DOCKETED	
Docket Number:	09-AFC-08C
Project Title:	Genesis Solar Energy Project
TN #:	226123
Document Title:	Avian and Bat Monitoring Plan, 2nd Annual Report BIO-16
Description:	Second annual summary of monitoring activities and recommendations, dated September, 2018
Filer:	Eric Veerkamp
Organization:	Genesis Solar, LLC
Submitter Role:	Commission Staff
Submission Date:	12/14/2018 1:12:36 PM
Docketed Date:	12/14/2018

Post-Construction Monitoring at the Genesis Solar Energy Project Riverside County, California

Second Annual Report 2016 - 2017

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Initial Submittal: July 2017
Revised: September 2018

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EXECUTIVE SUMMARY

The Genesis Solar Energy Project (Project) consists of two solar power electrical generating facilities (Units 1 and 2) with a combined net capacity of 250 megawatts (MW). The project also includes the following linear facilities: a generation tie line, distribution line, natural gas pipeline, and a main access road that are mostly co-located for approximately 10.5 kilometers (6.5 miles). The Project is located on land managed by the Bureau of Land Management (BLM) 40 kilometers (25 miles) west of Blythe, in Riverside County, California.

Avian and bat monitoring surveys were conducted from February 29, 2016 to February 28, 2017 (the 2016 – 2017 monitoring year) in accordance with the Project's Bird and Bat Conservation Strategy (BBCS). Specifically, standardized carcass searches, searcher efficiency trials, and carcass persistence trials were conducted. This report focuses on the methods and results of the second year of monitoring, with comparisons made to the first year of monitoring in the discussion.

Standardized carcass searches were conducted 1) in the solar field, consisting of a random stratified 50.5% sample (increased from 30% to 50.5% for the second year of monitoring) of solar troughs or solar collector assemblies (SCAs) of both Project units, 2) at each evaporation pond, 3) along the perimeter of each power block and beneath each air condensed cooling (ACC) unit, 4) along inner and outer portions of the "fenceline", resulting in 100% of the length of the perimeter fence surveyed, and 5) along 25% of the total length of generation-tie (gen-tie) and distribution lines (collectively, overhead lines) from the southernmost Project fence to Wiley's Well rest stop, which co-occur with the Project access road. Searches were conducted at intervals of approximately seven days during spring and fall and 21 days during summer and winter. All components were searched 32 times during the 2016 – 2017 monitoring year (13 times during spring, five during summer, eight during fall, and six during winter).

All dead and injured birds and bats that were discovered by observers, referred to as "detections" in this report, including those found incidentally and during standardized carcass searches, were documented. During the reporting period, 195 avian detections and 10 bat detections were made. Composition of the 2016 – 2017 detections included 55 avian species from 17 guilds (excluding unidentified birds). Waterbirds and waterfowl comprised the largest number of detections (n = 56): the most common waterbird species detected was eared grebe (8 detections or 4.1% of all avian detections), with three found at the ponds, two at the SCAs, one at the power blocks, one at the fence, and one at a building. Blackbirds and orioles (family Icterid) were the second most common guild (n = 47): the most common blackbird species was brown-headed cowbird (*Molothrus ater*; n = 19). Four of the 10 bats detected were found at the ponds, three at the power blocks, one at the fence, one at a conex box, and one at a Project building. No bats were found in the SCAs. The most common bat species found was the canyon bat (*Parastrellus hesperus*; n = 9).

Avian detections were categorized by facility component, size and suspected cause of death. These standardized carcass search results, along with searcher efficiency and carcass persistence rates from bias trials conducted on site, were analyzed following Huso's (2011) methods, modified for distance sampling, to provide an estimate of the number of fatalities that occurred at the Project during the reporting period adjusted for sources of bias.

To account for scavenging and other forms of carcass removal bias, fatalities were adjusted for the probability of being available at (or "persisting to") the next scheduled search (variable by migration period). Models were fit for each size class separate with combinations of covariates, and evaluated for relative performance with the Akaike Information Criterion corrected for sample size (AICc). Persistence trials from both the first and second monitoring year were used. Season, year, and Project component location were included in the best models for each size class. During the second monitoring year, carcass persistence models estimated the probability of persistence for small, medium, and large birds by Project location (inside or outside the perimeter fence), season (spring, summer, fall, winter) and year (first and second monitoring year). The probability of a carcass persisting to the next search was lower during the second monitoring year than during the first for every season and size class combination in the solar field and at the overhead lines. The general decline in persistence is likely the reason both year and season were included in the best model. No seasonal pattern was apparent but there was a general trend of decreasing carcass persistence over the two year monitoring period. Probability of persistence to the next search was less for smaller sized carcasses and less for carcasses placed outside the perimeter fence.

Median persistence time followed the same patterns, in general being shorter for smaller carcasses, shorter outside the perimeter fence, and shorter during year two. The shortest median persistence time was predicted for small carcass outside the fence in fall of year two, being just under 12 hours. The longest was for large birds inside the perimeter fence in fall of year one, predicted to be greater than 30 days. There were no clear seasonal patterns across all size classes and there was no evidence of avian migration periods influencing carcass persistence.

To account for a searcher's ability to detect a carcass, detections were adjusted by a searcher efficiency estimate. Searcher efficiency was modeled separately for small, medium, and large birds. Trials placed at the SCAs were modeled using distance sampling methods to reflect searches being conducted from a transect while scanning out to a distance of 59 meters, a deviation from the Huso (2011) model. Searches at the other Project components did not have large viewsheds and searcher efficiency trials in these locations were modeled with logistic regression following the Huso (2011) model. Model comparisons using AICc indicated that neither season, location (inside/outside fence), nor component type had an effect on a searcher's ability to find a carcass at the Project for all size classes and search types. Trials from the overhead lines, fence, and power block were combined. At these components, searcher efficiency during the 2016 – 2017 monitoring year was 84%, 93%, and 100% for small birds, medium birds, and large birds, respectively. At the SCAs, searcher efficiency was 61%, 88%, and 88% for small, medium, and large birds, respectively during the 2016 – 2017 monitoring year. Trials from the first year of monitoring were not used to inform the model due to the change in search methods at the SCAs the second year.

During the 2016 – 2017 monitoring year there were an estimated total of 724 bird fatalities (CI: 511 – 1,005) and 25 bat fatalities (CI: (6) – 48) at the Project (all components combined). For all components associated with both solar units (SCAs, power blocks, evaporation ponds, and along the perimeter fence; totaling 1,727 acres), there were an estimated 484 (CI: 380 – 611) bird fatalities (0.28/acre, 1.9/nameplate MW) and 25 (CI: (6) – 48) bat fatalities (0.01/acre, 0.1/nameplate MW). There were an estimated 240 (CI: 53 – 469) bird fatalities along overhead lines. No bat carcasses were detected along the overhead lines.

The density of estimated bird fatalities in the SCAs (1,163 acres) was lower (0.18 fatalities per acre) during the second year of monitoring compared to the first year (0.56 fatalities per acre). Along the overhead lines, the density of estimated bird fatalities was 14 fatalities per kilometer during the second monitoring year compared to 30 fatalities per kilometer during the first monitoring year. It is not clear why there were more detections and estimated fatalities during the first year of monitoring compared to the second. There are potentially many factors that might influence variation in detections and fatality estimates from year to year, but attempting to determine those factors is beyond the scope of this report. The density of estimated bat fatalities in the SCAs was 0.006 fatalities per acre during the first monitoring year and was based upon one bat found in the SCAs. During the second monitoring year, no bats were found in the SCAs.

STUDY PARTICIPANTS

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REPORT REFERENCE

Western Ecosystems Technology, Inc. (WEST). 2018. Avian and Bat Monitoring at the Genesis Solar Energy Project, Riverside County, California. Annual Report, 2016 – 2017. Prepared for Genesis Solar LLC, Juno Beach, Florida. Prepared by WEST, Cheyenne, Wyoming.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1 INTRODUCTION

1.1 Project Background

The Genesis Solar Energy Project (Project) consists of two solar power electrical generating facilities (Units 1 and 2) and associated infrastructure with a combined net capacity of 250 megawatts. The Project is located on land managed by the Bureau of Land Management (BLM) 40 km (25 miles) west of Blythe, in Riverside County, California (Figure 1). The Project facility consists collectively of two power blocks, power generating equipment (solar collector assemblies [SCAs] of mirrored parabolic troughs [solar troughs or troughs]), support facilities, and evaporation ponds. The project also includes the following linear facilities, a generation tie line, distribution line, natural gas pipeline, and a main access road that are mostly co-located for approximately 10.5 km (6.5 miles). The Project comprises approximately 1,800 acres. The solar field and associated structures comprise 1,727 acres (699 ha) and linear facilities comprise 93 acres (38 ha).

1.2 Monitoring Plan Overview and Goals

A Bird and Bat Conservation Strategy (BBCS) was prepared by the Project proponent in collaboration with the US Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), California Energy Commission (CEC), and BLM to guide comprehensive monitoring of impacts to birds and bats associated with operation of the Project. Final agency acceptance of the BBCS occurred in March 2015. The sampling protocol and sample size for searcher efficiency and carcass persistence trials were modified for the second year of monitoring per the TAG meeting decision on February 11, 2016. These changes are noted in the amended BBCS (WEST 2016) and described in the methods section below.

The BBCS details post-construction monitoring to be conducted and the data analysis and reporting processes that will be implemented by Genesis Solar in collaboration with the USFWS, CDFW, CEC, and BLM. As identified in the BBCS, the goals are:

1. Estimate overall annual avian fatality rate and species composition associated with the Project infrastructure. This estimate will include mortality associated with SCAs, overhead lines (gen-tie line and distribution lines), perimeter fence and other features of the Project that may result in injury and mortality.

2. Determine whether there are spatial and temporal/seasonal patterns of mortality associated with Project infrastructure (e.g., different mortality rates near SCAs on the edge of the solar field versus the interior area of the solar field).
3. Provide information that will assist the CEC and BLM, in consultation with the USFWS and the CDFW, in understanding which species and potentially which regional populations are at risk.
4. Collect data in such a way that the CEC and BLM, in consultation with the USFWS and CDFW, may make comparisons with other solar sites.

1.3 Purpose of This Report

This report represents the comprehensive annual report for the second year of monitoring, summarizing monitoring methods and results for avian and bat detections and injuries based on the procedures and requirements specified in the approved BBCS and as required by CEC Condition of Certification BIO-16. This report includes data and final information from all four quarterly monitoring periods.

This report covers the 2016 – 2017 monitoring year, which includes the period from February 29, 2016 to February 28, 2017. This annual report includes the observed mortality rates broken out by likely diurnal and likely nocturnal species, and by ecological guilds of interest (e.g., raptors, water-associated birds, passerines, bats) for each of the facility types and suspected causes of death. Species composition of detections, the results of the bias trials, and fatality estimates (adjusted based upon the bias trial results) are also included in this report.

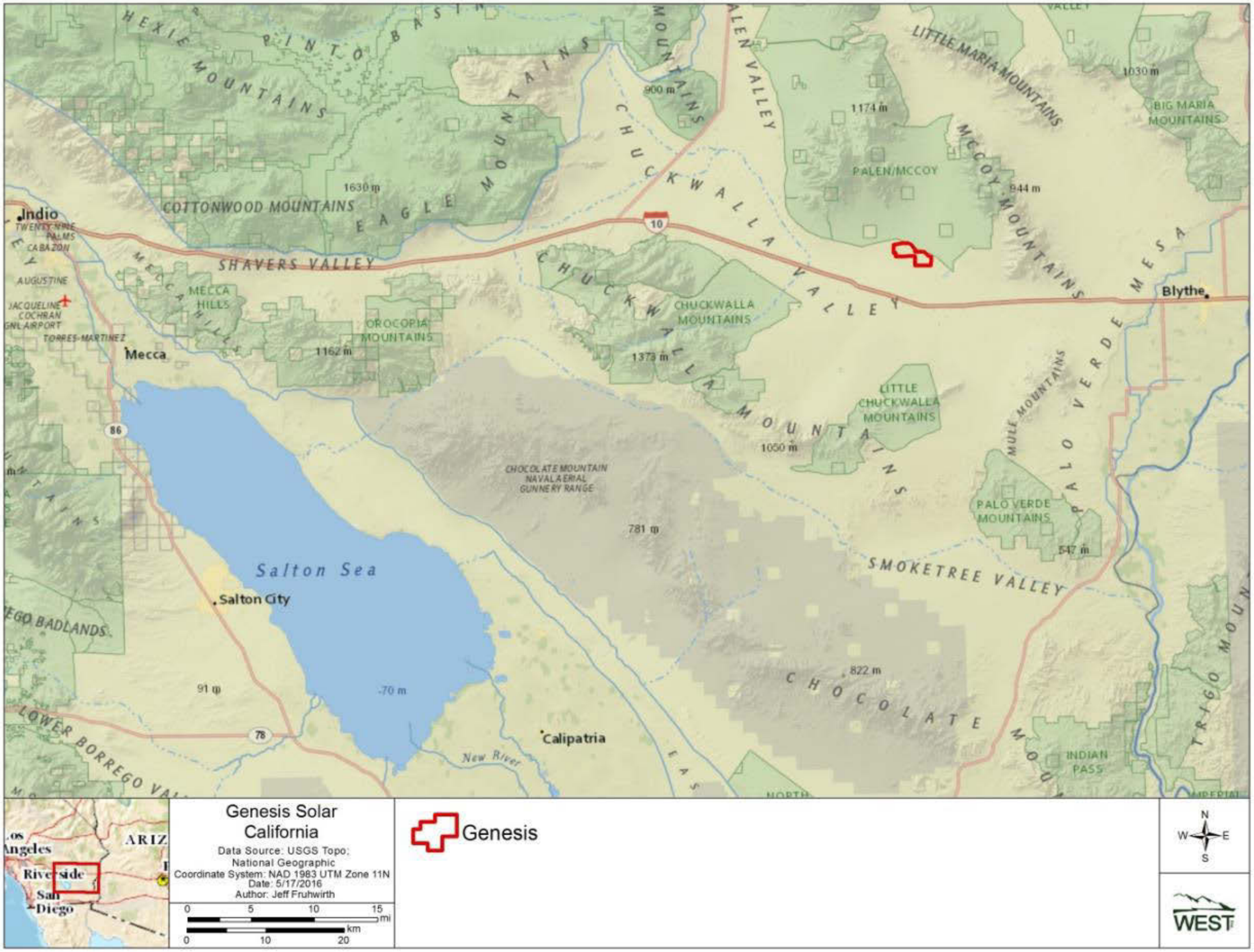

Figure 1. Genesis Solar Energy Project vicinity map, Riverside County, California.

2.0 METHODS

The following section describes the field and statistical methods used during the monitoring period, including the analytical methods for estimating overall avian and bat fatality rates.

2.1 Standardized Carcass Searches

Standardized carcass searches were conducted throughout the second monitoring year (February 29, 2016 – February 28, 2017). In order to capture variability across the monitoring period and Project site, searches varied temporally and spatially. This section describes areas surveyed, the timing and frequency of searches, and the methods by which standardized searches were conducted to identify dead/injured birds and bats at the Project.

2.1.1 Areas Surveyed

Standardized carcass searches were conducted at five facility related components (Figure 2). Searches were conducted at a sample of the solar collector assemblies in each unit, the perimeter of each power block (including the area below each air condensed cooling [ACC] unit; Figures 3 and 4), the evaporation ponds (Figure 3), the “fenceline” (defined as the perimeter fence for each unit and includes 100% of the total length of the fence; Figures 3 and 4), and the overhead lines (gen-tie and distribution lines; 25% of the total length of each line from the Project fence to Wiley’s Well rest stop; Figure 5). Table 1 provides information on characteristics (e.g., number and size) of each component as well as the proportion of each component that was searched.

To ensure a balanced distribution of sampled area in the solar collector assemblies with no spatial clustering, each unit was divided into blocks and sampled using a systematic random sample with random start amounting to 50.5% of rows of the SCAs. The proportion of area sampled was increased from 30% during the first monitoring year to 50.5% during the second. Randomly, some of the same rows were sampled the first and second year, but most were not. A systematic sample with random start was also used at the gen-tie and distribution lines. Sections that were monitored during the previous year were excluded from the random selection to ensure a new set of overhead lines were monitored the second year.

(a) Solar Collector Assemblies (SCAs)

(b) Gen-tie and Distribution Lines

(c) Fence

(d) Evaporation Ponds

(e) Evaporation Pond Netting

(f) Power block ACC Unit

Figure 2. Areas of standardized searches at the (a) SCAs, (b) gen-tie and distribution line, (c) perimeter fence, (d,e) evaporation ponds north and south and (f) power blocks at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017)

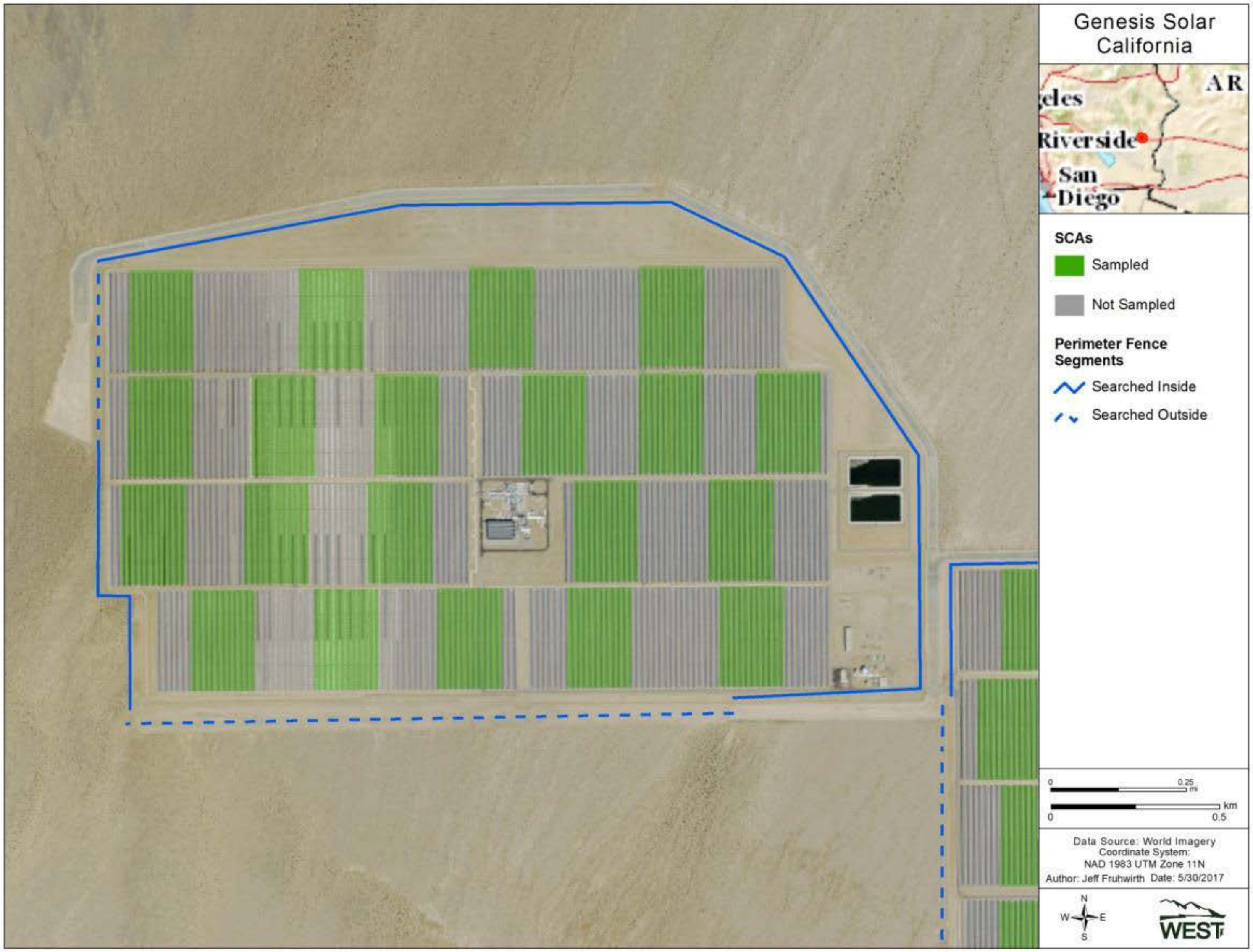

Figure 3. Areas of standardized searches at Unit 1 of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017)

