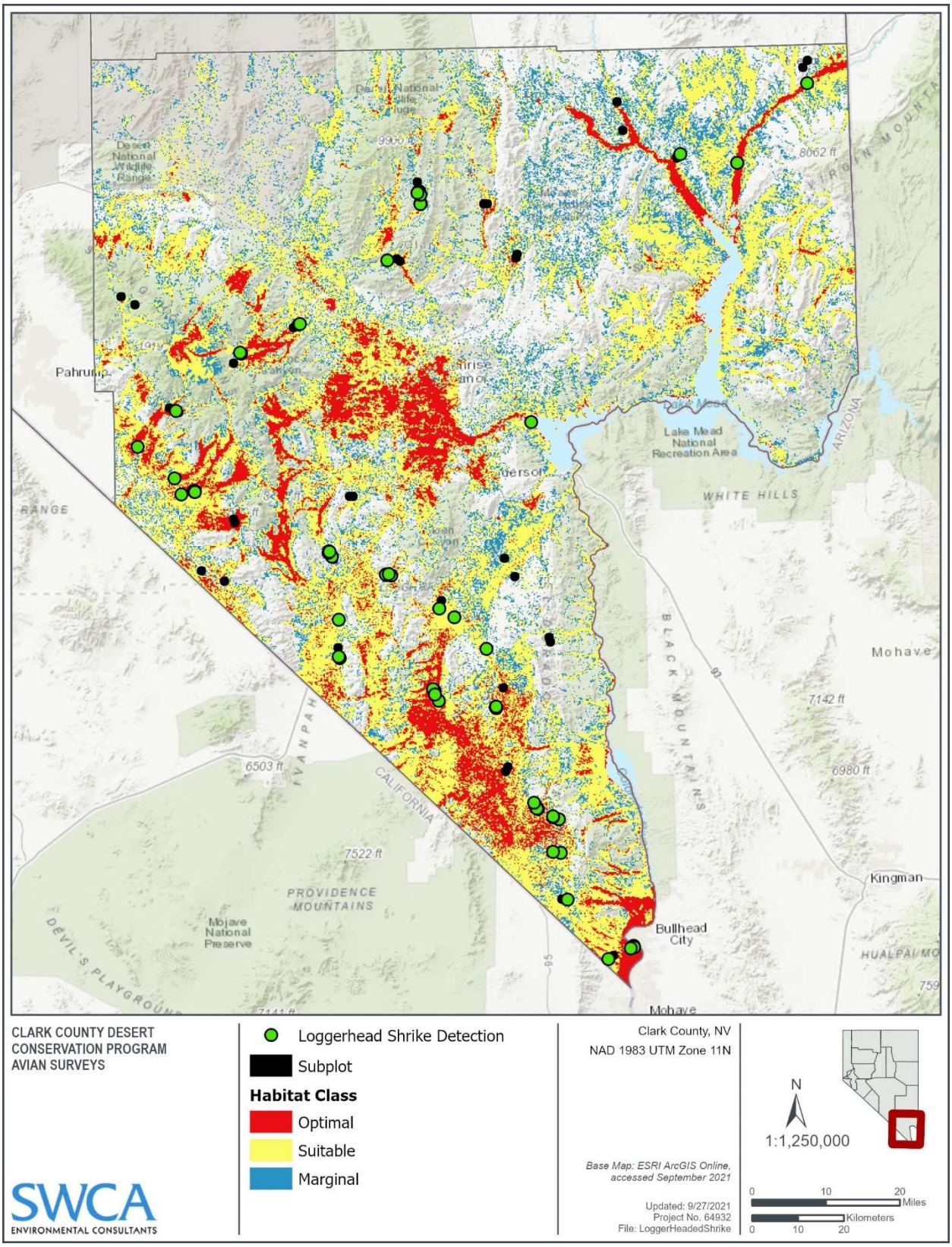

Figure 7. Loggerhead shrike survey and incidental detections, Clark County, 2021.

