LeConte's Thrasher (*Toxostoma lecontei*) Status and Nest Site Requirements in the Coachella Valley

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Cover photo: LeConte's Thrasher nest with four eggs, near Fried Liver Wash, Joshua Tree National Park, 12 February 2019. Photo by Kimberly Ferree.

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Executive Summary

Our team from the San Diego Natural History Museum has undertaken a study of the LeConte's Thrasher in support of the Coachella Valley Multiple Species and Habitat Conservation Plan. In the early 20th century the Coachella Valley was among the areas where LeConte's Thrasher was best known, but numbers have dwindled. Much of the valley has been converted to agriculture and communities, but even where apparently suitable habitat remains, numbers have dropped sharply since baseline surveys in 2004-2005. Desert bird populations are clearly depressed after years of drought, but there may be other factors at play. To investigate the current status of the LeConte's Thrasher in the Coachella Valley, we surveyed after a wet winter in 2019 with three objectives: (1) determine the current distribution of the thrasher in the Coachella Valley by locating and mapping any territories, (2) gain a better understanding of territory and nest-site requirements in this region, and (3) identify likely causes of decline. Anticipating low sample sizes, we surveyed intensively in the Coachella Valley by means of three different protocols, but we also expanded the study areas to include neighboring areas of the Colorado Desert, Joshua Tree National Park (higher elevations) and Anza-Borrego Desert State Park (lower elevations), where populations are known to persist. From January to July 2019 we located a total of 26 LeConte's Thrasher nests, confirmed at least 23 territories, and tallied 229 observations, but none of these were in the Coachella Valley. In Joshua Tree we detected LeConte's Thrasher at 11 of 12 sites, in Anza-Borrego at 9 of 20 sites, and in the Coachella Valley we had no detections at 40 sites surveyed. We measured habitat features of nest plots and compared them to unoccupied plots, finding that lack of nest substrates, especially the scarcity of large cholla, is a key factor contributing to reduced quality of Coachella Valley plots. Cholla die-off from recent droughts has been documented in the region, and fires, facilitated by invasive grasses and mustards, have virtually eliminated chollas in some areas. Increases in nest predators and competitors, especially the Common Raven and Northern Mockingbird, make the quality and quantity of nest substrates all the more critical. We used multiple criteria to rank 20 sites in the Coachella Valley for their potential to sustain LeConte's Thrasher populations in the future and recommend that future survey efforts be concentrated on just a few highest quality "sentinel" sites. Despite our extensive efforts, we can't be sure of complete extirpation, which would represent a substantial contraction of the range, and a few recent sightings have been reported (www.ebird.org). However, some or most of the sightings of LeConte's Thrasher in the Coachella Valley in the past few years may be of unmated birds displaced from territories rendered unsuitable. Furthermore, no recent reports have been supported by photographs, and follow-up of some has revealed they were misidentifications of the California Thrasher, which has recently been spreading on the valley floor, perhaps aided by vegetation planted around communities and golf courses. The LeConte's Thrasher is one of very few avian desert specialists of the southwest and was formerly emblematic of the Coachella Valley. Its habitat needs overlap with those of many other species of interest, such as the Desert Tortoise, Burrowing Owl, and Round-tailed ground squirrel, all documented during our surveys. Future research could consider comparisons of the ground arthropod community in nest plots vs. unoccupied plots, improved predictive modeling, and efforts to restore cholla.

Background

The LeConte's Thrasher (*Toxostoma lecontei*; LCTH) is not only a xerophile, but an extremophile, occurring in the driest, hottest, most barren parts of the desert southwest, including Death Valley. It occurs along relatively flat dry washes, sinks, or alluvial fans, wherever there are pockets of at least a few shrubs other than creosote. It spends most of its time running on the ground and digging for arthropods in soft sand with its sickle-shaped bill. The thrasher avoids steep terrain (Fletcher 2009) and gravelly areas (Blackman et al. 2012). It is an enigma—infamously cryptic (invisibly sand-colored), shy, and scarce—it has eluded and frustrated biologists and bird-watchers alike. Our limited knowledge about its biology has been summarized by Jay Sheppard, who in the late 1960s banded and studied the birds near Maricopa, Kern County (Sheppard 1970). He also compiled natural history data on the species from throughout its range (Sheppard 1996, 2018). The species is sedentary (non-migratory), and aridity appears to define its limits, because it occurs over a wide range of temperatures and desert or sage scrub habitat within its range as long as annual rainfall is not much more than 16-17 cm and snowfall is minimal. Two exceptional localities where it has been recorded despite average precipitation >20 cm/yr are Cabazon and Palmdale, both in extremely windy passes where desiccation is apparently sufficient to keep the vegetation open. Otherwise, too much vegetation cover or too much snow inhibits its specialized foraging, which requires ample runways of open sand. This species has declined in at least parts of California, including the San Joaquin Valley and Coachella Valley, even in areas of apparently suitable habitat. Data from the Breeding Bird Survey (www.mbr-pwrc.usgs.gov/bbs.html) are not robust but suggest a significant decline statewide over the entire length of the survey (1966–2017). The Coachella Valley Multiple Species and Habitat Conservation Plan (CVMSHCP 2007) identified this thrasher as a focal species for monitoring and conservation efforts.

History in the Coachella Valley

Though historical records and collections were concentrated around train stops, they confirm that LeConte's Thrasher once ranged over the entire length of the Coachella Valley, from the San Gorgonio Pass, including Banning and Cabazon, to the north end at Whitewater (along the current Tipton Road) and Desert Hot Springs, down to Indio, Thermal, and Mecca (Figure 1). However, the majority of historic collections were from the Palm Springs area, where more specimens were collected than anywhere in the species' range (123 specimens, including egg clutches, listed at www.vertnet.org, covering each decade from 1884 to 1938), but where no suitable habitat remains today because of extensive development. Though Palm Springs was a popular collecting locality, the take from the area represents only 2.2 specimens per year and is of the same order of magnitude as many other bird species that remain common in the area today. Much of the southern part of the valley, only lightly collected (Figure 1), was converted into agriculture. Some possibly suitable habitat remains in a few areas, but LeConte's Thrasher has not been found there for many decades (Patten et al. 2003; www.ebird.org). There are still

many areas with possibly suitable habitat at the north end of the Coachella Valley where LeConte's Thrasher has been found regularly, as at Desert Hot Springs in the 1970s (Sheppard 2018).

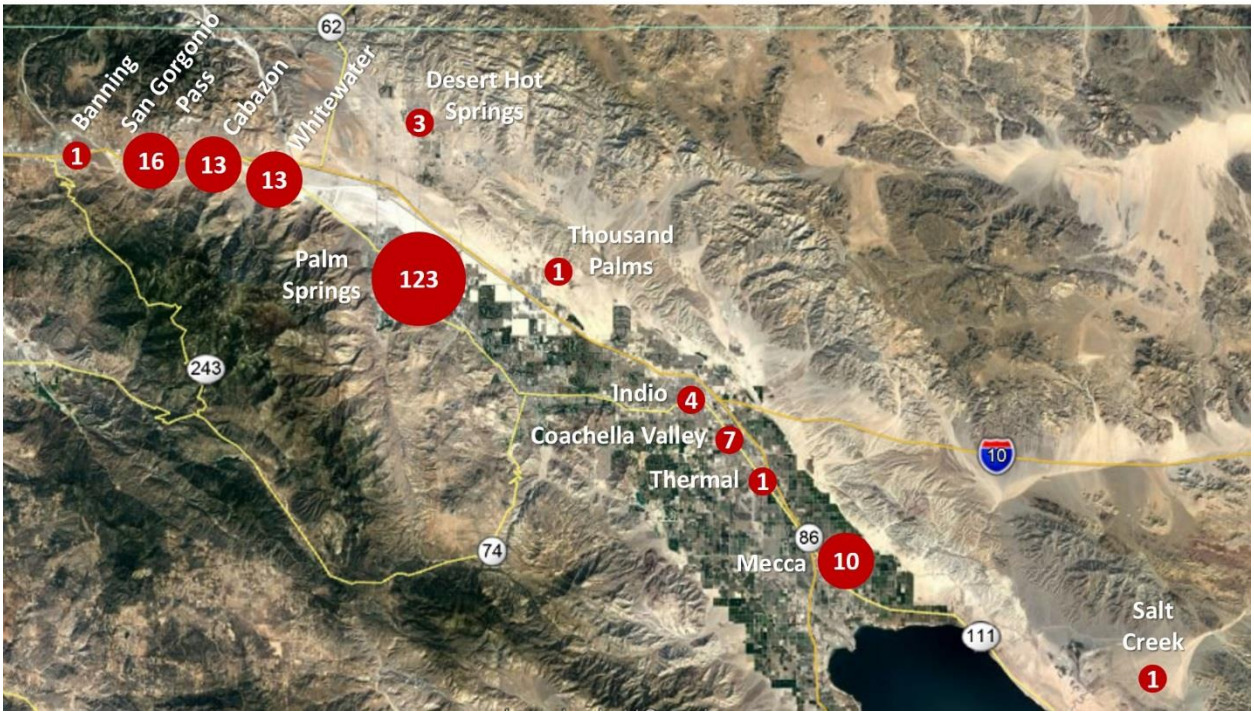

Figure 1. Specimens of LeConte's Thrasher collected in the Coachella Valley since the 1880s, including individual birds and egg sets (from www.vertnet.org).

The Coachella Valley Multiple Species and Habitat Conservation Plan considered the species "to occur at low densities in suitable habitat throughout the Plan Area," on the basis of 33 records widely scattered in the Coachella Valley. Ten of these are more recent than 1990. The plan identified three objectives toward the general goals of conserving the species and its habitat: (1a) conserve habitat within 20 Conservation Areas that have habitat potentially suitable for the species, (1b) conserve nest sites, and (2) implement actions to ensure self-sustaining populations within each Core Habitat area. During baseline surveys by the University of California at Riverside's Center for Conservation Biology, LeConte's Thrasher was detected on 4 of 20 transects in 2004 and on 4 of 8 transects in 2005 with a grand total of 40 detections (Hutchinson 2005). Occupied areas included Mission Creek east of Highway 62, Willow Hole Preserve, and Thousand Palms Preserve, where at least one of two pairs nested successfully (Hutchinson 2005). These baseline surveys found that use of song broadcast increased detections approximately 3x that of transect surveys without. The Biological Working Group thus adopted broadcast survey into their monitoring protocol and identified 30 survey sites for monitoring (CCB 2013).

In 2014, however, thorough surveys at 16 high-priority sites yielded only one possible pair near Stubbe Canyon (CCB 2015). Recent Grinnell Resurveys by SDNHM (Hargrove et al. 2014) have found the species to be missing from Banning, Cabazon, Palm Springs, and Mecca. We found only a single bird at Whitewater (Tipton Road) in 2010, implying numbers greatly reduced from 100 years ago. Most recently, only a few scattered sightings have been reported from these areas via www.ebird.org. None of these, however, is supported by photograph, while recent photographs of the California Thrasher from these sites, historically unknown from the floor of the Coachella Valley, abound. Therefore we believe that recent reports of LeConte's from the upper Coachella Valley, into which the California Thrasher has apparently spread in the 21st century, must be regarded with caution. Observers' expectations based on past history are evidently not keeping pace with the two species' changes in status. For example, after a resident of Desert Hot Springs reported a LeConte's Thrasher to us, she later sent a photo that showed the bird to be a California Thrasher.

Possible causes of decline

Although drought is expected to depress population sizes, there may be other factors impairing the suitability of remaining habitat. The LeConte's Thrasher has three basic habitat requirements: (1) large contiguous areas of relatively flat, open, arid scrub, especially alluvial fans, washes, or sinks; (2) open stretches of sand for foraging with a healthy ground arthropod community, and (3) at least a few large chollas, shrubs, or trees for nesting and shelter. Gilman (1904) commented on this thrasher's frequent nesting in cholla (*Cylindropuntia* spp.) in the Coachella Valley, and Hanna (1933), who also collected in the Coachella Valley, stated that "probably 99% of the large deep nests of LeConte's Thrasher which I have observed have been in cacti." Nesting in cholla was also noted by Stephens near Palm Springs (Stephens 1884), and Pemberton (1916) published photographs of LeConte's Thrasher nests in Cabazon and Whitewater—two were in chollas; one was in a yucca (*Yucca schidigera*). Fieldwork in support of the San Diego County Bird Atlas (Unitt 2004) found nests in a broader variety of plants equipped with thorns and/or stiff dense twigs, including, besides cholla, desert thorn (*Lycium* sp.), saltbush (*Atriplex* sp.), mesquite (*Prosopis* sp.), ocotillo (*Fouquieria splendens*), smoketree (*Psorothamnus spinosus*), mistletoe (*Phoradendron californicum*), and palo verde (*Parkinsonia florida*). Sheppard (2018) emphasized that lack of nesting substrate can be a limiting factor in regions that appear to be otherwise suitable, and also noted that nests can sometimes be placed in manmade structures.

Monitoring challenges

Study of LeConte's Thrasher is challenging because the species is so sparsely distributed and difficult to detect. While a defended territory around a nest can be as little as 4 ha, the pair moves around within a much larger home range, which over a year can be 30 ha (Sheppard 2018). For example, Sheppard (2018) documented a banded pair that built successive nests over 1 km apart. LeConte's can also be confused with other species such as the Crissal and California Thrasher (Table 1), which overlap in the Coachella Valley. Each species' song and call are distinctive, but LeConte's is often quiet, and it can be mimicked by other species of the

Table 1. Contrasting morphology of three sickle-billed thrashers in the Coachella Valley. Each also has distinctive calls and songs, but mimicry can occur.

Character	LeConte's	Crissal	California
Upperparts	Pale sand color	Medium gray	Dark brown
Breast and belly	Uniform cream color	Uniform gray	Breast brownish gray, belly tawny
Throat	White, bordered by very narrow dark mustache stripe	White, bordered by distinct black and white mustache stripes that contrast boldly with gray head	Buff, bordered by dark mustache stripe that contrasts weakly with brown head
Crissum	Tawny, contrast muted	Rufous, contrast bold	Tawny, same as belly
Tail	Gray, contrastingly darker than upperparts	Nearly the same as rest of upperparts	Nearly the same as rest of upperparts
Bill	Gently curved, 30-35 mm	Strongly curved, 32-39 mm	Strongly curved, 32-40 mm
Iris color	Dark	Medium olive-greenish	Dark

family Mimidae. Other clues of its presence are old nests, dig marks, and tracks. These alone may not prove occupancy, but their absence helps to confirm that an area is not within an active territory.

After the disappointing surveys in 2014, the CCB (2015) suggested repeat surveys after a wet winter, and developed a habitat model to identify highest-priority sites. One possibility is that the birds could be easier to detect in a wetter year when actively nesting, and another is that some could recolonize.

The Desert Thrasher Working Group (DTWG 2018) adopted a monitoring protocol for Bendire's Thrasher (*T. bendirei*) that covers LeConte's as well. Its survey protocol is based on 300-m^2 plots with no broadcast. Using a habitat model, it has instituted stratified random sampling across the thrashers' range, but this sampling is focused mostly on the Mojave Desert. Neither the CCB's nor the DTWG's models appear to have good predictive power in the parts of Riverside and San Diego counties where LeConte's Thrasher is known currently, based on the CCB's records (Figure 5 in CCB 2015) and Unitt (2004). However, for a rare species with depressed population sizes, the utility of predictive modeling is limited because even high quality habitat may be unoccupied.

Objectives and strategy for study in 2019

To investigate the current status of the LeConte's Thrasher in the Coachella Valley, the San Diego Natural History Museum (SDNHM) undertook surveys after a wet winter in 2019 with three objectives: (1) determine the current distribution of the thrasher in the Coachella Valley by locating and mapping any territories, (2) gain a better understanding of territory and nest-site requirements in this region, and (3) identify likely causes of decline. Anticipating low sample sizes, we surveyed the Coachella Valley extensively, using both the BWG and DTWG

protocols, and we also expanded the study areas to include neighboring areas of the Colorado Desert, Joshua Tree National Park (higher elevations) and Anza-Borrego Desert State Park (lower elevations), where populations are known to persist (Figure 2). Through a better understanding of the bird's nesting ecology in this region, we hope to identify sites that have the best potential of sustaining LeConte's Thrashers in the Coachella Valley.

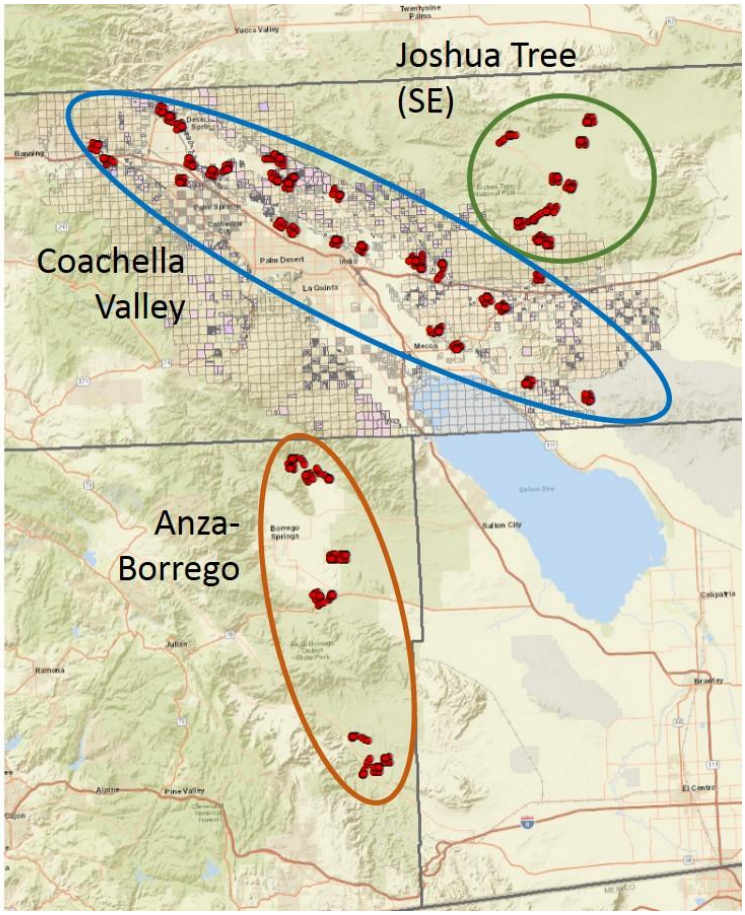

Figure 2. Three study areas (south-east Joshua Tree, Coachella Valley, and Anza-Borrego), and sites with combined standardized surveys (red dots), 2019.

Methods

During winter-spring 2019, we surveyed for LeConte's Thrashers in the three study areas according to standardized protocols adapted from both the CCB (2013) and the DTWG (2018).

We established survey sites with a goal of at least 20 sites in the Coachella Valley and 10 each in Joshua Tree National Park and the Anza-Borrego Desert, but augmented this number as needed to obtain a minimum total sample size of 20 territories. First, we identified general areas of possibly suitable habitat in or near areas of historic or recent records. Then within these areas we delineated by map any types of sandy desert scrub, avoiding only steep rugged terrain and

private property. In the Coachella Valley, wherever possible we used existing survey transects established previously (CCB 2013, 2015). These consisted of a pair of transects each 1 km long and separated by 1 km. Each transect had two end points and one middle point for broadcast. In new areas without existing transects, we overlaid a 500-m^2 grid to place transects in a similar fashion, orienting them however they best fit within the delineated areas. Finally, we added a single 300-m^2 plot to a randomized point at the end of a transect. Thus each survey site consisted of a pair of 1-km transects and one 300-m^2 plot (Figure 3).

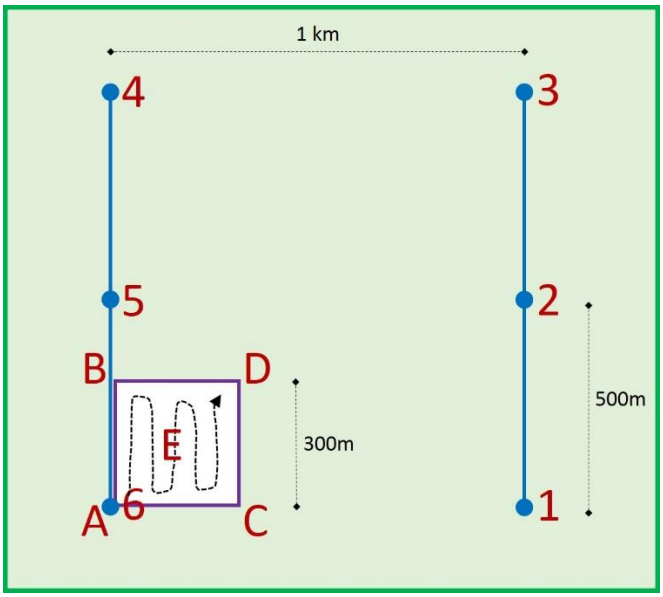

Figure 3. Diagram of one survey site, consisting of a pair of 1-km transects (6 points) and one 300-m^2 plot.

In summary, we used three survey methods to locate thrashers:
(1) transect survey: 1-km transect, with broadcast of song and calls at each of 3 points after first pass if no thrashers were detected, and recording perpendicular distance to all vertebrate species detected along the transect. Two per site.
(2) plot survey: limited to 40 minutes within a 300-m^2 area, and no broadcast.
(3) area search: unconstrained searching within and adjacent to site, before and/or after transect and plot surveys.

Surveys took place during morning or afternoon hours during fair weather, and were usually done by a single observer per site, or by two observers split up. We recorded all vertebrate species detected during each survey method, the method of detection (visual, call, song), and any evidence of nesting activity (survey form, Appendix 1). To search for thrasher nests we looked inside all large dense shrubs, trees, and cacti that might support and shelter a thrasher nest. If a LeConte's Thrasher was detected, or any possible thrasher was detected, we paused the survey to confirm the identification and observe its behavior for any evidence of nesting. Impressions of size and color can be deceptive in the field, so multiple criteria are essential (Table 1). Whenever possible, we also obtained photographs and/or recordings for documentation.

We attempted to visit all sites during a first round of surveys from mid-January to mid-February. For sites without detections, we prioritized them for second and third rounds of surveys on the basis of any suggestive evidence (tracks, dig marks) and dropped sites with the most obviously unsuitable habitat (e.g., gravelly, absence of any suitable nest shrubs).

For sites with detections, we mapped territories, observed behavior, searched for nests, and returned approximately weekly to check any active nests (nest-monitoring form, Appendix 2). We limited disturbance by avoiding use of broadcast in occupied areas, by observing a thrasher less than one hour per visit, and by not forcing birds to flush off nests.

To increase sample sizes of territories and nests, we opportunistically added other sites with area searching only, including any with recent sightings or reports from the Coachella Valley.

From May to July we returned to measure each nest, and measured habitat features around each nest by defining a 300-m^2 plot with the nest as the centroid, for comparison to unoccupied plots. During habitat measurements at nest plots and unoccupied plots, we also recorded vertebrate species detected as during plot surveys but did not constrain the survey to 40 minutes (habitat form and instructions, Appendix 3).

For the whole 300-m^2 plot, we estimated the relative cover and average height of each dominant non-herbaceous plant species, the overall percentage of the plot that was open vs. covered by non-herbaceous vegetation, herbaceous vegetation, rock (>25 cm diameter), and other (e.g., road), the overall percentage of the plot that was covered by wash, sink, drift sand, desert pavement, any other flat terrain, and steep terrain, and we described the herbaceous cover, any disturbance, and the surrounding terrain. We counted and rated prospective nest substrates as of moderate (rank 2) or high quality (rank 3) by species (Table 2).

At each of 5 plot points (4 corners and centroid), we located the nearest potential nest substrate (i.e., shrub, tree, yucca, or cholla) within the plot with quality rank of at least 1, and recorded the species, quality rank, and measured its height and width. If no truly suitable substrate was within 50 m, we selected the best we could find. We used a penetrometer to measure soil compaction at five positions within 5 m of each point, and we used a laser rangefinder to measure the distance to the nearest plant (>0.5 m tall) in each of four quarters by compass. We used a sifting kit to measure the composition of silt (<.06 mm diameter), fine sand (0.06–0.25 mm), coarse sand (0.25–2.0 mm), fine gravel (2-4 mm), and large gravel (4-250 mm) in any friable substrate within 2 m of the plant substrate, and we took photographs in each cardinal direction.