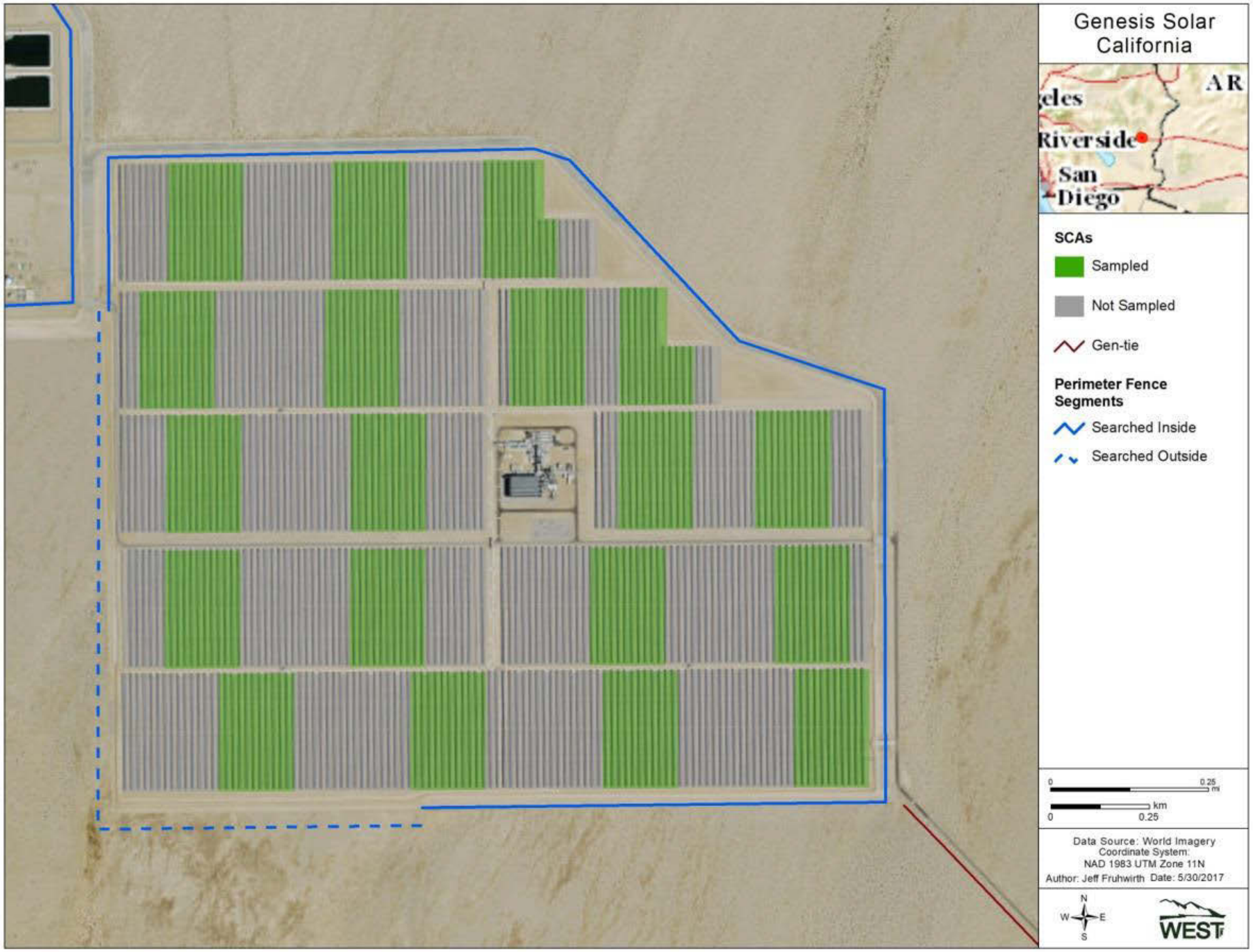

Figure 4. Areas of standardized searches at Unit 2 of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017)

Figure 5. Areas of standardized searches along the overhead lines at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017)

Table 1. Areas included in standardized carcass searches at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Project Component	Total Size	Units	Percent of Component Searched
SCAs	920.0	rows of solar troughs	50.5
Unit 1	460.0	rows of solar troughs	52.0
Unit 2	460.0	rows of solar troughs	49.0
ACC units	2.2	Acres	100
Power Blocks (perimeter)	0.8	Kilometers	100
Evaporation ponds	7.7	Acres	100
Distribution Line	8.4	Kilometers	25.0
Generation Tie Line	8.4	Kilometers	25.0
Fence	14.5	Kilometers	100

2.1.2 Search Frequency and Timing

The 2016 – 2017 monitoring year includes the period from February 29, 2016 through February 28, 2017. Standardized searches occurred at seven-day intervals during spring (February 29 – May 29, 2016) and fall (September 5 – October 28, 2016), and 21-day intervals during summer (May 30 –September 4, 2016) and winter (October 29, 2016 – February 28, 2017). All Project components included in standardized searches were surveyed 32 times during the 2016 – 2017 monitoring year. Each sample unit was sampled 13 times during spring, five during summer, eight during fall, and six during winter. Inadvertently, three sample units at the SCAs were searched 12 rather than 13 times during spring. All searches took place during daylight hours between approximately 5:30 am and 5:30 pm.

The average search interval was 7.0 days (median 7 days) during spring, 19.6 days (median 21 days) during summer, 7.0 days (median 7 days) during fall, and 18.7 days (median 21 days) during winter. The shorter search interval during spring and fall, typical of most mortality monitoring projects, helps to account for the increase in bird activity and bird diversity during the spring and fall migration periods leading to potentially higher expected fatality rates during these periods. Searching more often during high activity periods is also an attempt to increase the precision and accuracy of the estimate by increasing the probability of carcass persistence (it is more probable a carcass will last seven days than 21), and by obtaining better estimates of carcass age as it is easier to age fresh carcasses. Slight variation in search interval was anticipated due to weather, scheduling and logistical delays.

2.1.3 Search Methods

During the second monitoring year, standardized carcass searches were performed by CEC- and BLM-approved biologists, in accordance with methods outlined in the amended BBCS (WEST 2016). At the end of the first year of study, WEST and the TAG agreed to increase the viewsheds of the observers during the transect surveys at the Genesis Solar Energy Project, which resulted in an increased proportion of the solar field that is searched (see WEST 2016). In addition, some changes were made to the transect survey methods (Figure 6). The reason for these recommended changes is that the searcher efficiency rates were very high during the first monitoring year and especially high for medium and large birds for a 30-meter (m) viewshed. It was determined that precision could be increased for the same or less effort for medium to large birds (e.g. water-associated birds) by covering more SCAs overall, but with less effort per sample unit (larger viewsheds).

A distance survey method was employed for searches at the SCAs. Searchers slowly drove (5.0 miles per hour [mph; 8.0 km per hour (kph)] or less) transect lines parallel to solar troughs and scanned out to approximately 60 m, beneath three solar troughs. Each sample unit spanned 12 SCAs plus half of the distance to the next SCA on each side (Figure 6). Biologists slowly drove transects that made two loops between the third and fourth, and between the ninth and tenth solar troughs of a sample unit; searchers began on the right side of the row (scanning left out of the driver's side window) to approximately 59 m (194 feet [ft]), 8.5 m beyond the third visible trough (Figure 6). On the return drive, biologists drove on the opposite side of the same row while looking to the left to 59 m. After the first loop was completed, biologists drove to the next loop and repeated the same search pattern. Within Units 1 and 2, 468 solar troughs or 50.5% of the total solar troughs were surveyed during the second monitoring period.

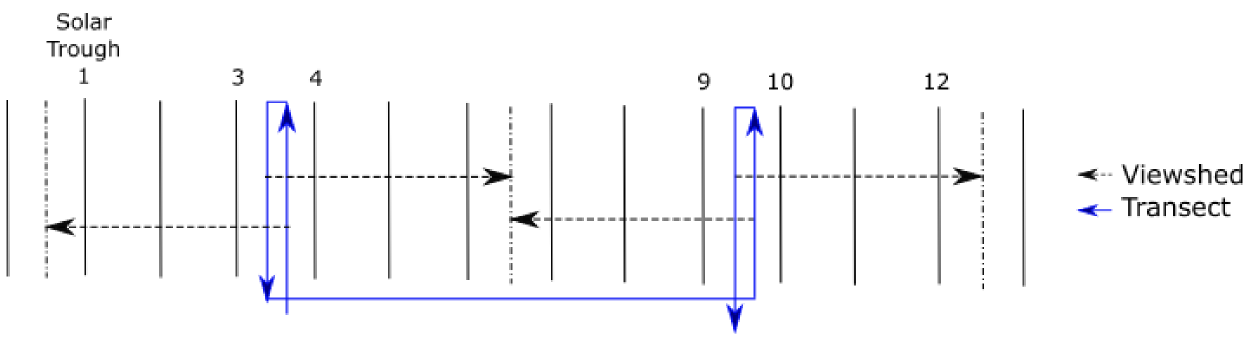

Figure 6. Survey method for a single SCA sample unit at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). The driving transect is shown in blue; the dashed line indicates the expanded viewshed.

At each power block, biologists slowly walked around the entire perimeter looking for dead and injured birds and bats, and used binoculars to scan interior portions of the power block. The search area for the power block is defined as the 0.8-km (0.5 miles) perimeter of each power block, and the area of the interior power block that was available for visual inspection from the periphery. Beneath ACC units, biologists walked four or five evenly spaced transects (approx. 15-m [49 ft] apart) through the gravel (Figure 2f).

At each evaporation pond, biologists walked the entire perimeter looking for dead and injured birds and bats on the ground, in the netting, and in the pond below the netting (Figure 2d and 2e). Binoculars or a spotting scope was used to scan across the top of the netting and the surface of each pond. Biologists also scanned under the netting for bowing that would indicate a heavier carcass may be present though not visible from the top.

The entire length of fence (19.3 km or approximately 12 miles) was searched by vehicle. Biologists searched approximately 3.2 km (2.0 miles) along drivable sections of the outside of the fence, and the remaining 15.2 to 16.9 km (9.5 to 10.5 miles) from the inside of the fence (Figures 2c, 3 and 4). Due to privacy slats woven into the fence, inner and outer sections of fence were unable to be scanned simultaneously. Biologist scanned six meters from either side of fence. Travel speed was below five mph while searching.

The overhead lines (Figure 2b) were each surveyed using a 30-m wide strip transect centered on the line (i.e., 15 meters (m) of ground on either side of the overhead line). A 25% sample of both lines from the Project fence to the Project outer gate located near the Wiley's Well Road rest stop were searched for detections. Biologists slowly walked every fourth 300-meter (984-ft) segment of each line, scanning for dead or injured birds or bats within 15 meters (49.2 ft) of the transect line. Given the location of the lines relative to the road, detections found in the strip transects below overhead lines could be caused by collision with an overhead line, collision with vehicles along the road, scavenging of carcasses from the road or overhead lines, predation, or some combination thereof.

Once a carcass was detected, it was immediately photographed, and data (i.e. date discovered, species, age, sex, detection condition and description, size class, detection ID, estimated time of death/injury, suspected cause of injury/mortality, evidence of injury, level of certainty for suspected cause, evidence of scavenging , disposition of detection, rehabilitation outcome of injured bird, GPS coordinates of detection location, sample unit, nearest project component, distance and bearing to nearest project feature, inside/outside search area, whether found incidentally or during carcass search, weather conditions, habitat, visibility index, percent vegetation cover, etc.) were recorded according to specifications outlined in Section 6.7 of the approved Genesis BBCS (WEST 2016). Detections were immediately retrieved from their location on the ground, labeled, and placed in a freezer on site. In addition, feather spots were classified as a detection based on the standards commonly applied in California (CEC and CDFG 2007), which dictate that when only feathers are found, to be classified as a detection, each find must include a feather spot of at least five tail feathers or two primaries within 5 m (16.4 ft) or less of each other, or a total of 10 or more feathers of any type concentrated together in an area of three square m (m^2; 32 square ft [ft^2]).

Suspected cause of death was assigned based on evidence available on the detection (e.g. broken neck, broken wing, broken bill), evidence available on the Project infrastructure (e.g. imprint on panels, feathers on panels), and proximity of the detection to Project infrastructure. Detections that had no evidence of cause on the carcass and lacked evidence on Project infrastructure or that were scavenged to a degree that cause was unclear were assigned as "unknown". Detections that were relatively intact (i.e., with minimal evidence of scavenging), located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines), and had evidence of injury had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is uncertainty associated with cause of death assignments because no events were directly observed and necropsies were not performed. Detections assigned to the "unknown" category were included in fatality estimates if they were located within standardized carcass search areas, and all detections made during the 2016 – 2017 monitoring year are reported here.

2.2 Carcass Persistence Trials

Carcass persistence trials were conducted in each of the four seasons during the 2016 – 2017 monitoring year. Trial carcasses from three size classes (small [zero-100 grams [g]], medium [101 –999 g], and large [1000+ g]) were used for trials. Carcass persistence results from small birds were used as a proxy for bat carcass persistence. The small size class comprised house sparrows (*Passer domesticus*) and two to three week-old coturnix quail (*Coturnix coturnix*), the medium size class comprised rock pigeons (*Columba livia*), chukar (*Alectoris chukar*), northern bobwhite (*Colinus virginianus*) and older coturnix quail, and the large size class comprised hen mallard (*Anas platyrhynchos*) and hen ring-necked pheasant (*Phasianus colchicus*).

2.2.1 Carcass Persistence Data Collection

During the 2016 – 2017 monitoring year 440 carcasses were placed and monitored, as specified in Appendix D (2016 Monitoring Changes) of the amended BBCS (WEST 2016). During the second monitoring year, 97 trial carcasses within the SCAs, 23 along the fence, one at the power blocks and 18 along the overhead lines were monitored using motion-triggered digital trail cameras, while the remaining trial carcasses were visited on foot for 30 days or until the carcass had deteriorated to a condition at which it would no longer qualify as a documentable carcass (i.e., a feather spot). Fewer trial carcasses along the overhead lines were monitored with cameras because of theft and vandalism concerns. Trial carcasses without trail cameras were visited and photographed once per day for the first four days, and then every three to five days until the end of the monitoring period. To avoid training scavengers to recognize cameras as “feeding stations,” trail cameras were installed five days before specimens were placed, and fake cameras without bias trial carcasses were placed (60 within the Project fence, and 18 along the overhead lines). Periodic ground-based checking of trial carcasses with trail cameras also occurred to guard against misleading indicators of carcass removal, such as wind blowing the carcass out of the camera’s field of view. To minimize potential biases caused by scavenger swamping (i.e., too many carcasses in the field at once, Smallwood 2007, Smallwood et al. 2010), carcass-persistence specimens were distributed randomly across the entire Project so as to not attract scavengers to any one location, especially at regularly searched areas. In addition, trials were initiated on two to four different dates throughout each season so that all trials allocated to a specific size group and season were not all distributed at the same time.

2.2.2 Estimating Carcass Persistence Times

Measurements of carcass persistence rates were subject to censoring. In this context, censoring refers to the instance when a value (e.g., days a carcass is present before being removed) may not be exactly known but is known to be within a finite range. For example, suppose a trial carcass was checked on day seven and was present, and was checked again on day ten, but was found to be missing. The exact time until removal is unknown; however, it is known that the trial carcass became unavailable at some point between seven and ten days. This trial carcass would be considered “interval censored”. Similarly, if a trial carcass lasts the entire 30-day trial period, that carcass is “right censored”— it is known that the carcass lasted at least 30 days, but it may have persisted longer. Because carcass persistence data were censored, persistence was analyzed using methods that can accommodate censored data and still produce unbiased estimates of the probability of persistence (Therneau 2015, Therneau & Grambsch 2000). It is beyond the scope of this document to provide statistical foundations of censored-data survival models, but functions identical to those provided with the USGS-developed fatality estimator software (Huso et al. 2012) were used to fit survival models to the censored carcass persistence data, and some background is available in the documentation provided with that software.

USGS-developed fatality estimator software (Huso et al. 2012) was used to fit survival models to the censored carcass persistence data. There were four distributions implemented in survival models used to estimate the probability that a carcass was available to be found at the end of the search interval: exponential, Weibull, loglogistic, and lognormal. These four distributions exhibit varying degrees of flexibility in order to model a wide variety of distributions of persistence time. Season (spring, summer, fall, and winter; and migration, non-migration), Project component location (inside or outside the perimeter fence), and year were investigated as potential predictor variables for improving model performance. Trial data from year one and year two were used to fit the models. Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model. All models within two AICc values of the top model with the lowest AICc value were considered. The model with the fewest parameters (i.e. predictor variables) was selected. The model with the lowest AICc score is typically chosen as the "most supported" model relative to other models tested; however, any model within two AICc points of the most supported model is considered competitive with the most supported model (Burnham and Anderson 2004).

2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the 2016 – 2017 monitoring year. Carcasses from three size classes (small, medium, and large) were used for trials. Searcher efficiency results from small birds were used as a proxy for bat detection. The small size class comprised house sparrows and two-three week old coturnix quail, the medium size class comprised rock pigeons, chukar, northern bobwhite and older coturnix quail, and the large size class comprised hen mallards and hen ring-necked pheasants.

2.3.1 Searcher Efficiency Data Collection

A total of 360 searcher efficiency trial carcasses were placed at the Project during the second monitoring year as specified in Appendix D (2016 Monitoring Changes) of the amended BBCS (WEST 2016). Eighty-five searcher efficiency trials (25 small birds, 15 medium birds, and ten large birds within SCAs, power blocks and along the perimeter fence, and 15 small, 10 medium, and 10 large along the overhead lines) were placed at the Project during each season. During fall and winter, several small trial carcasses went missing before the searches occurred; an additional 10 small bird trials were placed during fall and 10 during winter to account for this. Trial carcasses were placed in various vegetation heights and vegetation types randomly, if any vegetation existed, to represent the range of conditions under which searches occurred. However, little variation existed at the Project due to a general lack of vegetation. Trial carcasses were placed in all areas where standardized searches occur except for at the evaporation ponds because placement atop the netting was not possible. Searcher efficiency at the pond was assumed to be similar to the components that were not searched by distance sampling (overhead lines, fence and power blocks).

Searcher efficiency trial carcasses were placed at random locations within the search areas prior to the actual search effort that same day by the biologist designated as the "experimenter." Prior to placement in the field by the experimenter, all trial carcasses were marked with an inconspicuous piece of black tape around the leg so that they could be clearly identified as experimental trial carcasses, but so that they were not visible as such from a distance. Trial carcasses were placed by dropping the carcasses from waist height or higher, in order to simulate natural positioning of fallen carcasses, and to avoid placement bias. A global positioning system (GPS) was used by the experimenter to record the location of each trial carcass placed. After the search effort was completed, the number and location of searcher efficiency trial carcasses found during the carcass survey was recorded. The number of trial carcasses available for detection during each trial was determined after the trial by the experimenter, who returned to the location of any undiscovered trial carcasses to document whether they were still available. Trial carcasses were collected either as they were detected by a searcher, or shortly after the search occurred but always within a few hours of the completion of a search.