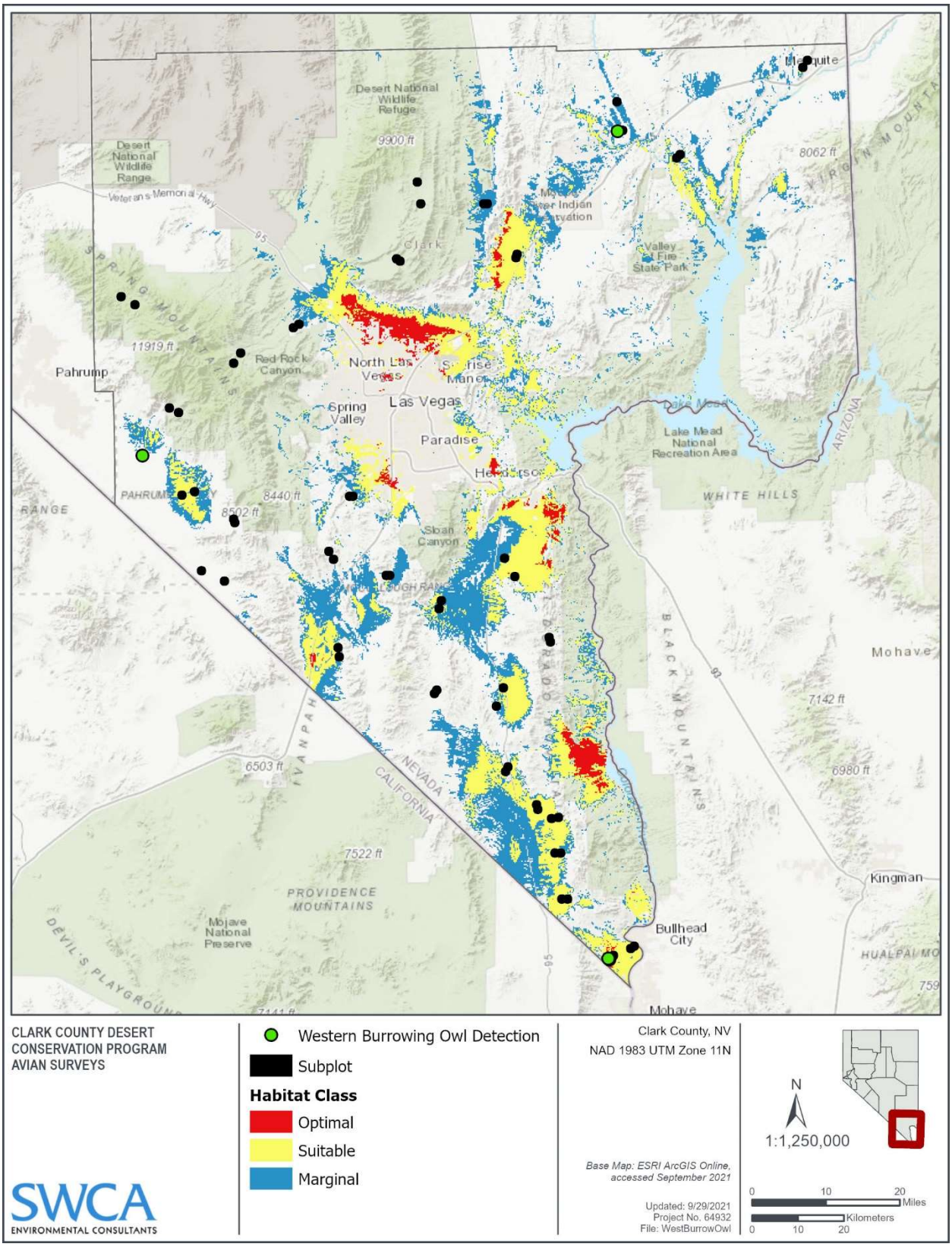

Figure 8. Western burrowing owl survey and incidental detections, Clark County, 2021.

3.4.2 Habitat Data

In total, 68 photographs with associated habitat data were recorded. More than one photograph and set of habitat data were recorded in seven subplots; no more than three photographs were recorded in any subplot. Average vegetation height within each subplot ranged from 0.3 to 6.0 m (average 1.4 m). Maximum vegetation height within each subplot ranged from 1.2 to 10.0 m (average 4.7 m). Vegetation density was most commonly reported as "sparse" (69% of records), and the most commonly reported species of vegetation were creosote bush (*Larrea tridentata*), sage (*Salvia* spp.), yucca (*Yucca* spp.), and jointfir (*Ephedra* spp.). Large trees (≥ 12 cm dbh) were reported for 21 (35%) subplots. Burrows of a suitable size for burrowing owl were reported for 50 (83%) subplots. Signs of leporid mammals were reported for 41 (68%) subplots. Surface water was adjacent to one (2%) of the subplots.