Table 2. Ranking system for categorizing potential nest substrates.

Rank	Description
0	Unsuitable (inadequate support and concealment)
1	Possibly suitable, low quality (minimal support and concealment)
2	Probably suitable, moderate quality (sufficient support but concealment poor)
3	Definitely suitable, high quality (good support and concealment)

Results

From January to July 2019, we completed a total of 332 site surveys for LeConte's Thrasher (Appendix 4), with 169 transect surveys, 104 plot surveys, and 54 habitat surveys. Surveys encompassed a total of 72 sites (Table 3, Appendix 5), 40 in Coachella Valley, 12 in Joshua Tree, and 20 in Anza-Borrego, with some combination of standardized plot-transect surveys at 51 sites (Appendix 6). Excluding time spent returning to occupied sites, we logged almost 400 hours of field time searching for LeConte's Thrashers, more than half of which was spent at Coachella Valley sites (Table 3).

Table 3. Summary of LeConte's Thrasher survey results at three study areas, 2019.

Survey summary	Coachella Valley	Joshua Tree	Anza-Borrego	Grand Total
Study sites	40	12	20	72
Study sites with plot/transect surveys	29	10	12	51
Total time (hours)	220	60	115	395
Area search time	150	33	74	257
Plot survey time	26	10	16	52
Transect survey time	45	18	25	88
Sites with LCTH detected	0	11	9	20
LCTH territories minimum	0	15	8	23
LCTH nests	0	17	9	26

We located at least 23 LeConte's Thrasher territories, where we detected birds on multiple visits, but this is a conservative minimum estimate since no birds were banded. We detected the birds at 20 sites and we located 26 nests. In the Coachella Valley, we detected LeConte's Thrasher at 0 of 40 sites (Figure 4), in Joshua Tree we detected LeConte's Thrasher at 11 of 12 sites (Figure 5), and at Anza-Borrego at 9 of 20 sites (Figure 6).

In the Coachella Valley study area we surveyed 29 sites with some combination of standardized transects or plots (Stubbe Canyon, Snow Creek west, Desert Hot Springs west, middle, and east, Whitewater River, Seven Palms Valley west and east, Willow Hole, Sky Valley west and east, Thousand Palms west, north, and south, Coachella Valley National Wildlife Refuge west and east, Pushawalla Canyon, Indio west and east, Double Canyon west and east, Thermal Canyon, Painted Canyon, Box Canyon, Shaver's Valley west, east, and north, and Dos Palmas Preserve west and east). Also, we searched on a less standardized basis at an additional 11 sites (Snow Creek east, Tipton Rd., Mission Creek Preserve, Seven Palms Valley north and south-east, Thousand Palms Preserve north and south, Coachella Valley National Wildlife Refuge north, Willis Palms, Biskra Palms, and Shaver's Valley BLM south of aqueduct).

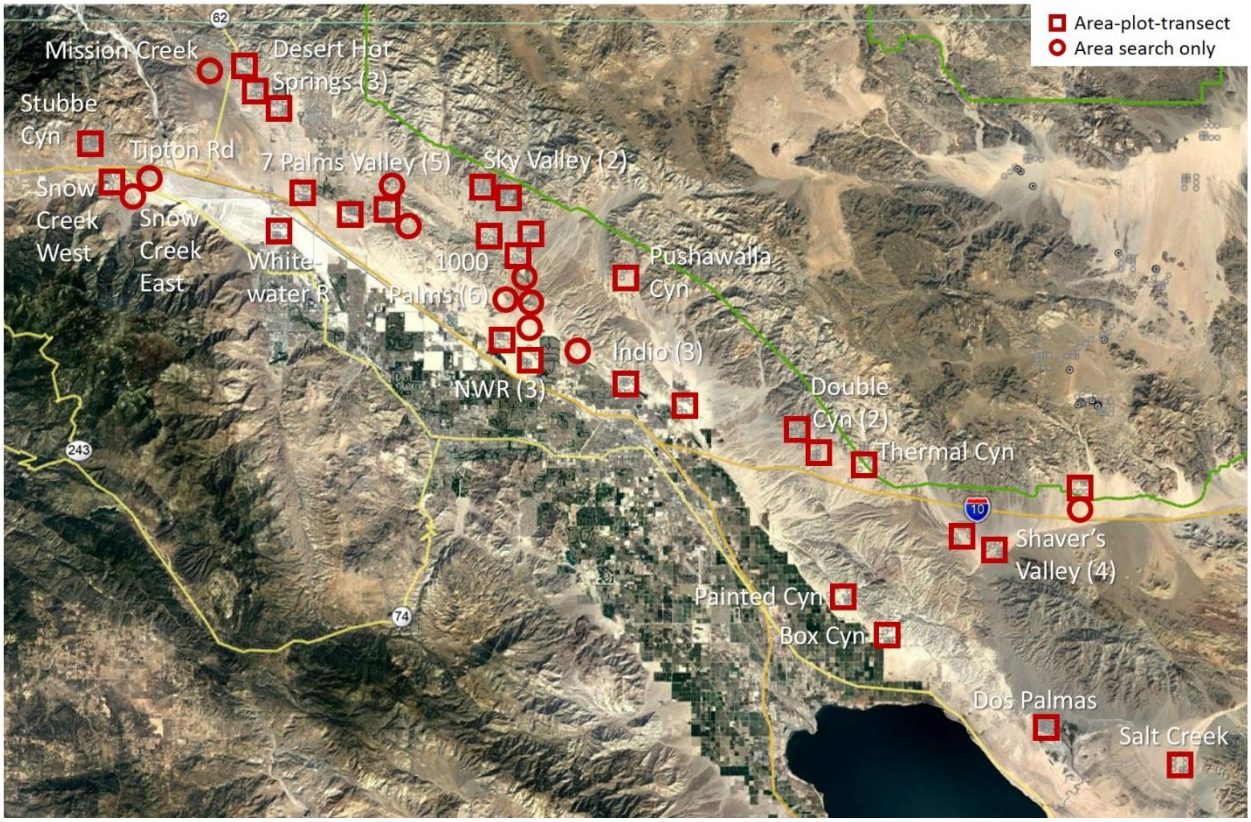

Figure 4. Coachella Valley study sites: no occupancy detected (squares encompass 1-km^2 area).

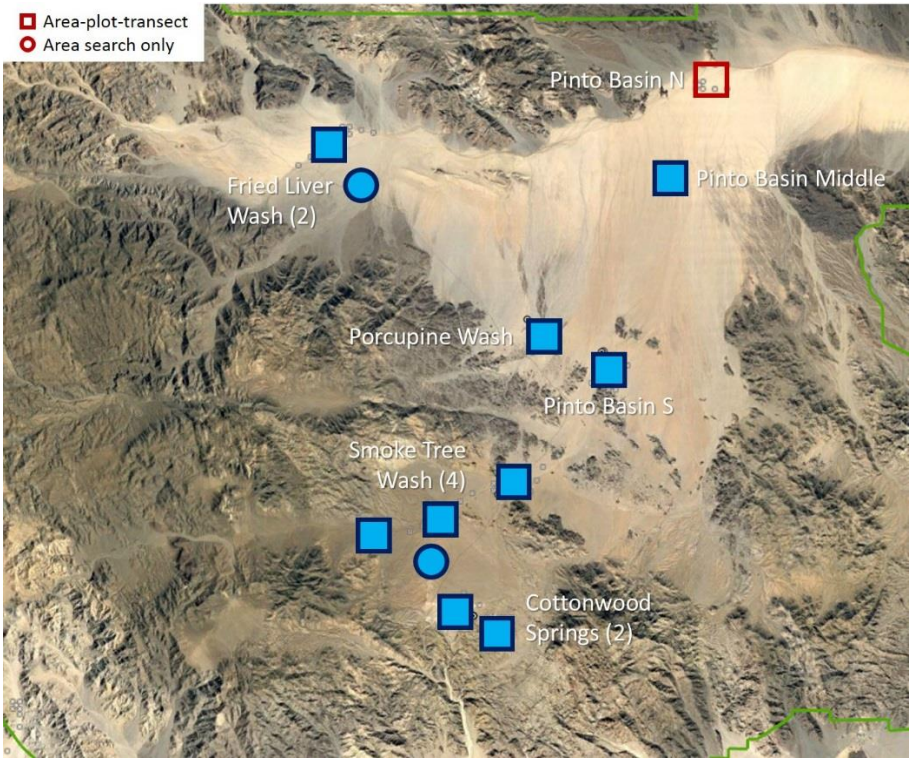

Figure 5. Joshua Tree study sites: blue indicates occupancy (squares encompass 1-km^2 area).

Figure 6. Anza-Borrego study sites: blue indicates occupancy (squares encompass 1-km^2 area).

In Joshua Tree National Park we surveyed 10 sites with some combination of standardized transects or plots (Cottonwood Springs campground northwest and northeast, Pinkham Canyon, Smoketree Wash west and east, Black Eagle Mine Road, Pinto Basin north and middle, Porcupine Wash, and Fried Liver Wash). For greater comparability, all sites were in the southern "Sonoran" part of the park. Because we found territories relatively easily in Joshua Tree NP, we added only two sites with incidental searching, one south-east of the Fried Liver Wash site, and another near Smoke Tree Wash along a service road. In Anza-Borrego Desert we surveyed 12 sites with some combination of standardized transects or plots (Clark Valley west, north, east, and south, Borrego Sink Wash west and east, Cactus Valley, San Felipe Wash at Borrego Valley Road, Bow Willow, Palm Spring, Carrizo Wash west and east), and an additional 8 sites with incidental searching (Clark Dry Lake, Font's Wash, 4 sites in Borrego Sink, east San Felipe Wash north of Borrego Mountain, and Ocotillo Wells).

Most nests were very well concealed in nooks of large chollas or within other dense shrubs. The majority were in chollas (16), most often silver (or golden) cholla (*Cylindropuntia echinocarpa*) but also pencil (or diamond) cholla (*C. ramosissima*). Five nests were in honey mesquite (*Prosopis glandulosa*), always below a "roof" of mistletoe, and other shrubs used were desert almond (*Prunus fasciculata*), desert lavender (*Hyptis emoryi*), jojoba (*Simmondsia chinensis*), and smoke tree (*Psorothamnus spinosus*) (Figure 7).

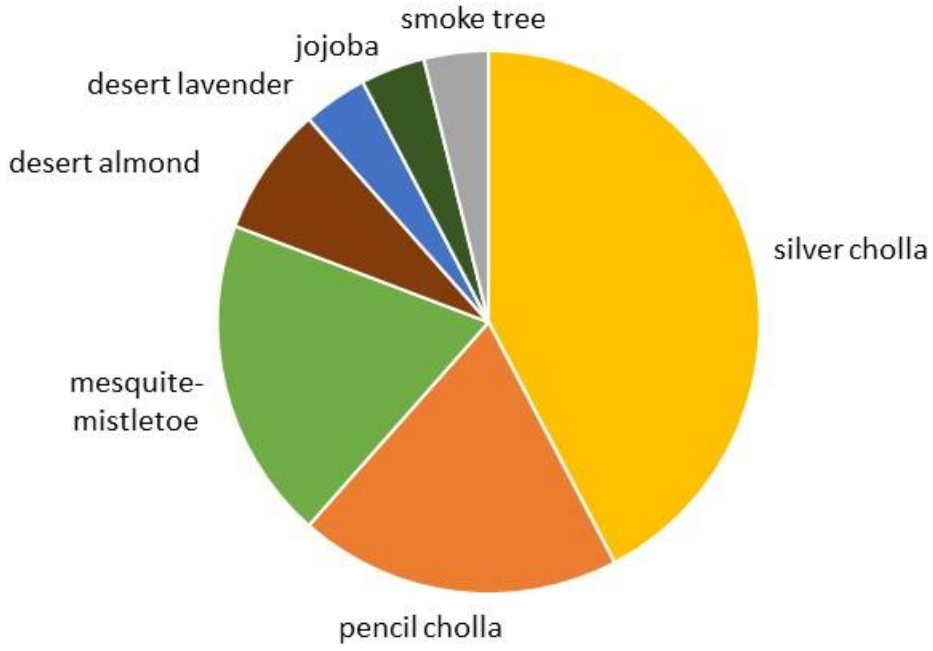

Figure 7. Proportion of substrates used for nests, 2019 (*N*=26).

All nests were wide bowls of a similar build (average 23 cm wide and 14 cm tall, Table 4), always composed of small twigs (2-4 mm in diameter) and often shredded bark, and always lined with a distinctive thick, soft pad (Figure 8). Their average height (from ground to base of nest) was 0.8 m (range 0.5–1.6 m), and the average height of the supporting shrub was 1.8 m (range 1.0–4.1 m). The tallest nest substrate was a smoke tree (Figure 9); the shortest were chollas. Across nests, an average of 85% of the nest was hidden from view from the sides at a distance of 3 m, and 84% was hidden if viewed from above (estimated), providing protection from both sun and predators (Figures 10-14).

Table 4. Summary of LeConte's Thrasher nest measurements, 2019.

Nest measurements	Min	Max	Avg	SD	N
% concealment sides	66%	100%	85.1%	10.2%	26
% concealment above	30%	100%	83.8%	20.5%	25
% concealment below	10%	90%	46.4%	26.0%	25
substrate height (m)	1.0	4.1	1.82	0.89	26
substrate width (m)	1.0	7.6	3.02	2.29	26
nest height (m)	0.5	1.6	0.83	0.34	26
outer nest height (cm)	8	19	13.5	2.7	25
outer nest width (cm)	15	35	22.7	4.4	25
inner cup height (cm)	5	12	7.1	1.8	24
inner cup width (cm)	9	15	11.7	1.7	24
clutch size	3	5	4	0.7	18

In the 18 nests whose final clutch size we could determine, the average clutch size was 4 eggs, higher than reported in the literature (mean 3.3, Sheppard 2018). Four of the 18 nests had 3 eggs, 8 had 4, and 4 had 5. One of the eggs in a clutch, however, often failed to hatch, and in none of the 5-egg clutches did all 5 eggs hatch. None of the birds were banded, but it was clear that most if not all pairs attempted multiple successive nests. Evidently, some pairs had three successful nests within the season. Successive nests we suspected were built by the same pair were up to 350 m apart but were sometimes located within the same shrub (Figure 14). Sheppard (2018) documented a banded pair that built successive nests 1 km apart.

Figure 8. LeConte's Thrasher nest with four eggs. Note densely padded lining within bowl of sticks and bark (near Fried Liver Wash, Joshua Tree National Park, 12 February 2019).

Figure 9. Smoke Tree in which LeConte's Thrasher nested, Joshua Tree National Park (same nest as above). Note size and density sufficient to both support and conceal a large stick nest.

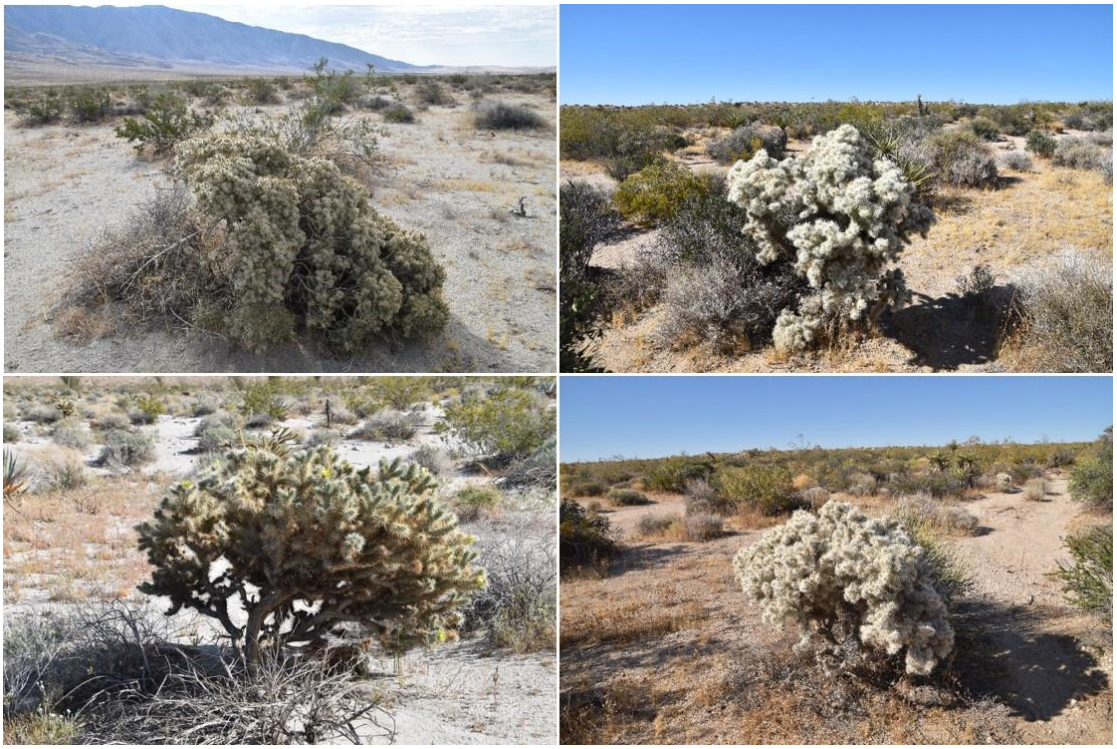

Figure 10. Typical chollas in which LeConte's Thrashers nested (*Cylindropuntia ramosissima*, upper left; remainder *C. echinocarpa*). Each contains a well-concealed nest.

Figure 11. Relatively exposed nests in golden cholla (upper left) and jojoba (lower left) vs. completely concealed nests in a pencil cholla shrouded by desert star vine (*Brandegea bigelovii*, upper right) and desert almond (taller shrub behind *Tetracoccus hallii*, lower right).

Figure 12. Five-egg clutch in nest of LeConte's Thrasher near Cottonwood Springs campground, Joshua Tree National Park, 7 May 2019. Nearly 100% of the nest was concealed within the cholla.

Figure 13. LeConte's Thrasher nestlings shielded from predators and sun inside nook of cholla, San Felipe Wash, Anza-Borrego Desert State Park, 31 March 2019.

Figure 14. Mesquite supporting three successive LeConte's Thrasher nests, each placed below a mistletoe roof, Borrego Sink, 2019.

We could not be certain of every nest's outcome, but we confirmed that from 11 nests the young successfully fledged (Table 5), often observing fledglings at or near the nest (Figures 15–16). In only two cases did the nest clearly fail. We observed fledglings or young juveniles at some point in almost all territories, in most cases repeatedly.

Table 5. Summary of LeConte's Thrasher nest outcomes, 2019.

Nest outcomes	#
Successfully fledged	11
Probably fledged	4
Unknown (at least to nestling stage)	2
Unknown (eggs unconfirmed, fresh nest near fledglings)	5
Unknown (eggs unconfirmed, fresh nest near pair)	2
Failed	2
Total	26

Figure 15. Young LeConte's Thrasher fledgling, probably within 1 day of fledging, hiding inside agave within 20 m of nest, San Felipe Wash, Anza-Borrego Desert State Park, 28 May 2019.

Figure 16. Older fledgling LeConte's Thrasher, three weeks out of nest (nest in Figures 8–9), 26 March 2019. Note the bill only slightly decurved and the wing and tail feathers not quite full length. Its 3 siblings were also seen in the same large *Chilopsis*, which had not yet begun to leaf out. Even with fledglings so young, the parents were evidently working on their second nest, in which the eggs hatched approximately 2 weeks later.

Figure 17. Adult LeConte's Thrasher for comparison, with more strongly decurved bill, Joshua Tree National Park, 11 April 2019.

Detectability

As expected, detectability was low, and we sometimes did not detect any LeConte's Thrashers until the third visit to a site. At one site we had already spent 9 hours until we had our first detection (Figure 18). However, over half of our sites with confirmed territories had detections on the first visit, and almost half of our first detections were within the first hour of visiting a site (Figure 18). Unoccupied sites were visited up to four times (including a final visit to measure habitat), but the number of visits per site varied.

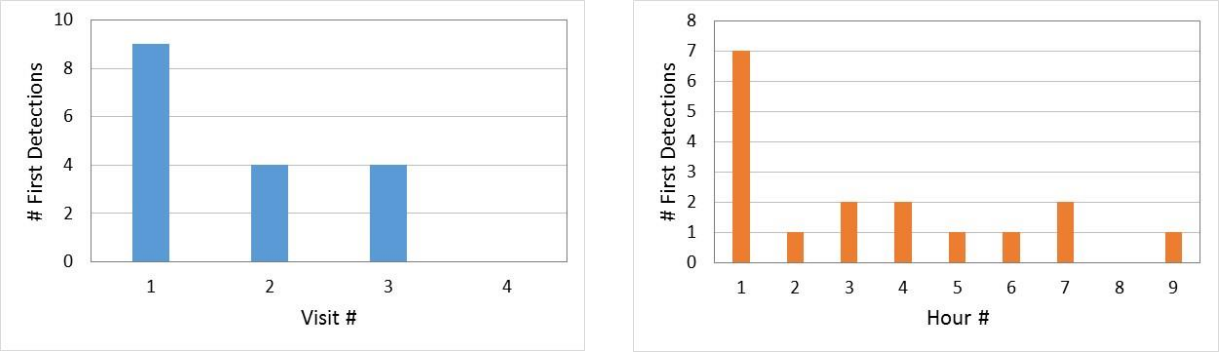

Figure 18. Of sites with confirmed territories, in more than half we detected a LeConte's Thrasher during the first visit (left) and in many cases within the first hour of survey (right, all visits combined).

Although about half of all first detections resulted from area searching, after division by the time spent on each method prior to the first detection, plot surveys appeared to be the most efficient. However, we did not randomize the order of the methods used at a site. Also, we often found clues first: tracks, dig marks, or old nests, so at these sites we spent more time area searching where we might have missed the birds had we only used the standardized methods.

Almost half of nests were discovered by searching for the nests in any potential substrates in the general areas where adults had previously been seen or heard, but almost as many were found by directly observing or following an adult (Figure 19, left). Some nests were found incidentally because of their proximity to the previous nest, including one that was found during measurement of the habitat. Only one nest was located prior to detection of any adults, during a plot survey (Figure 19, left). No nests were located during transect surveys. Almost half of nests were at the egg stage when first found (Figure 19, right). We also counted fresh, complete, intact nests that were found immediately adjacent to a pair and/or fledglings, but we could not be certain if these nests were used or of their outcome.

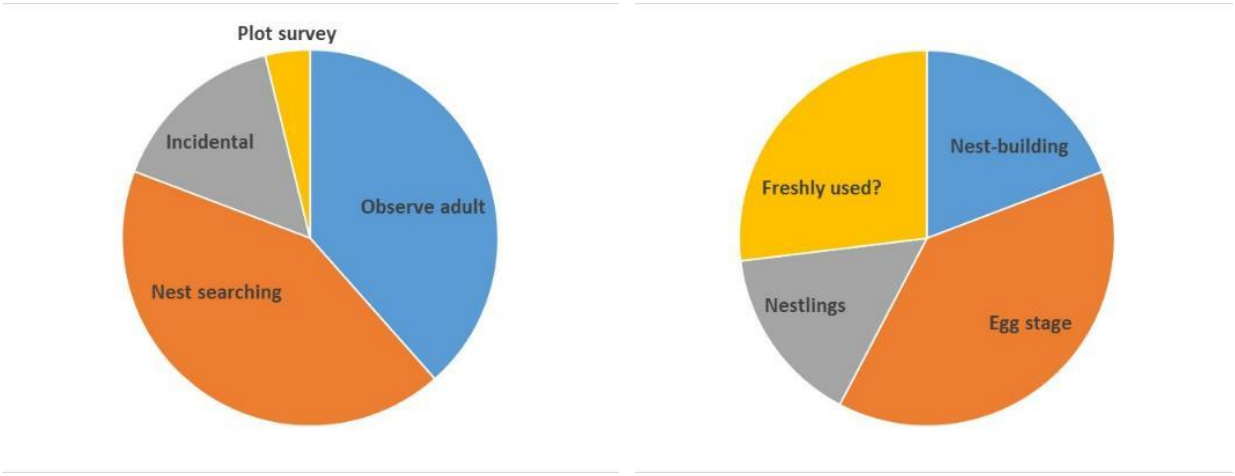

Figure 19. Method of nest discovery (left) and stage when first found (right).