2.3.2 Estimating Searcher Efficiency

For the overhead lines, fence, and power block features, logistic regression models were fit separately for each size class to searcher efficiency data. Season (spring, summer, fall, and winter; and migration, non-migration) and Project component type were investigated as potential predictor variables for improving model performance. AICc was used to rank the relative fit of each model. All models within two AICc values of the top model with the lowest AICc value were considered. The model with the fewest parameters (i.e. predictor variables) was selected. Results of the logistic regression model ($\hat{p}$; probability of detection) for each category *i* are equivalent to:

$$\hat{p}_i = \frac{Number\ of\ Carcasses\ Found\ in\ category\ i}{Number\ of\ Carcasses\ Available\ in\ category\ i}$$

For the SCAs, searcher efficiency was evaluated using a distance sampling approach (Buckland et al. 1993). Distance sampling assumes perfect detection on the transect line (at a distance equal to zero), an assumption that is likely valid in the SCAs given the relatively flat and vegetation-free nature of the soil surface. A curve was fitted to the observed carcass data that predicted the probability of detection as a function of distance from the transect line. The mean value of this function over a specified distance, *w,* is equal to the average searcher efficiency for a transect of width *w*. The mean value of the detection curve is the integral of the detection function calculated between zero meters and the maximum survey distance (*w;* 59 meters), divided by the maximum survey distance:

$$p = \frac{\int_0^w f(x)dx}{w},$$

where *f(x)* is the detection function evaluated at distance, *x*.

One departure in the methods used here, relative to the methods presented in Buckland et al. (1993), was that for this study the detection function was estimated using trial carcasses, which meant that there were both presence (detected) and absence (not detected) data available to fit the detection function. The availability of both presence and absence data means that the detection function can be estimated using only trial carcasses whose distribution is known. Therefore, the detection function, the average searcher efficiency among the SCAs, and the final fatality estimate within the SCAs are all insensitive to the spatial distribution of carcasses within individual SCAs, and the overall searcher efficiency estimate is valid even if the distribution of carcasses among the SCAs is not uniform.

Distances of trial carcasses (both found and missed trial carcasses) from the transect line were used to fit half-normal, exponential, hazard rate, and uniform distribution detection functions (all commonly used functions for distance sampling surveys; Buckland et al. 1993). Searcher efficiency was modeled separately for small, medium, and large birds. Season (spring, summer, fall, and winter; and migration, non-migration) and Project component type were investigated as potential predictor variables for improving model performance. The fit of detection functions were compared using AICc. All models within two AICc values of the top model with the lowest AICc value were considered. The model with the fewest parameters (i.e. predictor variables) was selected.

There are two visibility classes present at the Project site. Easy visibility (defined as ≥ 90% bare ground [BG]; vegetation <6" tall) and moderate visibility (defined as 26 – 89% BG; vegetation <6" tall) exist, however, within the solar field the moderate visibility class has a very limited spatial extent due to management aimed at minimizing vegetation cover. Thus, within the solar field, samples were not stratified by visibility class and visibility was not considered as a potential predictor variable because sample sizes were not sufficient in the moderate class. Because the moderate visibility class has a greater spatial extent along the overhead lines, we included a test of visibility class when modeling searcher efficiency along the overhead lines.

2.4 Fatality Estimator

Fatality rate estimation is a complex task due to several variables inherent to every fatality monitoring study. Carcasses may persist for variable amounts of time due to local scavenger activity or environmental conditions leading to carcass degradation over time. Carcasses and feather spots are also detected with varying levels of success based on carcass characteristics and ground cover (e.g., vegetated areas underneath the gen-tie and distribution lines versus cleared areas beneath SCAs). For these reasons, it is generally inappropriate to draw conclusions based on the raw number of detections alone. The desire to estimate fatalities given these variables has driven the development of several statistical methods for estimating fatalities (e.g., Smallwood 2007, Huso 2011, Korner-Nievergelt et al. 2011). All of these fatality estimation methods share a similar underlying model. Generally, the fatality estimation for a given site may be written as:

$$\hat{F} = C/\hat{r}\hat{p}a$$

where $\hat{F}$ is the estimated total number of fatalities, *C* is the number of detections found and included in fatality estimation*,* $\hat{r}$ is the estimated probability that a carcass is un-scavenged and available to be found at the end of the search interval, $\hat{p}$ is the estimated probability of detecting a carcass, and *a* is the proportion of area searched (Huso 2011). The binomial carcass detection model was used to calculate fatality estimates at the Project fence, overhead lines and power blocks, and the average probability of detection based on distance sampling (described previously) was used to estimate probability of detection within the SCAs.

All fatality estimates were calculated using the Huso estimator (modified to accommodate the distance-sampling based estimate of searcher efficiency in the SCAs), as well as 90% confidence intervals (CIs) using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and CIs for complicated test statistics. A total of 1,000 bootstrap replicates were used for each variable, including searcher efficiency ($\hat{p}$), probability of a carcass persisting to the next search ($\hat{r}$), adjusted search interval, and observed detections. From these bootstraps, the probability of available and detected was calculated for the point estimate CI. The probability of available and detected that was applied to the bootstrapped observed detections for adjusted estimates was calculated from, *p,* bootstrapped from trial data and $\hat{r}$, bootstrapped from fatality observations and observed search intervals. The lower 5^{th} and upper 95^{th} percentiles of the 1,000 bootstrap estimates provide estimates of the lower limit and upper limit of an approximate 90% CI on all estimates. In some instances, the lower limit was less than the actual number of detections found, so the actual number found was assumed to be the lower limit. This is identified in the text and Appendix F by a *(#)*, where *(#)* represents the actual number found and used to inform the analysis.

Confidence intervals for fatality estimates with five or fewer detections are provided but should be interpreted with caution. Low carcass counts create difficulties in the fatality estimation process. Although the Huso estimator accounts for carcasses missed by searchers and scavenged before scheduled searches, all estimators become unstable as the count of carcasses become small. Korner-Nievergelt et. al (2011) showed via simulation that the best possible precision (of estimates) decreases below approximately 10 carcasses, and dramatically so, as the count approaches zero. The software published by the USGS to estimate using the Huso estimator suggests caution when 5 or fewer carcasses are observed in a group. The effect is more pronounced as the probability of detection decreases. Intuitively, the low carcass count effect makes sense, as it becomes more and more difficult to determine if the small number of detections is the result of a low fatality rate, a low detection rate, or some combination of both—all of which is unknowable.

2.5 Incidental Reporting

Some detections were found outside standardized search areas, or were within search areas but not observed during standardized searches. Such detections were found by WEST avian biologists and operational personnel and were considered "incidental" detections. When found by operational personnel, these detections were reported to WEST avian biologists for documentation. Data on incidental detections are reported here, as well as in the Special Purpose – Utility (SPUT) Permit Avian Injury and Mortality Report Forms, February 29, 2016 – February 28, 2017. To be conservative, all detections made in search areas that were estimated to have occurred within twice the duration of the actual search interval (usually seven days during spring and fall; 21 days during summer and winter) were included in fatality estimates, regardless of whether they were detected incidentally or during searches. All incidental detections made at the power blocks, estimated to have occurred within twice the duration of the search interval (assuming a one day interval due to daily maintenance by site personnel) were included in fatality estimates.

3.0 MONITORING RESULTS

3.1 Summary of Avian Detections

Figures 7 – 12 show the locations of detections found during the monitoring year. Detailed maps of detection locations along the overhead lines are provided with species codes in Appendix A. Detailed maps of detections within the power blocks are presented with species codes in Appendix B. During the 2016 – 2017 monitoring year, 205 detections (including all stranded and injured birds, incidental detections, and bats) were recorded, with a total of 55 avian species and two species of bats identified during the surveys (Table 2). The most numerous detection was of unidentified grebes (n = 18), all of which were either feather spots or broken up. Of the 18 unidentified grebes, three were determined to be Podiceps species (e.g. eared grebe, horned grebe), one was determined to be an Aechmophorus species (e.g. western grebes, Clark's grebe), and the remainder could not be identified to genus. The most numerous detection of an identified avian species was of brown-headed cowbird (n = 19), followed by western meadowlark (n = 17), and eared grebe (n = 8). The highest number of detections for a species in the SCAs were western meadowlark (4), western grebe (4), with no other species with more than two detections. Western meadowlark (7) and greater roadrunner (3) were the species with the most detections along the fence. Nine birds were detected along the overhead lines including one unidentified small bird and one of each of the following species: western meadowlark, savannah sparrow, Brewer's sparrow, common yellowthroat, lazuli bunting, orange-crowned warbler, ruby-crowned kinglet, and sagebrush sparrow. Brown-headed cowbird (12), western meadowlark (4), and cliff swallow (4) were the species with the most detections in the power blocks. Fresh detections, body weights and weather conditions the preceding nights are described in Appendix C. A summary of all avian guilds, migration behavior, four-letter species codes, scientific names, and sizes represented by detections found during the 2016 – 2017 monitoring year can be found in Appendix D.

More detections (n = 61, or 29.8% of total detections) were found within the power blocks (Tables 2, 3, and 4) than at other project components (Figure 7, 8, 11, and 12). One hundred twenty-six detections (61.5%) were made during standardized carcass searches and 79 (38.5%) were documented as incidentals, with most incidental detections found (n = 39) at the power blocks. Sixty-four percent of all detections made at the power blocks were found incidentally by site personnel.

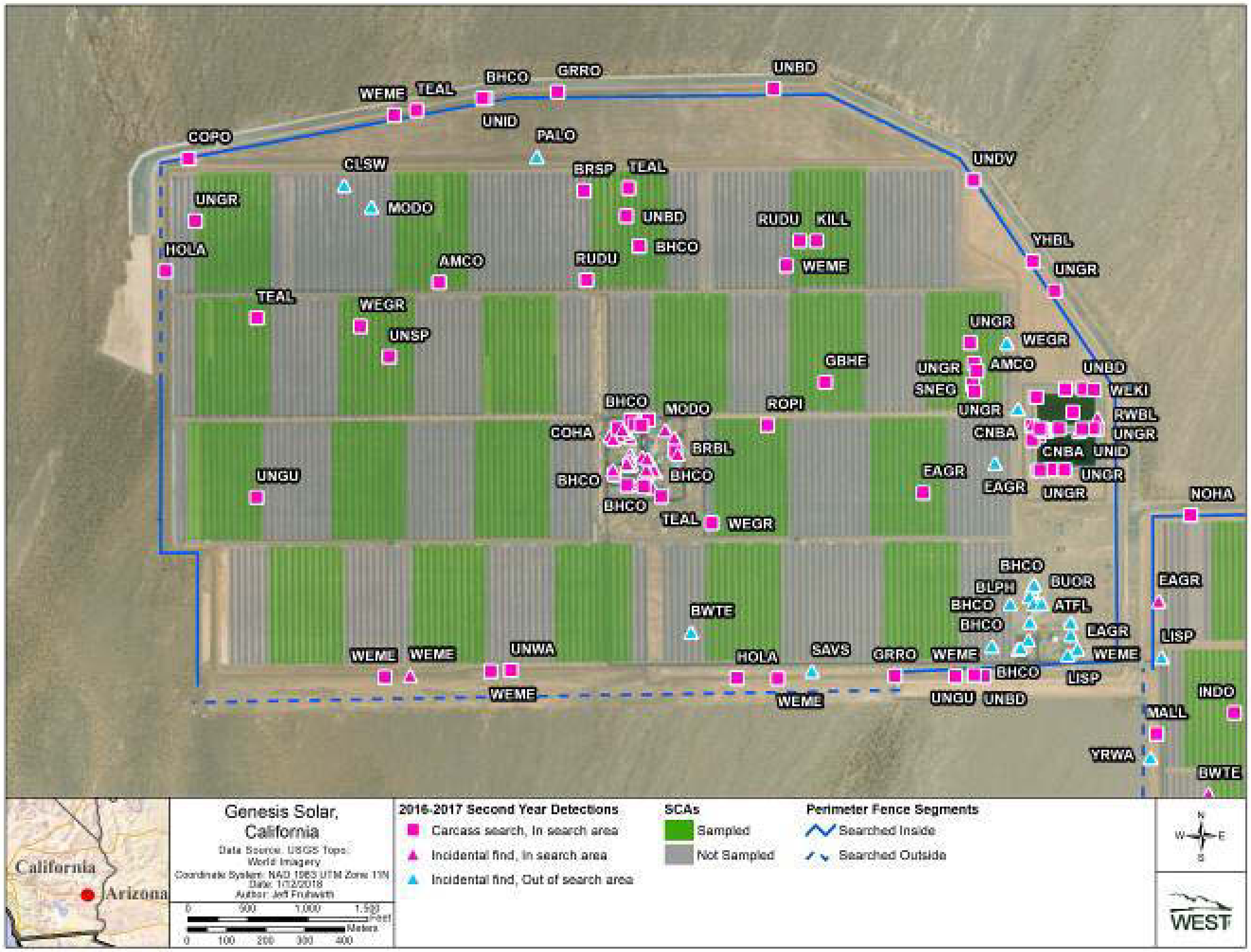

Figure 7. Areas of standardized searches and detections (those made during searches and those made as incidental finds) at Unit 1 of the Genesis Solar Energy Project during the second monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

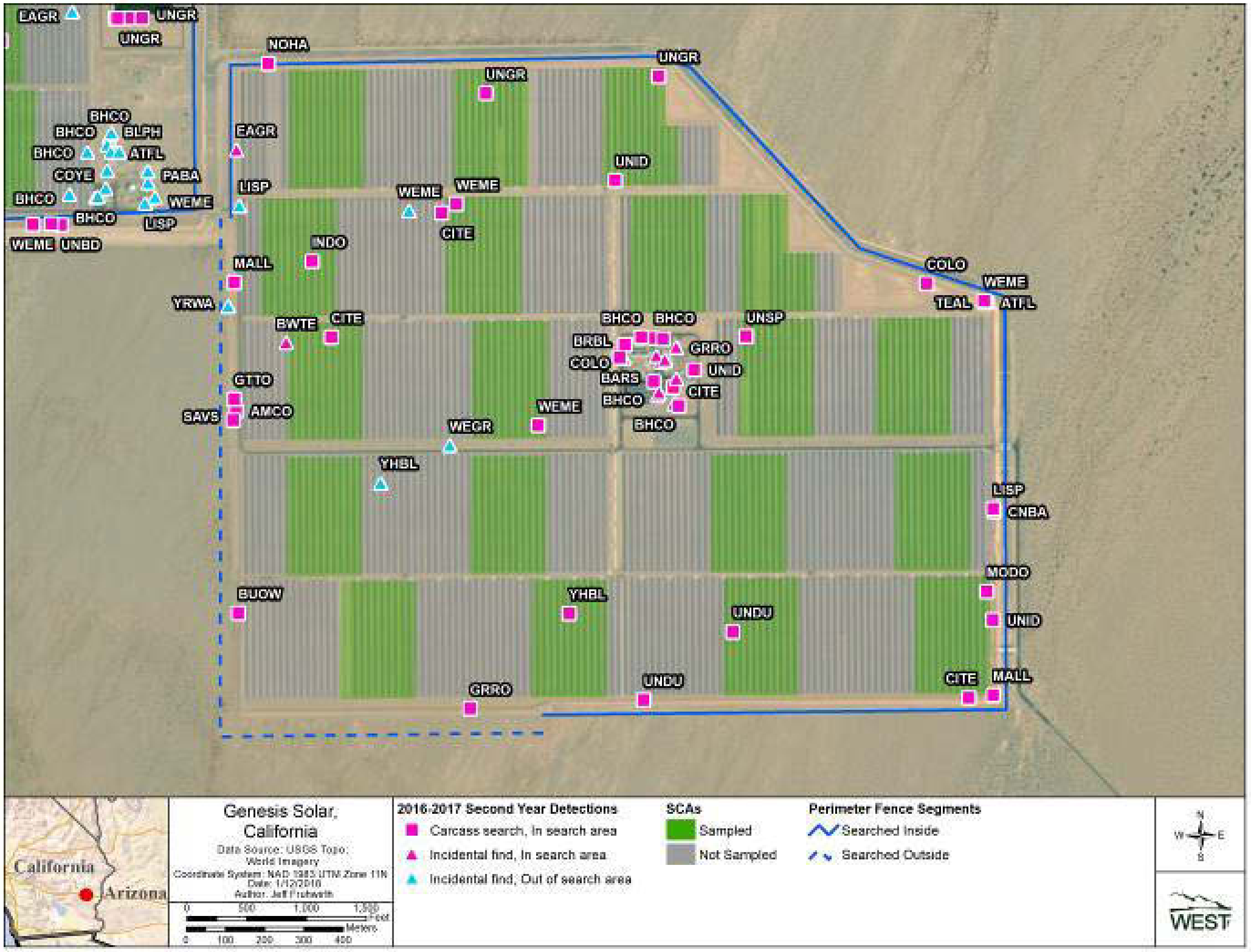

Figure 8. Areas of standardized searches and detections (those made during searches and those made as incidental finds) at Unit 2 of the Genesis Solar Energy Project during the second monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

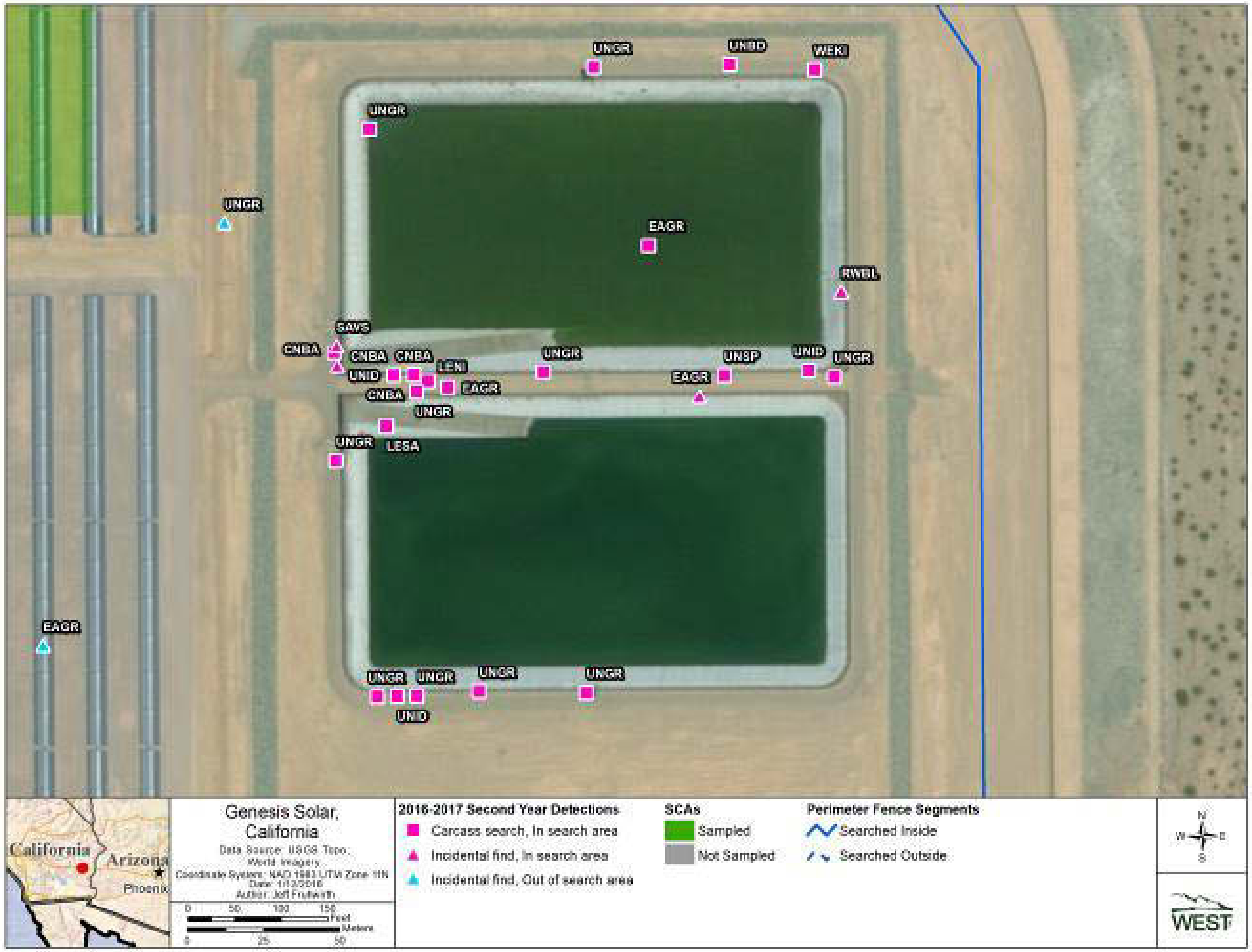

Figure 9. Close-up of area at evaporation ponds and detections (those made during searches and those made as incidental finds) within Unit 1 of the Genesis Solar Energy Project during the second monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