4 EVALUATION/DISCUSSION OF RESULTS

Many factors (e.g., breeding season phenology or level of breeding activity) 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). True absence is difficult to prove for avian species due to their highly mobile nature, and discussions below will 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 0.6–3 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 (RECON 2000). Bell's vireo is primarily found below 1,300 m above mean sea level (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).

Though 18 subplots intersected habitat modeled as suitable for Arizona Bell's vireo, only eight subplots (13%) were within relatively large blocks of habitat modeled as suitable. The other 10 subplots (17%) were on the edge of relatively large blocks of habitat modeled as suitable or in an area where predicted habitat was present in sparse density. Habitat data and surveyors' observations suggest that components of potentially suitable habitat were present in only four of the eight subplots that were within relatively large blocks of habitat modeled as suitable. These components included suitable vegetation species (e.g., tamarisk and mesquite) of sufficient height and density in all four subplots and proximity to surface water for one subplot. The four subplots were in habitat modeled as desert riparian (two subplots),

the edge of open water and Mojave desert scrub (one subplot), and the edge of desert riparian and Mojave desert scrub (one subplot). Of the four subplots, the northern Mohave Valley subplot had the largest areal extent of potentially suitable habitat, which covered nearly half the subplot according to on-the-ground observations. Examination of aerial imagery showed that this subplot was also within 300 m of the Colorado River and intersected the riparian zone adjacent to the river. The single survey detection was recorded at this subplot (Figure 9). For the other three subplots, examination of aerial imagery showed that components of potentially suitable vegetation were limited in areal extent, covering less than 25% of any of the plots.

Figure 9. Edge of habitat where Arizona Bell's vireo was detected in the northern Mohave Valley subplot, 2021.

The remaining four of the eight subplots within relatively large blocks of habitat modeled as suitable all lacked the dense shrub layer preferred by Arizona Bell's vireo (Figures 10 and 11). These subplots were in the Spring Mountains, at the Spring Mountains and Harris Springs Canyon sites. Both the Spring Mountains and Harris Springs Canyon sites (2,057–2,210 m amsl and 1,798–1,948 m amsl, respectively) were above the elevation at which Arizona Bell's vireo typically occurs. According to modeling completed by Heaton et al. (2011), the Spring Mountains site is in the pinyon juniper ecosystem, and the Harris Springs Canyon site is near the intersection of the pinyon juniper, sagebrush, and blackbrush ecosystems (Heaton et al. 2011). Surveyors' observations show that three subplots were within pinyon juniper and the fourth was within blackbrush (see Figures 10 and 11). One Spring Mountains subplot and both Harris Springs Canyon subplots had been burned, and observed structure was consistent with post-fire shrub regrowth, which had not reached the density typically seen in Bell's vireo habitat. Though Bell's vireo can use juniper as a nest substrate, it is not known to breed in the pinyon juniper ecosystem. The species is also not known to breed in the sagebrush or blackbrush ecosystems.

Figure 10. Habitat in the Spring Mountains site, 2021.

Images show pinyon juniper ecosystem with mature woodland structure (left) and post-fire regrowth of shrub species associated with pinyon juniper (right).

Figure 11. Habitat in the Harris Springs Canyon site, 2021.

Images show post-fire regrowth of shrub species associated with both the pinyon juniper ecosystem (left) and blackbrush ecosystem (right).

Of the remaining 10 subplots associated with habitat modeled as suitable but located outside relatively large blocks of modeled suitable habitat, none had the dense shrub layer preferred by the species. Six of these subplots were in areas mapped as Mojave desert scrub, one was on the edge of an area mapped as salt desert scrub and Mojave desert scrub (Figure 12), two were in blackbrush (see Figure 12), and one was in an area at the edge of pinyon juniper, sagebrush, and blackbrush ecosystems. Surveyor observations support all these ecosystem classifications. Arizona Bell's vireo is not known to breed in any of the ecosystems associated with these 10 subplots.

Figure 12. Habitat in the southern Dry Lake subplot (left) and northwestern Trout Canyon subplot (right), 2021.

Images show habitat at the edge of salt desert scrub and Mojave desert scrub ecosystems (left) and the blackbrush ecosystem (right).

