Western Riverside County MSHCP
Biological Monitoring Program
Loggerhead Shrike 2018 Survey Protocol

INTRODUCTION

The Loggerhead Shrike (*Lanius ludovicianus*) is one of 45 bird species covered by the Western Riverside County MSHCP (Dudek & Associates 2003), and is designated as a Species of Special Concern by the State of California (Humple 2008). The statewide population is considered greatly reduced (>40–80%) since population estimates reported by Grinnell and Miller (1944), with a current estimated size of 10,000–100,000 birds. By 2028, habitat loss, habitat degradation, or other human-induced threats are projected to moderately reduce (>10–15%) the species' population in California (Humple 2008). The indirect effects of climate change may also negatively affect the productivity of the species (Borgman and Wolf 2016).

Within California, the species is distributed statewide except for the coastal slopes, the Coast Ranges, the Klamath and Siskiyou Mountains in the northwest, the Sierra Nevada and southern Cascades, and high elevations of the Transverse Ranges (Humple 2008). Shrikes are widely distributed throughout the Plan Area, occurring relatively frequently within the central portion of the Plan Area, but with few records in the montane areas (Fig. 1). Shrikes occur in western Riverside County as yearlong residents, both breeding and wintering in the area (Garrett et al. 2012).

The Western Riverside County MSHCP identifies three species objectives for Loggerhead Shrikes. The first objective requires the conservation of a minimum of 167,590 ac (67,820 ha) of suitable nesting and foraging habitat, including agriculture; grassland; cismontane alkali marsh; playa and vernal pools; desert scrubs; Riversidean alluvial fan sage scrub; coastal sage scrub; peninsular juniper woodland and scrub; riparian scrub, woodland and forest; and oak woodlands and forest. The second objective requires the conservation of at least eight breeding and foraging Core Area locations for the species, including Prado Basin/Santa Ana River, Lake Mathews/Estelle Mountain, Wasson Canyon, Temecula Creek, Wilson Valley, Quail Valley, Lake Perris/Mystic Lake/San Jacinto Wildlife Area (SJWA), and the Badlands (Fig. 1). Finally, the third species objective for Loggerhead Shrikes requires that shrikes use and successfully reproduce in at least 75% of the aforementioned Core Areas once every eight years (Dudek and Associates 2003).

Shrikes in California tend to breed mainly in shrublands or open woodlands that contain some grass cover mixed with open ground. They also require tall, isolated perches, such as trees or power lines, from which to hunt (Humple 2008; Becker et al. 2009). Such perches should ideally be located near open areas consisting of short grasses, forbs, or open ground, in which shrikes can locate and capture their prey, which consist of arthropods, reptiles, amphibians, small rodents, and birds (Craig 1978; Yosef 1996). Finally, shrikes require impaling sites from which they can hang their prey, and such sites can either be natural (e.g., thorns) or man-made (e.g., barbed wire fences) (Humple 2008).

Loggerhead Shrikes in southern California begin breeding in January and February and may continue through July (Unitt 2004). Nests, built by both males and females, are typically constructed 1–2 m above ground (Yosef 1996; Biological Monitoring Program 2011; Borgman

and Wolf 2016), though investigators have reported nest heights exceeding 9 m above ground on nearby San Clemente Island (Sullivan et al. 2005). In southern California, shrike nests may be constructed in a variety of substrates, especially mesquite (*Prosopis* spp.) (Unitt 2004), though thorny or spiny substrates may be preferred if they are available (Humple 2008). Within the Plan Area, shrikes in 2010 most frequently constructed nests in big saltbush (*Atriplex lentiformis*), California scrub oak (*Quercus berberidifolia*), chaparral bush mallow (*Malacothamnus fasciculatus*), and sugar bush (*Rhus ovata*) (Biological Monitoring Program 2011). Rangewide, shrike nests typically contain five or six eggs (overall range of 1–9 eggs), with nests at higher latitudes or in the western U.S. containing more eggs (Yosef 1996). Females are the sole incubators and will begin incubating before the last egg is laid (Sullivan et al. 2005). Hatching occurs approximately 14 days into the incubation period, at which time both parents provide food to the nestlings. Young typically fledge 17 or 18 days post-hatching and may remain with their parents for several weeks, though they are capable of independent foraging at about 40 days post-fledging. In southern California, shrikes may undertake a second nesting attempt following a first attempt (successful or unsuccessful; Sullivan et al. 2005).