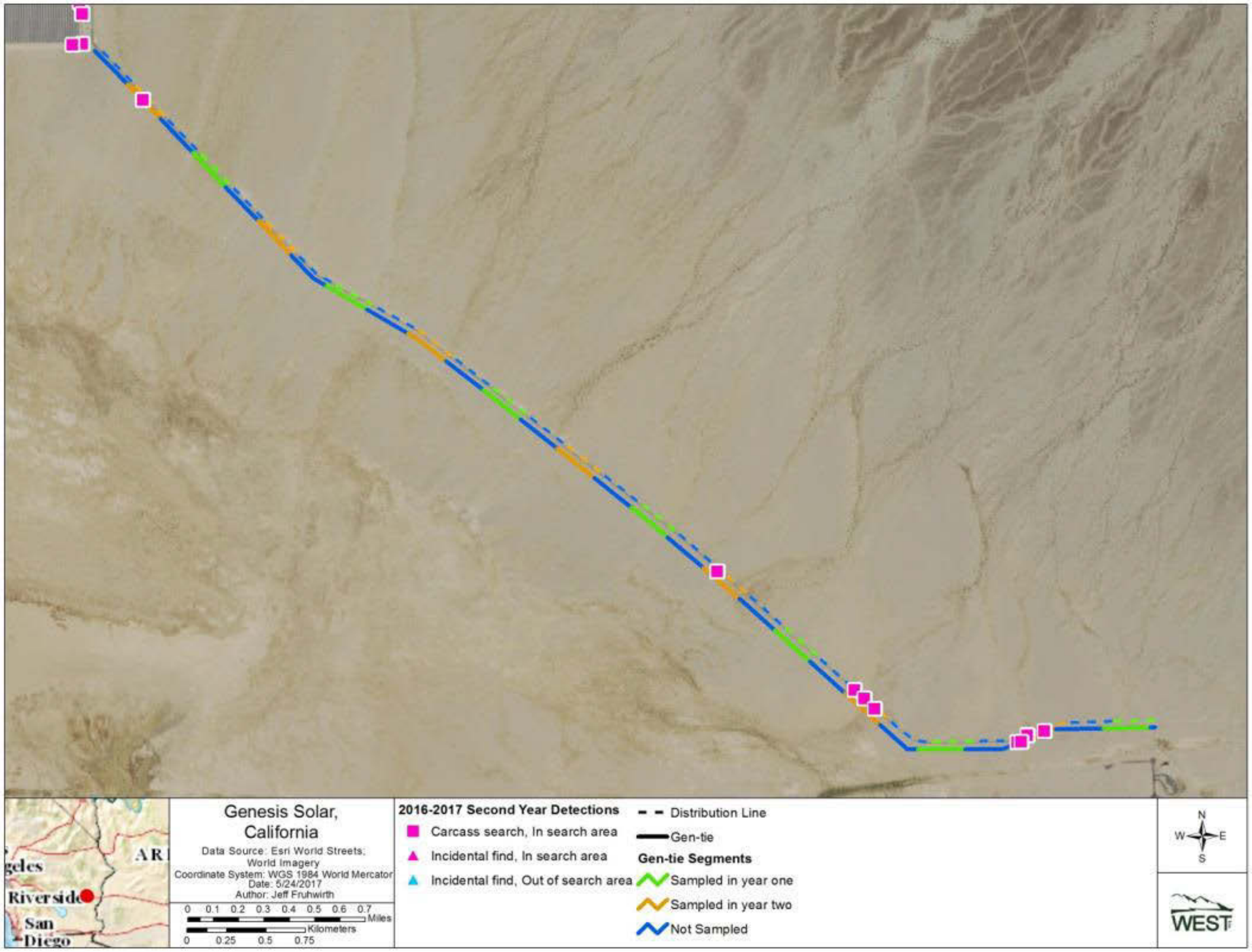

Figure 10. Areas of standardized searches and detections (those made during searches and those made as incidental finds) along the overhead lines and Project access road at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

Figure 11. Locations of water-associated and non-water-associated bird detections at Unit 1 of the Genesis Solar Energy Project during the second monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

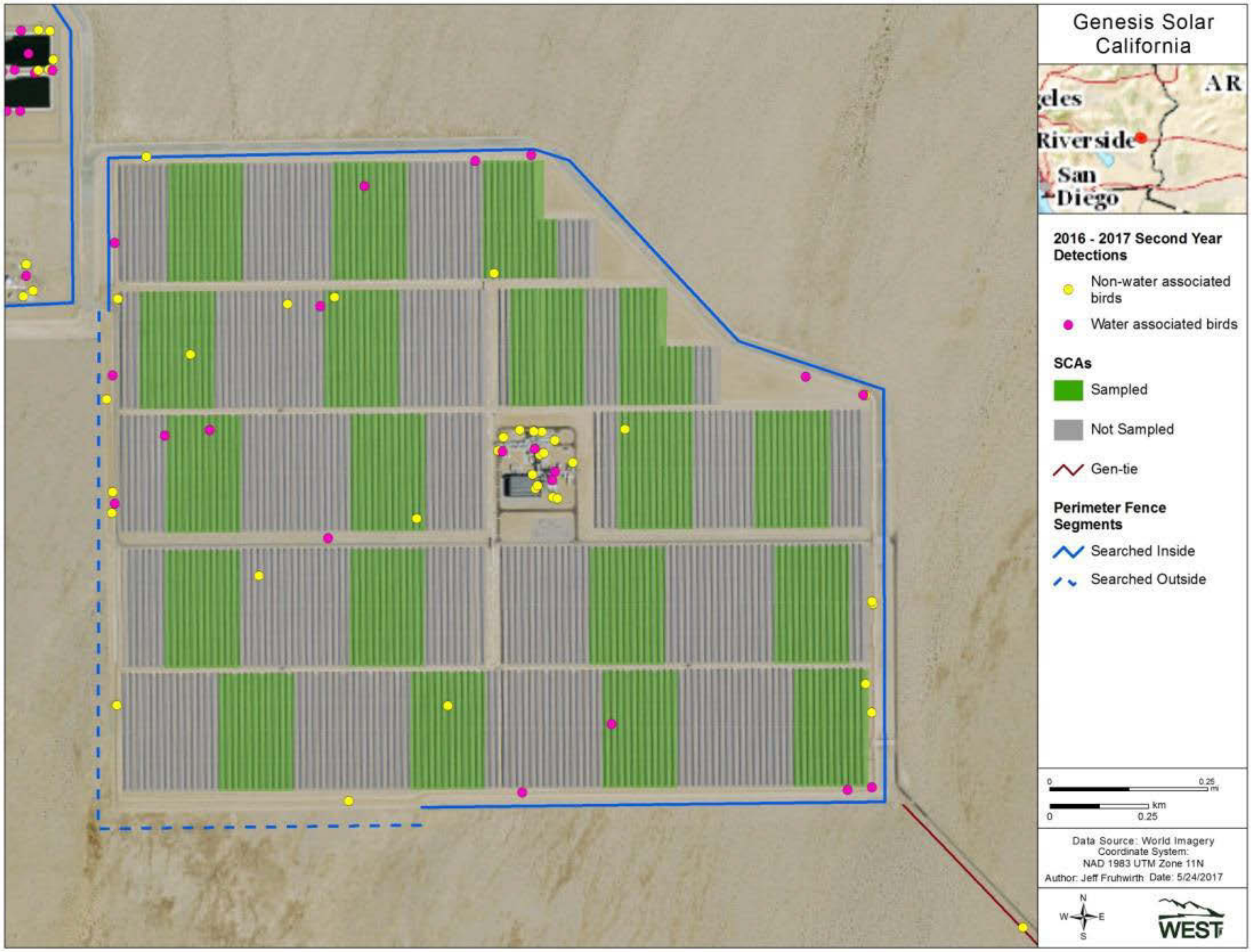

Figure 12. Locations of water-associated and non-water-associated bird detections at Unit 2 of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road; NA = not applicable

Common Name	Other	Fence	Overhead Lines	Pond	Power Blocks	SCAs	Total Count
Water-Associated Birds							
unidentified grebe	0	2	0	10	1	5	18
eared grebe	1	1	0	3	1	2	8
unidentified teal	0	2	0	0	1	2	5
cinnamon teal	0	1	0	0	1	2	4
western grebe	0	0	0	0	0	4	4
American coot	0	1	0	0	0	2	3
common loon	0	1	0	0	1	1	3
unidentified gull	0	1	0	0	0	2	3
blue-winged teal	0	0	0	0	0	2	2
great blue heron	1	0	0	0	0	1	2
Mallard	0	2	0	0	0	0	2
ruddy duck	0	0	0	0	0	2	2
unidentified duck	0	1	0	0	0	1	2
green heron	0	0	0	0	1	0	1
Killdeer	0	0	0	0	0	1	1
least sandpiper	0	0	0	1	0	0	1
northern pintail	0	0	0	0	1	0	1
Pacific loon	0	0	0	0	0	1	1
snowy egret	0	0	0	0	0	1	1
Subtotal (water-associated birds)	2	12	0	14	7	29	64
Non-Water-Associated Birds							
brown-headed cowbird	4	1	0	0	12	2	19
western meadowlark	1	7	1	0	4	4	17
unidentified bird (small)	0	2	1	3	3	1	10
unidentified bird (unknown size)	0	2	0	1	3	1	7
greater roadrunner	0	3	0	0	3	0	6

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road; NA = not applicable

Common Name	Other	Fence	Overhead Lines	Pond	Power Blocks	SCAs	Total Count
cliff swallow	0	0	0	0	4	1	5
mourning dove	0	0	0	0	3	2	5
Savannah sparrow	0	2	1	1	1	0	5
yellow-headed blackbird	0	1	0	0	1	2	4
Lincoln's sparrow	1	1	0	0	0	1	3
red-winged blackbird	0	0	0	1	2	0	3
unidentified sparrow	0	0	0	1	0	2	3
ash-throated flycatcher	1	1	0	0	0	0	2
barn swallow	1	0	0	0	1	0	2
black phoebe	2	0	0	0	0	0	2
Brewer's blackbird	0	0	0	0	2	0	2
Brewer's sparrow	0	0	1	0	0	1	2
Bullock's oriole	1	0	0	0	1	0	2
common yellowthroat	1	0	1	0	0	0	2
horned lark	0	2	0	0	0	0	2
lesser nighthawk	1	0	0	1	0	0	2
unidentified dove	0	1	0	0	1	0	2
yellow warbler	1	0	0	0	1	0	2
burrowing owl	0	1	0	0	0	0	1
common poorwill	0	1	0	0	0	0	1
Cooper's hawk	0	0	0	0	1	0	1
curve-billed thrasher	0	0	0	0	1	0	1
Eurasian collared-dove	0	0	0	0	1	0	1
green-tailed towhee	0	1	0	0	0	0	1
Inca dove	0	0	0	0	0	1	1
lazuli bunting	0	0	1	0	0	0	1
northern harrier	0	1	0	0	0	0	1
northern mockingbird	0	0	0	0	1	0	1

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road; NA = not applicable

Common Name	Other	Fence	Overhead Lines	Pond	Power Blocks	SCAs	Total Count
northern rough-winged swallow	0	0	0	0	1	0	1
orange-crowned warbler	0	0	1	0	0	0	1
rock pigeon	0	0	0	0	0	1	1
ruby-crowned kinglet	0	0	1	0	0	0	1
Sagebrush sparrow	0	0	1	0	0	0	1
song sparrow	0	0	0	0	1	0	1
tree swallow	0	0	0	0	1	0	1
unidentified warbler	0	1	0	0	0	0	1
western kingbird	0	0	0	1	0	0	1
western tanager	0	0	0	0	1	0	1
yellow-breasted Chat	0	0	0	0	1	0	1
yellow-rumped warbler	0	1	0	0	0	0	1
Subtotal (non-water-associated birds)	14	29	9	9	51	19	131
Subtotal (all birds)	16	41	9	23	58	48	195
Bats							
canyon bat	1	1	0	4	3	0	9
pallid bat	1	0	0	0	0	0	1
Subtotal (bats)	2	1	0	4	3	0	10
Total (All Species)	**18**	**42**	**9**	**27**	**61**	**48**	**205**

3.2 Suspected Cause of Avian Mortality

Most detections observed did not show clear outward signs of cause of death (Table 3). Of these, 43 detections were feather spots and 138 detections (4 bats, 134 birds) showed signs of scavenging, impeding positive identification of a suspected cause of mortality. Evidence of collision as cause of death without conducting a full necropsy could include broken neck or beak, or bird imprint in the dust on a solar mirror. Few detections had evidence of collision, but necropsies were not performed and thus internal injuries resulting from collision or deaths due to heat related illnesses would not be detected. There were 64 water-associated birds (including waterbirds, waterfowl, coots, and shorebirds) detected during the 2016 -– 2017 monitoring year, and 90.6% were assigned unknown cause, 6.3% were found alive and suspected to have been stranded (each of the four water-associated birds found alive were considered stranded because each is a species that generally requires a water surface to take-off from), and 3.1% were suspected to have been due to collision (Table 3). Of those suspected to be due to collision, one had a broken wing and one had a broken bill. There were 131 non-water-associated birds detected during the 2016 – 2017 monitoring year and 79.4% were assigned unknown cause, 13.7% were suspected to be due to collision, 2.3% were found alive, 1.5% were due to predation, and 3.1% due to other causes (e.g. trapped, trench; Table 3). Of those suspected to be due to collision, seven had broken necks, three had broken bills, one had both a broken neck and bill, two had broken wings, three had missing feathers or skin on neck, one had a head injury, and for one detection there were feathers on the barbed wire where the bird was found. Two bats were found alive while the other eight detected were assigned an unknown cause of death (Table 3).

3.3 Temporal Patterns of Avian Detections

The fact that different search intervals were used for the migration (7-day) and non-migration seasons (21-day) should be kept in mind while interpreting temporal patterns of the avian detections. The search interval influences the number of searches, and observed patterns are influenced by effort. The number of detections per day represents those discovered during standardized carcass searches as well as those discovered incidentally. For each day in which there were six or more detections made, an Avian Injury & Mortality Report form (in accordance with Special Purpose Utility Permit MB44900B-0 Condition H.1(c)) was submitted within 24 hours to the USFWS, BLM, CDFW, and CEC.

The 2016 - 2017 monitoring year was characterized by a peak in avian detections during the fall season. The number of avian detections recorded daily during the 2016 – 2017 monitoring year ranged from zero to seven (Figure 13). Six or more detections occurred on a total of seven days. The highest daily counts occurred on September 29, 2016 (7 detections) and October 20, 2016 (7 detections).

The highest peaks in avian detections at the evaporation ponds and fence occurred during late summer and fall (Figure 14). The highest peaks in avian detections at the power blocks occurred during summer and fall. At the SCAs and overhead lines, the greatest number of detections occurred during the fall season (Figure 14). The greatest number of avian detections occurred during the month of October (n = 46) followed by September (n = 35) and August (n = 32), with water-associated bird detections greatest during October (n = 13) and September (n = 10).

Table 3. Total detections (including incidentals) by Project component and suspected cause of death during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

	Suspected Cause of Death*						
Project Component	**Alive**	**Collision**	**Predated**	**Other**	**Unknown**	**Total**	**% of Total**
			Water-associated birds				
Other	1	0	0	0	1	2	3.1
Fence	0	0	0	0	12	12	18.8
Overhead Lines	0	0	0	0	0	0	0
Ponds	0	0	0	0	14	14	21.9
Power Blocks	1	1	0	0	5	7	10.9
SCAs	2	1	0	0	26	29	45.3
Water-associated bird total	4	2	0	0	58	64	
% of total	6.3	3.1	0	0	90.6	100	
			Non-water-associated birds				
Other	2	0	1	4	7	14	10.7
Fence	0	4	1	0	24	29	22.1
Overhead Lines	0	3	0	0	6	9	6.9
Ponds	0	0	0	0	9	9	6.9
Power Blocks	1	10	0	0	40	51	38.9
SCAs	0	1	0	0	18	19	14.5
Non-water-associated bird total	3	18	2	4	104	131	
% of total	2.3	13.7	1.5	3.1	79.4	100	
			Bats				
Other	1	0	0	0	1	2	20.0
Fence	1	0	0	0	0	1	10.0
Overhead Lines	0	0	0	0	0	0	0
Ponds	0	0	0	0	4	4	40.0
Power Blocks	0	0	0	0	3	3	30.0
SCAs	0	0	0	0	0	0	0
Bat total	2	0	0	0	8	10	
% of total	20.0	0	0	0	80.0	100	
Grand Total	**9**	**20**	**2**	**4**	**170**	**205**	
% of grand total	**4.4**	**9.8**	**1.0**	**2.0**	**82.9**	**100**	

* Suspected cause of death was assigned based on evidence available on the detection, evidence available on Project infrastructure, and proximity of detection to Project infrastructure. Detections that lacked sufficient evidence to make a determination of cause of the fatality were assigned as “unknown”. Detections that were relatively intact (i.e., minimal evidence of scavenging), located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines), and containing evidence of injury had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is uncertainty associated with cause of death assignments because no events were directly observed.