Habitat Survey Results

We had one last chance to detect LeConte's Thrashers when we returned to plots to measure habitat from May to July. Our habitat-survey protocol included covering the whole 300-m^2 plot and noting all vertebrate species detected. For plots centered around a nest, we completed 22 habitat surveys. Of those, we detected LeConte's Thrashers at 13 plots, for a repeat detection rate of over 50%, (Table 6). We found that juveniles were highly detectable, often perched out in the open and calling very frequently, even in July.

Even though we detected LeConte's Thrashers at almost all of the Joshua Tree sites, territories did not always appear to overlap with the smaller 300-m^2 plots, so we were able to consider 6

plots in Joshua Tree unoccupied, as well as 6 in Anza-Borrego. For comparison, we measured 20 unoccupied plots in the Coachella Valley, favoring those that seemed more potentially suitable. Of all 32 "unoccupied" plots, we detected LeConte's Thrashers in two plots (Table 6), but in both cases we believe the birds to have been dispersing juveniles, away from any known territories. One of these cases was a juvenile found dead, tangled in a desert star-vine in Pinto Basin (Figure 20).

Table 6. Summary of habitat surveys at three study areas, 2019.

Study Area	Nest plots	Nest plots with LCTH detections	Unoccupied plots	"Unoccupied" plots with LCTH detections
Joshua Tree	15	10	6	2
Anza-Borrego	7	3	6	0
Coachella Valley	0	0	20	0
Total	22	13	32	2

Figure 20. Juvenile found dead, tangled in desert star-vine (Pinto Basin, 22 May 2019).

At unoccupied sites, vegetation density, as measured by distance to nearest "shrub" (shrub, tree, yucca, or cholla > 0.5 m tall) within each quarter, tended to be lower (Figure 21, left). Thus open sand alone is not adequate habitat; LeConte's Thrasher likely requires some minimum and maximum spacing of shrubs. Cover of cholla was particularly low in the Coachella Valley (Figure 21, right). The number of potential nest substrates tended to be greater at nest plots than at unoccupied plots, both for shrubs ranked as moderate quality (Figure 22, left) and high quality (Figure 22, right).

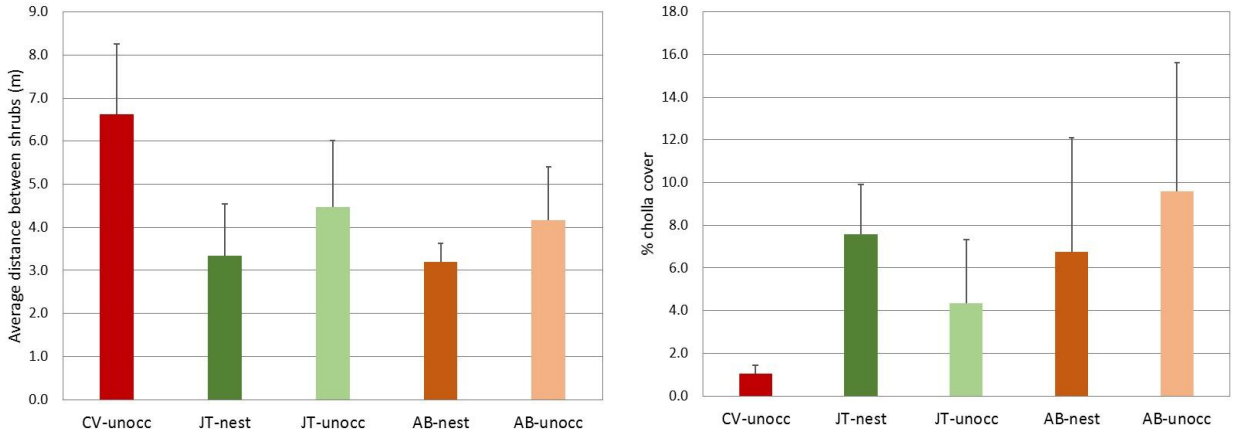

Figure 21. Average spacing of "shrubs" (any non-herbaceous vegetation >0.5 m in height, left) and relative cover of cholla (right), by study area and plot occupancy. Lines above bars, 95% confidence intervals.

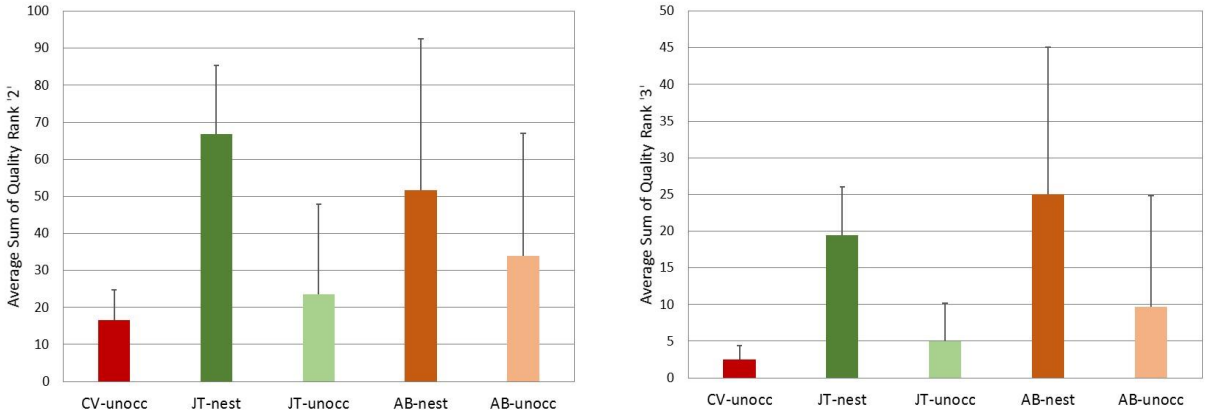

Figure 22. Average number of possible nest substrates of moderate rank (left) and high rank (right), by study area and plot occupancy. Lines above bars, 95% confidence intervals.

Sand tended to be looser or more friable in nest plots than in unoccupied plots, as measured by compression with a penetrometer (Figure 23, left), and there was little difference in average vegetation height (Figure 23, right). Coarse sand was dominant at all plots, but Joshua Tree plots tended to have slightly more gravel (Figure 24, left), Anza-Borrego nest plots less (Figure 24, right).

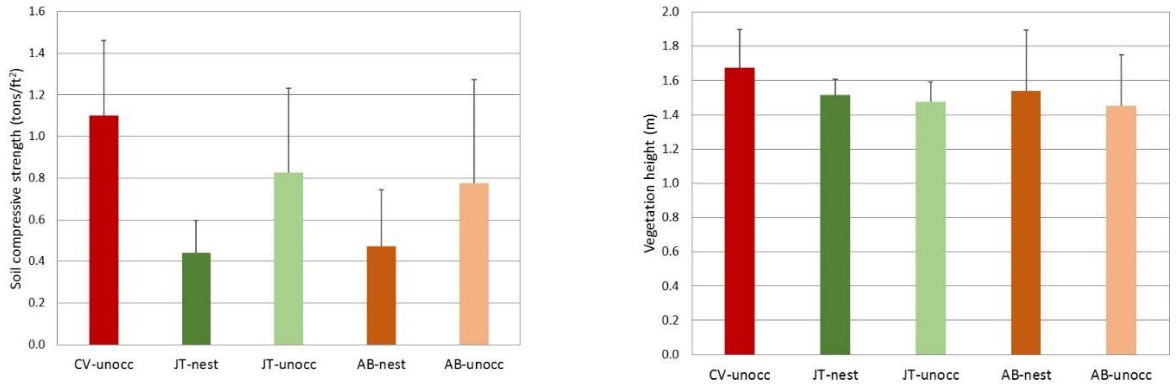

Figure 23. Soil compression (left), and vegetation height (right), by study area and plot occupancy. Lines above bars, 95% confidence interval.

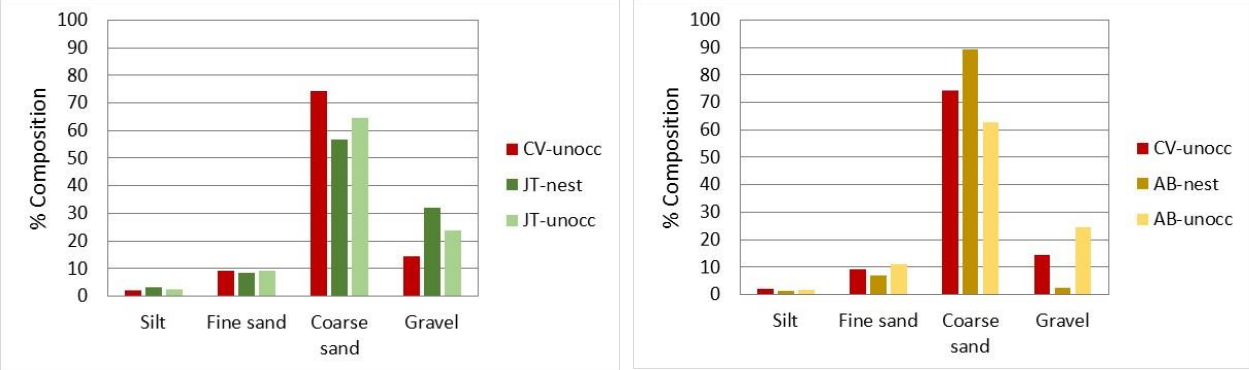

Figure 24. Soil composition, by study area and plot occupancy.

When relative cover by plant species was averaged across plots, coverage of creosote ranked highest (33% average on nest plots, 44% on unoccupied plots), followed by ambrosia (12% average on nest plots, 6% on unoccupied plots), desert indigo (3% average on nest plots, 10% on unoccupied plots), honey mesquite (7% average on nest plots, 3% on unoccupied plots), and saltbush (1% average on nest plots, 7% on unoccupied plots).

To quantify vegetation composition, we performed a detrended correspondence analysis (unconstrained) using PC-ORD version 5.33. Unconstrained ordination of 38 plant species' cover (Appendix 7) showed a tendency toward separation of a higher-elevation community with juniper at Joshua Tree and two lower-elevation communities: palo verde–desert ironwood and mesquite–tamarisk. However, there was a zone of overlap within which the vegetation composition of some Coachella Valley plots was similar to nest plots.

To identify which Coachella Valley sites were most similar to occupied nest plots, we used 10 habitat measures: sum of weighted nest-substrate rankings, soil compaction, composition of rock and gravel, cholla cover, vegetation spacing, vegetation height, road density within 3-km radius, and vegetation composition (first two axes of ordination). We scored each measure for each site as 0 if it fell outside the range of values for nest plots, and 1 if it fell within the range (Appendix 8). On the basis of these measures, only Indio #23 had the highest score possible with 10 out of 10 points. It was followed by Snow Creek #3, Thousand Palms #17, Desert Hot Springs #7, and Seven Palms Valley #13, each with 9 out of 10 possible points. Snow Creek lost one point only because of the nearby road density exceeding the value of any nest plots, while the other three plots lost one point because they lacked nest substrates of adequate quality. Six plots scored 8 points: National Wildlife Refuge #15 and #18 (both with widely spaced vegetation and no cholla), Desert Hot Springs #6 and #8 (high adjacent road density, and differences in vegetation), and Thousand Palms Preserve #14 and #16 (both with compacted soil and lack of adequate nest substrates). Of course, the location of a single 300-m^2 plot is not necessarily representative of the broader surrounding habitat, so additional measures at various scales could improve the analysis. For example, Dos Palmas Preserve #28 scored relatively poorly by these criteria, but we noticed pockets of potentially more suitable habitat within the broader landscape.

Discussion

The LeConte's Thrasher appears to be extirpated or nearly extirpated from the Coachella Valley. Despite our extensive coverage, there is still the possibility that a few birds could be at least wandering through, and there could be territories at sites that we did not visit. An extensive cholla patch near Cabazon is one potential area that we did not survey. However, this is relatively isolated, and there are evidently no nesting populations at the 40 sites that we surveyed in the Coachella Valley. Population decline in the Coachella Valley has been dramatic in comparison to historic (<1940) records, and has evidently continued since the baseline surveys in 2004-2005. Use of the same survey methods concurrently at nearby Joshua Tree National Park (higher elevations) and Anza-Borrego Desert State Park (lower elevations) confirmed the persistence of populations in these areas and also helped to both validate and inform our findings in the Coachella Valley.

Cholla was not the only nest substrate used and was not always present within the LeConte's Thrasher territories that we measured. Abundance of cholla is not necessarily a good territory predictor but rather some moderate amount of shrub spacing combined with high-quality nest substrates is likely key, as Figures 21-22 illustrate. However, cholla was a preferred nest substrate and there is evidence that it has declined in the Coachella Valley. The historic distribution of cholla in the Coachella Valley is not known in detail, but it was clearly more common historically in at least some areas. In 1904 Grinnell wrote: "In the vicinity of Palm Springs the desert floor is more or less closely dotted with several peculiar species of cacti" (Grinnell 1904). The Palm Springs area was where more LeConte's Thrashers were collected

historically than anywhere else in its range, and several biologists noted the use of cholla for nesting. Smeaton Chase (1919) described how difficult it was to pass through "the Devil's Garden, a great cactus thicket between the Whitewater Wash and Seven Palms." Walking near this area at Tipton Road, we noted hundreds of dead cholla trunks. Cholla occurred historically even at lower elevations, such as near Mecca, but not below the shoreline of ancient Lake Cahuilla as noted by Taylor in 1908: "There is even a markt difference in the vegetation as one crosses the shore-line. Below it there is no species of Opuntia whatever, while above it there are several" (field notes archived at Museum of Vertebrate Zoology, University of California, Berkeley; available at http://ecoreader.berkeley.edu/). Here the 1908 team of biologists noted LeConte's Thrashers using the extensive thickets of mesquite, along with many other birds and even Cactus Wrens. Occurrence records (www.calflora.org) suggest that cholla is much more common along the rocky foothills, but we documented presence of cholla at 75% of plots we measured in the Coachella Valley, so it is still widespread away from the foothills, but mostly small in stature and in very low numbers.

After the record dry year of 2002, massive die-offs of cholla were documented in both Deep Canyon (Bobich et al. 2014) and Joshua Tree National Park (Miriti et al. 2007). And these studies preceded the most recent cycle of drought. After the wet winter of 2018–2019 we saw exuberant fresh growth of most individual chollas, but many areas had only dead chollas. Photos taken by Jay Sheppard near Desert Hot Springs in 1970 depict typical LeConte's Thrasher habitat in the Coachella Valley at that time. Retakes of the same views 49 years later illustrate how the habitat has changed. Housing has replaced former LeConte's Thrasher habitat (Figures 25–26), and in areas without houses chollas are far fewer, whereas the creosote bush and exotic mustard have increased (Figures 27–28). Even in areas not urbanized, we estimate from these photos that 49 years ago there was at least 40 times more cholla than in those same areas today. Besides drought and development, cholla is also threatened by the increased risk of fire due to invasive grasses and mustard—plants prevalent in 2019. Fires are at least partly responsible for reduced cholla and shrub cover in some areas, facilitated by invasive grasses and mustard. Historic photographs and accounts suggest that other shrubs that the thrasher can use for nesting have been greatly reduced in the Coachella Valley as well, including mesquite, yucca, saltbush, and smoke tree. We noted extensive areas with dieback of mesquite, including in the Seven Palms Valley area, where water levels are being monitored at Willow Hole. In some areas, lowered ground water levels may be contributing to dieback, which can be exacerbated by ground-water pumping, such as has been suggested for Cabazon (https://www.desertsun.com/story/news/2014/07/22/nestle-arrowhead-bottling-plant-responds-aquifer-story/13019397/) and for Borrego Springs (https://www.desertsun.com/story/news/environment/2019/01/11/california-farmer-borrego-springs-groundwater-pumping-cuts/2169848002/).

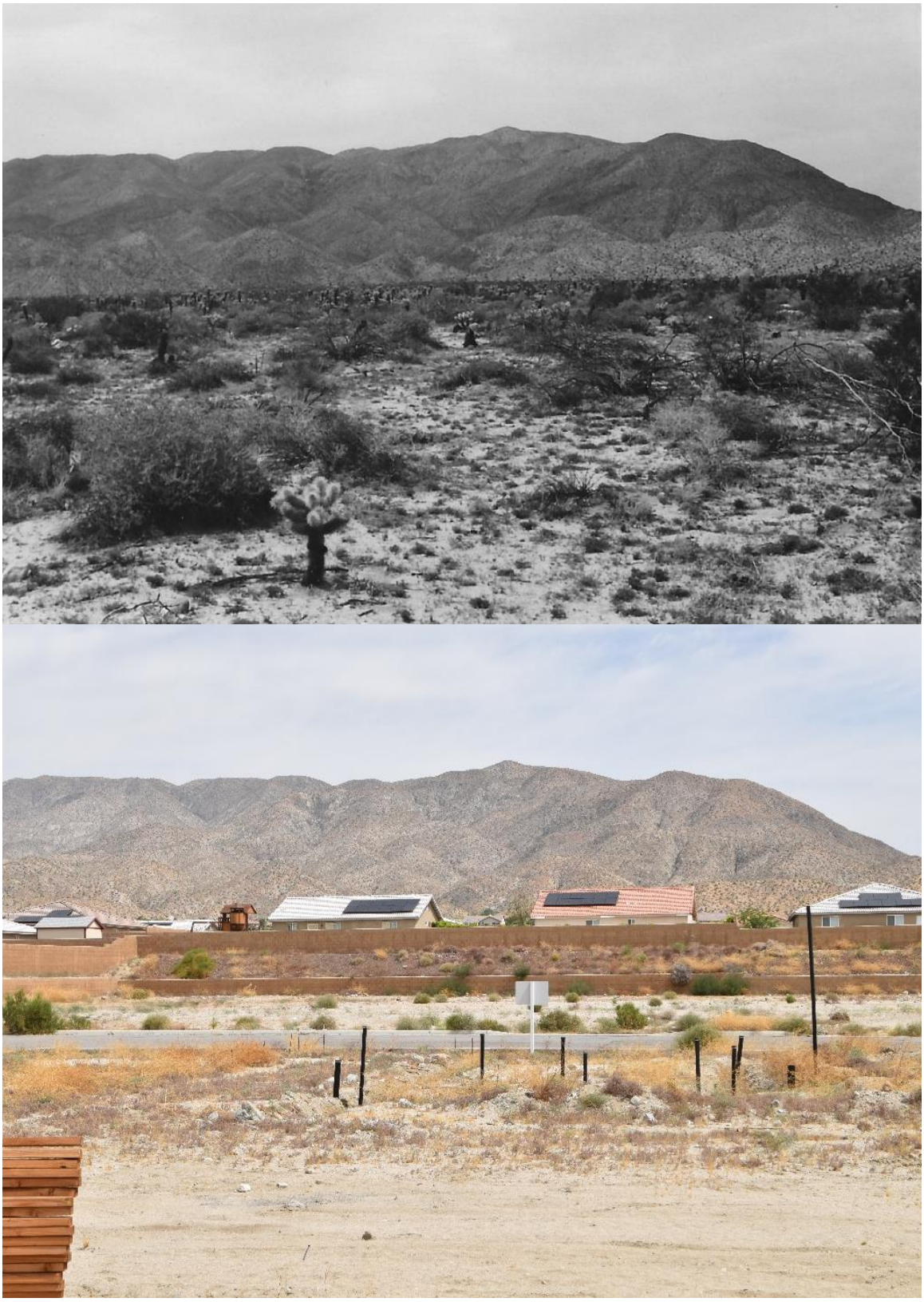

Figure 25. Former LeConte's Thrasher habitat in Desert Hot Springs (top, photo by Jay Sheppard, May 1970) vs. today (bottom), view to northwest.

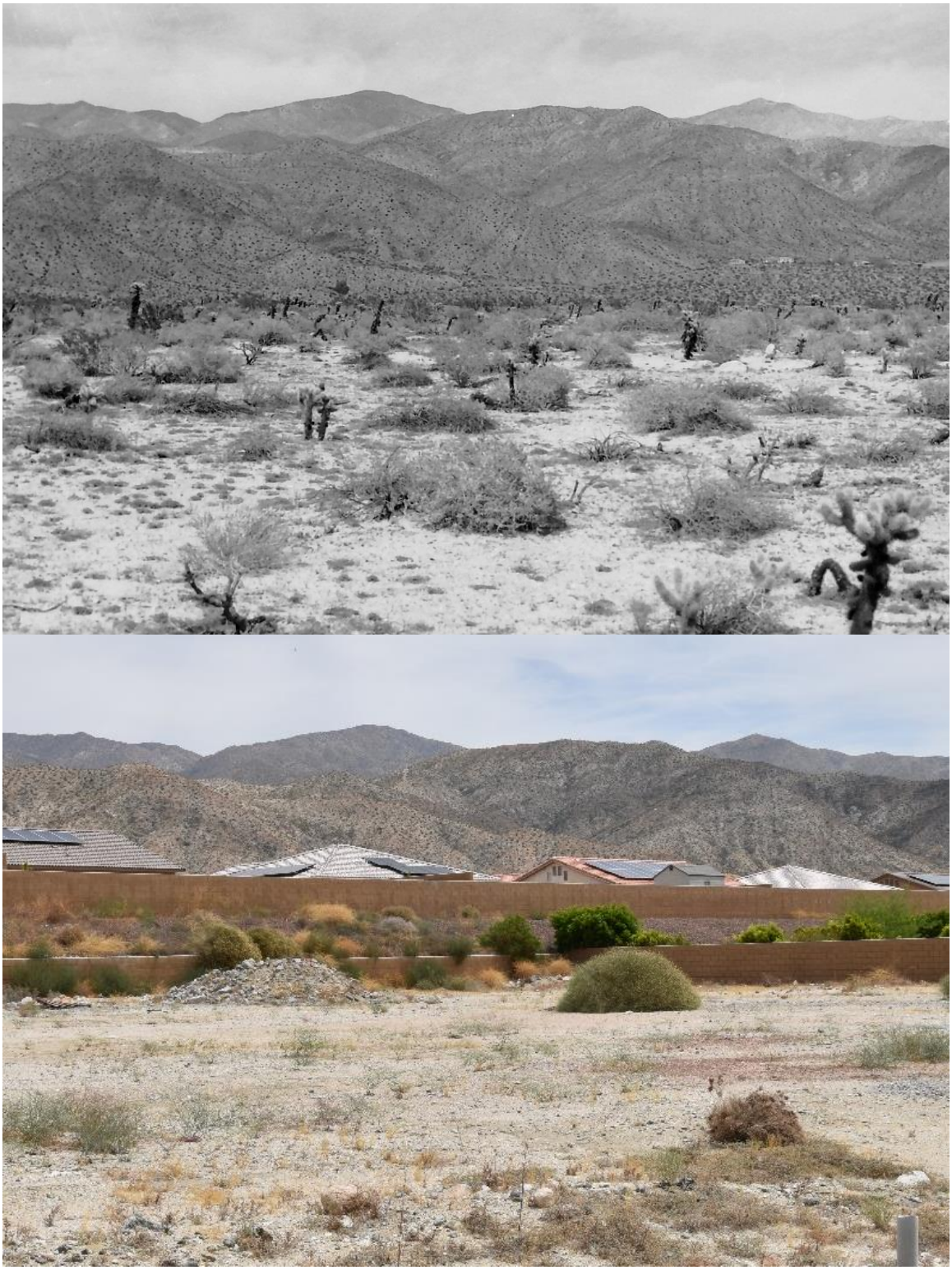

Figure 26. Former LeConte's Thrasher habitat in Desert Hot Springs (top, photo by Jay Sheppard, May 1970) vs. today (bottom), view to northeast.