Goals and Objectives

1. Document the distribution and density of Loggerhead Shrikes in the MSHCP-identified Core Areas.
    a. Conduct repeat-visit line transect surveys within accessible Loggerhead Shrike habitat in the Plan Area, recording all bird species observed.
    b. Collect data on shrikes seen perpendicular to the transects to determine their density within the survey areas. Density estimates generally require a minimum of 60–80 detections (Buckland et al. 2001).

2. Determine whether Loggerhead Shrikes are successfully reproducing in at least 75% of the MSHCP-identified Core Areas.
    a. Conduct nest searches and monitoring for any nesting shrike pairs detected during our 2018 surveys. Active nests will be monitored two or three times per week until fledging or failure occurs.

METHODS

Survey Design

We will conduct surveys for Loggerhead Shrikes by making repeat visits (n = 8 visits) to line transects (n = 113 transects) within the MSHCP-identified Core Areas (Fig. 2). We developed distance sampling survey methods using techniques described in Buckland et al. (2001) and Rosenstock et al. (2002). The design we used allows for the calculation of shrike density, transect-level detection probability and can be used to evaluate correlations between covariates (MacKenzie et al. 2006).

I began study site selection by identifying apparently suitable Loggerhead Shrike habitat on Conserved Lands within the MSHCP-identified Core Areas. These habitats were selected from our ArcGIS (ESRI 2006) vegetation layer (CDFG et al. 2005) and were based upon the habitat types in which our biologists have most often detected shrikes from 2005–2017, namely agricultural land; chaparral; coastal sage scrub; grasslands; playas and vernal pools; and riparian scrub, woodland, and forest. Finally, I generated 113 transects that are 150 m long and separated

by at least 300 m, within the patches of apparently suitable shrike habitat. Transects are oriented in a north-south direction (Buckland et al. 2015), except where this is not feasible due to the configuration of small parcels of Conserved Land.

Field Methods

Surveys will begin in January 2018 and will potentially extend through July 2018. Surveys will occur from 0.5–4.5 hours following sunrise and 0.5–2.5 hours preceding sunset, both of which generally represent periods of daily peak activity for Loggerhead Shrikes (Craig 1978). We will terminate surveys during any periods of rain or dense fog, if the ambient temperature exceeds 35°C, or if maximum wind speed exceeds 38 km h^{-1}.

At the beginning of the survey, observers will record on their datasheet the survey start time, ambient temperature (°C), and sky conditions. Observers will survey transects beginning at one of the transect termini and navigating to the central point, and then to the opposite terminus of the transect, ensuring that they remain along a straight path during the survey. Observers shall attempt to walk at a constant speed while surveying for shrikes, spending a minimum of 15 min walking the length of the transect. For each perched shrike encountered perpendicular to the transect, observers will record its distance (m), determined using a laser rangefinder, and the sighting angle (°) to the bird relative to the transect. If a shrike is detected and it is not perpendicular to the transect, the observer will still record on the datasheet the presence of the bird, but distance and sighting angle will not be recorded. Observers will not record the sighting angle or distance to shrikes that are flying because accurately measuring such distances with a rangefinder would be difficult or impossible. Instead, the observer shall record the sighting angle and distance if the shrike eventually perches perpendicular to the transect. If the shrike never perches perpendicular to the transect, then the observer will still record the shrike detection on their datasheet, leaving blank the sighting angle and distance categories.

While walking the transect, observers will also record on their data sheet (Appendix A) information for all bird species detected. For non-covered species, observers will record information for only the first individual of that species detected, which provides species richness data for the site. For such species, observers will record the four-letter species code, age class information, and sex. For Covered Species, observers will record the four-letter species code, age class, and sex for every individual detected along the transect. If observers are unsure whether they have already recorded data on an individual (i.e., they are double-counting), they will err on the side of caution and record information on that individual.