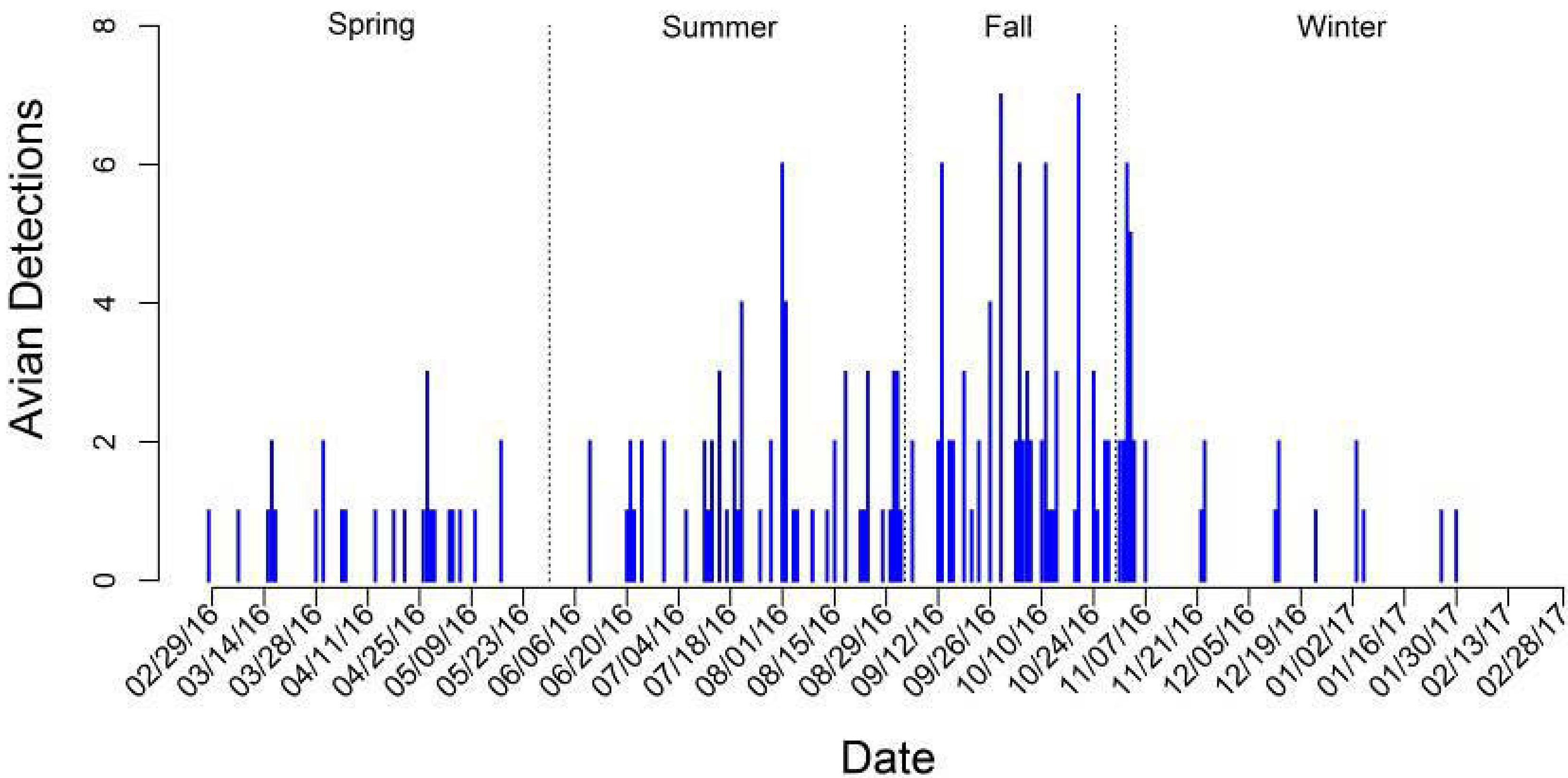

Figure 13. Total number of avian detections by date during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

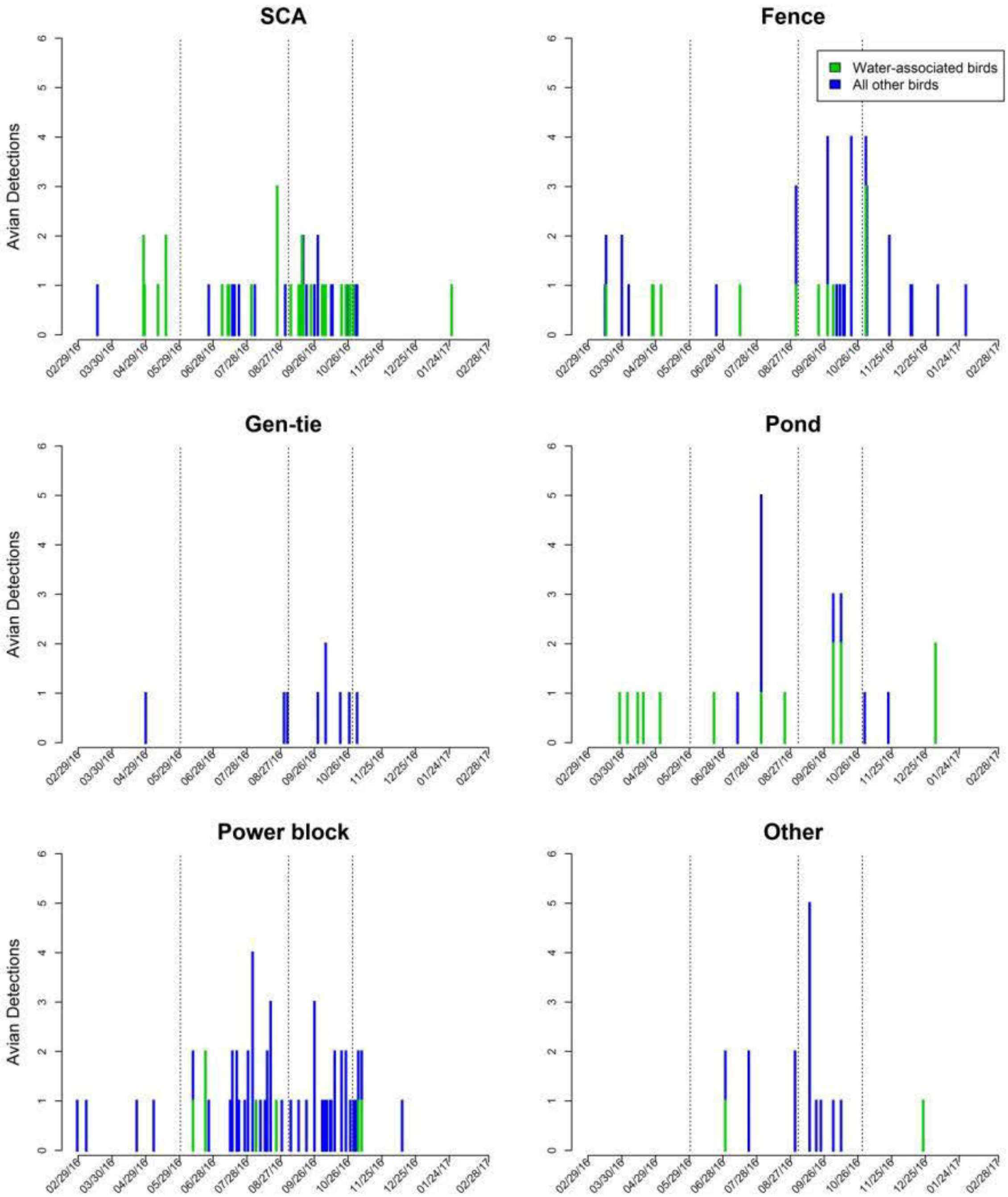

Figure 14. Total number of avian detections by month and component during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

3.4 Spatial Distribution of Avian Detections

3.4.1 Detections by Project Component

During the 2016 – 2017 monitoring year, detections were documented from Project buildings, the perimeter fence, overhead lines, evaporation ponds, the power blocks, and the SCAs (Tables 2, 3, and 4; Figures 7 – 12). There was a cluster of 18 incidental detections (two bats, two water-associated birds, and 14 non-water-associated birds) near the parking lot and buildings which were found primarily by site personnel (Figure 11). Four of those were at the collection trench, a grate-covered trench surrounding the drum/container storage area. The birds appear to have been trapped after entering the grate. Shortly after this incident, a fine mesh was installed over the trench grating that prevents birds of any size from entering the trench. Of the 151 detections within both Project units (SCAs, power blocks, and fence), 96 (63.6%; 93 birds, 3 bats) were detected at Unit 1, and 55 (36.4%; 54 birds, 1 bat) were detected at Unit 2. When considering the SCAs only, there were 32 detections (32 birds, no bats) at Unit 1 SCAs and 16 detections (16 birds, no bats) at Unit 2 SCAs. There were 22 water-associated birds found at Unit 1 SCAs and 7 at Unit 2 SCAs. There were 27 detections (23 birds, 4 bats) at the evaporation ponds (excluded from Unit 1 and Unit 2 tally). The majority of water-associated birds detected (n = 29; 45.3%) were found at the SCAs while most non-water-associated birds were detected at the power blocks (n = 51; 38.9%) and fence (n = 29; 22.1%; Table 3). There were a number of instances in which pairs of birds or bats were found in close proximity to one another.

Table 4. Total avian and bat detections by Project component and detection category during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Inside carcass search area		Outside carcass search area		Total
	Carcass search	Incidental	Carcass search	Incidental	
Water-associated birds					
Other	0	0	0	2	2
Fence	11	1	0	0	12
Overhead Lines	0	0	0	0	0
Ponds	13	1	0	0	14
Power Blocks	2	5	0	0	7
SCAs	21	1	0	7	29
Waterbird total	**47**	**8**	**0**	**9**	**64**
Non-water-associated birds					
Other	0	0	0	14	14
Fence	26	1	0	2	29
Overhead Lines	9	0	0	0	9
Ponds	7	2	0	0	9
Power Blocks	20	31	0	0	51
SCAs	13	0	0	6	19
Non-water-associated bird total	**75**	**34**	**0**	**22**	**131**
Bats					
Other	0	0	0	2	2
Fence	1	0	0	0	1
Overhead Lines	0	0	0	0	0
Ponds	3	1	0	0	4
Power Blocks	0	3	0	0	3
SCAs	0	0	0	0	0
Bat total	**4**	**4**	**0**	**2**	**10**
All detection total	**126**	**46**	**0**	**33**	**205**

3.4.2 Feather Spot Detections

Forty-three (22.1%) of the 195 avian detections made during the 2016 – 2017 monitoring year consisted of feather spots. Along the fence, 15 of 41 total avian detections (36.6%) were feather spots. Twelve detections at the SCAs, nine at the ponds, five at the power blocks, and two at buildings were feather spots.

3.5 Detections of Stranded and Injured Birds

There were 7 detections of stranded or injured birds and 2 detections of stranded or injured bats during the 2016 – 2017 monitoring year (Table 5). Four of the seven live birds found were water-associated species.

Table 5. Detections of stranded or injured birds at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Project Component	Common Name	Latin Name	Outcome	Count
SCAs	Western Grebe	*Aechmophorus occidentalis*	Released	2
Power Blocks	Common loon	*Gavia immer*	Released	1
	Greater roadrunner	*Geococcyx californianus*	Released	1
Fence	Canyon bat	*Parastrellus hesperus*	Died	1
Other	Brown-headed cowbird	*Molothrus ater*	Died	1
	Eared grebe	*Podiceps nigricollis*	Released	1
	Lesser nighthawk	*Chordeiles acutipennis*	Released	1
	Pallid bat	*Antrozous pallidus*	Released	1

3.6 Summary of Bat Detections

Ten bats were detected during the 2016 – 2017 monitoring year. Identified species included canyon bat (n = 9; *Parastrellus hesperus)* and pallid bat (n = 1; *Antrozous pallidus*; Table 2). The number of bat detections recorded daily during the second monitoring year ranged from zero to three (Figure 15). Seven of the ten bats detected were found during summer (Figure 15). Of these seven, three were canyon bats found on the same day, July 20, 2016, although each with a different estimated time since death, ranging from 2 days to 2 weeks. Two of the three were found at the ACC Unit fans and one at a project building. Two bats were found during winter and one in early spring. Of the ten bats detected, four (40%) were found at the ponds, one at the fence (10%), three at the power blocks (30%), one at a conex box (10%), and one at a Project building (10%; Table 4, Figure 16).

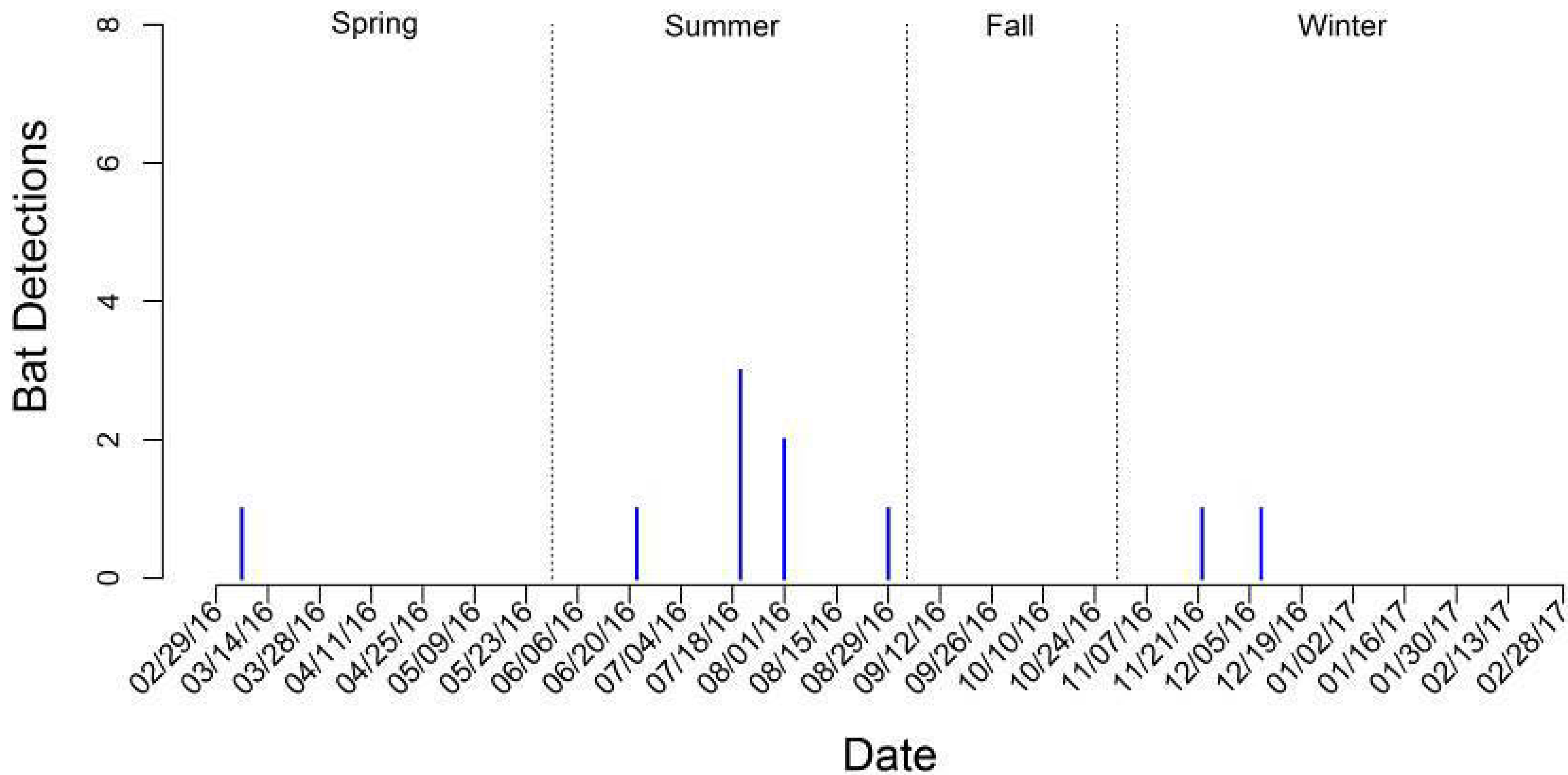

Figure 15. Total number of bat detections by date during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

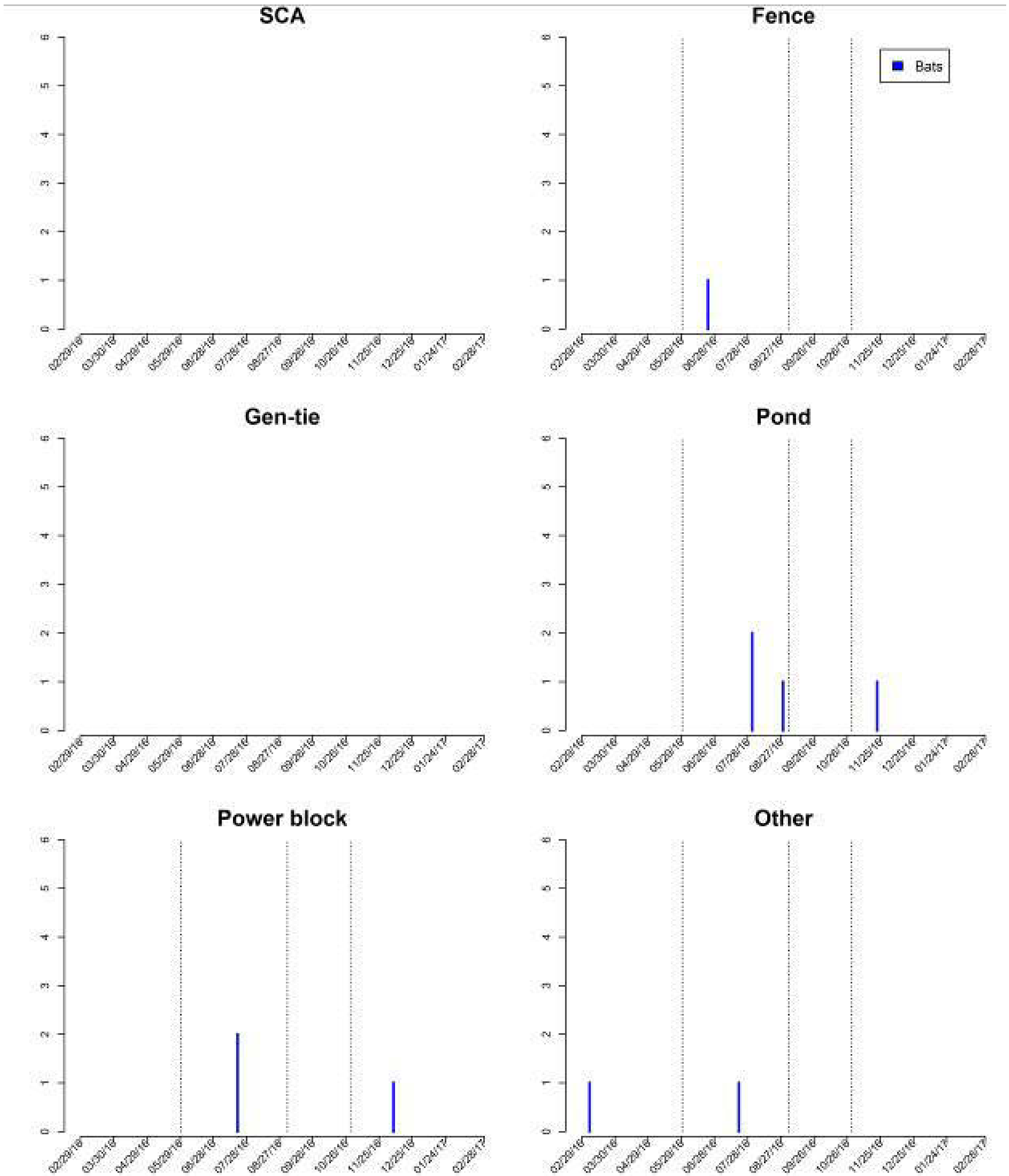

Figure 16. Total number of bat detections by month and component during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

3.7 Carcass Persistence Trials

Data from the trial carcasses used in the carcass persistence trials were available from all four seasonal monitoring periods across two years at the solar field (which includes the SCAs, power blocks, and perimeter fence) and overhead lines. During the 2016 – 2017 monitoring period, there were 10, 20, and 30 large, medium and small birds, respectively, placed at the solar field and 10, 15, and 25, large, medium, and small birds, respectively, placed along the overhead lines each season. A total of 680 trial carcasses were available for model fitting, 440 from the second year of monitoring and 240 from the first.