Figure 27. Former LeConte's Thrasher habitat in Desert Hot Springs (top, photo by Jay Sheppard, May 1970) vs. today (bottom), view to north, from a point south of previous photos. Note increase of creosote and mustard.

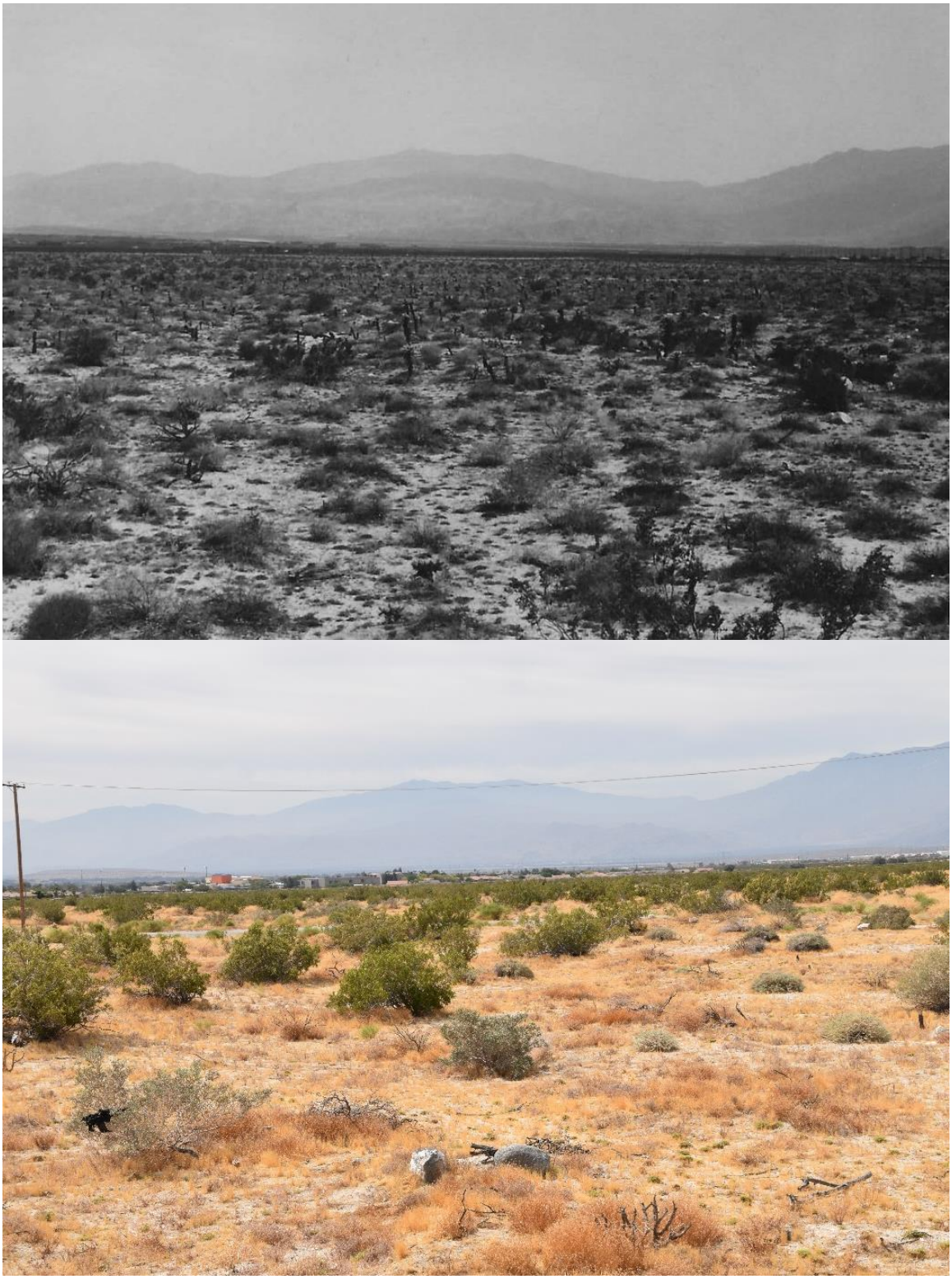

Figure 28. Former LeConte's Thrasher habitat in Desert Hot Springs (top, photo by Jay Sheppard, May 1970) vs. today (bottom), view to south. Note remains of dead cholla in foreground.

At most of our Coachella Valley sites we measured at least a few shrubs with at least a moderate quality ranking for nest substrate potential, and several sites scored very highly suggesting possible suitability, but other quality indicators often fell short (Appendix 8). Besides presence of dead chollas (Figure 29), many sites had varying degrees of disturbance, or poor foraging substrate (choked with mustard, rocky, too hard-packed/impenetrable, or recently flood scoured). While other large thorny/stiff shrubs, or even manmade structures, could substitute for cholla as a nest substrate, extensive sand with some minimum penetrability and open runways are required for suitable foraging substrate for this thrasher that specializes on probing for ground arthropods.

Figure 29. Dead cholla, impenetrable ground, and/or thick mustard (top left, Stubbe Canyon, top middle and right, Mission Creek); flood scouring (lower right, National Wildlife Refuge); good foraging substrate but lack of nest substrates (lower left and middle, Seven Palms Valley).

Of the key requirements, lack of suitable nest substrates appears to be the strongest factor distinguishing Coachella Valley sites from nest plots measured in nearby Joshua Tree and Anza-Borrego. However, multiple factors have likely contributed to the decline of the LeConte's Thrasher in the Coachella Valley (Table 7). Reduced and fragmented habitat is an especially important factor for LeConte's because it is a year-round resident bird with a large home range, a weak flyer prone to vehicle strikes, and not known for long-distance dispersal (Sheppard 2018). Although recent droughts have likely taken a toll throughout its range, other less drought-tolerant species are faring better in the Coachella Valley.

Table 7. Multiple causes have likely contributed to the decline of the LeConte's Thrasher in the Coachella Valley.

Possible causes of decline	Effects
--die-off of cholla and other large shrubs	--lack of suitable nest substrates, shelter
--reduced, fragmented habitat	--area insufficient to support populations, high mortality during dispersal, edge effects
--recent droughts	--suppresses nesting attempts, increases mortality, contributes to cholla die-off, leads to arthropod community collapse
--nest predators, competitors	--makes quality and quantity of nest substrates more critical
--invasive grasses, mustard	--blocks open runways for foraging, facilitates fire, depresses arthropod community
--past disturbance (e.g., off-road vehicles)	--may have contributed to decline of nest substrates, arthropod community
--floods scouring washes	--local, temporary decline of nest substrates, arthropod community

An increase of nest predators makes the quality of the nest substrate all the more important, and competitors make the number of nest substrates all the more important. A predator, the Common Raven, detected at 64 of 72 sites, was the species noted most widely (Table 8), and is also one of the species most increased over historic numbers in this region (Hargrove et al. 2014).

Increased competition for nest sites with the Northern Mockingbird and possibly the California Thrasher or even the Crissal Thrasher is likely. The mockingbird was our second most widespread species, detected at 60 sites (Table 8), and is another human-commensal species that has increased dramatically over historic numbers in this region (Patten et al. 2003). In natural desert habitat, the mockingbird is notably nomadic, invading in large numbers after wet winters like 2018-2019, then disappearing after nesting. Other thrasher species tended to be rare and localized—although we counted up to 7 California Thrashers per day at Stubbe Canyon. The apparent recent spread of the California Thrasher into the upper Coachella Valley represents a possibly increasing threat of competition.

Our focus was on LeConte's Thrashers and these numbers do not control for differences in level of effort, but, strikingly, of all predators and competitors, only in LeConte's did occupancy (% sites with detections) in the Coachella Valley differ appreciably from the proportion of all study sites combined (Table 8). The wide distribution of nest predators and competitors suggests that they alone are not the cause of LeConte's Thrasher decline in the Coachella Valley, but are likely an important factor in conjunction with limited availability of high-quality nest substrates.

Table 8. Total numbers observed and % of sites with records for potential nest predators and competitors relative to LCTH, 2019. (See Appendix 9 for complete list of species by study area.)

Species	Total Obs	Total % Sites	CV Obs	CV % Sites
Common Raven	1137	89%	595	90%
Greater Roadrunner	53	32%	20	28%
Loggerhead Shrike	345	81%	125	78%
Northern Mockingbird	517	83%	187	83%
California Thrasher	23	6%	17	8%
Crissal Thrasher	9	7%	3	5%
Bendire's Thrasher	4	3%	0	0%
Cactus Wren	209	46%	83	45%
LeConte's Thrasher	229	28%	0	0%

An average creosote is not sufficient to support or conceal a thrasher nest, but use of creosote has been documented (Sheppard 2018) and should be possible if the shrub is very large and tangled, especially if it is overgrown with vines. Shrikes and mockingbirds have slightly smaller, softer nests and are a bit more flexible in what they are capable of nesting in. We documented 14 shrike nests, including one in a large tangled creosote, but none in cholla. Cactus Wrens nest almost exclusively in cholla, but can perch their roofed nests in more exposed areas, such as on teddy-bear cholla (*C. bigelovii*), which often grows taller but less branched than the other local species of cholla. We found no LeConte's Thrasher nests in teddy-bear cholla.

LeConte's Thrasher nests all had distinctive soft padding inside a similarly sized inner bowl. Other thrashers and mockingbirds tend to use much more grassy material in the lining. Thrasher surveys should always include checking any potential nest substrates for nests. We noted that the LeConte's Thrasher nests were very sturdy, deteriorating little if at all over several months, while the mockingbird and shrike nests deteriorated rapidly.

Figure 30. California Thrasher photographed near Willow Hole, Merganser Road, 16 July 2019. Photo by Kevin Clark.

Large dense shrubs and cholla are critical not only for nest sites but also provide shelter during the hottest summer months and protection from storms, wind, and predators. Cholla and other large thorny shrubs can still be found in some parts of the Coachella Valley, but they have become rare remnants, patches isolated in a fragmented landscape (Figure 31). However, the persistence of very large cholla at sites such as Palm Springs shows that it is capable of withstanding severe droughts, and these survivors all had exuberant fresh growth after the wet winter. Conservation and restoration of cholla and other potential nest shrubs such as mesquite-mistletoe, smoke tree, saltbush, and jojoba would improve habitat suitability for LeConte's Thrashers in the Coachella Valley and would likely benefit many other species as well.

Figure 31. A few remnant cholla patches in Palm Springs (left) and Snow Creek (right), both sites that LeConte's Thrasher formerly occupied.

Future Survey Efforts

Reproductive success of LeConte's Thrashers in the neighboring areas of Joshua Tree National Park and Anza-Borrego Desert was very high this year, so although we found no evidence of dispersal into the Coachella Valley this spring-summer, it is possible that the species could recolonize after a series of wet winters. We suggest that resurveys occur only after a series of wet winters, that they be focused on the highest-quality sites, and that they include nest searching. Additional potential sites may be identified through assessing the presence of any high-quality potential nest substrates combined with open friable sand.

Although our standardized surveys revealed no LeConte's Thrashers in the Coachella Valley, they will provide a solid baseline for future comparisons if the population should ever rebound. And a better understanding of LeConte's Thrasher's nest-site requirements will reveal the degree to which the reduction in the supply of suitable nest sites or declines in other aspects of habitat quality are contributing to the thrasher's decline in this region.

We used a ranking system based on multiple habitat criteria to identify sites in the Coachella Valley with the most potential of supporting LeConte's Thrasher populations. This tool can be expanded by measurements of additional plots and by adding more GIS layers that quantify the

habitat at a variety of scales. Finally, a predictive model can be constructed with each variable weighted. LeConte's Thrasher's requirement for sandy soil and relatively flat desert terrain is already well established. Because all our surveys were in such habitat our data do not clearly demonstrate this relationship, but it should be included in any predictive habitat modeling that is used to map suitable habitat across the wider region.

Additional analysis and larger sample sizes across the region will likely shed more light on territory and nest-site requirements, and enable the building of an accurate predictive model that can be used as a tool to identify highest-quality sites for conservation and monitoring. Standardized survey methods allow for analysis of abundance and occupancy while controlling for covariates that affect probability of detection, while nest-centered measurements are useful for revealing habitat features most directly related to quality thresholds or limitations. Many additional analyses are possible, such as testing use versus availability of different nest substrates.

The LeConte's Thrasher is one of very few avian desert specialists of the southwest and was formerly emblematic of the Coachella Valley. Its habitat needs overlap with those of many other species of interest that we documented during these surveys, including the Desert Tortoise (3 sites, Figure 32), Burrowing Owl (6 sites, Figure 33), and Round-tailed ground squirrel (18 sites). We documented a total of 142 species, including 112 in the Coachella Valley (Appendix 9). Our database includes confirmations of nesting of 20 species, including 75 nests of species other than LeConte's Thrasher. Most frequent among these was the Loggerhead Shrike (14 nests). We had 88 records of fledglings and/or feeding young by species other than LeConte's Thrasher, most commonly the Loggerhead Shrike (29). Conservation and restoration of LeConte's Thrasher habitat will benefit many other desert species.

Figure 32. Desert Tortoise within a LeConte's Thrasher territory near Cottonwood Springs, one of several species of conservation concern with overlapping habitat requirements.

Figure 33. More examples of species documented during this project include a fledgling Long-eared Owl (left, Carrizo Wash in Anza-Borrego Desert State Park), and adult Burrowing Owl near nest burrow (right, Pushawalla Canyon near Dillon Road).

Recommendations

(1) Limit future LeConte's Thrasher survey efforts to a few sites with highest quality rankings, which can be refined with additional quality measures and modeling. Refined predictive modeling may identify additional high-quality sites. Selected "sentinel" sites should be searched more intensively with multiple visits during the season, preferably after a series of wet winters, including searching for nests in plots and in adjacent areas. Only after reoccupancy has been documented should a broader-scale resurvey be considered. On the basis of our habitat measures, the sites that should be given highest priority for more intensive surveys should include:

- South sentinel site: Indio #23
- North sentinel site: Snow Creek #3
- Middle sentinel site: Thousand Palms #17

Additional sites to consider:

- National Wildlife Refuge #15
- Seven Palms Valley #12 (Willow Hole)
- Desert Hot Springs #7
- Dos Palmas Preserve #28: although this site did not rank highly, expanding the number of plots to include more areas could reveal pockets of higher-quality habitat

(2) Experiment with restoration of cholla, which has been effective for recovery of the Cactus Wren on the coastal slope (The Nature Conservancy 2015 Appendix D). Remnant cholla patches in Palm Springs, Snow Creek, and next to houses in many areas including Cabazon and Desert Hot Springs, especially from any areas to be developed, could be used for propagation. High-priority sites to consider for cholla restoration should demonstrate past cholla or individuals

nearby, show evidence of past disturbance that may have contributed to their decline, and have high quality rankings in all areas except that they are lacking in nest substrates, such as:

- Seven Palms Valley #13
- Thousand Palms #14
- Desert Hot Springs #7

(3) Consider experimentation with artificial wooden nest structures (Sheppard 2018, page 63), as a temporary measure in areas selected for cholla restoration. These can be partially hidden within creosote bushes.

(4) Consider comparisons of ground arthropod community in regional nest plots vs. Coachella Valley plots, as the food supply could be a critical factor contributing to habitat suitability.

(5) Future research could be expanded to other study areas to increase sample sizes and obtain representative sampling across the Colorado Desert region for better predictive modeling, and especially to include low-elevation areas for better comparisons with the Coachella Valley. Three other major areas with recent sightings of LeConte's Thrasher are the Chuckwalla Valley, Algodones Dunes, and Yuha Desert (Figure 34). Other possibilities with recent records include Chuckwalla Bench and Ocotillo Wells.

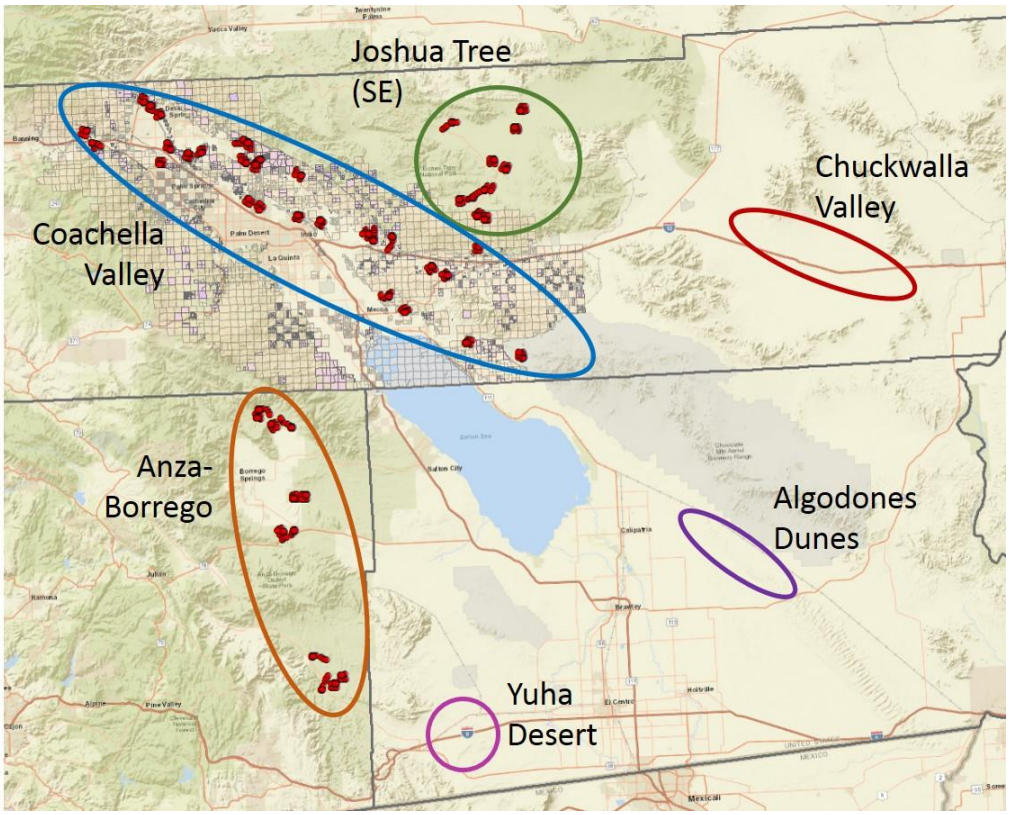

Figure 34. Prospective areas for expanding the study to broaden its perspective and improve understanding of territory and nest-site requirements for the LeConte's Thrasher in the Colorado Desert region.

Acknowledgments

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LeConte's Thrasher (*Toxostoma lecontei*) Status and Nest Site Requirements in the Coachella Valley

Final Appendices October 31, 2019

Appendix 1. LCTH survey form and instructions

THRASHER SURVEY FORM

Date:	**Observer:**	**Site:**
Start time:	NOTES- PLOT PAUSES, METHODS (AREA, TRANS, PLOT), BROADCAST, PIX (cont on back or map):	
End time:		
Temperature:	*%Cloud Cover:*	*Wind/Other:*

Species	*Div into cols by method:* *Start time:* *End time:*	Ttl #
LCTH		
CRTH		

Optional Codes: Use multiple per indiv or group, commas between, eg. (SVC, 4FO, S, C, PR/NB) = 9 ttl, or just 1,4,1,1,2. Note repeat indiv as *

Observations: V=Visual, S=Song, C=Call, J=Juvenile, **FO**=Flyover, Forage, Fly, Flush, Run, Perch (Height, Substrate).
Breeding Codes: **FL**=Fledglings, **NN**=Nest with Nestlings, **NE**=Nest with Eggs, **ON**=Occupied Nest, **FY**=Feeding Young, **CF**=Carrying Food, **FS**=Fecal Sac, **NB**=Nest Building, **DD**=Distraction Display, **CB**=Courtship Behavior, **PR**=Pair.
Transects: include distance in meters (SVC50m,4FO, S75m, C100m, PR/NB20m).

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LeConte's Thrasher Survey Instructions/Notes Coachella Valley 2019

Background: Apparent declines of LCTH, very few observations for monitoring.

Goals: Status of LCTH in Coachella Valley, recommendations for future monitoring.

Objectives:

- Locations of target thrashers in Coachella Valley 2019
- Nest site characteristics vs. non-nest sites in CV, JOTR, ABDSP
- Territory characteristics vs. unoccupied plots in CV, JOTR, ABDSP
- Method comparisons (1-km transects, 300-m plots, area searches, with and w/o broadcast)

Field Methods:

- Area searching (incidental): record start/end time, approximate route, if/when broadcast used.
- Transects (1-km): record start/end time of each 1-km transect, and any time paused, if broadcast used, perpendicular distance between bird and transect in meters at first detection. TR1 = transect 1-3, and TR2 = transect 4-6. Play broadcast at each point during resurveys.
- Plots (300-m^2 DTWG protocol): 40 minutes exactly, record start/end time and any time paused, do not use broadcast, apx 50 m between each pass for best coverage. Distinguish observations that are ON PLOT (within perimeter) vs. OFF plot or during pause (=incidental).
- Mapping: plot locations of any target thrashers (or coordinates with distance and direction), with time of each observation, substrate, perch height, behavior, observe for up to 1 hour.
- Nest-monitoring: document each nest, check apx weekly for outcome.
- Document localities of other target species (e.g., Burrowing Owl, desert tortoise)

Reminders:

- If any possible LCTH are detected, PAUSE plot/transects, and attempt to observe/map. Note time of pause, and if/when resumed.
- Confirm thrasher species and note any uncertainties (eg. pale CATH).
- Use broadcast only after first survey is completed at a site to help confirm absence, and on subsequent visits at each of 3 transect points. If any LCTH are detected, do not use broadcast within 1 km of suspected territory perimeter.
- Minimize disturbance: use distant vantage points, do not approach nests during early stage or just prior to fledging, limit observations to 1 hour.

LCTH Tips (Sheppard 2018):

- Very sensitive to observer movements, so best to conceal self and/or stand very still at reasonable distance to observe behavior.
- Response to playback usually only occurs if it is within their territory, with highest likeliness of response in mid-Dec to late February, then dropping near zero response during incubation/nestling time period when the male will only defend a small area immediately around the nest, but then increases again between nesting attempts.
- Full singing bouts typically 3-10 minutes from top of shrub or cactus, audible at over 500 m.

- Full singing only by male, any time of day in December to February, especially during mid-morning and dusk, but spend less than 15% of day in song. Other times of year less often and most often near dawn and dusk. During incubation, most often only at dusk.
- Softer singing by male and female in close proximity and from nest, only audible within 30 m.
- The classic and distinctive contact call can be heard up to 1 km away, given by both sexes and juveniles, frequent any time of day, but most common near dawn and dusk.
- A "mild alarm call" is also rather common, a shorter, double-noted call with stress on second note. (And large variety of stronger alarm calls and contact calls.)
- Nest in almost any shrub/tree/cholla/structure with sufficient support and overhead cover/shade, even rarely creosote and ocotillo. Often re-use same substrate but not same nest.
- Old nests usually survive 3 years, including their distinctive padding (extra inner layer of thick soft padding), so 1 territory should contain several identifiable nests.
- Very wide range of nest heights: 0-4.6m, but usually in denser area of shrub/tree/cactus, mean nest height 83-84 cm.
- Nest exterior diameter: 18-46 cm, exterior depth: 15-46 cm.
- Nest construction only 1-2 hours per day during mid-morning or mid-afternoon, with nest material collected nearby. Approach nest usually from below, then often quietly pause at top of shrub after depositing nest material or bringing food, then short flight away. (Quiet bird on top of shrub is big clue.)
- Eggs light bluish-green with variable markings (if any), tending to be more concentrated toward wider end. Average 27x19mm.
- Eggs laid one per day, clutch size usually 3-4. Incubation starts after clutch is complete and is irregular the first day.
- Males assist with nest-building, incubation, brooding, feeding nestlings, and often carry food to the female while she is incubating and brooding.
- Adults sometimes vigorously "dig" inside the nest.
- Pairs tend to have very high site fidelity, but successive nest after failure can be up to 1 km away
- Pairs tend to stay within 50-100m of each other, except during incubation up to 200m, and during molt further apart.
- During non-breeding the male often perches on look-out as female forages, and follows behind.
- Culmen at fledging: 11-14 mm (adult 24-30 mm)
- Tail at fledging: 40-60mm (adult 107-132 mm)
- TIMING:
    - Nest site selection: several days to several weeks earlier in season
    - Nest-building: typically 3-10 days, longer earlier in season, "trial" nests = few twigs only
    - Incubation period (last egg laid to first egg hatched): 14-19 days
    - Hatching period: 18-36 hours
    - Nestling period (last egg hatched to first fledge): 12-20 days, all fledge same day
    - Fledgling period: 7-8 days mostly running and climbing, 2-3 weeks fed by adults
    - Incubation on second or third nest: only 1-2 weeks after fledging previous nest

Appendix 2. Nest monitoring form, instructions

NEST MONITORING FORM

NEST ID | DATE | SITE

SPECIES | METHOD

SUBSTR | APX NEST HEIGHT | APX SUBST HEIGHT

DIRECTIONS/NOTES

SKETCH

Rem to note: apx distance and direction of nest from flagging, flagging height and substrate, coordinates of flagging, nest visibility, how flagging should be approached, draw arrow to nest in sketch, only note contents if known, always note if adult on nest, flushed, etc.