If a shrike is detected during a survey, observers will spend as much time as necessary to determine whether the shrike has an active nest nearby. This can be done while either standing on the transect and observing the shrike, or following completion of the transect survey. We will visit on a semiweekly basis all active shrike nests found in 2018. Such follow-up visits shall occur at a distance from which the observer can determine nest status based upon shrike behavior, but not so close that the shrikes are disturbed. We will continue monitoring active nests until fledging or failure occurs.

TRAINING

All field personnel will demonstrate proficiency at visual and aural identification of Loggerhead Shrikes prior to conducting surveys via an in-house examination. All personnel will also attend a pre-survey training, and demonstrate proficiency with survey techniques before

field surveys commence. After surveys start, less experienced personnel will continue to train by accompanying more experienced personnel on surveys. Less experienced personnel will not conduct surveys on their own until they have accompanied experienced personnel on a minimum of 15 surveys.

DATA MANAGEMENT

While observers are in the field, they will collect data on paper data sheets that are designed to correspond with a data entry form within the MSHCP electronic database. This will assure inferential integrity of collected data. After observers have returned to the office, they will enter their field data into an electronic Microsoft Access database, after which the data sheet will be marked as "Loggerhead Shrike Data Entered." Once all data have been entered, personnel will take data sheets from that folder and double-check the corresponding data that have been entered into the database for accuracy. When complete, data sheets will then be marked as "Loggerhead Shrike Data Checked."

DATA ANALYSIS

If we detect a minimum of 60–80 shrikes perpendicular to the transects, I will use Program DISTANCE to estimate the detection probability and population density of Loggerhead Shrikes (Buckland et al. 2001). Distance sampling allows for density estimation with incomplete detection of animals (i.e., not all animals present need to be observed to estimate density). The method relies on fitting data to several pre-defined detection functions based upon the assumption that animals are less detectable with increasing distance from the observer (Buckland et al. 2001). Distance sampling also requires that the following four assumptions be met: 1) animals are distributed independently of the survey stations, 2) animals on the transect line are detected with certainty, 3) distance measurements are exact, and 4) animals are detected at their initial location (Buckland et al. 2015).

I will examine detection histograms (i.e., number of observations per distance category) for spikes in the number of observations away from the transect (suggesting violation of assumption 2, above) and for relatively few observations near the transect in relation to other distance categories (suggesting violations of assumptions 1 and 2, above). I will then pool detection data to fit a detection function from which I can derive both stratified (i.e., daily) and pooled (i.e., average daily) estimates of shrike density. I will then fit models for the detection function, using the following models and adjustment terms as recommended by Buckland et al. (2015): uniform key with cosine adjustment, half-normal key with Hermite polynomial adjustment, and hazard-rate key with simple polynomial adjustment. I will assess model fit by graphical inspection of the detection function and using a chi-square goodness-of-fit test. I will exclude any models from the candidate set that demonstrate significant lack of fit based upon the above criteria. Finally, I will rank competing models using Akaike's Information Criterion adjusted for small sample size (AIC_C) (Buckland et al. 2015).

We will calculate daily nest survival rate (DSR) using Program MARK (White and Burnham 1999; Dinsmore et al. 2002; White 2005), assuming a constant DSR if we have few follow-up visits for nests, or a DSR that varies by nesting stage if we have sufficient data. DSR values, when raised exponentially to a power that is equal to the length of a nesting cycle (from first egg laid until first chick fledges), will give us a nest success rate for Loggerhead Shrikes.

TIMELINE

- Summer 2017: GIS work, specifically identifying habitat, assigning survey points.
- Autumn 2017: Distribution of study materials, getting access to survey areas, and ground-truthing potential survey sites.
- Winter 2017: Train survey personnel.
- January through July 2018: Surveys will be conducted. Data will be entered concurrently with surveys.
- Fall 2018: Data analysis and report writing.