Surveyors' observations indicate that habitat where each Arizona Bell's vireo detection (both incidental and survey) was recorded was within riparian vegetation adjacent to the Virgin River, lower Las Vegas Wash, or the lower Colorado River. These observations are consistent with desert riparian ecosystem classification for 11 of the detections (Heaton et al. 2011). The remaining detection was in an area of riparian habitat in lower Las Vegas Wash within the full-pool level of Lake Mead that was classified as open water and modeled as unsuitable. As Lake Mead has receded, this area has become desert riparian habitat, though it is still mapped as open water. Except for the lower Las Vegas Wash detection, all detections were in habitat modeled as optimal or suitable. Surveyors' observations also indicate that habitat where each detection was recorded included a dense shrub layer of appropriate height that covered a relatively large areal extent. This habitat structure was lacking from all survey sites except the Mohave Valley site, where the single survey detection of Arizona Bell's vireo was recorded. These detections support the current knowledge that the species uses the desert riparian ecosystem. Ten of the incidental detections were also near previously recorded detections, thereby corroborating some of the County's current data.

In all sites except Mohave Valley, the habitat component that appeared to be most commonly lacking was a dense shrub layer of sufficient height or aerial extent, or both. The presence of wide expanses of predicted habitat in ecosystems that Arizona Bell's vireo is not known to use, as well as at elevations above that at which Arizona Bell's vireo has been documented breeding, suggests that the habitat model overestimates the presence of Arizona Bell's vireo habitat in the county.

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 et al. 2020). The structure of all occupied habitat types tends to be relatively open with scattered shrubs or trees (England et al. 2020). When the species occurs in low-elevation desert grassland or shrubland, at least one large individual of a cholla (*Cylindropuntia* spp.), yucca, or spinescent shrub (e.g., palo verde, mesquite, catclaw acacia [*Senegalia wrightii*], desert-thorn [*Lycium* spp.]) is almost always present (England et al. 2020).

These habitat types best align with mesquite/acacia, Mojave desert scrub, blackbrush, sagebrush, and pinyon juniper ecosystems.

The three detections of Bendire's thrasher recorded during surveys likely represented a single territory, which was within habitat modeled as optimal. Vegetation structure observed within the site had components of habitat suitable for Bendire's thrasher, as described above, and was consistent with the classification of optimal habitat (Figure 13).

Figure 13. Optimal habitat where Bendire's thrasher was detected in the Highland Range site, 2021.

Given that 77% of subplots intersected predicted habitat, the low number of detections is somewhat unexpected. Bendire's thrasher is known to have a secretive nature and be difficult to detect (England et al. 2020), and survey methods were selected specifically to maximize detection probability of both this species and LeConte's thrasher (DTWG 2018). Breeding activity and phenology of Bendire's thrasher can be altered by winter rainfall, with later phenology and reduced breeding activity following dry winters (DTWG 2018). Clark County and the greater southwest have been experiencing prolonged drought (Environmental Protection Agency 2021), and the winter of 2020–2021 was dry. A record-setting number of consecutive days without measurable precipitation (240 days) was recorded in Las Vegas between April 20 and December 17, 2020 (National Weather Service 2021), and conditions did not improve in 2021. As an example, for the 2021 water year (October 2020 – September 2021), the city of Searchlight had received only 32% of the average annual precipitation as of the end of August 2021 (California Nevada River Forecast Center 2021). Given the dry conditions observed during surveys, it is possible that this contributed to a lower than normal detection probability.

It is also possible that some subplots did not contain suitable habitat despite model classification to the contrary. Three subplots that intersected predicted habitat were modeled as in or on the edge of desert riparian, which is not an ecosystem the species is known to use. In other areas, where ecosystem classification better aligned with predicted habitat, it is possible that suitable nesting substrates or suitable vegetation density was lacking. Figure 14 shows habitat at the Hidden Valley site, which is within a patch of habitat modeled as suitable but appears to lack suitable nest substrates (e.g., large cholla, yucca, or spinescent shrubs). These observations suggest that the habitat model could overestimate the presence of Bendire's thrasher habitat in Clark County.

Figure 14. Habitat modeled as suitable for Bendire's thrasher at the Hidden Valley site, 2021.