DATE	TIME	INITS	TTL EGGS	CB	TTL NESTL	CB	ACTIONS, OBSERVATIONS, and NOTES (OK to use multiple lines)

Especially note all evidence of possible depredation or fledging: nest damage, fragments below nest, tracks, distance of FL to nest, #, age of FL, and adult behavior. Also note description/age of nestlings. CB=# cowbird eggs or nestlings out of total. Note if photographs taken.

NEST MONITORING FORM (side 2)

DATE	TIME	INITS	TTL EGGS	CB	TTL NESTL	CB	ACTIONS, OBSERVATIONS, and NOTES (OK to use multiple lines)

NEST MEASUREMENT FORM

FLAGS COLL

NEST ID SITE

MEAS DATE

INITS

SPECIES

NEST COND

NEST COORDS: N W Elev Err

% CONCEAL: N E S W T B

SUBSTR

SUBSTR HEIGHT

SUBSTR WIDTH

PLACEMENT

NEST HEIGHT

NEST ORIENT

NEST DIMENS: OUTER HEIGHT OUTER WIDTH INNER HEIGHT INNER WIDTH

NEST CONSTRUCT

OTHER NOTES

Nest Measurement Instructions

Only perform at least 1 week after fledging or failure confirmed.

Item	Definition/Instructions
Flags Coll	Check-mark if all flags collected
Nest ID	Eg. LCABD02-L1N1
Meas Date	Today's date
Inits	Your initials
Species	Eg. LCTH
Nest Cond	Eg. intact, disheveled, partially destroyed
Nest Coords N	Latitude
W	Longitude
Elev	Elev (include units)
Err	accuracy (include units)
%Conceal N	view N-side of nest at 3-m, estimate % concealed from view (looking S, level with nest)
E	same on E-side
S	same on S-side
W	same on W-side
T	estimate % concealed from view if looking down at nest from 3-m above
B	estimate % concealed from view if looking up at nest from ground
Substr	nest substrate species
Substr Height	height of nest substrate (95%, excluding odd branches and inflorescense)
Substr Width	width of nest substrate (95%, excluding odd branches)
Nest Height	measure from ground to base of nest (include units)
Nest Orient	degrees from center of shrub
Outer Height	measure from outer base of nest to top (95%, excluding odd pieces)
Outer Width	measure width between outer edges (95%, excluding odd pieces)
Inner Height	measure from bottom of inner cup to top of nest (95%, excluding odd pieces)
Inner Width	measure width between inner sides of cup (95%, excluding odd pieces)
Nest Placement	describe (eg. middle of shrub, edge of shrub, on large branch)
Nest Construct	describe (eg. outer bowl of sticks, bark, no grass, inner base pad 2 cm thick, pale soft material)
Other Notes	predators, competitors, disturbance in area

Appendix 3. Habitat survey form, instructions

THRASHER HABITAT FORM

Date:	**Observer:**	**Nest/Plot:**
Start time:	METHOD NOTES:	
End time:		
Temperature:	*%Cloud Cover:*	*Wind/Other:*

Vert Species	Plant Species	Tally Q Ranks 2, 3	RC	HT

Point	Species	Q	HT	W	4D	Friability	F	C	G	R	NOTES
A-SW											
B-NW											
E-mid											
C-SE											
D-NE											

%OPEN		%WASH		Wt 5		OLD NESTS	
%NH VEG		%SINK		Wt 10		DIG/BURROW	
%HERB VEG		%DRIFT		Wt 60		DISTURB	
%ROCK		%CRUST		Wt 230		HERB COV	
%_____		%OTH FLAT		Wt base		SURROUND	
%_____		%STEEP		FLAGS COLL		PHOTOS	
OTHER NOTES							

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Instructions:

Plot size is 300x300m, with nest as centroid, or if unoccupied, point 'E' is centroid.
Set GPS to UTM and use map to track your location and write additional notes on map.

1. Survey plot as you normally would, but time is unconstrained.
   - Record all vertebrate species in or immediately adjacent to plot. (Record incidentals on map.)
   - Record all dominant NON-herbaceous plant species in second column. (Note invasive herbaceous species such as mustard under disturbance and/or other important herbaceous species under herb cov.)
   - As you zig-zag through plot, place tick-marks next to each plant species that you give nest quality ranking of 2 or 3 (eg. 2,2,2,3,3,2 or 2:1111, 3:11).

     Nest quality rankings:
     0: Unsuitable (eg. average creosote, average small saltbush, average small ocotillo, anything under 0.75m tall, spindly, insufficient space, support, or concealment for a thrasher nest, very unlikely to be used)
     1: Possibly suitable (provides some minimal support and concealment, but low quality)
     2: Probably suitable (good support and concealment, plausible for thrasher nest, but low to moderate quality)
     3: Definitely suitable (very good support and concealment, definitely plausible for thrasher nest, moderate to high quality)
   - At mid-point or at end of survey, estimate the relative cover (RC) of each non-herbaceous plant species (should sum to 100% but OK to leave 'misc' category with up to 5-10%). A larger denser shrub should have more cover than a smaller shrub.
   - Also estimate the average height for each plant species.

2. At each of the 5 points, find the nearest plant that you would rank '1' within the plot (if none, find best nearest shrub).
   - Record the species, quality ranking, height, and width.
   - With laser rangefinder or measuring tape, measure distance between chosen plant and next nearest plant (excluding small or herbaceous) in each of 4 quarters (ie. open space, in meters).
   - At the chosen plant, estimate the friability of the ground in ~2m radius around the plant:

     Friability rankings:
     0: Mostly rock or hardpan that would be difficult to place a tent stake. (Unsuitable friability.)
     1: Mostly very hard-packed or gravelly such that heel does not drive into ground but could probably place a tent stake fairly easily. (Low quality.)
     2: Mostly harder-packed or gravelly such that heel drives into ground but with some resistance. (Low to moderate quality.)
     3: Mostly loose or lightly-packed sand or silt. Heel drives easily into ground. (Moderate to high quality.)
     Optionally use penetrometer to take 5 readings.
   - In the same ~2m radius estimate the % fine/silt (F <0.25mm), coarse (C 0.25-2mm), gravel (G 2mm-25cm), rock (R >25cm), which should sum to 100%.

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3. At mid-point (and/or at end of survey), estimate the following summary for the whole plot:
   - Estimate the %open ground vs. non-herbaceous vegetation vs. herbaceous vegetation vs. rock (or write in "other" such as road, structures, water), summing to 100%.
   - For the open areas, estimate the %wash, sink, drift, crust/pavement, other flat/sloping terrain, and %steep, summing to 100%.
   - Optionally use sieve set at centroid to measure composition of sand/gravel: choose loose area and scoop ~2 cups (~1000g) into top sieve, cover, shake, and weigh each sieve. (Remove lid, use plastic riser for each weight, do not tare.)
   - If any flagging was used, check-mark that it was removed.
   - As you survey the plot, carefully check all '3' quality shrubs and most '2' quality for old nests. Tick-mark the # of any med-large stick nests that are thrasher-like (or LOSH, NOMO).
   - Note if any thrasher-like dig marks were observed in the plot and/or animal burrows. (Describe, or rank 0-3 for low to high #s.)
   - Describe the herbaceous cover: especially %low vs. high (obstructing)
   - Describe the surrounding areas adjacent to the plot: same, or higher/lower quality?
   - Note any photos taken, include NESW at centroid.

Appendix 4. List of surveys

List of all site visits and tasks performed, excluding brief visits (<30 minutes). Personnel: Lori Hargrove (LH), Philip Unitt (PU), Kimberly Ferree (KF), Lea Squires (LDS), and Kevin Clark (KC). Tasks: area searching (A), 300-m^2 plot survey (P), 1-km transect survey (T), habitat plot survey (H), and scouting (S). See Appendix 5 for site codes.

Date	Personnel	Site Code	Tasks
1/14/2019	KF	THP16	APTT
1/14/2019	KF	THP17	APTT
1/14/2019	KC	SKY-W	APTT
1/14/2019	KC	SKY-E	APTT
1/14/2019	LDS	SHV26	APTT
1/14/2019	PU	SHV27	APTT
1/14/2019	LH	SHV29	APTT
1/15/2019	KF	DHS06	APTT
1/15/2019	KC	DHS07	APTT
1/15/2019	LDS	SPV12	APTT
1/15/2019	LH	SPV10	APTT
1/15/2019	PU	SPV13	APTT
1/15/2019	LH	SPV13-NW	A
1/21/2019	LH	MCP	A
1/21/2019	LDS	MCP	A
1/21/2019	LH, LDS	Coachella Valley, various	S
1/22/2019	LDS	JTR01	APTT
1/22/2019	LH	JTR03	APTT
1/23/2019	LH	IND22	APTT
1/23/2019	LDS	IND23	APTT
1/23/2019	LH	BOX25	APTT
1/23/2019	LDS	PTC24	APTT
1/24/2019	KF	ABD01	APTT
1/24/2019	KF	ABD02	APT
1/24/2019	PU	ABD03	AP
1/24/2019	PU	ABD04	AP
1/29/2019	LDS	ABD11	APTT
1/29/2019	LDS	ABD12	APTT
1/29/2019	KC	ABD09	APTT
1/29/2019	KC	ABD10	APTT
1/29/2019	PU	SNC03	AT
1/29/2019	KF	SNC03	APT
1/29/2019	KF	SNC-E	A
1/29/2019	PU	STC02	APT

1/29/2019	KF	STC02	AT
1/30/2019	KF	JTR07	APT
1/30/2019	PU	JTR07	AT
1/30/2019	KF	JTR08	AT
1/30/2019	PU	JTR08	APT
1/30/2019	KF	JTR02	APT
1/30/2019	PU	JTR02	AT
1/31/2019	KF	NWR18	AT
1/31/2019	PU	NWR18	AP
1/31/2019	KF	NWR15	APT
1/31/2019	PU	NWR15	AT
2/5/2019	LDS	ABD07	APTT
2/5/2019	LDS	ABD-BDW	A
2/5/2019	KC	ABD08	APTT
2/6/2019	LH	JTR09	APTT
2/6/2019	LH	JTR03	A
2/6/2019	KF	JTR10	APTT
2/6/2019	KF	JTR01	A
2/6/2019	LH	DBL-THC	AT
2/6/2019	KF	DBL-THC	APT
2/7/2019	KF	THP14	APTT
2/7/2019	KF	DHS08	APTT
2/7/2019	LH	PSH	APTT
2/7/2019	LH	WWR09	APTT
2/12/2019	LH	ABD01	A
2/12/2019	LH	ABD02	A
2/12/2019	LH	ABD06	APTT
2/12/2019	LH	ABD05	AP
2/12/2019	KF	JTR11	APTT
2/12/2019	KF	JTR03	A
2/12/2019	LDS	JTR01	A
2/13/2019	LH	ABD09	APTT
2/13/2019	KF	DPP28	APT
2/13/2019	KF	DPP30	AT
2/13/2019	LDS	DPP28	AT
2/13/2019	LDS	DPP30	APT
2/13/2019	LDS	DPP28	A
2/18/2019	PU	ABD12	APTT
2/18/2019	PU	ABD11	APTT
2/18/2019	PU	ABD09	A
2/18/2019	LDS	SPV12	APTT

2/18/2019	LDS	DHS06	APTT
2/18/2019	KF	SPV13	APTT
2/18/2019	KF	SPV13-NW	A
2/19/2019	PU	ABD-BSP	A
2/19/2019	PU	ABD-BDW	A
2/19/2019	PU	ABD-BDN	A
2/19/2019	LH	JTR06	APTT
2/19/2019	LH	JTR05	APTT
2/19/2019	LH	JTR10	A
2/19/2019	LH	JTR03	A
2/19/2019	LDS	THP17	APTT
2/19/2019	LDS	THP16	AT
2/19/2019	KF	IND21	A
2/19/2019	KF, LDS	Coachella Valley, various	S
2/20/2019	LH	JTR01	A
2/20/2019	LH	JTR02	AT
2/20/2019	LDS	DHS07	APT
2/20/2019	KF	DHS07	AT
2/20/2019	LDS	MCP	A
2/20/2019	KF	MCP	A
2/25/2019	KC	NWR15	APTT
2/25/2019	LDS	NWR18	APTT
2/25/2019	KC	PSH	AT
2/25/2019	LDS	PSH	APT
2/26/2019	KF	ABD03	APTT
2/26/2019	KF	ABD04	AT
2/26/2019	LDS	JTR07	APTT
2/26/2019	KC	JTR09	APTT
2/26/2019	KC, LDS	JTR03	A
2/26/2019	KC, LDS	JTR01	A
2/27/2019	KF	ABD02	A
2/27/2019	KF	ABD-BSP	A
3/4/2019	PU	ABD-FW	A
3/4/2019	LDS	JTR01	AP
3/4/2019	LH	JTR08	AP
3/4/2019	LH	JTR11	A
3/4/2019	LH	JTR03	A
3/4/2019	LDS	JTR10	A
3/5/2019	LDS	THP-S	A
3/5/2019	LDS	THP-S	A
3/5/2019	LDS	NWR-N	A

3/5/2019	LDS	THP-E	A
3/5/2019	LDS	THP-E	A
3/5/2019	LDS	THP-E	A
3/5/2019	LH	THP14	APTT
3/5/2019	LH	THP17	A
3/5/2019	LH	THP-N	A
3/11/2029	LH	SHV-BLM	A
3/11/2019	LH	JTR01	A
3/11/2019	KC	SHV29	APTT
3/11/2019	KC	JTR08	A
3/12/2019	LDS	ABD02	APT
3/12/2019	LDS	ABD01	APTT
3/12/2019	LH	NWR-N	A
3/12/2019	LH	THP-S	A
3/12/2019	LH	SPV13	APTT
3/12/2019	KC	THP-E	A
3/12/2019	KC	DHS08	APTT
3/12/2019	KC	SPV12	A
3/13/2019	LDS	ABD-BDW	A
3/13/2019	LDS	ABD05	APTT
3/13/2019	LDS	ABD-BSW	A
3/13/2019	LDS	ABD-BDN	A
3/13/2019	LH	SNC-E	A
3/13/2019	LH	SNC03	A
3/13/2019	KC	SNC03	A
3/13/2019	LH	STC02	AT
3/13/2019	KC	STC02	APT
3/18/2019	LH	ABD09	A
3/18/2019	LH	ABD10	APTT
3/18/2019	LH	ABD12	A
3/18/2019	KF	JTR05	APTT
3/18/2019	PU	JTR03	A
3/18/2019	PU	JTR11	APTT
3/18/2019	PU	JTR08	A
3/19/2019	LH	ABD07	AP
3/19/2019	LH	ABD08	A
3/19/2019	LH	ABD-BSP	A
3/19/2019	LH	ABD-BDW	A
3/19/2019	KF	DBL-W	APTT
3/19/2019	PU	DBL-E	APTT
3/20/2019	LH	ABD04	A

3/20/2019	PU	JTR01	A
3/20/2019	KF	JTR01	A
3/25/2019	PU	ABD08	APTT
3/25/2019	PU	ABD-BSP	A
3/25/2019	PU	ABD-BDW	A
3/26/2019	PU	ABD-CDL	A
3/25/2019	LH	SHV27	APTT
3/25/2019	LH	JTR08	A
3/26/2019	LH	JTR01	A
3/26/2019	LH	JTR02	APT
3/26/2019	LH	JTR09	A
3/27/2019	LH	DPP28	APTT
3/27/2019	LH	DPP28	A
3/27/2019	KF	IND23	APTT
3/27/2019	KF	PSH	A
3/27/2019	KF	SKY-E	A
3/28/2019	KF	BOX25	AP
3/28/2019	KF	PTC24	APTT
3/29/2019	KC	ABD03	APTT
3/31/2019	LH	ABD11	APTT
3/31/2019	LH	ABD12	A
3/31/2019	LH	ABD08	A
4/2/2019	PU	THP-N	A
4/2/2019	KF	MCP	A
4/2/2019	PU	MCP	A
4/3/2019	KF	JTR01	A
4/3/2019	PU	JTR03	AP
4/3/2019	PU	JTR10	AP
4/3/2019	PU	JTR09	A
4/4/2019	PU	NWR18	A
4/4/2019	PU	SNC03	A
4/8/2019	LH	ABD12	A
4/8/2019	KC	ABD-OW	A
4/8/2019	KC	ABD-SFW	A
4/8/2019	KC	ABD05	APT
4/10/2019	KF	SNC03	AT
4/10/2019	KF	SNC-E	A
4/10/2019	LH	SNC03	APT
4/10/2019	KF	TIP04	A
4/10/2019	LH	TIP04	A
4/10/2019	KF	DHS07	APTT

4/10/2019	LH	DHS06	AT
4/11/2019	PU	ABD03	A
4/11/2019	PU	ABD04	AP
4/11/2019	PU	ABD-CDL	A
4/11/2019	LH	JTR03	A
4/11/2019	LH	JTR09	A
4/11/2019	KF	JTR11	A
4/11/2019	KF	JTR08	A
4/16/2019	PU	ABD-BDW	A
4/16/2019	PU	ABD-BDN	A
4/16/2019	PU	ABD08	A
4/16/2019	PU	ABD-SFW	A
4/16/2019	PU	ABD12	A
4/17/2019	KF	ABD02	A
4/17/2019	KF	ABD04	A
4/17/2019	PU	ABD12	A
4/18/2019	LH	JTR08	A
4/18/2019	LH	JTR-GATE	A
4/18/2019	LH	JTR01	A
4/18/2019	LH	JTR03	A
4/24/2019	LH	ABD01	AP
4/24/2019	LH	ABD02	A
4/24/2019	LH	ABD-CDL	A
4/24/2019	KF	ABD12	AP
4/24/2019	KF	ABD-BSP	A
4/24/2019	KC	JTR-GATE	A
4/24/2019	KC	JTR08	A
4/24/2019	KC	JTR03	A
4/24/2019	KC	JTR10	A
4/24/2019	KC	JTR09	A
4/24/2019	PU	JTR01	A
4/24/2019	PU	JTR03	A
4/24/2019	PU	JTR10	A
4/24/2019	PU	JTR-FLWS	A
4/25/2019	PU	SHV26	AP
4/25/2019	PU	IND23	APT
4/25/2019	KC	SHV27	AP
4/25/2019	KC	IND23	AT
4/25/2019	KC	PSH	A
4/30/2019	LH	JTR07	APT
4/30/2019	LH	JTR10	A

4/30/2019	LH	JTR03	A
4/30/2019	LH	JTR01	A
4/30/2019	PU	JTR-FLWS	A
4/30/2019	PU	JTR09	A
4/30/2019	PU	JTR10	A
4/30/2019	PU	JTR03	A
4/30/2019	PU	JTR-GATE	A
4/30/2019	PU	JTR08	A
5/1/2019	LH	PSH	A
5/1/2019	PU	PSH	A
5/1/2019	LH	THP17	APTT
5/1/2019	LH	THP16	A
5/1/2019	PU	THP16	A
5/5/2019	LH	ABD12	A
5/5/2019	LH	ABD09	AP
5/5/2019	LH	ABD08	A
5/6/2019	LH	ABD03	A
5/6/2019	LH	ABD-CDL	A
5/7/2019	LH	JTR07	A
5/7/2019	LH	JTR-FLWS	A
5/7/2019	LH	JTR09	A
5/7/2019	LH	JTR03	A
5/7/2019	LH	JTR01	A
5/8/2019	LH	NWR15	AHT
5/8/2019	LH	NWR18	AH
5/12/2019	LH	ABD12	A
5/12/2019	LH	ABD10	AH
5/12/2019	LH	ABD-CDL	A
5/14/2019	LH	JTR11	A
5/14/2019	LH	JTR01	A
5/14/2019	LH	JTR07	A
5/15/2019	LH	DPP28	AH
5/17/2019	PU	ABD-CDL	A
5/19/2019	LH	ABD12	A
5/19/2019	LH	ABD-SFW	A
5/19/2019	LH	ABD-BSP	A
5/21/2019	PU, LH	PTC24	AH
5/21/2019	LH, PU	BOX25	AH
5/21/2019	LH, PU	IND23	AH
5/22/2019	LH	JTR05	AH
5/22/2019	LH	JTR06	AH

5/22/2019	PU	JTR01	AH
5/22/2019	LH, PU	SPV12	A
5/28/2019	LH	ABD12	A
5/28/2019	LH	ABD08	A
5/28/2019	LH	ABD-BDW	A
5/28/2019	LH	ABD-CDL	A
5/28/2019	LH	JTR01	A
6/5/2019	LH	JTR01	A
6/10/2019	LH	JTR02	AH
6/10/2019	LH	JTR02	AH
6/10/2019	LH	JTR01	AH
6/11/2019	LH	JTR03	AH
6/11/2019	LH	JTR-GATE	AH
6/17/2019	PU	ABD-BDW	AH
6/17/2019	LH	JTR09	AH
6/17/2019	LH	JTR09	AH
6/17/2019	LH	JTR09	AH
6/17/2019	LH	JTR-FLWS	AH
6/17/2019	LH	JTR07	AH
6/18/2019	PU	ABD08	AH
6/18/2019	LH	JTR10	AH
6/18/2019	LH	JTR10	AH
6/24/2019	LH, PU	SPV12	AH
6/24/2019	LH, PU	SPV13	AH
6/24/2019	LH, PU	SPV10	AH
6/24/2019	PU	JTR07	AH
6/24/2019	PU	JTR10	AH
6/24/2019	LH	JTR01	AH
6/25/2019	LH, PU	DHS06	AH
6/25/2019	LH, PU	DHS08	AH
6/30/2019	LH	ABD03	AH
6/30/2019	LH	ABD01	AH
6/30/2019	LH	ABD02	AH
7/1/2019	LH	SHV27	AH
7/1/2019	LH	SHV29	AH
7/2/2019	LH	THP17	AH
7/2/2019	LH	THP16	AH
7/2/2019	LH	STC02	AH
7/21/2019	LH	SNC03	AH
7/21/2019	LH	DHS07	AH
7/22/2019	LH	JTR02	AH

7/22/2019	LH	JTR01	AH
7/23/2019	LH	SKY-E	AH
7/23/2019	LH	THP14	AH
7/28/2019	LH	ABD12	AH
7/28/2019	LH	ABD12	AH
7/28/2019	LH	ABD11	AH
7/28/2019	LH	ABD09	AH
7/29/2019	LH	ABD05	AH
7/29/2019	LH	ABD08	AH
7/29/2019	LH	ABD07	AH
7/30/2019	LH	JTR01	AH

Appendix 5. List of sites

List of all sites surveyed in 2019 with at least 30 minutes of area searching. APT indicates if site included area-searching (A), 300-m^2 plot survey (P), and/or pair of 1-km transects (T).