Survival models were fitted separately for each size class (small, medium and large) and compared for relative quality using the corrected AICc score, as suggested in Huso (2011). Model selection indicated that season, year, and Project component location were important predictors of carcass persistence for all three size classes. Thus, the best models included main effects of season, year, and Project component location (either inside the solar field or at the overhead lines), for small, medium, and large sized birds. None of the models included interaction terms. The best model for large and medium bird persistence followed a lognormal distribution while the small bird model followed a loglogistic distribution (Table 6). The sample sizes for the interception of each of the three models were 340, 220, and 120 for small, medium, and large carcass persistence models, respectively.

Table 6. Top five carcass persistence models for each size class from the AICc model selection process. Bold indicates chosen model. ΔAICc is the difference in AICc between the model listed and the top model.

Size	Model Predictors	Distribution	AICc	ΔAICc
Small Birds	Location + Season + year + Location*year	loglogistic	1388.1	0
	Location + Season + year + year*Season + Location*year	lognormal	1388.3	0.18
	Location + Season + year + Location*year	lognormal	1388.4	0.32
	Location + Season + year + year*Season + Location*year	loglogistic	1389	0.88
	Location + Season + year	**loglogistic**	**1389.7**	**1.57**
Medium Birds	**Location + Season + year**	**lognormal**	**1009.5**	**0**
	Location + Season + year	loglogistic	1010.1	0.6
	Location + Season + year + Location*year	lognormal	1011.6	2.03
	Location + Season + year + Location*Season	lognormal	1011.9	2.41
	Location + Season + year + Location*year	loglogistic	1012	2.52
Large Birds	Location + Season + year + year*Season	weibull	423.37	0
	Location + Season + year	**lognormal**	**424.33**	**0.96**
	Location + Season + year + year*Season + Location*year	weibull	424.84	1.47
	Location + Season + year	weibull	425.05	1.68
	Location + Season + year	loglogistic	425.65	2.28

Small, medium and large carcasses are predicted to persist longer inside the fence than outside and there is a general trend of decreasing persistence through the search interval over the two year monitoring period (Figure 17; Table 7). The probability of a carcass persisting to the next search was lower during the second monitoring year than during the first monitoring year for every season and size class combination at both the solar field and at the overhead lines. During both monitoring years, carcass persistence for small bird carcasses was longest during spring, followed by fall, summer, and winter at both the solar field and the overhead lines. Carcass persistence for medium bird carcasses was longest during spring, followed by summer, fall, and winter at both the solar field and overhead lines. At the solar field, large bird carcass persistence was longer during spring, summer, and fall compared to winter during both monitoring years. Large bird carcass persistence at the overhead lines was longest during fall and lowest during winter during both monitoring years. Median carcass persistence times in the solar field and at the overhead lines are also provided for each season and size class (Table 8). Figure 18 shows the proportion of trial carcasses remaining as a function of days since placement and carcass model covariate (component year, season and location).

During the 2015 – 2017 monitoring years, game cameras, used to monitor 139 of the trial carcasses, provided information regarding the scavenger community. Final carcass condition for each camera trial carcass is provided by scavenger in table 9. For trials that were removed, the last scavenger observed at the carcass (presumably the scavenger that removed the trial carcass) is provided. For trial carcasses that were scavenged, but never removed and for feather spots, all scavengers observed at these trials are listed. Of the 139 carcasses placed, the majority of these (84.2%) were removed by scavengers, whereas for the other trials carcasses, scavenged remains (12.9%) or feather spots (2.9%) were still present at the end of the camera trials. There were a total of 85 trial carcasses for which cameras successfully recorded scavenger images. Common raven was the most common scavenger (n = 51), followed by turkey vulture (n = 12), and kit fox (n = 9). Representative photos of each scavenger are provided in Appendix E.

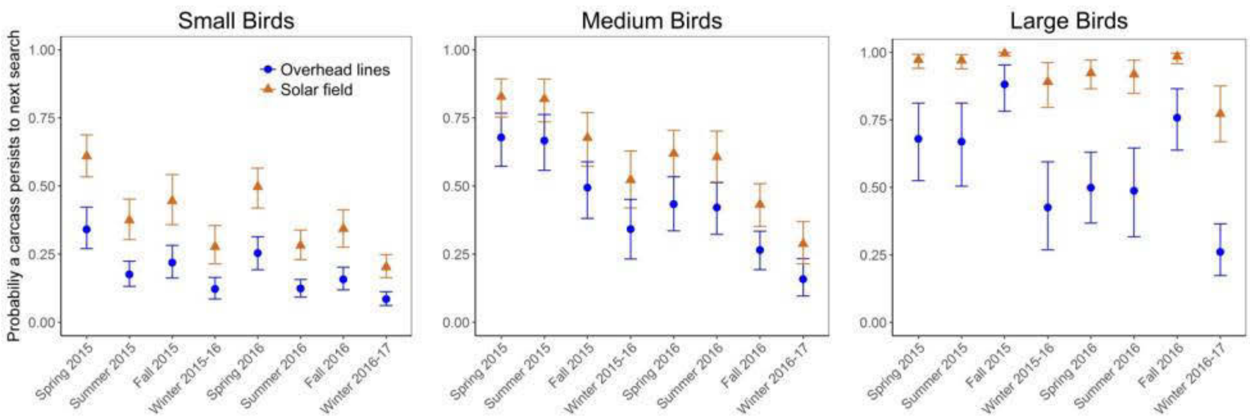

Figure 17. Model predicted probability of carcass persistence with 90% confidence interval from initiation of post-construction monitoring in spring of 2015 through the end of the second monitoring year, ending February 28, 2017.

Table 7. Average probability of carcass persistence to the next search during both years of monitoring ($\hat{r}$; search interval approximately is 7 days during spring and fall migration periods, and 21 days during summer and winter non-migration periods).

		Small Birds		Medium Birds		Large Birds	
		$\hat{r}$	90% CI.	$\hat{r}$	90% CI	$\hat{r}$	90% CI
Year 2	**Solar Field**						
	Spring	0.50	0.42 – 0.57	0.62	0.54 – 0.71	0.92	0.87 – 0.97
	Summer	0.28	0.23 – 0.34	0.61	0.52 – 0.70	0.92	0.85 – 0.97
	Fall	0.34	0.28 – 0.41	0.43	0.35 – 0.51	0.99	0.96 – 1.00
	Winter	0.20	0.16 – 0.25	0.29	0.22 – 0.37	0.77	0.67 – 0.88
	Overhead Lines						
	Spring	0.25	0.19 – 0.32	0.43	0.34 – 0.53	0.50	0.37 – 0.63
	Summer	0.12	0.09 – 0.16	0.42	0.32 – 0.51	0.49	0.31 – 0.65
	Fall	0.16	0.12 – 0.20	0.27	0.19 – 0.33	0.76	0.64 – 0.87
	Winter	0.09	0.06 – 0.11	0.16	0.10 – 0.23	0.26	0.17 – 0.36
Year 1	**Solar Field**						
	Spring	0.62	0.53 – 0.69	0.83	0.75 – 0.89	0.97	0.94 – 0.99
	Summer	0.37	0.30 – 0.45	0.82	0.74 – 0.89	0.97	0.94 – 0.99
	Fall	0.45	0.36 – 0.54	0.68	0.57 – 0.77	1.00	0.99 – 1.00
	Winter	0.28	0.22 – 0.36	0.52	0.42 – 0.63	0.89	0.80 – 0.96
	Overhead Lines						
	Spring	0.34	0.27 – 0.42	0.68	0.57 – 0.77	0.68	0.53 – 0.81
	Summer	0.18	0.13 – 0.23	0.67	0.56 – 0.76	0.67	0.51 – 0.81
	Fall	0.22	0.16 – 0.28	0.49	0.38 – 0.59	0.88	0.78 – 0.95
	Winter	0.12	0.09 – 0.17	0.34	0.23 – 0.45	0.43	0.27 – 0.60

Table 8. Median carcass persistence time in days during both monitoring years at the Genesis Solar Energy Project, Riverside County, California.

		Small Birds		Medium Birds		Large Birds	
		Median	**90% CI**	**Median**	**90% CI**	**Median**	**90% CI**
Year 2	**Solar Field**						
	Spring	2.82	2.09 – 3.70	17.14	10.3 – 27.65	>30	-
	Summer	2.97	2.26 – 3.90	43.76	25.11 – 77.66	>30	-
	Fall	1.47	1.06 – 2.01	6.75	3.97 – 10.99	>30	-
	Winter	1.86	1.44 – 2.50	8.37	5.07 – 14.39	>30	-
	Overhead Lines						
	Spring	0.94	0.65 – 1.31	6.79	3.93 – 11.13	6.87	3.11 – 14.24
	Summer	0.99	0.71 – 1.34	17.35	9.96 – 29.41	17.64	7.73 – 41.09
	Fall	0.49	0.34 – 0.69	2.67	1.5 – 4.23	26.93	11.83 – 65.84
	Winter	0.62	0.44 – 0.86	3.32	1.76 – 5.87	5.15	2.30 – 11.95
Year 1	**Solar Field**						
	Spring	4.39	3.25 – 6.13	4.99	3.28 – 7.61	>30	-
	Summer	4.62	3.38 – 6.40	12.74	8.06 – 20.46	>30	-
	Fall	2.29	1.59 – 3.36	1.96	1.28 – 2.89	>30	-
	Winter	2.90	2.03 – 4.23	2.44	1.54 – 3.87	>30	-
	Overhead Lines						
	Spring	1.46	1.04 – 2.10	1.98	1.18 – 3.27	2.74	1.42 – 5.10
	Summer	1.54	1.11 – 2.15	5.05	2.99 – 7.97	7.04	3.02 – 15.30
	Fall	0.76	0.53 – 1.10	0.78	0.47 – 1.21	10.74	5.46 – 20.68
	Winter	0.96	0.65 – 1.41	0.97	0.54 – 1.70	2.05	1.12 – 3.92

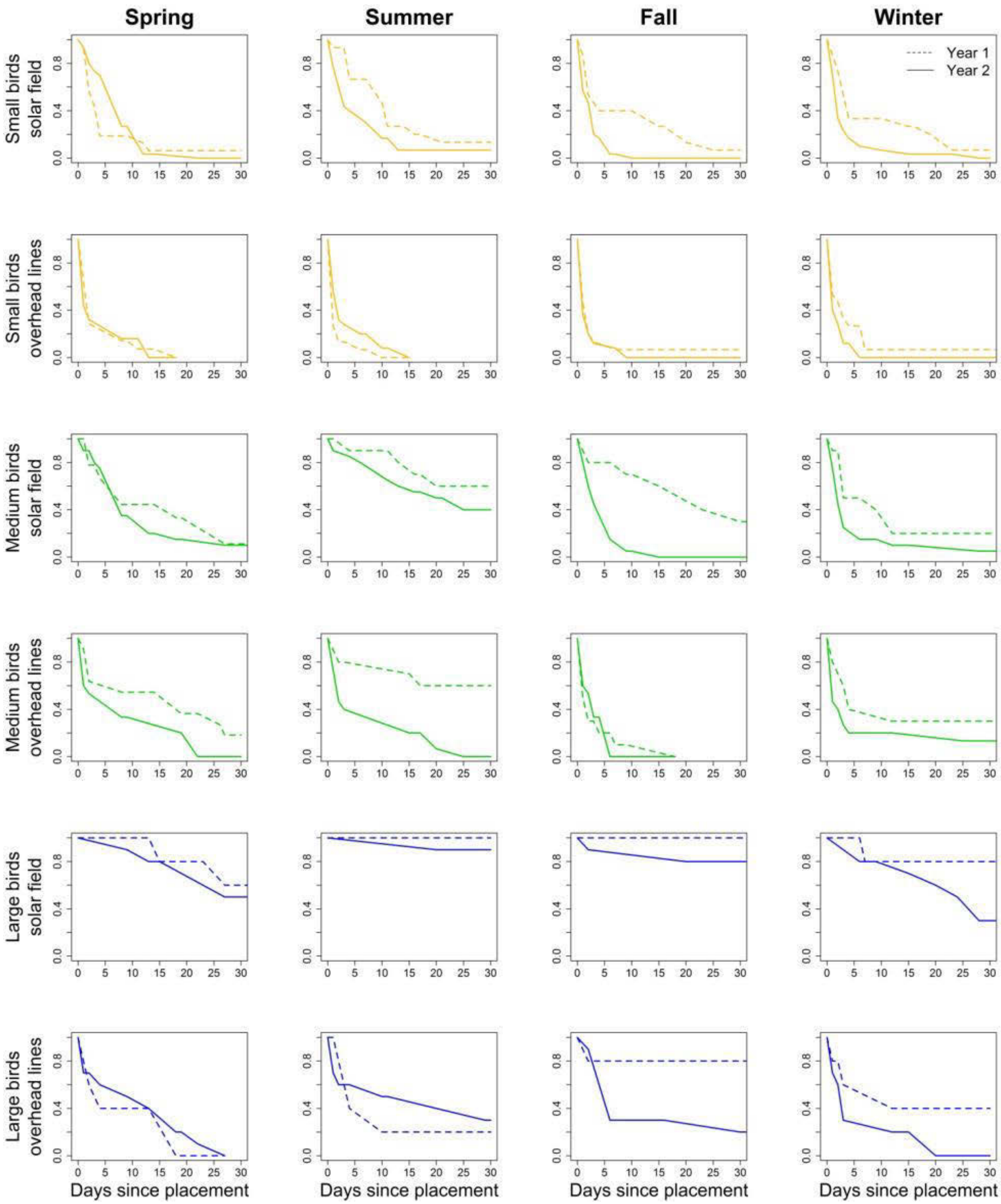

Figure 18. Proportion of trial carcasses remaining as a function of days since placement and carcass model covariate (component location, season, and year) during both monitoring years at the Genesis Solar Energy Project, Riverside County, California. Dashed lines represent the first monitoring year while solid lines represent the second monitoring year. Sample sizes are n = 220, 140, and 80 for small, medium, and large size classes, respectively in year two, and n = 120, 80 and 40 for small, medium, and large size classes, respectively in year one.

Table 9. Final carcass condition by scavenger for the carcass removal camera bias trials during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California.

	Scavenger									
Final Carcass Condition By Size	Common Raven	Coyote	Kit Fox	Turkey Vulture	American Kestrel	Common Raven & Turkey Vulture	Common raven, turkey vulture and Kit	Turkey Vulture and Coyote	Unknown	**Total**
Feather Spot										
Large	2	-	-	-	-	-	-	-	-	2
Medium	1	-	-	1	-	-	-	-	-	2
Small	-	-	-	-	-	-	-	-	-	-
Removed										
Large	1	1	3	3	-	-	-	-	6	14
Medium	17	1	2	2	-	-	-	-	13	35
Small	27	-	4	4	1	-	-	-	32	68
Scavenged										
Large	2	-	-	-	-	6	1	1	1	11
Medium	1	-	-	2	-	2	-	-	1	6
Small	-	-	-	-	-	-	-	-	1	1
Total	**51**	**2**	**9**	**12**	**1**	**8**	**1**	**1**	**54**	**139**

3.8 Searcher Efficiency Trials

During the 2016 – 2017 monitoring year, 85 searcher efficiency trial (SEEF) carcasses (40 small, 25 medium, and 20 large birds) were placed at the Project during each of the four seasonal study periods. During fall and winter, several small trial carcasses went missing before the SEEF trial could occur; an additional 10 small bird trials were placed during fall and 10 during winter to account for this. Thus, a total of 360 searcher efficiency trial carcasses placed. Overall, 165 trial carcasses were placed in the SCAs, 33 trial carcasses were placed along perimeter fences (inner and outer perimeters), and 17 trial carcasses were placed at power blocks (along perimeter and beneath ACC units). One of the 165 trial carcasses placed in the SCAs was incidentally placed at an SCA unit that is not sampled and was therefore excluded from the analysis. Forty-five trial carcasses were placed along the gen-tie and 100 were placed along the distribution line. Two hundred and eighty-six trial carcasses were available to be found, and 74 trial carcasses disappeared (37 in the SCAs, seven along the fence, two at the power blocks, and 28 along the overhead lines). All trial carcasses removed by scavengers during searcher efficiency trials are assumed to have been removed before the observer had a chance to detect the trial carcass. Eleven observers conducted searches at the Project during the 2016 – 2017 monitoring year. Searcher efficiency trials were conducted on each observer in approximate proportion to the number of searches they conducted at the Project, as follows: Stephanie Herrera (number of trials available to be found: 103), Anne Winters (42), Richard Aracil (42), Jason Pietrzak (40), Samantha Treu (27), Curtis Hart (22), Emily Pollom (19), John Gorey (19), Lindsay Gedacht (18), Frank Mayer (16), and Brian Arnold (11). All trials were included in the estimation of searcher efficiency.

Searcher efficiency was modeled separately for small, medium, and large birds and trials placed at the SCAs were modeled separately using distance sampling methods. Model comparisons using AICc indicated that neither season, location (inside/outside fence) nor component type had an effect on searcher efficiency at the Project. Trials from the overhead lines, fence, and power blocks were combined. The best model at the fence, overhead lines, and power blocks was an intercept only model (Table 10). Likewise, the best models for all three size classes at the SCAs were also intercept only models and all three models followed an exponential distribution (Table 11).

At the fence, overhead lines, and power blocks, searcher efficiency during the 2016 – 2017 monitoring year was 84%, 93%, and 100% for small birds, medium birds, and large birds, respectively (confidence intervals provided in Table 12; Appendix F). At the SCAs, searcher efficiency was 61%, 88%, and 88% for small, medium, and large birds, respectively during the 2016 – 2017 monitoring year (Table 12; Appendix F).

Table 10. Top five searcher efficiency models from model selection for the fence, power blocks, and overhead lines for each size class. Bold indicates chosen model form. ΔAICc is the difference in AICc between the model listed and the top model.

	Model Form	AICc	ΔAICc
Small birds	**Intercept-only**	**57.20**	**0.00**
	response ~ Location	59.33	2.13
	response ~ Component	61.45	4.25
	response ~ Season	61.69	4.49
	response ~ typeGroup + Season	64.04	6.84
Medium birds	**Intercept-only**	**23.71**	**0.00**
	response ~ Location	24.60	0.89
	response ~ Season	26.17	2.46
	response ~ Component	26.93	3.21
	response ~ Location + Season	27.70	3.99
Large birds	**Intercept-only**	**2.08**	**0.00**
	response ~ Location	4.24	2.16
	response ~ Component	6.49	4.41
	response ~ Season	8.83	6.75
	response ~ Location + Season	11.28	9.20

Table 11. Top five searcher efficiency models from model selection for the SCAs for each size class. Bold indicates chosen model form. ΔAICc is the difference in AICc between the model listed and the top model.