4.3 Gilded Flicker

The 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 2005). In southern Nevada, where saguaros are absent, gilded flickers are associated with Joshua trees (*Yucca brevifolia*) and other tall yuccas of sufficient size to provide a substrate for nest cavities (Great Basin Bird Observatory 2010). Of the 23 subplots in predicted habitat, only nine (39%) had trees of suitable size, which included Joshua trees and other yuccas. Of the 37 subplots outside predicted habitat, 11 (30%) had trees of suitable size.

The known population of gilded flickers in southern Nevada is near the Highland and Eldorado Ranges, and most of the detections used in generating the habitat suitability model were in the vicinity of the Wee Thump Joshua Tree Wilderness, immediately southwest of the Highland Range (Nussear and Simandle 2020). The Wee Thump Joshua Tree Wilderness has some of the densest Joshua tree forest in Clark County, presumably providing the highest quality habitat. Most of the survey detections of gilded flickers (four of six) were just north of the Wee Thump Joshua Tree Wilderness at the McCullough Mountain site (Figure 15). Of all the sites surveyed in 2021, McCullough Mountain had the largest and densest Joshua trees. Another detection, which consisted of a pair of gilded flickers, was at the Highland Range site (see Figure 13), between the Highland Range and Eldorado Mountains. These survey detections are consistent with the known population of gilded flickers in the county and are within the core area of predicted habitat for the species.

Figure 15. Habitat in the McCullough Mountain site where multiple detections of gilded flicker were recorded, 2021.

The final survey detection was at the Bird Springs site in the Bird Springs Range. This site is not near any previously recorded detections and is outside predicted habitat, but this site has a moderate density of Joshua trees (Figure 16). Unlike at the McCullough Mountain and Highland Range sites, there was no evidence of a territory (e.g., repeat detections, counter-calling, pair in suitable habitat) at the Bird Springs site, and no inference on territory status can be drawn. The density and size of Joshua trees at the Bird Springs site appeared similar to that at the southern Kyle Canyon subplot and at the Las Vegas Range site (Figure 17), which were modeled as suitable and optimal habitat, respectively. The Joshua trees at the Bird Springs site appeared larger and denser than at the Highland Range site, where the pair of gilded flickers was detected (see Figure 13). The detection of a gilded flicker in habitat that appears suitable but is outside predicted habitat suggests gilded flicker habitat could be present in additional areas beyond those currently modeled. However, a single detection of an individual of unknown territory status is insufficient evidence to confirm this idea.

Figure 16. Habitat in the Bird Springs site where gilded flicker was detected, 2021.

Figure 17. Habitat in the southern Kyle Canyon subplot (left) and northern Las Vegas Range subplot (right), 2021.

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 (Southwest Ecology 2018; Katzner et al. 2020). 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).

Due to the distance at which a golden eagle can be visually detected (average 1,976 m during these surveys), sampling of different habitat suitability categories was not strictly limited to the immediate search area within a site (i.e., the subplots and the 800-m-radius count circle). All survey sites were within 2 km of predicted foraging habitat, and 26 of 30 sites (87%) overlapped predicted foraging habitat. The result is that surveyors could see into predicted habitat from all survey sites. Conversely, surveyors were able to see into unsuitable habitat from at least 19 of 30 sites (63%).

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). Of the 18 detections, 12 were of individuals in flight and six were of perched individuals. While no specific foraging behavior (e.g., active hunting) was observed during surveys, individuals that were perched provide the most direct evidence of habitat use. Five of the six perched individuals were in or immediately adjacent to predicted foraging habitat. The sixth individual was at least 5 km from predicted foraging habitat but had a full crop, suggesting it had recently foraged. Leporid mammals were detected in at least one subplot of 23 sites (76%), including two of the sites located entirely in unsuitable habitat, indicating that that food resource might be available across a wide geographic area within Clark County. 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

Survey results do not suggest a poor model fit for LeConte's thrasher, as all 49 detections were within predicted habitat and 10 subplots were outside predicted habitat. Survey results also corroborate the data used in generating the habitat suitability model as all detections were within 6 km of previously recorded detections.

4.6 Loggerhead Shrike

Survey results do not suggest a poor model fit for loggerhead shrike, as 56 of 62 detections (90%) were recorded within predicted habitat. Six (10%) detections were recorded outside predicted habitat but were within 600 m of such habitat. Given that shrikes are raptorial in foraging habits (Yosef 2020), the detections of the species outside predicted habitat could be driven by variable food availability, rather than habitat structure. Survey results also corroborate the data used in generating the habitat suitability model as all detections were within 10 km of previously recorded detections.