Study Area	Site Name	Site Code	APT	Notes
Coachella Valley	Stubbe Canyon	STC02	APT	existing CVCC points, avoid yellow house at end of Johnson St
Coachella Valley	Snow Creek	SNC03	APT	existing CVCC plot; San Gorgonio Wash Snow Creek to Fingal
Coachella Valley	east side of Snow Creek	SNC-E	A	general area
Coachella Valley	Tipton Road	TIP04	A	existing CVCC plot; north of Tipton Rd
Coachella Valley	Mission Creek Preserve	MCP	A	dry washes below the riparian area; CVCC plot#5 is on mesa
Coachella Valley	Desert Hot Springs West	DHS06	APT	existing CVCC points
Coachella Valley	Desert Hot Springs Mid	DHS07	APT	existing CVCC points
Coachella Valley	Desert Hot Springs East	DHS08	APT	existing CVCC points
Coachella Valley	Whitewater River	WWR09	APT	existing CVCC plot east of N Indian Cyn Dr
Coachella Valley	Seven Palms Valley West	SPV10	APT	existing CVCC plot along power line road
Coachella Valley	Seven Palms Valley Willow Hole	SPV12	APT	existing CVCC points at Willow Hole; beware of loose dogs
Coachella Valley	Seven Palms Valley East	SPV13	APT	existing CVCC points below east end of 20th
Coachella Valley	Seven Palms Valley North	SPV13-NW	A	Corkill Rd to Langlois Rd, N and NW of plot 13
Coachella Valley	Seven Palms Valley SE	SPV13-SE	A	SE of plot 13, east of dump
Coachella Valley	Sky Valley West	SKV-W	APT	washes north of Sky Valley, West Deception Canyon (SKY01)
Coachella Valley	Sky Valley East	SKV-E	APT	East Deception Canyon (SKY02)
Coachella Valley	Thousand Palms West	THP14	APT	existing CVCC plot at Hot Springs Rd
Coachella Valley	Thousand Palms North	THP16	APT	existing CVCC points in upper north wash
Coachella Valley	Thousand Palms South	THP17	APT	existing CVCC points in wash just above palms
Coachella Valley	Thousand Palms Preserve - North	THP-N	A	McCallum Grove and side canyons to north, NW, and W
Coachella Valley	Thousand Palms Preserve - East	THP-E	A	visitor center area and side canyons on east side of road
Coachella Valley	Thousand Palms Preserve South - Willis Palms	THP-S	A	Willis Palms
Coachella Valley	Coachella Valley NWR North	NWR-N	A	large area north of plots 15 and 18, Washington St to Ramon Rd

Coachella Valley	Coachella Valley NWR West	NWR15	APT	exisiting CVCC points on west side of NWR
Coachella Valley	Coachella Valley NWR East	NWR18	APT	existing CVCC points on east side of NWR
Coachella Valley	Pushawalla Canyon	PSH	APT	potentially good habitat noticed during scouting (PSH01)
Coachella Valley	Indio, Biskra Palms	IND21	A	existing CVCC plot south of Biskra Palms
Coachella Valley	Indio West	IND22	APT	existing CVCC points on west side of water tower
Coachella Valley	Indio East	IND23	APT	existing CVCC plot on east side of water tower
Coachella Valley	Double Canyon West	DBL-W	APT	potentially good habitat (DBL03)
Coachella Valley	Double Canyon East	DBL-E	APT	potentially good habitat (DBL04)
Coachella Valley	Double Canyon - Thermal	DBL-THC	APT	potentially good habitat; Thermal Canyon above and below Aqueduct Rd (DBL05)
Coachella Valley	Painted Canyon	PTC24	APT	existing CVCC plot, but recently flood scoured
Coachella Valley	Box Canyon	BOX25	APT	existing CVCC points, but recently flood scoured
Coachella Valley	Shaver's Valley West	SHV26	APT	existing CVCC plot
Coachella Valley	Shaver's Valley East	SHV27	APT	existing CVCC points
Coachella Valley	Shaver's Valley North	SHV29	APT	existing CVCC plot
Coachella Valley	Shaver's Valley BLM	SHV-BLM	A	below plot 29, large BLM camping area between aqueduct and I-10
Coachella Valley	Dos Palmas Preserve West	DPP28	APT	existing CVCC points, west of preserve
Coachella Valley	Dos Palmas Preserve East	DPP30	APT	existing CVCC plot, Salt Creek
Anza-Borrego	Clark Valley West	ABD01	APT	west end, Rockhouse Cyn Road
Anza-Borrego	Clark Valley North	ABD02	APT	north end, transects in linear array, long hike
Anza-Borrego	Clark Valley South	ABD03	APT	next to road above dry lake
Anza-Borrego	Clark Valley East	ABD04	APT	east end, transects in linear array, long hike
Anza-Borrego	Clark Dry Lake	ABD-CDL	A	large areas on east and north side of dry lake
Anza-Borrego	Font's Wash	ABD-FW	A	south of S-22
Anza-Borrego	Borrego Dump North	ABD-BDN	A	Borrego Sink, east of Old Springs Rd
Anza-Borrego	Borrego Dump West	ABD-BDW	A	Borrego Sink, west of dump
Anza-Borrego	Borrego Sewage Pond	ABD-BSP	A	Borrego Sink, east of sewage ponds
Anza-Borrego	Borrego Sink East	ABD-BSE	A	Borrego Sink, east side to Borrego Sink Wash (4wd)

Anza-Borrego	Borrego Sink Wash West	ABD05	APT	north side of road, west end of wash
Anza-Borrego	Borrego Sink Wash East	ABD06	APT	north side of road, east end of wash
Anza-Borrego	San Felipe Wash - Ocotillo Wells	ABD-SFW	A	north of Borrego Mountain
Anza-Borrego	Ocotillo Wells	ABD-OW	A	various washes north of Ocotillo Wells (4wd)
Anza-Borrego	Cactus Valley	ABD07	APT	north of San Felipe Wash
Anza-Borrego	San Felipe Wash	ABD08	APT	between narrows and Borrego Springs Road
Anza-Borrego	Palm Spring	ABD09	APT	Overland Stage Route, linear array
Anza-Borrego	Bow Willow	ABD10	APT	mouth of Bow Willow toward Overland Stage Route
Anza-Borrego	Carrizo Wash East	ABD11	APT	thicker areas of mesquite
Anza-Borrego	Carrizo Wash West	ABD12	APT	at edge of mesquite and above in open wash
Joshua Tree	Cottonwood Spr West	JTR01	APT	north and northwest of campground and housing
Joshua Tree	Cottonwood Spr East	JTR02	APT	east and northeast of plot 1, long hike
Joshua Tree	Smoke Tree Wash East	JTR03	APT	both sides of road at xing
Joshua Tree	Smoke Tree Wash West	JTR11	APT	wash between plots 8 and 3 (instead of JTR04- access was too difficult)
Joshua Tree	Smoke Tree Wash Gate	JTR-GATE	A	service road between gate and plot 11
Joshua Tree	Pinto Basin Middle	JTR05	APT	east side of road
Joshua Tree	Pinto Basin North	JTR06	APT	Pinto Wash at road xing
Joshua Tree	Porcupine Wash	JTR07	APT	Porcupine Wash (Pinto Basin West)
Joshua Tree	Pinkham Canyon	JTR08	APT	where road bends west at wash
Joshua Tree	Fried Liver Wash	JTR09	APT	main wash just west of Fried Liver Wash to Pinto Wash
Joshua Tree	Fried Liver Wash South	JTR-FLWS	A	SE of plot 9
Joshua Tree	Black Eagle Mine West	JTR10	APT	both sides of Black Eagle Mine Rd just above main road junction (4wd)

Appendix 6. List of points

Coordinates for all sites with transects (points #1-6) and 300-m^2 plots (points #A-E, with one corner falling on a transect end point), surveyed in 2019.

Study Area	Site Code	Point Code	Lat	Long
Coachella Valley	STC02	LCSTC02-1	33.94130	-116.70535
Coachella Valley	STC02	LCSTC02-2	33.94285	-116.71042
Coachella Valley	STC02	LCSTC02-3	33.94574	-116.71458
Coachella Valley	STC02	LCSTC02-4	33.93611	-116.71762
Coachella Valley	STC02	LCSTC02-5	33.93456	-116.71253
Coachella Valley	STC02	LCSTC02-6	33.93262	-116.70748
Coachella Valley	STC02	LCSTC02-B	33.94401	-116.70534
Coachella Valley	STC02	LCSTC02-C	33.94130	-116.70210
Coachella Valley	STC02	LCSTC02-D	33.94400	-116.70209
Coachella Valley	STC02	LCSTC02-E	33.94265	-116.70372
Coachella Valley	SNC03	LCSNC03-1	33.90803	-116.68904
Coachella Valley	SNC03	LCSNC03-2	33.91248	-116.68886
Coachella Valley	SNC03	LCSNC03-3	33.91712	-116.69443
Coachella Valley	SNC03	LCSNC03-4	33.91707	-116.68364
Coachella Valley	SNC03	LCSNC03-5	33.91483	-116.67836
Coachella Valley	SNC03	LCSNC03-6	33.91253	-116.67279
Coachella Valley	SNC03	LCSNC03-B	33.91982	-116.69442
Coachella Valley	SNC03	LCSNC03-C	33.91711	-116.69119
Coachella Valley	SNC03	LCSNC03-D	33.91981	-116.69118
Coachella Valley	SNC03	LCSNC03-E	33.91846	-116.69280
Coachella Valley	DHS06	LCDHS06-1	33.99150	-116.56817
Coachella Valley	DHS06	LCDHS06-2	33.99485	-116.57249
Coachella Valley	DHS06	LCDHS06-3	33.99637	-116.57761
Coachella Valley	DHS06	LCDHS06-4	34.00475	-116.57363
Coachella Valley	DHS06	LCDHS06-5	34.00320	-116.56854
Coachella Valley	DHS06	LCDHS06-6	34.00010	-116.56464
Coachella Valley	DHS06	LCDHS06-A	33.99151	-116.57141
Coachella Valley	DHS06	LCDHS06-B	33.99421	-116.57140
Coachella Valley	DHS06	LCDHS06-D	33.99420	-116.56815
Coachella Valley	DHS06	LCDHS06-E	33.99285	-116.56978
Coachella Valley	DHS07	LCDHS07-1	33.97965	-116.56077
Coachella Valley	DHS07	LCDHS07-2	33.97827	-116.55559
Coachella Valley	DHS07	LCDHS07-3	33.97690	-116.55042
Coachella Valley	DHS07	LCDHS07-4	33.98565	-116.54787
Coachella Valley	DHS07	LCDHS07-5	33.98706	-116.55309
Coachella Valley	DHS07	LCDHS07-6	33.98845	-116.55823
Coachella Valley	DHS07	LCDHS07-A	33.98574	-116.55825
Coachella Valley	DHS07	LCDHS07-C	33.98573	-116.55500
Coachella Valley	DHS07	LCDHS07-D	33.98844	-116.55498
Coachella Valley	DHS07	LCDHS07-E	33.98709	-116.55661

Coachella Valley	DHS08	LCDHS08-1	33.96617	-116.52905
Coachella Valley	DHS08	LCDHS08-2	33.96427	-116.53396
Coachella Valley	DHS08	LCDHS08-3	33.96395	-116.54106
Coachella Valley	DHS08	LCDHS08-4	33.97291	-116.54198
Coachella Valley	DHS08	LCDHS08-5	33.97301	-116.53655
Coachella Valley	DHS08	LCDHS08-6	33.97488	-116.53162
Coachella Valley	DHS08	LCDHS08-A	33.96618	-116.53229
Coachella Valley	DHS08	LCDHS08-B	33.96889	-116.53228
Coachella Valley	DHS08	LCDHS08-D	33.96888	-116.52903
Coachella Valley	DHS08	LCDHS08-E	33.96753	-116.53066
Coachella Valley	WWR09	LCWWR09-1	33.88042	-116.54047
Coachella Valley	WWR09	LCWWR09-2	33.88041	-116.53497
Coachella Valley	WWR09	LCWWR09-3	33.88057	-116.52957
Coachella Valley	WWR09	LCWWR09-4	33.87152	-116.52969
Coachella Valley	WWR09	LCWWR09-5	33.87148	-116.53508
Coachella Valley	WWR09	LCWWR09-6	33.87153	-116.54059
Coachella Valley	WWR09	LCWWR09-B	33.87423	-116.54058
Coachella Valley	WWR09	LCWWR09-C	33.87151	-116.53735
Coachella Valley	WWR09	LCWWR09-D	33.87422	-116.53734
Coachella Valley	WWR09	LCWWR09-E	33.87287	-116.53897
Coachella Valley	SPV10	LCSPV10-1	33.90771	-116.51309
Coachella Valley	SPV10	LCSPV10-2	33.91140	-116.51618
Coachella Valley	SPV10	LCSPV10-3	33.91376	-116.52083
Coachella Valley	SPV10	LCSPV10-4	33.90484	-116.52178
Coachella Valley	SPV10	LCSPV10-5	33.90237	-116.51723
Coachella Valley	SPV10	LCSPV10-6	33.89875	-116.51393
Coachella Valley	SPV10	LCSPV10-B	33.90146	-116.51391
Coachella Valley	SPV10	LCSPV10-C	33.89874	-116.51068
Coachella Valley	SPV10	LCSPV10-D	33.90144	-116.51067
Coachella Valley	SPV10	LCSPV10-E	33.90010	-116.51230
Coachella Valley	SPV12	LCSPV12-1	33.89354	-116.47400
Coachella Valley	SPV12	LCSPV12-2	33.89171	-116.46906
Coachella Valley	SPV12	LCSPV12-3	33.89012	-116.46401
Coachella Valley	SPV12	LCSPV12-4	33.88182	-116.46882
Coachella Valley	SPV12	LCSPV12-5	33.88364	-116.47378
Coachella Valley	SPV12	LCSPV12-6	33.88543	-116.47875
Coachella Valley	SPV12	LCSPV12-A	33.89083	-116.47401
Coachella Valley	SPV12	LCSPV12-C	33.89082	-116.47077
Coachella Valley	SPV12	LCSPV12-D	33.89352	-116.47075
Coachella Valley	SPV12	LCSPV12-E	33.89218	-116.47238
Coachella Valley	SPV13	LCSPV13-1	33.90047	-116.43534
Coachella Valley	SPV13	LCSPV13-2	33.89924	-116.44054
Coachella Valley	SPV13	LCSPV13-3	33.89811	-116.44579
Coachella Valley	SPV13	LCSPV13-4	33.88965	-116.44942
Coachella Valley	SPV13	LCSPV13-5	33.89076	-116.44417
Coachella Valley	SPV13	LCSPV13-6	33.89122	-116.43878

Coachella Valley	SPV13	LCSPV13-A	33.89124	-116.44202
Coachella Valley	SPV13	LCSPV13-B	33.89394	-116.44200
Coachella Valley	SPV13	LCSPV13-D	33.89393	-116.43876
Coachella Valley	SPV13	LCSPV13-E	33.89258	-116.44039
Coachella Valley	SKY01	LCSKY01-1	33.90681	-116.36182
Coachella Valley	SKY01	LCSKY01-2	33.90681	-116.35643
Coachella Valley	SKY01	LCSKY01-3	33.90671	-116.35103
Coachella Valley	SKY01	LCSKY01-4	33.90671	-116.34558
Coachella Valley	SKY01	LCSKY01-5	33.91121	-116.34335
Coachella Valley	SKY01	LCSKY01-6	33.91561	-116.34153
Coachella Valley	SKY01	LCSKY01-A	33.91292	-116.34479
Coachella Valley	SKY01	LCSKY01-B	33.91563	-116.34477
Coachella Valley	SKY01	LCSKY01-C	33.91290	-116.34155
Coachella Valley	SKY01	LCSKY01-E	33.91426	-116.34316
Coachella Valley	SKY02	LCSKY02-1	33.90892	-116.33479
Coachella Valley	SKY02	LCSKY02-2	33.90442	-116.33484
Coachella Valley	SKY02	LCSKY02-3	33.90011	-116.33479
Coachella Valley	SKY02	LCSKY02-4	33.89533	-116.32687
Coachella Valley	SKY02	LCSKY02-5	33.90207	-116.32692
Coachella Valley	SKY02	LCSKY02-6	33.90652	-116.32511
Coachella Valley	SKY02	LCSKY02-A	33.90621	-116.33481
Coachella Valley	SKY02	LCSKY02-C	33.90619	-116.33156
Coachella Valley	SKY02	LCSKY02-D	33.90890	-116.33154
Coachella Valley	SKY02	LCSKY02-E	33.90755	-116.33318
Coachella Valley	THP14	LCTHP14-1	33.88296	-116.35118
Coachella Valley	THP14	LCTHP14-2	33.88027	-116.34494
Coachella Valley	THP14	LCTHP14-3	33.87646	-116.34040
Coachella Valley	THP14	LCTHP14-4	33.86786	-116.34051
Coachella Valley	THP14	LCTHP14-5	33.87147	-116.34512
Coachella Valley	THP14	LCTHP14-6	33.87382	-116.35130
Coachella Valley	THP14	LCTHP14-B	33.87056	-116.34049
Coachella Valley	THP14	LCTHP14-C	33.86784	-116.33727
Coachella Valley	THP14	LCTHP14-D	33.87055	-116.33725
Coachella Valley	THP14	LCTHP14-E	33.86920	-116.33888
Coachella Valley	THP16	LCTHP16-1	33.87599	-116.30416
Coachella Valley	THP16	LCTHP16-2	33.87481	-116.30939
Coachella Valley	THP16	LCTHP16-3	33.87290	-116.31425
Coachella Valley	THP16	LCTHP16-4	33.86997	-116.31172
Coachella Valley	THP16	LCTHP16-5	33.86810	-116.31667
Coachella Valley	THP16	LCTHP16-6	33.86635	-116.32166
Coachella Valley	THP16	LCTHP16-A	33.87330	-116.30743
Coachella Valley	THP16	LCTHP16-B	33.87601	-116.30741
Coachella Valley	THP16	LCTHP16-C	33.87329	-116.30418
Coachella Valley	THP16	LCTHP16-E	33.87465	-116.30579
Coachella Valley	THP17	LCTHP17-1	33.85797	-116.32354
Coachella Valley	THP17	LCTHP17-2	33.85562	-116.31893

Coachella Valley	THP17	LCTHP17-3	33.85453	-116.31368
Coachella Valley	THP17	LCTHP17-4	33.86264	-116.30899
Coachella Valley	THP17	LCTHP17-5	33.86375	-116.31425
Coachella Valley	THP17	LCTHP17-6	33.86607	-116.31887
Coachella Valley	THP17	LCTHP17-A	33.86337	-116.31889
Coachella Valley	THP17	LCTHP17-C	33.86335	-116.31565
Coachella Valley	THP17	LCTHP17-D	33.86605	-116.31563
Coachella Valley	THP17	LCTHP17-E	33.86471	-116.31726
Coachella Valley	NWR15	LCNWR15-A	33.79775	-116.33914
Coachella Valley	NWR15	LCNWR15-B	33.80045	-116.33912
Coachella Valley	NWR15	LCNWR15-C	33.79773	-116.33590
Coachella Valley	NWR15	LCNWR15-D	33.79909	-116.33751
Coachella Valley	NWR15	LCNWR15-1	33.79423	-116.34373
Coachella Valley	NWR15	LCNWR15-2	33.79145	-116.33948
Coachella Valley	NWR15	LCNWR15-3	33.78901	-116.33492
Coachella Valley	NWR15	LCNWR15-4	33.79460	-116.32760
Coachella Valley	NWR15	LCNWR15-5	33.79722	-116.33209
Coachella Valley	NWR15	LCNWR15-6	33.80043	-116.33588
Coachella Valley	NWR18	LCNWR18-A	33.77666	-116.31431
Coachella Valley	NWR18	LCNWR18-B	33.77936	-116.31429
Coachella Valley	NWR18	LCNWR18-C	33.77935	-116.31105
Coachella Valley	NWR18	LCNWR18-D	33.77800	-116.31268
Coachella Valley	NWR18	LCNWR18-1	33.78299	-116.30343
Coachella Valley	NWR18	LCNWR18-2	33.78660	-116.30694
Coachella Valley	NWR18	LCNWR18-3	33.78977	-116.31070
Coachella Valley	NWR18	LCNWR18-4	33.78333	-116.31823
Coachella Valley	NWR18	LCNWR18-5	33.78013	-116.31445
Coachella Valley	NWR18	LCNWR18-6	33.77664	-116.31107
Coachella Valley	PSH01	LCPSH01-1	33.85188	-116.22299
Coachella Valley	PSH01	LCPSH01-2	33.84733	-116.22499
Coachella Valley	PSH01	LCPSH01-3	33.84210	-116.22722
Coachella Valley	PSH01	LCPSH01-4	33.83379	-116.21655
Coachella Valley	PSH01	LCPSH01-5	33.83834	-116.21373
Coachella Valley	PSH01	LCPSH01-6	33.84274	-116.21097
Coachella Valley	PSH01	LCPSH01-A	33.84005	-116.21424
Coachella Valley	PSH01	LCPSH01-B	33.84276	-116.21421
Coachella Valley	PSH01	LCPSH01-C	33.84003	-116.21100
Coachella Valley	PSH01	LCPSH01-E	33.84139	-116.21260
Coachella Valley	IND22	LCIND22-1	33.75853	-116.23190
Coachella Valley	IND22	LCIND22-2	33.75762	-116.22659
Coachella Valley	IND22	LCIND22-3	33.75645	-116.22130
Coachella Valley	IND22	LCIND22-4	33.76439	-116.21614
Coachella Valley	IND22	LCIND22-5	33.76483	-116.22152
Coachella Valley	IND22	LCIND22-6	33.76568	-116.22709
Coachella Valley	IND22	LCIND22-A	33.76298	-116.22711
Coachella Valley	IND22	LCIND22-C	33.76296	-116.22387

Coachella Valley	IND22	LCIND22-D	33.76566	-116.22385
Coachella Valley	IND22	LCIND22-E	33.76432	-116.22548
Coachella Valley	IND23	LCIND23-1	33.75452	-116.17391
Coachella Valley	IND23	LCIND23-2	33.75186	-116.16933
Coachella Valley	IND23	LCIND23-3	33.74931	-116.16518
Coachella Valley	IND23	LCIND23-4	33.74166	-116.17089
Coachella Valley	IND23	LCIND23-5	33.74420	-116.17508
Coachella Valley	IND23	LCIND23-6	33.74684	-116.17974
Coachella Valley	IND23	LCIND23-A	33.75182	-116.17394
Coachella Valley	IND23	LCIND23-C	33.75180	-116.17070
Coachella Valley	IND23	LCIND23-D	33.75450	-116.17068
Coachella Valley	IND23	LCIND23-E	33.75316	-116.17231
Coachella Valley	DBL03	LCDBL03-1	33.73159	-116.06907
Coachella Valley	DBL03	LCDBL03-2	33.72709	-116.07176
Coachella Valley	DBL03	LCDBL03-3	33.72387	-116.07713
Coachella Valley	DBL03	LCDBL03-4	33.71541	-116.06650
Coachella Valley	DBL03	LCDBL03-5	33.72005	-116.06376
Coachella Valley	DBL03	LCDBL03-6	33.72450	-116.06089
Coachella Valley	DBL03	LCDBL03-A	33.72182	-116.06416
Coachella Valley	DBL03	LCDBL03-B	33.72453	-116.06413
Coachella Valley	DBL03	LCDBL03-C	33.72180	-116.06092
Coachella Valley	DBL03	LCDBL03-E	33.72316	-116.06253
Coachella Valley	DBL04	LCDBL04-1	33.73345	-116.04909
Coachella Valley	DBL04	LCDBL04-2	33.72885	-116.05015
Coachella Valley	DBL04	LCDBL04-3	33.72450	-116.05014
Coachella Valley	DBL04	LCDBL04-4	33.71986	-116.05009
Coachella Valley	DBL04	LCDBL04-5	33.71537	-116.05032
Coachella Valley	DBL04	LCDBL04-6	33.71091	-116.05026
Coachella Valley	DBL04	LCDBL04-A	33.70823	-116.05353
Coachella Valley	DBL04	LCDBL04-B	33.71094	-116.05350
Coachella Valley	DBL04	LCDBL04-C	33.70821	-116.05029
Coachella Valley	DBL04	LCDBL04-E	33.70957	-116.05189
Coachella Valley	DBL05	LCDBL05-1	33.71752	-116.00704
Coachella Valley	DBL05	LCDBL05-2	33.71273	-116.00715
Coachella Valley	DBL05	LCDBL05-3	33.70808	-116.00709
Coachella Valley	DBL05	LCDBL05-4	33.69904	-116.01270
Coachella Valley	DBL05	LCDBL05-5	33.69494	-116.01551
Coachella Valley	DBL05	LCDBL05-6	33.69063	-116.02094
Coachella Valley	DBL05	LCDBL05-A	33.71484	-116.01031
Coachella Valley	DBL05	LCDBL05-B	33.71754	-116.01028
Coachella Valley	DBL05	LCDBL05-C	33.71481	-116.00707
Coachella Valley	DBL05	LCDBL05-E	33.71618	-116.00867
Coachella Valley	PTC24	LCPTC24-1	33.60984	-116.01733
Coachella Valley	PTC24	LCPTC24-2	33.60690	-116.02234
Coachella Valley	PTC24	LCPTC24-3	33.60246	-116.02462
Coachella Valley	PTC24	LCPTC24-4	33.59797	-116.03284