LITERATURE CITED

Biological Monitoring Program. 2011. Western Riverside County MSHCP Biological Monitoring Program 2010 Loggerhead Shrike (*Lanius ludovicianus*) Survey Report. Prepared for the Western Riverside County Multiple Species Habitat Conservation Plan. Riverside, CA. Available online: http://wrc-rca.org/about-rca/monitoring/monitoringsurveys/.

Becker, M. E., P. A. Bednekoff, M. W. Janis, and D. C. Ruthven, III. 2009. Characteristics of foraging perch-sites used by Loggerhead Shrikes. Wilson Journal of Ornithology 121:104–111.

Borgman, C. C., and B. O. Wolf. 2016. The indirect effects of climate variability on the reproductive dynamics and productivity of an avian predator in the arid Southwest. Oecologia 180:279–291.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, Oxford.

Buckland, S. T., E. A. Rexstad, T. A. Marques, and C. S. Oedekoven. 2015. Distance sampling: Methods and applications. Springer, Cham, Switzerland.

[CDFG] California Department of Fish and Game, Aerial Information Systems, California Native Plant Society. 2005. Vegetation – Western Riverside Co. [ds170]. Publication Date: 2005-07-31. Available from http://bios.dfg.ca.gov/ (accessed October 2017).

Craig, R. B. 1978. An analysis of the predatory behavior of the Loggerhead Shrike. Auk 95:221–234.

Dinsmore, S. J., G. C. White, and F. L. Knopf. Advanced techniques for modeling avian nest survival. Ecology 83:3476–3488.

Dudek & Associates. 2003. Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). Final MSHCP, volumes I and II. Prepared for County of Riverside County Transportation and Lands Management Agency by Dudek & Associates, Inc. Approved June 17, 2003.

[ESRI] Environmental Systems Research Institute. 2006. ArcGIS: Release 10.1 [software]. Redlands, California: Environmental Systems Research Institute, 1999–2012.

Garrett, K. L., J. L. Dunn, and B. E. Small. 2012. Birds of southern California. R. W. Morse Company, Olympia, Washington.

Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27.

Humple, D. 2008. Loggerhead Shrike (*Lanius ludovicianus*) (mainland populations). In W. D. Shuford and T. Gardali, editors. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollack, L. L. Bailey, and J. E. Hines. 2006. Occupancy estimation and modeling: Inferring patterns and dynamics of species occurrence. Elseiver, London.

Rosenstock, S. S., D. R. Anderson, K. M. Giesen, T. Leukering, and M. F. Carter. 2002. Landbird counting techniques: Current practices and an alternative. Auk 119:46–53.

Sullivan, B. L., and E. L. Kershner. 2005. The birds of San Clemente Island. Western Birds 36:158–273.

Unitt, P. 2004. San Diego County bird atlas. Proceedings of the San Diego Society of Natural History 39.

White, G. C. 2005. Program MARK. Mark and recapture survival rate estimation. Version 7.1. Available from http://www.cnr.colostate.edu/~gwhite/mark/mark.htm (accessed July 2013).

White, G. C., and K. P. Burnham. 1999. Program MARK: Survival estimation form populations of marked animals. Bird Study 46 Supplement: 120–138.

Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*), version 2.0. In P. G. Rodewald, editor. The Birds of North America. Cornell Lab of Ornithology, Ithaca, New York. Available from https://doi.org/10.2173/bna.231 (accessed October 2017).

Figure 1. Loggerhead Shrike Core Areas and detections (2005–2017) within the Plan Area.