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 to be present. In Clark County, the most common type of burrow used by western burrowing owls is that of Mojave desert tortoise (Southwest Ecology 2018). Of the 31 subplots in predicted habitat, 22 had burrows of a size sufficient to support western burrowing owls. No description of vegetation density or slope near potential burrows was recorded; therefore, it is not within the scope of this project to fully assess habitat suitability in any subplot where burrows were present.

The two survey detections were in the only subplot within habitat modeled as optimal, suggesting some degree of model accuracy. Conversely, the two incidental detections were each outside but within 1 km of predicted habitat, and the possibly occupied burrow was well outside predicted habitat. This suggests that the model may underestimate the presence of western burrowing owl habitat.

5 CONCLUSION

Detections of all seven target species were recorded as part of this project, with four species detected within Impact Areas (i.e., Arizona Bell's vireo, western burrowing owl, LeConte's thrasher, and loggerhead shrike) and four species detected within the Reserve System (i.e., Arizona Bell's vireo, golden eagle, LeConte's thrasher, and loggerhead shrike). No Bendire's thrasher or gilded flicker were recorded within the Impact Areas or Reserve System. Additional species-specific conclusions are listed below.

- Arizona Bell's vireo was detected only within habitat modeled as optimal or suitable within the desert riparian ecosystem. Current published literature on habitat needs for the species suggests that the presence of habitat might be overestimated in the County's habitat model. Species- specific presence/absence surveys would help increase the database of detections and possibly provide true absence data for inclusion in modeling efforts. Inclusion of behavioral observations of detected individuals during surveys would provide information on which detections might represent potential territories rather than migrants, thereby further refining the habitat suitability model.

- Three detections of Bendire's thrasher were recorded for this project and likely represented one territory. The lack of detections was somewhat surprising given how much apparently suitable habitat was surveyed. This species is, however, notoriously difficult to detect, and dry conditions could have affected detection probability. A lack of suitable nesting substrate in some areas of predicted habitat could indicate that predicted habitat is overestimated in the County's habitat model. Additional species-specific surveys would help increase the number of detections and knowledge of the distribution and habitat use of this species within the county.

- Five of six gilded flicker detections were on the edge of the species' currently known range in Clark County; the detections were in habitat modeled as suitable. These survey detections are consistent with the known population of gilded flickers in the county and are within the core area of predicted habitat for the species. The remaining gilded flicker detection was in habitat that appeared suitable but was not predicted habitat. However, a single detection of an individual of unknown territory status is insufficient evidence to determine whether habitat is underestimated in the county. No detections were recorded in predicted habitat outside the current known range of the species, but additional species-specific surveys could determine if the species is truly absent from these areas.

- All golden eagle detections were relatively distant from each surveyor (138–6,880 m), which likely decreased the accuracy of the detection locations. Additionally, no active hunting behavior (e.g., chasing or catching prey) was observed, limiting the ability to infer actual habitat use for individuals in flight. Still 67% of detections were recorded within predicted foraging habitat. 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.

- Survey results do not suggest a poor model fit for LeConte's thrasher and corroborate the data used in generating the habitat suitability model.

- Survey results do not suggest a poor model fit for loggerhead shrike and corroborate the data used in generating the habitat suitability model.

- Four western burrowing owl detections were recorded in 2021, with two detections in habitat modeled as optimal and two in habitat modeled as unsuitable. It is possible the model may underestimate the presence of western burrowing owl habitat, but sample size is insufficient to draw a conclusive determination. Additional species-specific surveys could help inform the extent to which western burrowing owls occur outside predicted habitat.

6 RECOMMENDATIONS

Based on observations from the 2021 avian surveys and factors discussed in this report, the following recommendations would support the County's goal for refining the target species' distribution models:

- The County should continue surveys, especially for species with relatively few detection locations (i.e., Arizona Bell's vireo, Bendire's thrasher, western burrowing owl, and gilded flicker). Species-specific surveys, with survey timing micro-adjusted to each species, would help maximize detection probability.

- The County should consider use of telemetry for gathering specific data on golden eagle foraging behavior and distribution.

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