Coachella Valley	PTC24	LCPTC24-5	33.60061	-116.03826
Coachella Valley	PTC24	LCPTC24-6	33.60500	-116.04054
Coachella Valley	PTC24	LCPTC24-A	33.59975	-116.02465
Coachella Valley	PTC24	LCPTC24-C	33.59973	-116.02142
Coachella Valley	PTC24	LCPTC24-D	33.60243	-116.02139
Coachella Valley	PTC24	LCPTC24-E	33.60109	-116.02302
Coachella Valley	BOX25	LCBOX25-1	33.57390	-115.99409
Coachella Valley	BOX25	LCBOX25-2	33.57701	-115.99019
Coachella Valley	BOX25	LCBOX25-3	33.57950	-115.98571
Coachella Valley	BOX25	LCBOX25-4	33.57401	-115.97693
Coachella Valley	BOX25	LCBOX25-5	33.57157	-115.98159
Coachella Valley	BOX25	LCBOX25-6	33.56844	-115.98550
Coachella Valley	BOX25	LCBOX25-A	33.56847	-115.98873
Coachella Valley	BOX25	LCBOX25-B	33.57117	-115.98870
Coachella Valley	BOX25	LCBOX25-D	33.57114	-115.98547
Coachella Valley	BOX25	LCBOX25-E	33.56981	-115.98710
Coachella Valley	SHV26	LCSHV26-1	33.65808	-115.91889
Coachella Valley	SHV26	LCSHV26-2	33.65373	-115.91615
Coachella Valley	SHV26	LCSHV26-3	33.64884	-115.91334
Coachella Valley	SHV26	LCSHV26-4	33.64454	-115.92444
Coachella Valley	SHV26	LCSHV26-5	33.64913	-115.92689
Coachella Valley	SHV26	LCSHV26-6	33.65363	-115.92988
Coachella Valley	SHV26	LCSHV26-A	33.65540	-115.92216
Coachella Valley	SHV26	LCSHV26-B	33.65811	-115.92212
Coachella Valley	SHV26	LCSHV26-C	33.65538	-115.91892
Coachella Valley	SHV26	LCSHV26-E	33.65674	-115.92052
Coachella Valley	SHV27	LCSHV27-1	33.64373	-115.88858
Coachella Valley	SHV27	LCSHV27-2	33.64118	-115.89306
Coachella Valley	SHV27	LCSHV27-3	33.63930	-115.89796
Coachella Valley	SHV27	LCSHV27-4	33.63127	-115.89306
Coachella Valley	SHV27	LCSHV27-5	33.63315	-115.88816
Coachella Valley	SHV27	LCSHV27-6	33.63569	-115.88370
Coachella Valley	SHV27	LCSHV27-A	33.63572	-115.88694
Coachella Valley	SHV27	LCSHV27-B	33.63843	-115.88690
Coachella Valley	SHV27	LCSHV27-D	33.63840	-115.88367
Coachella Valley	SHV27	LCSHV27-E	33.63706	-115.88530
Coachella Valley	SHV29	LCSHV29-1	33.69073	-115.80780
Coachella Valley	SHV29	LCSHV29-2	33.69078	-115.81311
Coachella Valley	SHV29	LCSHV29-3	33.69088	-115.81854
Coachella Valley	SHV29	LCSHV29-4	33.68174	-115.81871
Coachella Valley	SHV29	LCSHV29-5	33.68169	-115.81328
Coachella Valley	SHV29	LCSHV29-6	33.68164	-115.80785
Coachella Valley	SHV29	LCSHV29-A	33.68805	-115.81107
Coachella Valley	SHV29	LCSHV29-B	33.69076	-115.81103
Coachella Valley	SHV29	LCSHV29-C	33.68802	-115.80783
Coachella Valley	SHV29	LCSHV29-E	33.68939	-115.80943

Coachella Valley	DPP28	LCDPP28-1	33.51253	-115.84562
Coachella Valley	DPP28	LCDPP28-2	33.51138	-115.84042
Coachella Valley	DPP28	LCDPP28-3	33.51008	-115.83527
Coachella Valley	DPP28	LCDPP28-4	33.50203	-115.84005
Coachella Valley	DPP28	LCDPP28-5	33.50333	-115.84522
Coachella Valley	DPP28	LCDPP28-6	33.50450	-115.85040
Coachella Valley	DPP28	LCDPP28-B	33.50720	-115.85037
Coachella Valley	DPP28	LCDPP28-C	33.50447	-115.84717
Coachella Valley	DPP28	LCDPP28-D	33.50717	-115.84714
Coachella Valley	DPP28	LCDPP28-E	33.50583	-115.84877
Coachella Valley	DPP30	LCDPP30-1	33.48242	-115.71916
Coachella Valley	DPP30	LCDPP30-2	33.47788	-115.71934
Coachella Valley	DPP30	LCDPP30-3	33.47338	-115.71934
Coachella Valley	DPP30	LCDPP30-A	33.47070	-115.72261
Coachella Valley	DPP30	LCDPP30-B	33.47341	-115.72257
Coachella Valley	DPP30	LCDPP30-C	33.47067	-115.71938
Coachella Valley	DPP30	LCDPP30-E	33.47204	-115.72097
Coachella Valley	DPP30	LCDPP30-4	33.47358	-115.73006
Coachella Valley	DPP30	LCDPP30-5	33.47807	-115.73001
Coachella Valley	DPP30	LCDPP30-6	33.48247	-115.73001
Anza-Borrego	ABD01	LCABD01-1	33.37563	-116.32808
Anza-Borrego	ABD01	LCABD01-2	33.37670	-116.33349
Anza-Borrego	ABD01	LCABD01-3	33.37694	-116.33775
Anza-Borrego	ABD01	LCABD01-4	33.38575	-116.33884
Anza-Borrego	ABD01	LCABD01-5	33.38516	-116.33332
Anza-Borrego	ABD01	LCABD01-6	33.38438	-116.32801
Anza-Borrego	ABD01	LCABD01-B	33.37965	-116.33773
Anza-Borrego	ABD01	LCABD01-C	33.37693	-116.33452
Anza-Borrego	ABD01	LCABD01-D	33.37963	-116.33450
Anza-Borrego	ABD01	LCABD01-E	33.37829	-116.33612
Anza-Borrego	ABD02	LCABD02-1	33.39518	-116.33320
Anza-Borrego	ABD02	LCABD02-2	33.39508	-116.32796
Anza-Borrego	ABD02	LCABD02-3	33.39489	-116.32261
Anza-Borrego	ABD02	LCABD02-4	33.39254	-116.31191
Anza-Borrego	ABD02	LCABD02-5	33.38794	-116.30917
Anza-Borrego	ABD02	LCABD02-6	33.38345	-116.30650
Anza-Borrego	ABD02	LCABD02-A	33.39248	-116.33322
Anza-Borrego	ABD02	LCABD02-C	33.39246	-116.33000
Anza-Borrego	ABD02	LCABD02-D	33.39517	-116.32998
Anza-Borrego	ABD02	LCABD02-E	33.39382	-116.33160
Anza-Borrego	ABD03	LCABD03-1	33.35412	-116.30138
Anza-Borrego	ABD03	LCABD03-2	33.35882	-116.30405
Anza-Borrego	ABD03	LCABD03-3	33.36326	-116.30673
Anza-Borrego	ABD03	LCABD03-4	33.36747	-116.29603
Anza-Borrego	ABD03	LCABD03-5	33.36307	-116.29335
Anza-Borrego	ABD03	LCABD03-6	33.35867	-116.29062

Anza-Borrego	ABD03	LCABD03-B	33.36597	-116.30671
Anza-Borrego	ABD03	LCABD03-C	33.36324	-116.30351
Anza-Borrego	ABD03	LCABD03-D	33.36595	-116.30349
Anza-Borrego	ABD03	LCABD03-E	33.36461	-116.30511
Anza-Borrego	ABD04	LCABD04-1	33.35828	-116.25577
Anza-Borrego	ABD04	LCABD04-2	33.36053	-116.26112
Anza-Borrego	ABD04	LCABD04-3	33.36316	-116.26647
Anza-Borrego	ABD04	LCABD04-4	33.36766	-116.27700
Anza-Borrego	ABD04	LCABD04-5	33.37201	-116.27974
Anza-Borrego	ABD04	LCABD04-6	33.37656	-116.28253
Anza-Borrego	ABD04	LCABD04-A	33.35559	-116.25902
Anza-Borrego	ABD04	LCABD04-B	33.35830	-116.25900
Anza-Borrego	ABD04	LCABD04-C	33.35557	-116.25580
Anza-Borrego	ABD04	LCABD04-E	33.35693	-116.25740
Anza-Borrego	ABD05	LCABD05-1	33.21888	-116.25164
Anza-Borrego	ABD05	LCABD05-2	33.21879	-116.25693
Anza-Borrego	ABD05	LCABD05-3	33.21879	-116.26199
Anza-Borrego	ABD05	LCABD05-4	33.22753	-116.26206
Anza-Borrego	ABD05	LCABD05-5	33.22788	-116.25682
Anza-Borrego	ABD05	LCABD05-6	33.22778	-116.25158
Anza-Borrego	ABD05	LCABD05-B	33.22150	-116.26197
Anza-Borrego	ABD05	LCABD05-C	33.21877	-116.25877
Anza-Borrego	ABD05	LCABD05-D	33.22148	-116.25875
Anza-Borrego	ABD05	LCABD05-E	33.22013	-116.26037
Anza-Borrego	ABD06	LCABD06-1	33.22753	-116.24088
Anza-Borrego	ABD06	LCABD06-2	33.22783	-116.23558
Anza-Borrego	ABD06	LCABD06-3	33.22778	-116.22977
Anza-Borrego	ABD06	LCABD06-4	33.21830	-116.23006
Anza-Borrego	ABD06	LCABD06-5	33.21844	-116.23553
Anza-Borrego	ABD06	LCABD06-6	33.21854	-116.24064
Anza-Borrego	ABD06	LCABD06-A	33.22509	-116.23301
Anza-Borrego	ABD06	LCABD06-B	33.22780	-116.23299
Anza-Borrego	ABD06	LCABD06-C	33.22507	-116.22979
Anza-Borrego	ABD06	LCABD06-E	33.22643	-116.23139
Anza-Borrego	ABD07	LCABD07-1	33.15100	-116.29492
Anza-Borrego	ABD07	LCABD07-2	33.15320	-116.28957
Anza-Borrego	ABD07	LCABD07-3	33.15554	-116.28422
Anza-Borrego	ABD07	LCABD07-4	33.16444	-116.28963
Anza-Borrego	ABD07	LCABD07-5	33.16233	-116.29515
Anza-Borrego	ABD07	LCABD07-6	33.15994	-116.30045
Anza-Borrego	ABD07	LCABD07-A	33.15556	-116.28744
Anza-Borrego	ABD07	LCABD07-B	33.15826	-116.28742
Anza-Borrego	ABD07	LCABD07-D	33.15824	-116.28420
Anza-Borrego	ABD07	LCABD07-E	33.15690	-116.28582
Anza-Borrego	ABD08	LCABD08-1	33.14220	-116.28969
Anza-Borrego	ABD08	LCABD08-2	33.14420	-116.28451

Anza-Borrego	ABD08	LCABD08-3	33.14650	-116.27898
Anza-Borrego	ABD08	LCABD08-4	33.15104	-116.26817
Anza-Borrego	ABD08	LCABD08-5	33.15559	-116.26542
Anza-Borrego	ABD08	LCABD08-6	33.15989	-116.26292
Anza-Borrego	ABD08	LCABD08-A	33.15718	-116.26295
Anza-Borrego	ABD08	LCABD08-C	33.15716	-116.25973
Anza-Borrego	ABD08	LCABD08-D	33.15987	-116.25971
Anza-Borrego	ABD08	LCABD08-E	33.15852	-116.26133
Anza-Borrego	ABD09	LCABD09-1	32.91634	-116.23283
Anza-Borrego	ABD09	LCABD09-2	32.91610	-116.22750
Anza-Borrego	ABD09	LCABD09-3	32.91600	-116.22217
Anza-Borrego	ABD09	LCABD09-4	32.91170	-116.21145
Anza-Borrego	ABD09	LCABD09-5	32.90921	-116.20601
Anza-Borrego	ABD09	LCABD09-6	32.90691	-116.20079
Anza-Borrego	ABD09	LCABD09-A	32.91363	-116.23286
Anza-Borrego	ABD09	LCABD09-C	32.91361	-116.22965
Anza-Borrego	ABD09	LCABD09-D	32.91632	-116.22962
Anza-Borrego	ABD09	LCABD09-E	32.91497	-116.23124
Anza-Borrego	ABD10	LCABD10-1	32.84850	-116.21458
Anza-Borrego	ABD10	LCABD10-2	32.85266	-116.21180
Anza-Borrego	ABD10	LCABD10-3	32.85735	-116.20908
Anza-Borrego	ABD10	LCABD10-4	32.86629	-116.20369
Anza-Borrego	ABD10	LCABD10-5	32.87079	-116.20097
Anza-Borrego	ABD10	LCABD10-6	32.87573	-116.19824
Anza-Borrego	ABD10	LCABD10-B	32.85121	-116.21455
Anza-Borrego	ABD10	LCABD10-C	32.84848	-116.21137
Anza-Borrego	ABD10	LCABD10-D	32.85118	-116.21135
Anza-Borrego	ABD10	LCABD10-E	32.84984	-116.21296
Anza-Borrego	ABD11	LCABD11-1	32.87744	-116.16907
Anza-Borrego	ABD11	LCABD11-2	32.87739	-116.16360
Anza-Borrego	ABD11	LCABD11-3	32.87734	-116.15840
Anza-Borrego	ABD11	LCABD11-4	32.86835	-116.15827
Anza-Borrego	ABD11	LCABD11-5	32.86835	-116.16360
Anza-Borrego	ABD11	LCABD11-6	32.86839	-116.16910
Anza-Borrego	ABD11	LCABD11-A	32.87473	-116.16910
Anza-Borrego	ABD11	LCABD11-C	32.87471	-116.16589
Anza-Borrego	ABD11	LCABD11-D	32.87742	-116.16587
Anza-Borrego	ABD11	LCABD11-E	32.87608	-116.16748
Anza-Borrego	ABD12	LCABD12-1	32.85285	-116.19060
Anza-Borrego	ABD12	LCABD12-2	32.85275	-116.18527
Anza-Borrego	ABD12	LCABD12-3	32.85271	-116.17976
Anza-Borrego	ABD12	LCABD12-4	32.86219	-116.17976
Anza-Borrego	ABD12	LCABD12-5	32.86189	-116.18509
Anza-Borrego	ABD12	LCABD12-6	32.86185	-116.19048
Anza-Borrego	ABD12	LCABD12-A	32.85951	-116.18300
Anza-Borrego	ABD12	LCABD12-B	32.86222	-116.18297

Anza-Borrego	ABD12	LCABD12-C	32.85949	-116.17979
Anza-Borrego	ABD12	LCABD12-E	32.86085	-116.18138
Joshua Tree	JTR01	LCJTR01-1	33.74728	-115.80966
Joshua Tree	JTR01	LCJTR01-2	33.75066	-115.80469
Joshua Tree	JTR01	LCJTR01-3	33.75378	-115.79985
Joshua Tree	JTR01	LCJTR01-4	33.75833	-115.80686
Joshua Tree	JTR01	LCJTR01-5	33.75559	-115.81141
Joshua Tree	JTR01	LCJTR01-6	33.75260	-115.81626
Joshua Tree	JTR01	LCJTR01-A	33.74731	-115.81290
Joshua Tree	JTR01	LCJTR01-B	33.75002	-115.81286
Joshua Tree	JTR01	LCJTR01-D	33.74999	-115.80962
Joshua Tree	JTR01	LCJTR01-E	33.74865	-115.81126
Joshua Tree	JTR02	LCJTR02-1	33.74923	-115.79611
Joshua Tree	JTR02	LCJTR02-2	33.74923	-115.79085
Joshua Tree	JTR02	LCJTR02-3	33.74914	-115.78542
Joshua Tree	JTR02	LCJTR02-4	33.74009	-115.78554
Joshua Tree	JTR02	LCJTR02-5	33.74019	-115.79085
Joshua Tree	JTR02	LCJTR02-6	33.74024	-115.79634
Joshua Tree	JTR02	LCJTR02-B	33.74294	-115.79630
Joshua Tree	JTR02	LCJTR02-C	33.74020	-115.79310
Joshua Tree	JTR02	LCJTR02-D	33.74291	-115.79306
Joshua Tree	JTR02	LCJTR02-E	33.74157	-115.79470
Joshua Tree	JTR03	LCJTR03-1	33.79655	-115.79015
Joshua Tree	JTR03	LCJTR03-2	33.80100	-115.78745
Joshua Tree	JTR03	LCJTR03-3	33.80554	-115.78458
Joshua Tree	JTR03	LCJTR03-4	33.80539	-115.77115
Joshua Tree	JTR03	LCJTR03-5	33.80046	-115.77391
Joshua Tree	JTR03	LCJTR03-6	33.79636	-115.77678
Joshua Tree	JTR03	LCJTR03-A	33.79658	-115.79339
Joshua Tree	JTR03	LCJTR03-B	33.79929	-115.79335
Joshua Tree	JTR03	LCJTR03-D	33.79926	-115.79011
Joshua Tree	JTR03	LCJTR03-E	33.79792	-115.79175
Joshua Tree	JTR11	LCJTR11-1	33.78115	-115.83104
Joshua Tree	JTR11	LCJTR11-2	33.78335	-115.82546
Joshua Tree	JTR11	LCJTR11-3	33.78550	-115.81983
Joshua Tree	JTR11	LCJTR11-A	33.78280	-115.81987
Joshua Tree	JTR11	LCJTR11-C	33.78277	-115.81663
Joshua Tree	JTR11	LCJTR11-D	33.78547	-115.81659
Joshua Tree	JTR11	LCJTR11-E	33.78413	-115.81823
Joshua Tree	JTR11	LCJTR11-4	33.78995	-115.81367
Joshua Tree	JTR11	LCJTR11-5	33.79264	-115.80839
Joshua Tree	JTR11	LCJTR11-6	33.79557	-115.80306
Joshua Tree	JTR05	LCJTR05-1	33.91762	-115.71819
Joshua Tree	JTR05	LCJTR05-2	33.91316	-115.71813
Joshua Tree	JTR05	LCJTR05-3	33.90867	-115.71819
Joshua Tree	JTR05	LCJTR05-4	33.90852	-115.70746

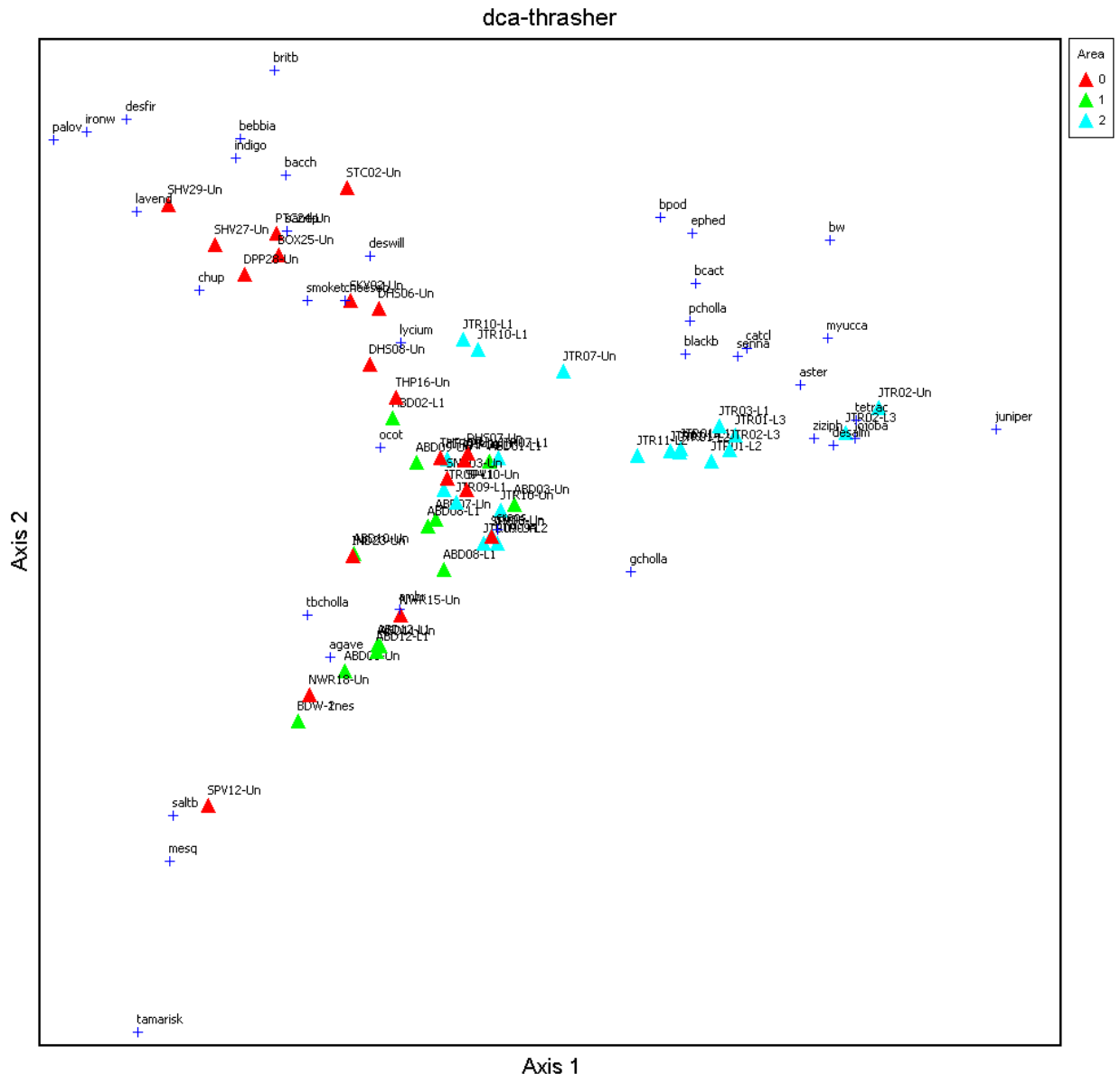
Joshua Tree	JTR05	LCJTR05-5	33.91302	-115.70734
Joshua Tree	JTR05	LCJTR05-6	33.91737	-115.70728
Joshua Tree	JTR05	LCJTR05-A	33.91491	-115.71823
Joshua Tree	JTR05	LCJTR05-C	33.91488	-115.71499
Joshua Tree	JTR05	LCJTR05-D	33.91758	-115.71495
Joshua Tree	JTR05	LCJTR05-E	33.91625	-115.71659
Joshua Tree	JTR06	LCJTR06-1	33.95558	-115.69874
Joshua Tree	JTR06	LCJTR06-2	33.95563	-115.69319
Joshua Tree	JTR06	LCJTR06-3	33.95554	-115.68788
Joshua Tree	JTR06	LCJTR06-4	33.94660	-115.68793
Joshua Tree	JTR06	LCJTR06-5	33.94655	-115.69342
Joshua Tree	JTR06	LCJTR06-6	33.94664	-115.69885
Joshua Tree	JTR06	LCJTR06-A	33.94667	-115.70210
Joshua Tree	JTR06	LCJTR06-B	33.94938	-115.70206
Joshua Tree	JTR06	LCJTR06-D	33.94934	-115.69881
Joshua Tree	JTR06	LCJTR06-E	33.94801	-115.70046
Joshua Tree	JTR07	LCJTR07-1	33.84821	-115.77585
Joshua Tree	JTR07	LCJTR07-2	33.85270	-115.77567
Joshua Tree	JTR07	LCJTR07-3	33.85720	-115.77578
Joshua Tree	JTR07	LCJTR07-4	33.85720	-115.76529
Joshua Tree	JTR07	LCJTR07-5	33.85266	-115.76529
Joshua Tree	JTR07	LCJTR07-6	33.84816	-115.76523
Joshua Tree	JTR07	LCJTR07-A	33.85452	-115.76857
Joshua Tree	JTR07	LCJTR07-B	33.85723	-115.76853
Joshua Tree	JTR07	LCJTR07-C	33.85449	-115.76532
Joshua Tree	JTR07	LCJTR07-E	33.85586	-115.76693
Joshua Tree	JTR08	LCJTR08-1	33.78359	-115.85262
Joshua Tree	JTR08	LCJTR08-2	33.78369	-115.84699
Joshua Tree	JTR08	LCJTR08-3	33.78370	-115.84147
Joshua Tree	JTR08	LCJTR08-4	33.77475	-115.84164
Joshua Tree	JTR08	LCJTR08-5	33.77460	-115.84705
Joshua Tree	JTR08	LCJTR08-6	33.77455	-115.85226
Joshua Tree	JTR08	LCJTR08-A	33.78089	-115.85265
Joshua Tree	JTR08	LCJTR08-C	33.78086	-115.84941
Joshua Tree	JTR08	LCJTR08-D	33.78356	-115.84938
Joshua Tree	JTR08	LCJTR08-E	33.78222	-115.85102
Joshua Tree	JTR09	LCJTR09-1	33.91810	-115.88153
Joshua Tree	JTR09	LCJTR09-2	33.92128	-115.87602
Joshua Tree	JTR09	LCJTR09-3	33.92533	-115.87197
Joshua Tree	JTR09	LCJTR09-4	33.93247	-115.85848
Joshua Tree	JTR09	LCJTR09-A	33.92979	-115.86176
Joshua Tree	JTR09	LCJTR09-B	33.93250	-115.86172
Joshua Tree	JTR09	LCJTR09-C	33.92976	-115.85852
Joshua Tree	JTR09	LCJTR09-E	33.93113	-115.86012
Joshua Tree	JTR09	LCJTR09-5	33.93125	-115.85314
Joshua Tree	JTR09	LCJTR09-6	33.93032	-115.84769