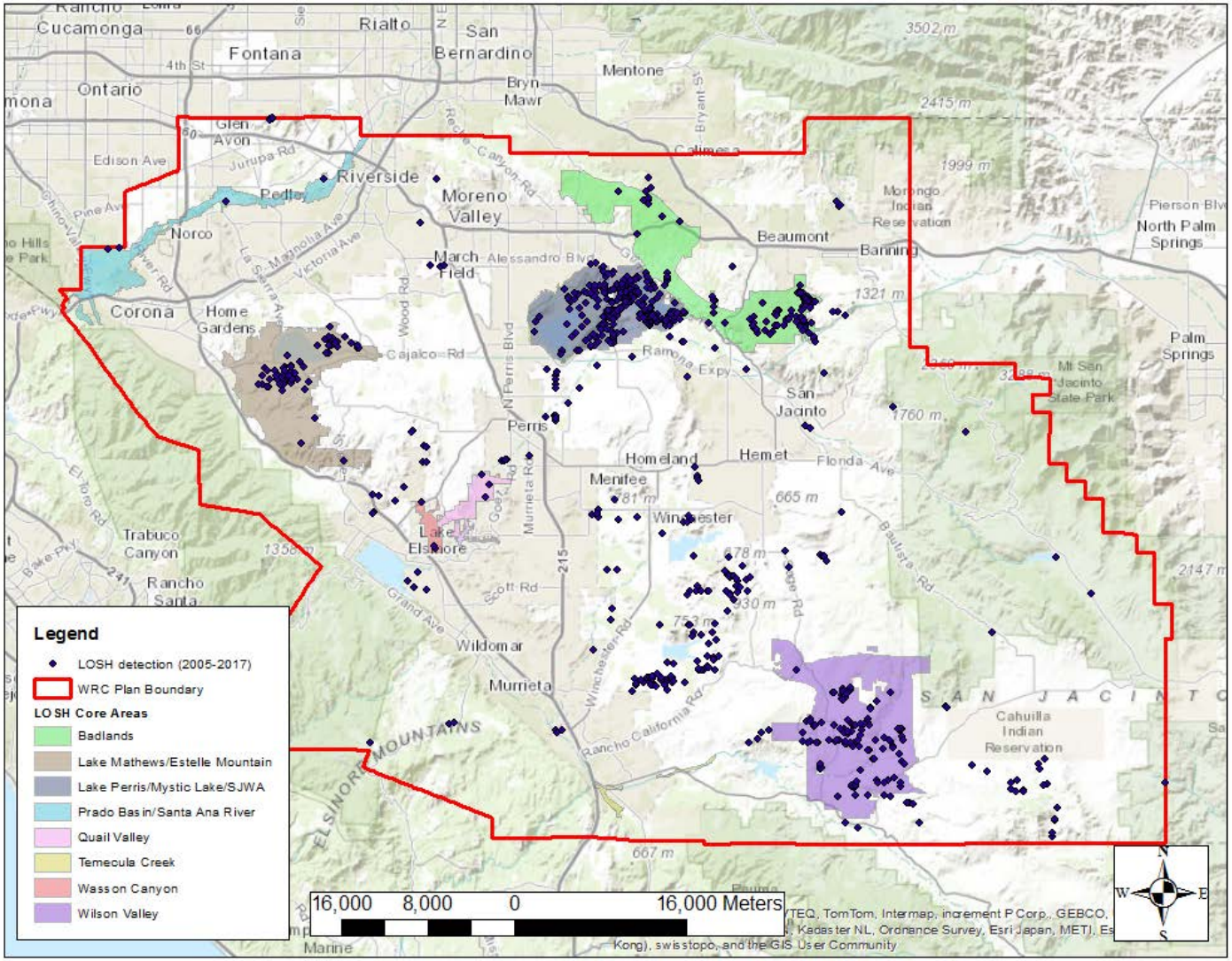
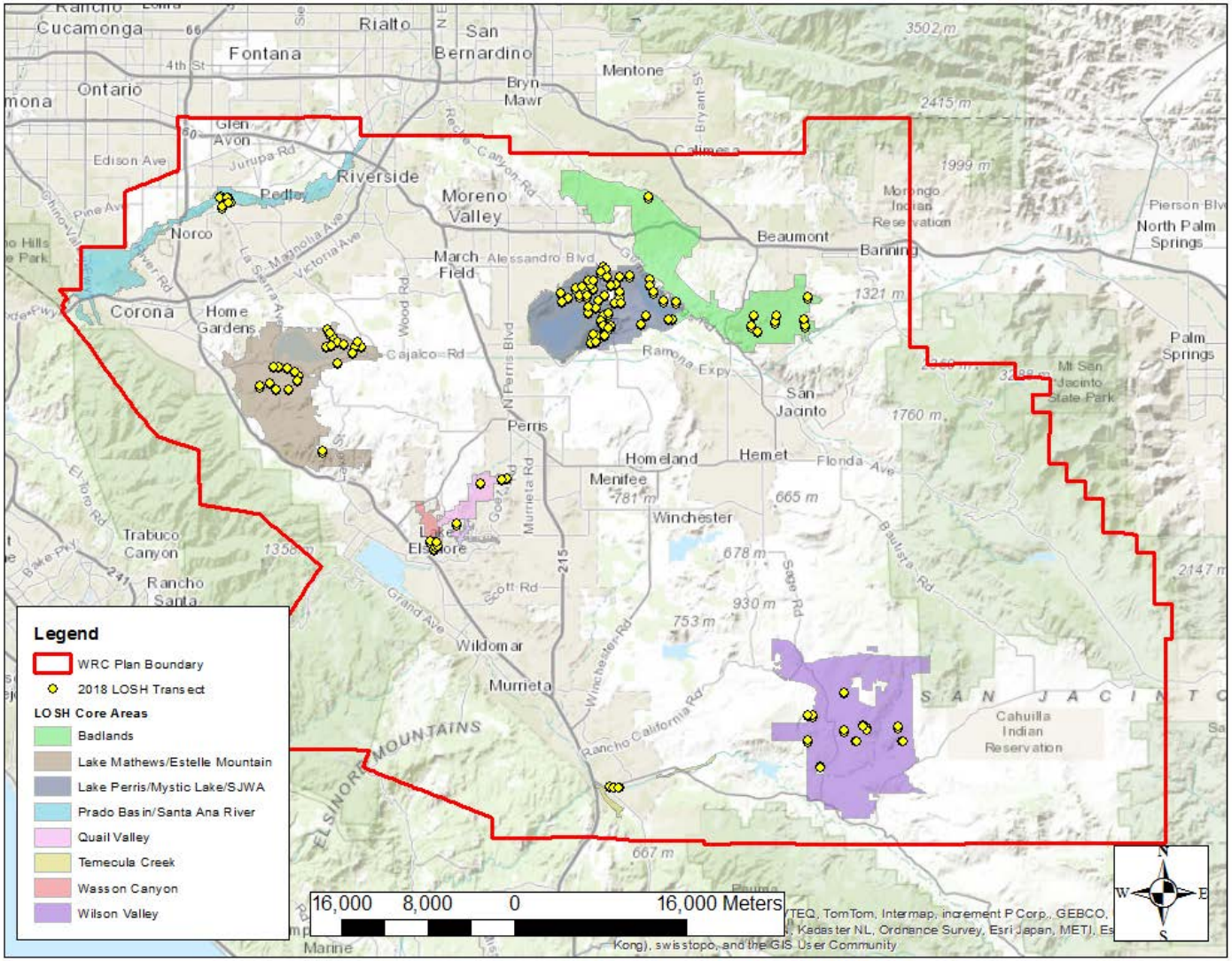


Figure 2. 2018 Loggerhead Shrike transect locations within Core Areas.



Appendix A. 2018 Loggerhead Shrike datasheet.

MSHCP Loggerhead Shrike Survey Data Sheet, 2018

Point ID:	**LS-**	Visit #:	
Date:			
Observer:			
Start time:			
End time:			

Site conditions

Max wind: _____ km h^{-1}

Avg. wind: _____ km h^{-1}

Sky code: _____

Ambient noise: _____

Start temp.: _____ End temp.: _____

Species code	Sex (M, F, U)	Age (Ad, Ju, Fl, U)	Relative angle (0-90°) to LOSH	Distance (m) to LOSH	Notes	Perp. dist. (m)

Notes, species observed in transit, etc.

Sky Condition Codes: 0 = clear or few clouds; 1 = partly cloudy; 2 = overcast; 3 = fog or smoke; 4 = light drizzle; 5 = constant snow; 6 = constant rain.

Noise Codes: 0 = no noise; 1 = noise, but not affecting bird detection; 2 = moderate noise, may be affecting detection; 3 = loud noise, reducing ability to detect birds; 4 = very loud noise, difficult to hear anything at all.