	Model Form	Distribution	AICc	ΔAICc
Small birds	**Intercept-only**	**Exponential**	**72.7**	**0.0**
	Intercept-only	Half-normal	74.2	1.5
	Intercept-only	Hazard rate	76.9	4.2
	response ~ Season	Exponential	78.4	5.7
	response ~ Season	Half-normal	79.5	6.8
Medium birds	**Intercept-only**	**Exponential**	**32.3**	**0.0**
	Intercept-only	Uniform	32.5	0.2
	Intercept-only	Half-normal	34.1	1.8
	Intercept-only	Hazard rate	34.8	2.5
	response ~ Season	Exponential	38.6	6.3
Large birds	**Intercept-only**	**Exponential**	**18.4**	**0.7**
	Intercept-only	Uniform	20.8	3.1
	response ~ Season	Half-normal	22.2	4.5
	Intercept-only	Hazard rate	23.2	5.5
	response ~ Season	Uniform	23.7	6.0

Table 12. Searcher efficiency estimates by Project component and trial carcass size during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. OH = Overhead Lines

	Small Birds		Medium Birds		Large Birds	
	Mean	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Fence, Power Blocks & OH lines	0.84	0.76 – 0.92	0.93	0.86 – 0.98	1.00	-
SCAs	0.61	0.51 – 0.70	0.88	0.79 – 0.95	0.88	0.77 – 0.96

Note: confidence interval (CI)

3.9 Fatality Estimates

Fatality estimates were calculated separately for each size class, component (SCAs, power blocks, fence, evaporation ponds, and overhead lines) and season. There were 205 bird and bat detections during the 2016 – 2017 monitoring year. Detections found in the standardized search areas that were determined to have occurred less than twice the length of the search interval were included. Detections used in the analysis, bias corrections, fatality estimates, and 90% confidence intervals are detailed in Appendix F.

Using the Huso (2011) fatality estimator model, during the 2016 – 2017 monitoring year, there were an estimated total of 724 bird fatalities (CI: 511 – 1,005) and 25 bat fatalities (CI: (6) – 48) at the Project (all components combined). Of the estimated avian fatalities, the model estimates 17 (CI: (10) – 26) large birds, 163 (CI: 121 – 217) medium birds, and 544 (CI: 335 – 818) small birds at the Project (all components combined; Table 13). Adjusted fatality estimates are provided by guild in Table 13.

For all components associated with both solar units (SCAs, power blocks, evaporation ponds, and along the perimeter fence; totaling 1,727 acres), there were an estimated 484 (CI: 380 – 611) bird fatalities (0.28/acre, 1.9/nameplate MW) and 25 (CI: (6) – 48) bat fatalities (0.01/acre, 0.1/nameplate MW; Table 14). Considering only the fatalities associated with the SCAs (1,163 acres), there were an estimated 209 (CI: 134 – 308) bird fatalities (0.18/acre, 0.8/nameplate MW). A breakdown by Project component is provided in Appendix F.

There were an estimated 240 (CI: 53 – 469; 14/km) bird fatalities along overhead lines (Table 14). No bat carcasses were detected along the overhead lines. Fatality estimates for each component are provided by guild in Table 15. A complete list of fatality estimates for each Project component and carcass size class with confidence intervals is presented in Appendix F.

Fatality estimates for resident, nocturnal migrating, diurnal migrating, and unidentified passerines during the spring and fall passerine migration periods are provided in Table 16. At the SCAs, the model estimated 6 (CI: *(1) – 18*) nocturnal migrating passerines, and 10 (CI*: (1) – 29*) diurnal migrating passerines. All 3 (CI*: (1) – 10*) estimated resident passerines fatalities are associated with the fence. At the overhead lines, the model estimated 160 (CI: 23 – 325) nocturnal migrating passerines, 37 (CI: *(1) – 104*) diurnal migrating passerines, and no resident passerines. Of the 182 (CI: 47 – 353) estimated nocturnal migrating passerines fatalities, 88% were along the overhead lines.

Table 13. Adjusted fatality estimates by size and taxonomic groupings during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California

Size/Group	Detections (carcass search and incidental)	Total Adjusted Fatalities	90% CI
Bats	10	25	(6) - 48
Large Birds	15	17	(10) – 26
Medium Birds	64	163	121 – 217
Small Birds and (unknown)	109 (7)	544	335 – 818
Passerines	92	440	239 – 715
All water-associated birds	64	153	112 – 207
Diurnal Raptors	2	5	*(2) – 13*

Table 14. Estimated number of fatalities within the solar field and along the overhead lines (using Huso estimator model) at the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

	Project Component	Actual Detections (carcass search and incidental)	Huso Estimates (fatalities)	90% CI	Huso Estimates (fatalities/acre or /km)	Huso Estimates (fatalities/mw)
Birds	Solar Field	186	**484**	380 – 611	0.28/acre	1.90
	Overhead Lines	9	**240**	53 – 469	14/km	0.96
Bats	Solar Field	10	**25**	*(6) – 48*	0.01/acre	0.10
	Overhead Lines	0	-	-	-	-

Table 15. Adjusted fatality estimates by guild and component type for the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. Confidence intervals in italics are considered unreliable due to low detection counts.

Guild	Fence	90% CI	Overhead Lines	90% CI	Ponds	90% CI	Power Blocks	90% CI	SCAs	90% CI	Overall	90% CI
Passerines	59	29 – 97	222	23 – 462	20	(4) – 44	59	40 – 81	80	36 – 142	440	239 – 715
All water-associated birds	19	(11) – 28	-	-	35	29 – 42	7	6 – 8	92	53 – 143	153	112 – 207
All birds	111	73 – 153	240	53 – 469	71	44 - 105	93	63 - 130	209	134 - 308	724	511 – 1,005
Diurnal Raptors	4	*(1) – 12*	-	-	-	-	*1*	*(1) – 3 -*	-	-	*5*	*(2) – 13*
Bats	6	*1 – 15*	-	-	18	*4 - 40*	*1*	*(1) – 39*		-	25	(6) – 48

Table 16. Adjusted fatality estimates by passerine group and component type for the spring (March 1 – May 31 2016), and fall (August 15 – October 31, 2016) seasons at the Genesis Solar Energy Project, Riverside County, California. Confidence intervals in italics are considered unreliable due to low detection counts.

Guild	Fence	90% CI	Overhead Lines	90% CI	Ponds	90% CI	Power Blocks	90% CI	SCAs	90% CI	Overall	90% CI
Passerines												
Resident	3	*(1) – 10*	-	-	-	-	-	-	-	-	3	*(1) – 10*
Nocturnal	6	*(2) – 12*	160	23 – 325	-	-	10	*(4) – 22*	6	*(1) – 18*	182	47 – 353
Diurnal	14	*(4) – 31*	37	*(1) – 104*	-	-	23	16 – 32	10	*(1) – 29*	83	33 – 157
Total Birds	26	8 – 48	197	23 – 419	-	-	33	25 – 41	35	9 – 69	291	114 – 526

4.0 DISCUSSION

The 2016 - 2017 monitoring year represented the second year of standardized mortality monitoring at the Genesis Solar Energy Project. Searcher efficiency trials and carcass persistence trials were conducted during each of the four seasons at the SCAs, power blocks, fence, and along the overhead lines. Data from these trials were used to produce fatality estimates adjusted for searcher efficiency and carcass persistence bias. Carcass persistence trial data from both the first and second monitoring years were used to inform carcass persistence models, and model predictions were used to adjust fatality estimates. Searcher efficiency trial data from the first monitoring year was unable to be pooled with the trial data from the second year given changes made to the search methods. The results provided in each seasonal report were considered preliminary because estimating carcass persistence, searcher efficiency, and adjusted numbers of fatalities within each season represents information based on a limited sample size. For this annual report, the analysis is comprehensive, with data from all four seasons included in the analysis.

The completion of the second year of monitoring met the goals and objectives (Section 6.1) of the amended BBCS (2016), and added to the understanding of avian and bat mortality associated with Genesis that was gained during the first year of monitoring.

4.1 Fatality Estimates

During the 2016 – 2017 monitoring year there were an estimated total of 724 (CI: 511 – 1,005) bird fatalities and 25 (CI: (6) – 48) bat fatalities at the Project (all components combined). There were an estimated 111 (73 – 153) bird fatalities along the fence, 209 (134 – 308) at the SCAs, 93 (63 – 130) at the power blocks, 71 (44 – 105) at the ponds, and 240 (53 – 469) along the overhead lines. There were an estimated 6 (*(1) – 15*) bat fatalities along the fence, 18 (*(4) – 39*) at the ponds, and 1 (*(1) – 3*) at the power blocks. Of the estimated avian fatalities, the model estimated 17 (CI: (10) – 26) large birds, 163 (CI: 121 – 217) medium birds, and 544 (CI: 335 – 818) small birds at the Project (all components combined). There were an estimated 440 (CI: 239 – 715) passerines and 153 (CI: 112 – 207) water-associated birds at the Project (all components combined). During the spring (March 1 – May 31, 2016) and fall (August 15 – October 31, 2016) migration seasons, there were an estimated 3 (CI: *(1) – 10*) resident, 83 (CI: 33 – 157) diurnal migrating, and 182 (CI: 47 – 353) nocturnal migrating passerines estimated at the Project (all components combined).

The power block fatality estimates should be interpreted with caution. The standardized searches are conducted from the perimeter of the power blocks. However, most of the carcasses reported in the power blocks are from operations personnel who make daily inspections throughout the area during routine maintenance checks. To be conservative, we adjusted the carcasses found incidentally by operations personnel as we would for those found during the standardized searches. However, given that most of the area for the power blocks is not systematically searched, there is greater uncertainty in estimates for the power blocks than for other project features.

The density of estimated bird fatalities in the SCAs (1,163 acres) was 0.18 fatalities/acre during the 2016 – 2017 monitoring year. Along the overhead lines, the density of estimated bird fatalities was 14 fatalities per kilometer. A higher fatality estimate was produced for the overhead lines than at the SCAs. Estimates for overhead lines have greater uncertainty (i.e. wider confidence intervals) than the SCAs due to high carcass removal rates along that Project component relative to search intervals. The greater uncertainty for the overhead lines estimate was especially apparent for small carcass sizes, where the probability of persistence to the next search was lowest.

4.2 Carcass Persistence and Searcher Efficiency Trials

During the 2016 - 2017 monitoring year, the carcass persistence rate was low outside of the Project fence along the overhead lines, while persistence rates were greater within the Project fence. Carcass persistence rates were greater for medium and large birds compared to smaller birds. Longer persistence times for larger sized birds compared to smaller sized birds is a consistent result seen in many other studies (e.g. wind energy project: Smallwood et al., 2010, Morrison 2002; and solar energy project: WEST, 2016b). Shorter persistence rates were observed for medium birds during fall and winter and for large birds during winter. For small birds, carcass persistence rates were longest during spring. The cause of these shorter persistence rates for medium birds and large birds and longer persistence rates for small birds during these particular seasons cannot be inferred from the data, but some of the observed differences may be due to random variation in scavenger activity.

Overall, searcher efficiency rates were high at all project components, particularly for medium and large birds. Given the good searcher efficiency rates within the SCAs, especially for medium and large birds, using an even larger viewshed may lead to a more efficient design. While searcher efficiency in the SCAs was lower for small birds and slightly lower for medium and large birds during the second monitoring year, overall detection probability is higher due to the increased proportion of area searched (Appendix G).

4.3 Temporal and Spatial Patterns of Detections

Temporal patterns of detections were examined for evidence of daily or seasonal peaks in detections. For each day during which six or more detections occurred, an Avian Injury & Mortality Report form (in accordance with Special Purpose Utility Permit MB44900B-0 Condition H.1(c)) was required to be submitted within 24 hours to the USFWS, BLM, CDFW, and CEC. Six or more detections occurred on a total of seven days, compared to 15 days during the first monitoring year. The highest daily counts occurred on September 29, 2016 (7 detections) and October 20, 2016 (7 detections). During all other survey days, five or fewer birds and bats were detected.

During high wind events, birds may fly at lower altitudes, potentially putting them at greater collision risk with project components. Wind data (average daily wind speed and maximum daily wind speed) collected on site was used to evaluate if there was a correlation between wind speed and number of detections. Pearson correlation coefficients were calculated for detections made during the spring and fall migration periods (7-day search interval), and average daily wind speed over the span of six days prior to the detection. Detections were standardized to a rate of detections made per search to account for sampling effort; therefore, only carcasses found on regular search plots during standard searches were included. In addition, only detections estimated to be less than seven days old or with unknown carcass ages were included in the analysis. The same was done for daily maximum wind speed. Pearson correlations were -0.16 for both metrics, indicating that very little or no relationship exists between wind speed and the number of detections found during the spring and fall migration periods.

During the 2016 – 2017 monitoring year, the highest numbers of avian detections and estimated fatalities were found during the fall season which coincides with the fall migration period, while most bat detections occurred during summer. The majority of avian detections and estimated fatalities occurred during October followed by September and August, with the greatest number of water-associated bird detections occurring during October and September. The higher number of avian detections and estimated fatalities during fall migration compared to spring migration is not well understood and we hypothesize it could be attributable to a larger population size in fall compared to spring due to the presence of juveniles. In addition, there may be differences in migration patterns and routes for some of the affected bird species resulting in more birds moving through the region in fall compared to spring (Patton et al. 2003). These are all currently untested hypotheses.

During the 2016 – 2017 monitoring period, more detections (n = 61, or 29.8% of total detections) were found within the power blocks than at other project components. Of the detections found at the power blocks, sixty-four percent were found incidentally by site maintenance personnel, who visit the power blocks daily. Recall that biologists search only the perimeter of the power blocks as they are not permitted to enter the power blocks. No bats were found in the SCAs, and spatial patterns of avian detections were not distinct within the SCAs. There was no consistent pattern in the number of birds observed at each unit. More bird detections were observed in Unit 1 (the unit containing the evaporation ponds), while the opposite was true during the first monitoring year. There were 28 water-associated detections in Unit 1 and 20 in Unit 2. More detections (n = 8) were found at the SCAs closest to the ponds than at other SCAs in Unit 1, and each of these detections were water-associated bird detections. There were 27 detections (23 birds, 4 bats) at the evaporation ponds (excluded from Unit 1 and Unit 2 tally).

4.4 Causation and Other Potential Biases

Detections attributed to an unknown cause (n = 170) accounted for approximately 83% of all detections (n = 205) during the 2016 – 2017 monitoring year, and the distribution of the unknown cause detections varied by Project component. Of the 170 bird and bat detections attributed to an unknown cause, the highest percentage occurred in association with the power blocks (28.2%) and SCAs (25.9%). Forty-eight (78.7%) of the 61 power block detections and 44 (91.7%) of the 48 SCA detections were attributed to an unknown cause. Of the 162 avian detections attributed to an unknown cause, 91 (56.2%) were scavenged detections, while 71 (43.8%) showed no signs of scavenging. Forty-three (26.5%) of those attributed an unknown cause were feather spots Determining a cause of mortality from a feather spot or scavenged bird is challenging because the evidence available rarely allows the inference of cause.

Detections assigned an unknown cause could be attributed to the Project; however, it is not unreasonable to assume that some of the detections found and assigned an unknown cause might have died from causes unrelated to the facility (e.g. predation). Due to this uncertainty of causation, some studies have estimated background fatality estimates at reference or control areas to try to provide some basis for addressing causation. Such studies, however, due to their location, cannot be used to represent background mortality expected at this Project.

In addition to issues associated with background mortality, scavengers could create multiple feather spots from one detection (WEST 2016b). The Technical Advisory Group (TAG) for the Ivanpah Solar Electric Generating Facility (ISEGS) reviewed bias trials for ISEGS and determined that in some cases scavengers created multiple feather spots from a single carcass. Adjustments to the fatality estimate were not conducted based on this finding as it is unknown how often feather spots disperse from a carcass location to be considered distinct. However, camera data from ISEGS support the idea that there is the potential for multiple feather spots to originate from one trial carcass. At Genesis, game cameras trained on carcasses for carcass persistence trials at the Project have also documented the potential for multiple feather spots originating from a single trial carcass. Camera images have been captured in which ravens and turkey vultures are dislodging feathers from their attachment to the skin of the carcass during the scavenging process. These feathers have the potential to be blown by the wind to create multiple feather spots. Thus, the presence of feather spots among the detections for the Project may inflate the fatality estimate based on the potential for multiple feather spots, resulting from one detection being counted as separate detections if feathers are blown around the site, or they are scattered by predators (e.g., plucking by ravens). Nonetheless, feather spots are included in the analysis here to provide a more conservative estimate of fatality.

4.5 Comparison of the First and Second Monitoring Year

During the first year of monitoring (March 1, 2015 – February 28, 2016) there were 400 bird and bat detections with an estimated total of 1,507 (CI: 1,214 – 1,952) bird fatalities and 26 bat fatalities at the Project (all components combined). During the second year of monitoring (February 29, 2016 – February 28, 2017), there were 205 bird and bat detections with an estimated total of 724 bird fatalities (CI: 511 – 1,005) and 25 bat fatalities (CI: (6) – 48) at the Project (all components combined). There were an estimated 997 (CI: 817 – 1,240; 0.58 fatalities/acre; 3.99 fatalities/MW) bird fatalities and 26 (CI: 10 – 46; 0.02 fatalities/acre; 0.10 fatalities/MW) bat fatalities within the solar field during the first monitoring year, compared to 484 (CI: 380 – 611; 0.28 fatalities/acre; 1.90 fatalities/MW) birds and 25 (CI: (*(6) – 48*; 0.01 fatalities/acre; 0.10 fatalities/MW; Appendix I) during the second monitoring year. Considering the SCAs only, the density of estimated bird fatalities in the SCAs was lower (0.18 fatalities/acre) during the second year of monitoring compared to the first (0.56 fatalities per acre). There were 85 (CI: 54 – 128) estimated fatalities at the fence, 10 (CI: 4 – 17) at the power blocks and 123 (CI: 28 – 255) at the ponds during the first monitoring year compared to 111 (CI: 73 – 153) estimated fatalities at the fence, 93 (CI: 63 – 130) at the power blocks, and 71 (CI: 44 – 105) at the ponds during the second monitoring year (Appendix I). Along the overhead lines, there were 240 (CI: 53 – 469; 14 fatalities/km) estimated bird fatalities during the second monitoring year compared to 510 (CI: 278 – 894; 30 fatalities/km) during the first. It is not clear why there were more detections and estimated fatalities during the first year of monitoring compared to the second. There are potentially many factors that might influence variation in detections and fatality estimates from year to year, but attempting to determine those factors is beyond the scope of this report.

During the first monitoring year there were an estimated 20 (CI: 8 – 36) large birds, 562 (CI: 423 – 744) medium birds, and 925 (CI: 674 – 1,347) small birds compared to 17 (CI: (10) – 26) large birds, 163 (CI: 121 – 217) medium birds, and 544 (CI: 335 – 818) small birds during the second monitoring year (Appendix I). There were an estimated 900 (CI: 664 – 1,302) passerine fatalities, 372 (CI: 263 – 518) water-associated bird fatalities, and 8 (CI: 3 – 14) diurnal raptor fatalities during the first monitoring. During the second monitoring year there were an estimated 440 (CI: 239 – 715) passerine fatalities, 153 (CI: 112 – 207) water-associated bird fatalities, and 5 (CI: *(2) – 13*) diurnal raptor fatalities, thus considerably lower fatality estimates than that observed for each bird type during the first monitoring year (Appendix I). During the first monitoring year, there were an estimated 302 (CI: 179 – 481) resident passerine fatalities, 216 (CI: 101 – 408) nocturnal migrating passerine fatalities, and 8 (1 – 18) diurnal migrating passerine fatalities (Appendix I). During the second monitoring year, there were fewer estimated nocturnal migrating bird fatalities (182 CI: 47 – 353), considerably fewer resident passerine fatalities (3 CI: *(1) – 10*), but considerably more diurnal migrating bird fatalities (83 CI: 33 – 157).