Joshua Tree	JTR10	LCJTR10-1	33.83682	-115.74934
Joshua Tree	JTR10	LCJTR10-2	33.84141	-115.74622
Joshua Tree	JTR10	LCJTR10-3	33.84567	-115.74381
Joshua Tree	JTR10	LCJTR10-4	33.84332	-115.73297
Joshua Tree	JTR10	LCJTR10-5	33.83878	-115.73549
Joshua Tree	JTR10	LCJTR10-6	33.83428	-115.73836
Joshua Tree	JTR10	LCJTR10-A	33.83431	-115.74160
Joshua Tree	JTR10	LCJTR10-B	33.83702	-115.74156
Joshua Tree	JTR10	LCJTR10-D	33.83698	-115.73832
Joshua Tree	JTR10	LCJTR10-E	33.83565	-115.73996

Appendix 7. Ordination results

List of plant species used in detrended correspondence analysis. Total variance in the species data was 4.1, with length of first gradient "Axis 1" 3.9 (eigenvalue 0.60) and length of second gradient "Axis 2" 3.4 (eigenvalue 0.48).

Code	Common Name	Species	AKA	Axis1	Axis2
agave	Desert Agave	*Agave deserti*	agave	89	82
ambr	White Bur-Sage	*Ambrosia dumosa*		128	108
aster	Sunflower sp.	*Asteraceae sp.*		350	232
bacch	Baccharis sp.	*Baccharis sp.*	broom baccharis	65	348
bcact	Barrel Cactus	*Ferocactus cylindraceus*		291	288
bebbia	Rush Sweetbush	*Bebbia juncea*	bebbia	39	368
blackb	Blackbush	*Coleogyne ramosissima*		286	249
bpod	Bladderpod	*Peritoma arborea*		272	325
britb	Brittlebush	*Encelia farinosa*		59	406
bw	Calif. Buckwheat	*Eriogonum fasciculatum*	buckwheat	366	312
catcl	Catclaw Acacia	*Senegalia greggii*	catclaw	320	252
cheeseb	Cheesebush	*Ambrosia salsola*		98	279
chup	Chuparosa	*Justicia californica*		17	285
creos	Creosote Bush	*Larrea tridentata*	creosote	182	152
desalm	Desert Almond	*Prunus fasciculata*	"pale lycium-like"	368	199
desfir	Desert Fir	*Peucephyllum schottii*	pigmy-cedar	-23	379
deswill	Desert-Willow	*Chilopsis linearis*	chilopsis	111	303
ephed	Ephedra sp.	*Ephedra sp.*	Mormon tea	289	316
gcholla	Golden Cholla	*Cylindropuntia echinocarpa*	silver cholla	256	129
indigo	Indigo Bush	*Psorothamnus schottii*	indigo, desert indigo	37	358
ironw	Ironwood	*Olneya tesota*		-46	372
jojoba	Jojoba	*Simmondsia chinensis*		379	203
juniper	California Juniper	*Juniperus californica*	juniper	457	208
lavend	Desert-Lavender	*Condea emoryi*	lavender	-18	328
lycium	Lycium sp.	*Lycium sp.*	desert thorn	128	256
mesq	Honey Mesquite	*Prosopsis glandulosa*	mesquite	1	-31
myucca	Mojave Yucca	*Yucca schidigera*	yucca	365	258
ocot	Ocotillo	*Fouquieria splendens*		117	198
palov	Blue Palo Verde	*Parkinsonia florida*	palo verde	-64	368
pcholla	Pencil Cholla	*Cylindropuntia ramosissima*	diamond cholla	288	267
saltb	Saltbush sp.	*Atriplex sp.*		3	-6
sandp	Sandpaper Plant	*Petalonyx linearis*		66	317
senna	Desert Senna	*Senna armata*	senna, spiny senna	315	248
smoket	Smoke Tree	*Psorothamnus spinosus*		77	279
tamarisk	Tamarisk sp.	*Tamarix sp.*		-17	-125
tbcholla	Teddy-Bear Cholla	*Cylindropuntia bigelovii*	jumping cholla	77	105
tetrac	Hall's Spurge	*Tetracoccus hallii*	"dark lycium-like"	380	213
ziziph	Lotebush	*Ziziphus obtusifolia*	"tall lycium-like"	357	203



Ordination results for axis 1 and axis 2, showing positions of each plant species and each plot, color-coded by study area: Coachella Valley (red), Anza-Borrego (green), and Joshua Tree (blue). Plots include those both unoccupied (Un) and those centered on a nest (L#).

Appendix 8. Habitat rankings for 20 Coachella Valley sites

Values outside the range of nest plots are highlighted with gray shading. See definitions below.

Plot	Sum	Cholla	Veg Q	Compr	Gravel	Rock	Space	Veg Ht	Rds	Veg1	Veg2
IND23	**10**	1	23	0.6	10%	1%	7.2	1.4	2	102	138
SNC03	**9**	2	30	0.4	8%	0%	2.4	1.9	11	154	181
THP17	**9**	2	5	0.9	13%	5%	5.2	1.5	1	150	192
DHS07	**9**	1	7	0.9	14%	3%	3.8	1.8	2	166	194
SPV13	**9**	1	1	0.3	0%	0%	8.8	1.8	1	179	149
NWR15	**8**	0	21	0.5	1%	0%	13.6	1.6	1	128	105
THP14	**8**	3	1	1.8	7%	6%	8.1	1.5	3	164	191
DHS06	**8**	1	15	0.9	13%	5%	3.8	1.3	5	116	274
DHS08	**8**	0	15	0.2	14%	2%	7.8	1.3	16	111	244
NWR18	**8**	0	10	0.8	0%	0%	12.6	1.6	3	78	61
THP16	**8**	2	4	1.5	25%	5%	3.2	1.4	4	126	226
SPV12	**7**	1	105	0.2	1%	0%	4	1.5	6	22	0
PTC24	**7**	0	10	1.4	14%	5%	8.1	1.5	1	60	316
SPV10	**7**	0	0	0.7	13%	2%	8.9	1.3	28	165	175
SHV29	**6**	2	65	1.2	53%	2%	3.8	2.8	2	0	332
SHV27	**6**	2	51	3.4	22%	0%	3.6	2.8	3	26	310
BOX25	**6**	1	17	1.4	6%	5%	11.5	1.6	5	61	304
STC02	**6**	1	10	2.3	51%	5%	1.2	0.9	10	99	341
SKY02	**6**	1	3	2.2	10%	18%	3.2	1.5	4	101	279
DPP28	**5**	0	41	0.8	6%	3%	11.6	2.6	3	42	293
Nest min		**0**	**8**	**0**	**0%**	**0%**	**1.1**	**1.1**	**0**	**72**	**46**
Nest max		**16**	**303**	**1.4**	**51%**	**15%**	**9.1**	**2.4**	**4**	**375**	**257**

-Cholla: relative cover (%) of *Cylindropuntia ramosissima* and *C. echinocarpa*

-Veg Q: weighted sum of potential nest substrates with quality rank of 2 (moderate quality) or 3 (high quality)

-Compr: soil compaction or compressive strength (tons/ft^2) measured with penetrometer, average of 5 readings around each plot point

-Gravel: % composition of gravel (2-250 mm diameter) measured by sieve at plot centroid

-Rock: % land cover of rock (>25 cm diameter) estimated for plot

-Space: average distance to nearest vegetation (>0.5 m tall) within each quarter around each plot point

-Veg Ht: average vegetation height (m) estimated for each dominant species and weighted by relative cover

-Rds: density of roads within 2 km radius of each plot centroid

-Veg1: weighted mean species scores from first ordination axis. (See Appendix 7.) Sites with more similar values represent sites with more similar vegetation, along a gradient of composition from palo verde to juniper.

-Veg2: weighted mean species scores from second ordination axis. (See Appendix 7.) Sites with more similar values represent sites with more similar vegetation, along a gradient of composition from tamarisk to brittlebush.

Appendix 9. Species list

List of all 142 species identified during LeConte's Thrasher surveys, with total numbers observed and % of sites with records (AB, Anza-Borrego, 20 sites; JT = Joshua Tree, 12 sites; CV = Coachella Valley, 40 sites). Includes incidental detections and some repeat observations.

Common Name	Species	AB Obs	AB Sites	JT Obs	JT Sites	CV Obs	CV Sites
Birds (126)							
Great Blue Heron	*Ardea herodias*	0	0%	0	0%	2	5%
Great Egret	*Ardea alba*	0	0%	0	0%	1	3%
Black-crowned Night-Heron	*Nycticorax nycticorax*	0	0%	0	0%	9	3%
Turkey Vulture	*Cathartes aura*	25	35%	19	50%	35	18%
Snow Goose	*Anser caerulescens*	0	0%	0	0%	35	3%
Canada Goose	*Branta canadensis*	0	0%	0	0%	21	3%
Green-winged Teal	*Anas crecca*	4	5%	0	0%	0	0%
Mallard	*Anas platyrhynchos*	3	5%	0	0%	4	3%
Cinnamon Teal	*Anas cyanoptera*	30	5%	0	0%	0	0%
Northern Shoveler	*Anas clypeata*	1	5%	0	0%	0	0%
Hooded Merganser	*Lophodytes cucullatus*	0	0%	0	0%	1	3%
Osprey	*Pandion haliaetus*	0	0%	1	8%	0	0%
Northern Harrier	*Circus cyaneus*	0	0%	0	0%	2	5%
Sharp-shinned Hawk	*Accipiter striatus*	0	0%	0	0%	1	3%
Cooper's Hawk	*Accipiter cooperii*	2	10%	0	0%	9	13%
Swainson's Hawk	*Buteo swainsoni*	7	20%	0	0%	12	5%
Red-tailed Hawk	*Buteo jamaicensis*	17	50%	8	42%	28	40%
Golden Eagle	*Aquila chrysaetos*	0	0%	2	17%	3	8%
American Kestrel	*Falco sparverius*	3	15%	4	8%	21	43%
Merlin	*Falco columbarius*	0	0%	0	0%	2	5%
Prairie Falcon	*Falco mexicanus*	1	5%	1	8%	3	5%
California Quail	*Callipepla californica*	2	5%	0	0%	21	8%
Gambel's Quail	*Callipepla gambelii*	4	15%	96	58%	204	55%
Sora	*Porzana carolina*	0	0%	0	0%	1	3%
American Coot	*Fulica americana*	1	5%	0	0%	3	5%
Killdeer	*Charadrius vociferus*	8	5%	0	0%	2	5%
Ring-billed Gull	*Larus delawarensis*	0	0%	0	0%	412	5%
California Gull	*Larus californicus*	0	0%	0	0%	12	3%
Franklin's Gull	*Leucophaeus pipixcan*	0	0%	0	0%	5	3%
Rock Pigeon	*Columba livia*	0	0%	0	0%	15	5%
Eurasian Collared-Dove	*Streptopelia decaocto*	3	5%	0	0%	15	15%
Mourning Dove	*Zenaida macroura*	118	65%	136	75%	193	65%
White-winged Dove	*Zenaida asiatica*	11	20%	2	17%	13	10%
Common Ground-Dove	*Columbina passerina*	4	5%	0	0%	0	0%

Common Name	Species	AB Obs	AB Sites	JT Obs	JT Sites	CV Obs	CV Sites
Greater Roadrunner	*Geococcyx californianus*	20	35%	13	42%	20	28%
Barn Owl	*Tyto alba*	0	0%	1	8%	2	5%
Great Horned Owl	*Bubo virginianus*	0	0%	0	0%	4	3%
Burrowing Owl	*Athene cunicularia*	0	0%	0	0%	16	15%
Long-eared Owl	*Asio otus*	3	5%	8	33%	0	0%
Lesser Nighthawk	*Chordeiles acutipennis*	4	15%	3	8%	4	10%
Common Poorwill	*Phalaenoptilus nuttallii*	3	15%	2	8%	0	0%
Vaux's Swift	*Chaetura vauxi*	0	0%	0	0%	5	3%
White-throated Swift	*Aeronautes saxatalis*	12	25%	0	0%	14	15%
Anna's Hummingbird	*Calypte anna*	3	15%	36	83%	40	38%
Costa's Hummingbird	*Calypte costae*	70	70%	73	83%	144	75%
Belted Kingfisher	*Megaceryle alcyon*	0	0%	0	0%	1	3%
Ladder-backed Woodpecker	*Picoides scalaris*	3	10%	24	58%	17	15%
Northern Flicker	*Colaptes auratus*	1	5%	4	17%	37	53%
Gray Flycatcher	*Empidonax wrightii*	1	5%	2	17%	1	3%
Western Flycatcher	*Empidonax difficilis*	10	20%	1	8%	0	0%
Say's Phoebe	*Sayornis saya*	21	40%	19	58%	93	78%
Black Phoebe	*Sayornis nigricans*	1	5%	0	0%	12	20%
Vermilion Flycatcher	*Pyrocephalus rubinus*	0	0%	0	0%	1	3%
Ash-throated Flycatcher	*Myiarchus cinerascens*	21	30%	58	67%	29	23%
Brown-crested Flycatcher	*Myiarchus tyrannulus*	0	0%	0	0%	1	3%
Western Kingbird	*Tyrannus verticalis*	15	20%	2	17%	26	25%
Loggerhead Shrike	*Lanius ludovicianus*	128	85%	92	83%	125	78%
Bell's Vireo	*Vireo bellii*	5	10%	0	0%	0	0%
Cassin's Vireo	*Vireo cassinii*	2	5%	0	0%	0	0%
Warbling Vireo	*Vireo gilvus*	4	20%	0	0%	0	0%
Pinyon Jay	*Gymnorhinus cyanocephalus*	0	0%	1	8%	0	0%
Common Raven	*Corvus corax*	370	80%	172	100%	595	90%
Phainopepla	*Phainopepla nitens*	285	55%	205	67%	128	28%
Western Bluebird	*Sialia mexicana*	0	0%	1	8%	4	3%
Mountain Bluebird	*Sialia currucoides*	0	0%	0	0%	49	15%
Swainson's Thrush	*Catharus ustulatus*	2	5%	0	0%	0	0%
Hermit Thrush	*Catharus guttatus*	0	0%	0	0%	1	3%
American Robin	*Turdus migratorius*	0	0%	1	8%	41	18%
European Starling	*Sturnus vulgaris*	0	0%	0	0%	13	5%
Northern Mockingbird	*Mimus polyglottos*	176	85%	154	83%	187	83%
Sage Thrasher	*Oreoscoptes montanus*	6	25%	14	33%	20	25%
Bendire's Thrasher	*Toxostoma bendirei*	0	0%	4	17%	0	0%
Le Conte's Thrasher	*Toxostoma lecontei*	76	45%	153	92%	0	0%

Common Name	Species	AB Obs	AB Sites	JT Obs	JT Sites	CV Obs	CV Sites
California Thrasher	*Toxostoma redivivum*	6	5%	0	0%	17	8%
Crissal Thrasher	*Toxostoma crissale*	6	15%	0	0%	3	5%
Cactus Wren	*Campylorhynchus brunneicapillus*	43	40%	83	58%	83	45%
Rock Wren	*Salpinctes obsoletus*	72	60%	25	50%	105	55%
Canyon Wren	*Catherpes mexicanus*	0	0%	8	17%	0	0%
Bewick's Wren	*Thryomanes bewickii*	41	25%	9	33%	50	40%
House Wren	*Troglodytes aedon*	0	0%	0	0%	4	8%
Verdin	*Auriparus flaviceps*	79	50%	136	92%	184	78%
Blue-gray Gnatcatcher	*Polioptila caerulea*	18	55%	14	25%	87	70%
Black-tailed Gnatcatcher	*Polioptila melanura*	173	50%	185	92%	120	63%
Tree Swallow	*Tachycineta bicolor*	19	15%	0	0%	61	10%
Violet-green Swallow	*Tachycineta thalassina*	10	5%	0	0%	6	5%
Purple Martin	*Progne subis*	1	5%	0	0%	0	0%
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	0	0%	0	0%	20	10%
Barn Swallow	*Hirundo rustica*	14	20%	0	0%	21	20%
Cliff Swallow	*Petrochelidon pyrrhonota*	7	15%	1	8%	102	23%
Ruby-crowned Kinglet	*Regulus calendula*	1	5%	20	50%	46	48%
Horned Lark	*Eremophila alpestris*	93	45%	116	67%	47	40%
House Sparrow	*Passer domesticus*	0	0%	0	0%	6	10%
American Pipit	*Anthus rubescens*	0	0%	0	0%	2	5%
Lesser Goldfinch	*Spinus psaltria*	7	15%	8	17%	86	45%
Lawrence's Goldfinch	*Spinus lawrencei*	9	25%	66	50%	17	20%
House Finch	*Haemorhous mexicanus*	116	60%	195	92%	769	85%
Lark Bunting	*Calamospiza melanocorys*	0	0%	16	17%	0	0%
Song Sparrow	*Melospiza melodia*	0	0%	0	0%	2	5%
Lincoln's Sparrow	*Melospiza lincolnii*	3	10%	3	25%	11	15%
White-crowned Sparrow	*Zonotrichia leucophrys*	382	75%	311	83%	778	83%
Savannah Sparrow	*Passerculus sandwichensis*	0	0%	1	8%	63	18%
Chipping Sparrow	*Spizella passerina*	5	5%	2	8%	10	10%
Brewer's Sparrow	*Spizella breweri*	272	70%	110	67%	184	53%
Lark Sparrow	*Chondestes grammacus*	2	10%	0	0%	18	15%
Black-throated Sparrow	*Amphispiza bilineata*	165	60%	404	92%	500	73%
Sage Sparrow	*Artemisiospiza belli*	27	35%	27	75%	82	55%
Green-tailed Towhee	*Pipilo chlorurus*	0	0%	2	17%	1	3%
Spotted Towhee	*Pipilo maculatus*	0	0%	0	0%	4	5%
California Towhee	*Melozone crissalis*	0	0%	0	0%	6	5%
Abert's Towhee	*Melozone aberti*	0	0%	0	0%	7	3%
Orange-crowned Warbler	*Oreothlypis celata*	6	15%	0	0%	8	15%

Common Name	Species	AB Obs	AB Sites	JT Obs	JT Sites	CV Obs	CV Sites
Yellow Warbler	*Setophaga petechia*	3	10%	0	0%	0	0%
Yellow-rumped Warbler	*Setophaga coronata*	25	40%	13	33%	239	78%
Black-throated Gray Warbler	*Setophaga nigrescens*	1	5%	0	0%	1	3%
Townsend's Warbler	*Setophaga townsendi*	1	5%	0	0%	0	0%
Common Yellowthroat	*Geothlypis trichas*	2	10%	1	8%	2	3%
Wilson's Warbler	*Cardellina pusilla*	3	10%	7	33%	2	3%
Western Tanager	*Piranga ludoviciana*	6	15%	0	0%	1	3%
Black-headed Grosbeak	*Pheucticus melanocephalus*	5	25%	2	17%	2	5%
Blue Grosbeak	*Passerina caerulea*	2	10%	0	0%	0	0%
Lazuli Bunting	*Passerina amoena*	1	5%	1	8%	0	0%
Bullock's Oriole	*Icterus bullockii*	6	25%	0	0%	3	5%
Scott's Oriole	*Icterus parisorum*	0	0%	8	17%	0	0%
Red-winged Blackbird	*Agelaius phoeniceus*	2	5%	0	0%	0	0%
Western Meadowlark	*Sturnella neglecta*	7	10%	4	17%	155	43%
Great-tailed Grackle	*Quiscalus mexicanus*	1	5%	0	0%	6	5%
Reptiles (7)							
Tiger Whiptail	*Aspidoscelis tigris*	3	15%	16	67%	5	10%
Zebra-tailed Lizard	*Callisaurus draconoides*	5	10%	17	50%	9	18%
Sidewinder	*Crotalus cerastes*	0	0%	1	8%	0	0%
Desert Iguana	*Dipsosaurus dorsalis*	4	20%	5	25%	2	5%
Long-nosed Leopard Lizard	*Gambelia wislizenii*	0	0%	1	8%	0	0%
Desert Tortoise	*Gopherus agassizii*	0	0%	6	25%	0	0%
Desert Spiny Lizard	*Sceloporus magister*	0	0%	3	25%	0	0%
Mammals (9)							
White-tailed antelope squirrel	*Ammospermophilus leucurus*	7	20%	33	67%	25	30%
Coyote	*Canis latrans*	10	35%	5	25%	15	25%
Black-tailed jackrabbit	*Lepus californicus*	56	60%	107	92%	95	60%
Bobcat	*Lynx rufus*	0	0%	0	0%	2	5%
Desert woodrat	*Neotoma lepida*	0	0%	9	25%	1	3%
Bighorn sheep	*Ovis canadensis*	0	0%	2	17%	0	0%
Desert cottontail	*Sylvilagus audubonii*	16	30%	23	25%	10	20%
Desert kit fox	*Vulpes macrotis*	0	0%	1	8%	0	0%
Round-tailed ground squirrel	*Xerospermophilus tereticaudus*	55	60%	16	33%	5	5%
Total Species (142)		**91**		**77**		**112**	