During the first year of monitoring, one unforeseen outcome was the number of water-associated birds (n = 100) found at the netted ponds, particularly during fall (n = 61). During the second monitoring year, far fewer water-associated birds (n = 27) were found at the netted ponds, with just four found during the fall season. One difference between the fall 2015 monitoring season and the fall 2016 monitoring season is that the wires over the netted ponds were not present during the fall 2016 monitoring season. The wires were removed July 10 – 22, 2016. However, during the fall 2016 monitoring season, fewer birds were found not just at the ponds, but at all project components. Furthermore, fewer birds were found during the spring 2016 monitoring season, prior to wire removal, than during the 2015 spring season. Regarding the spatial distribution of water-associated bird detections at the ponds, during the first monitoring year when the wires were present, a number of the detections appear to line up with the wires whereas this was not the case after the wires were removed (Appendix H).

There were both spatial and temporal similarities in carcass persistence rates between the first and second monitoring years. During both the first and second year of monitoring at the Project, the carcass persistence rate was low outside of the Project fence along the overhead lines, whereas persistence rates were greater within the Project fence. During the first and second monitoring year, shorter persistence rates were observed for medium birds during fall and winter and for large birds during winter. For small birds, carcass persistence rates were longest during spring. Among the two monitoring years, there were also similarities in carcass persistence that were related to trial carcass size. Carcass persistence rates were greater for medium and large birds compared to smaller birds during both years of monitoring. While there were similarities in carcass persistence rate patterns among the two monitoring years, overall, carcass persistence rates were lower during the second monitoring year and there was a general trend of decreasing persistence through the search interval over the two year monitoring period.

One hypothesis that might explain the trend of decreasing carcass persistence over the two year monitoring period is the idea that scavengers are learning how the trials are being set at the solar field and overhead lines and exploiting this consistent food source. Some scavengers, such as common ravens and other corvids, are able to remember the location of food items that they have observed others caching (Bugnyar and Kotrschal 2002). Thus, common ravens present during carcass persistence trials, may be observing the biologists as they place trial carcasses and then later retrieving the carcasses. It is possible that common ravens have learned to recognize biologists and follow them to food sources during carcass persistence trials at the Genesis Solar Energy Project. Marzluff et al. 2010 found that American crows, closely related to common ravens, have the ability to remember faces and associate those faces with a given experience. Furthermore, during carcass persistence trial placements, biologists at the Genesis Solar Energy Facility have reported common ravens following them to carcass locations with carcasses subsequently removed by ravens within a few hours or less (within minutes in some cases) of carcass placement. This could explain the faster removal rates observed during the second monitoring year. Similar observations have occurred at the McCoy Solar Energy Facility, Blythe Solar Energy Facility, and Desert Sunlight Solar Energy Facility in California and at the Ivanpah Solar Electric Generating Facility in Nevada. Alternatively, a second hypothesis that might explain the trend of decreasing carcass persistence over the two year monitoring period is the idea that the scavenger population has increased because scavengers are attracted to the facility as a food source. Based upon this hypothesis, estimated carcass persistence represents actual carcass persistence. However, under the first proposed hypothesis, estimated carcasses persistence does not represent natural carcass persistence because ravens are only targeting carcass persistence trials and not detections. Thus, under the first hypothesis proposed, scavengers introduce bias into the fatality estimate whereas this is not the case under the second hypothesis.

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Appendix A. Detailed Areas of Standardized Searches and Detection Locations along the Distribution and Generation Tie Lines of the Genesis Solar Energy Project during the 2016 – 2017 Monitoring Year (February 29, 2016 – February 28, 2017)

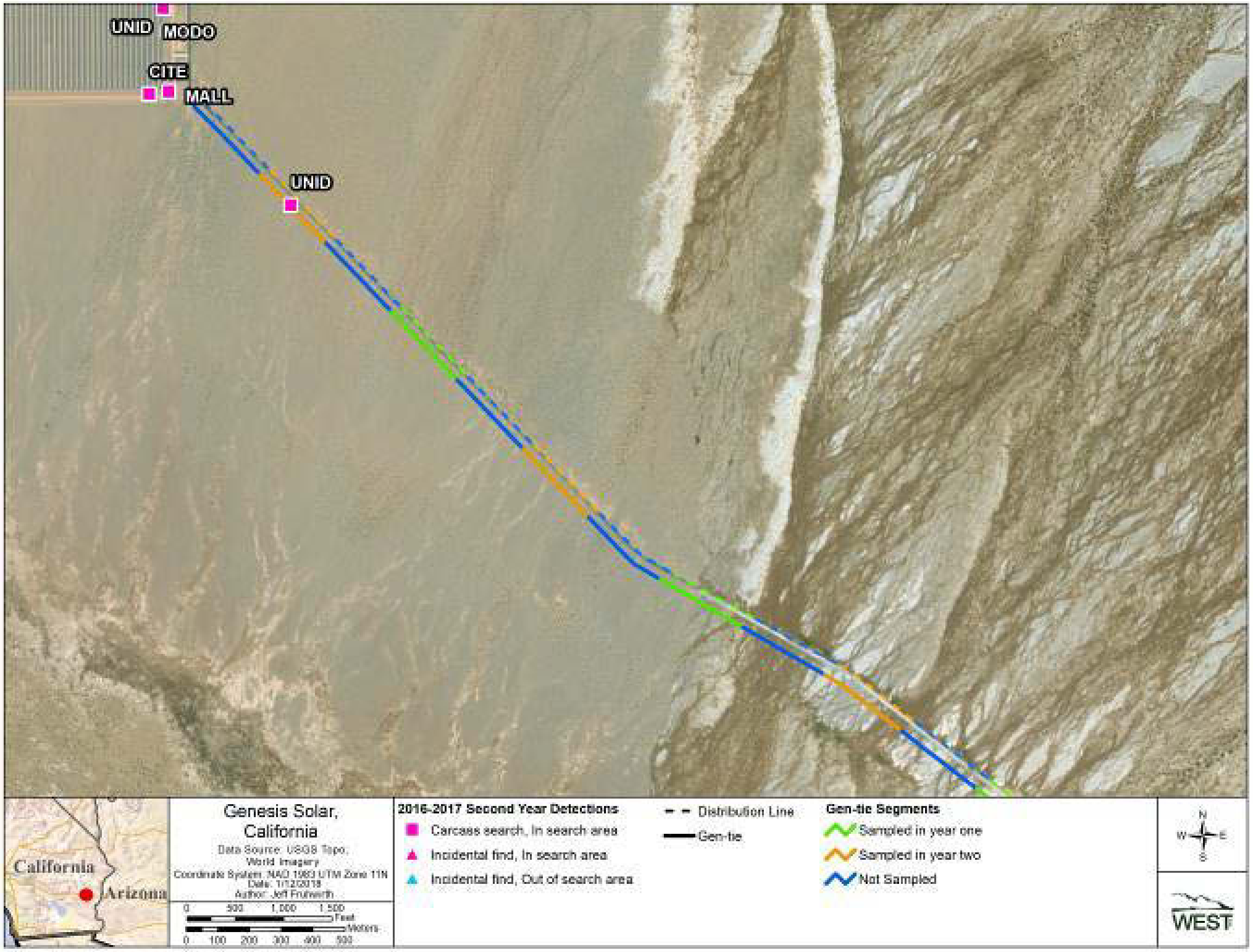

Figure A-1. Detailed map sections of detections along the overhead lines of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

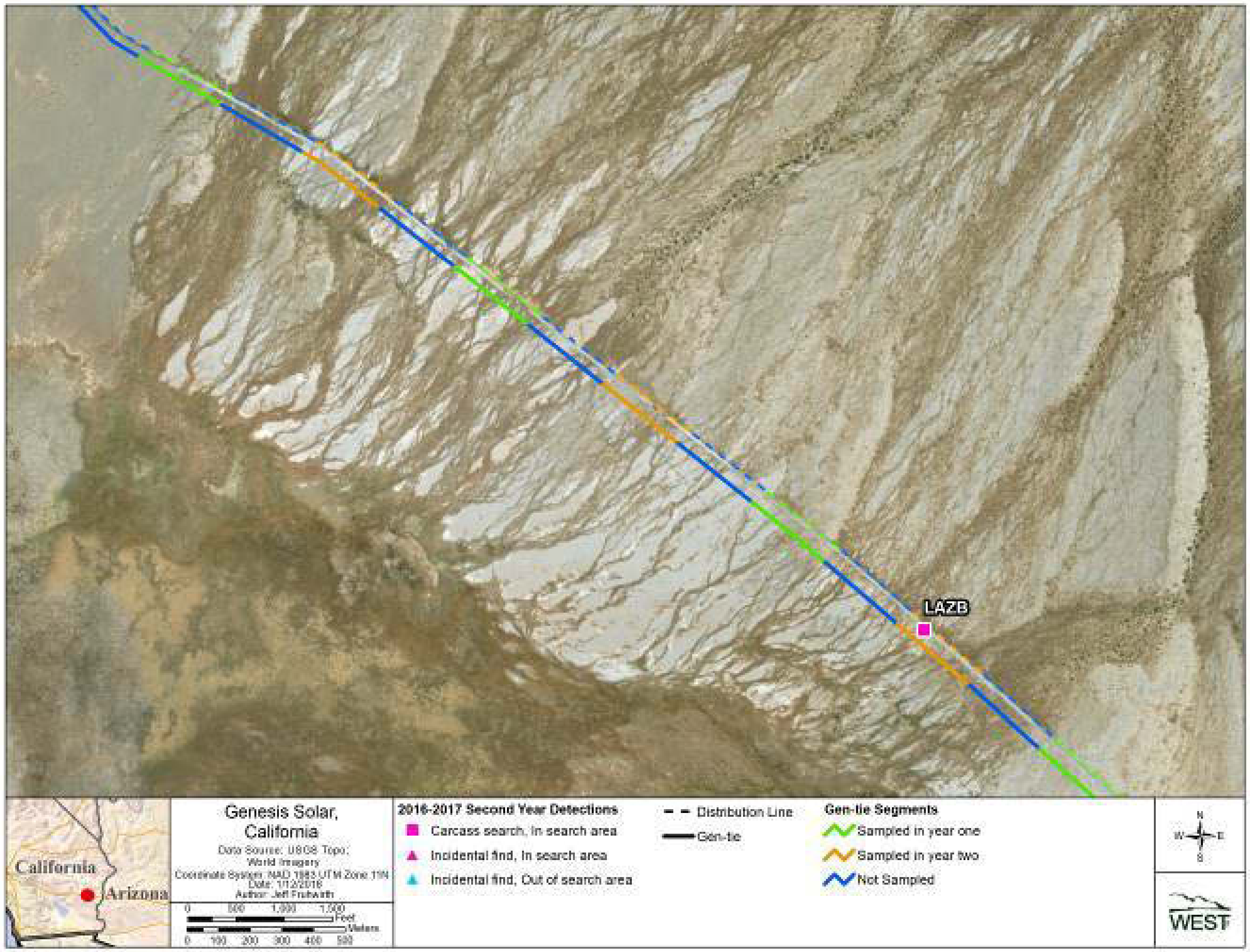

Figure A-2. Detailed map sections of detections along the overhead lines of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

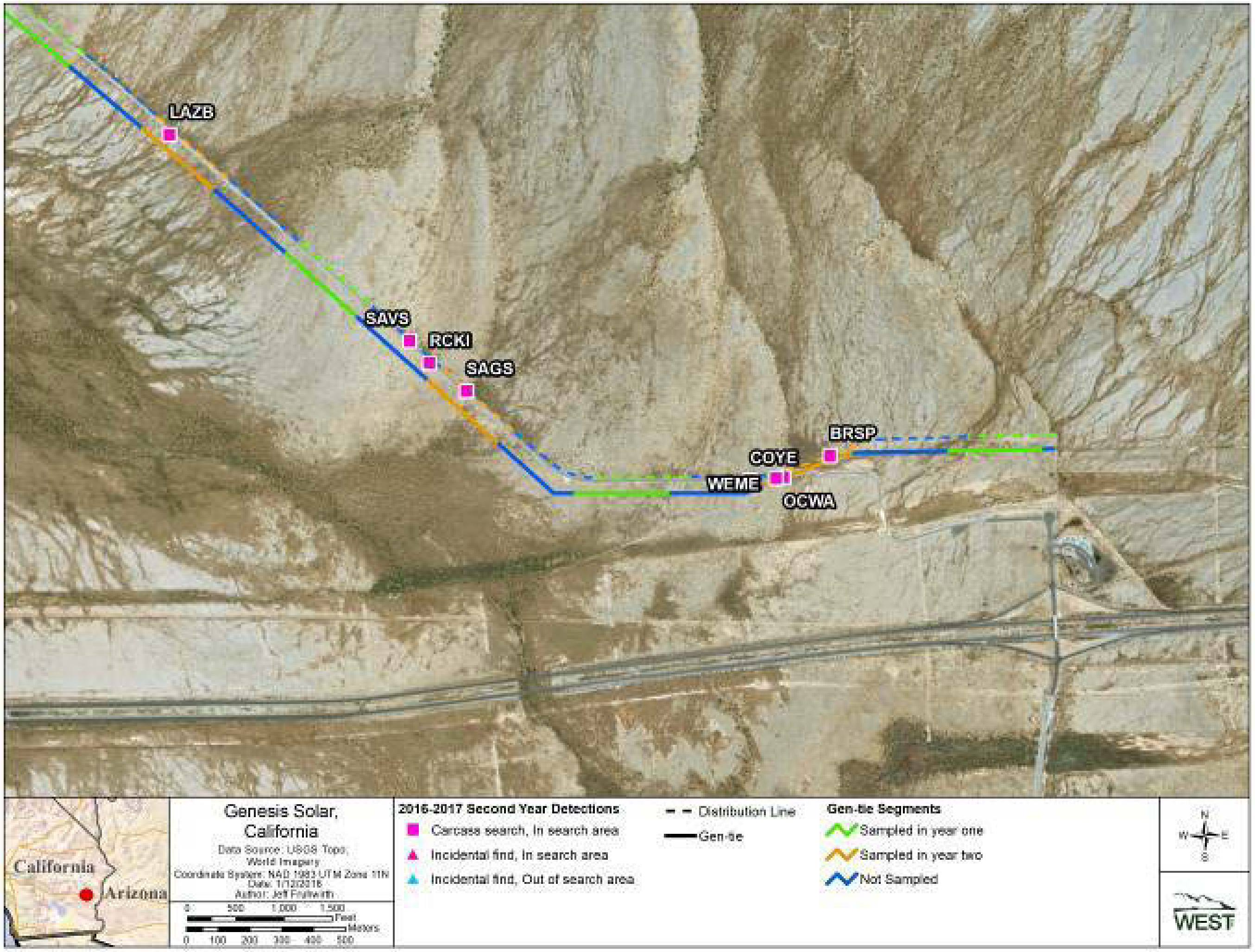

Figure A-3. Detailed map sections of detections along the overhead lines of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

Appendix B. Detailed Areas of Standardized Searches and Detection Locations within the Power Blocks of the Genesis Solar Energy Project during the 2016 – 2017 Monitoring Year (February 29, 2016 – February 28, 2017)

Figure A-1. Detailed map sections of detections within the Unit 1 power block of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

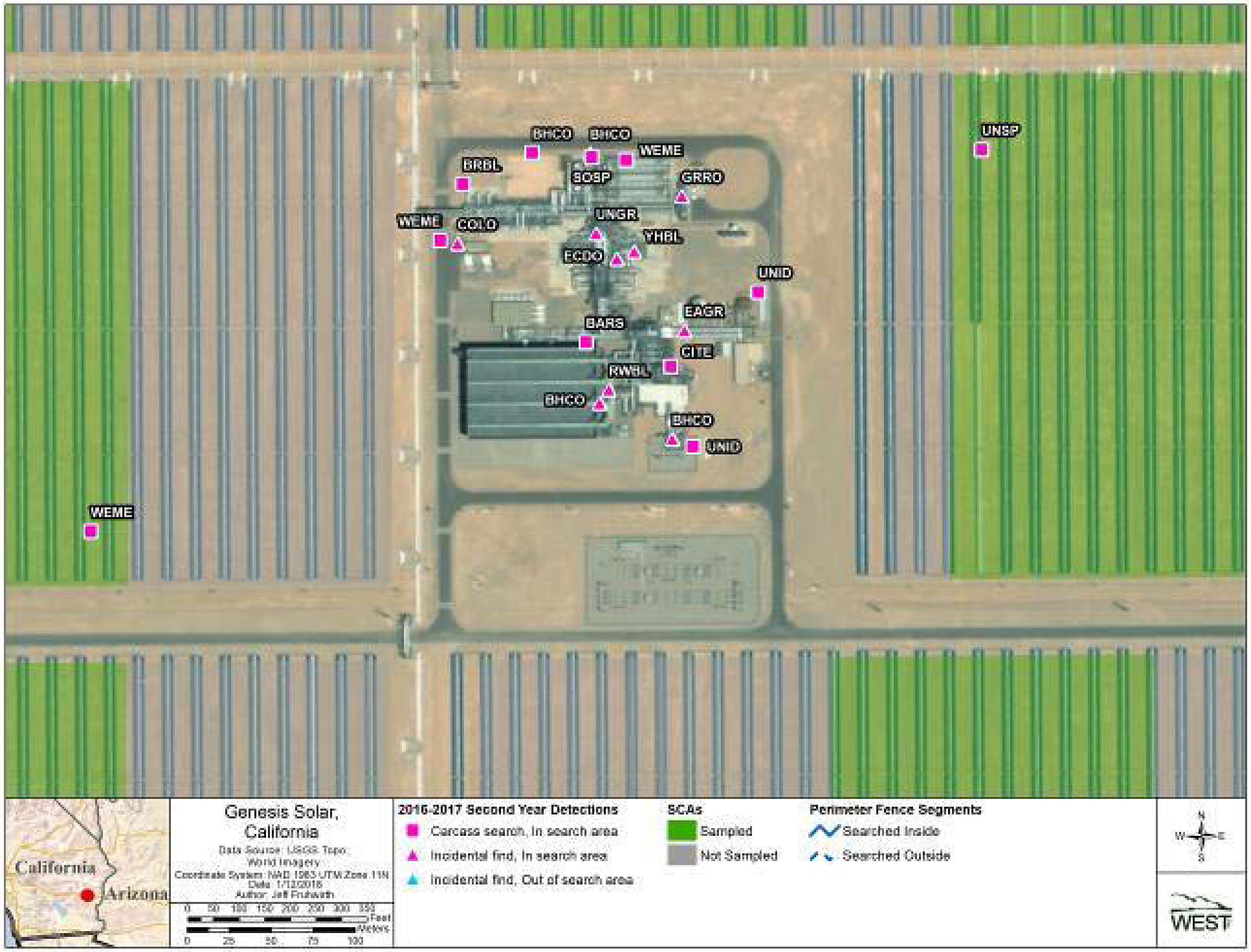

Figure A-1. Detailed map sections of detections along the Unit 2 power block of the Genesis Solar Energy Project during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

Appendix C. Weather Conditions and Body Weights Associated with Avian Detections Estimated to have been dead less Than 24 Hours during the 2016 – 2017 Monitoring Year (February 29, 2016 – February 28, 2017)

Table C. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather	Wind direction	Wind speed	Max wind speed
072116-SN-02	7/21/2016	0-8h	ash-throated flycatcher	24	clear	E	4	7
100416-SH-01	10/4/2016	8-24h	barn swallow	NA	clear	SW	4	5
072116-SN-05	7/21/2016	0-8h	brown-headed cowbird	NA	clear	S	11	21
072916-SN-01	7/29/2016	8-24h	brown-headed cowbird	28	clear	S	7	17
072116-SN-04	7/21/2016	0-8h	brown-headed cowbird	NA	clear	S	10	10
080416-SH-01	8/4/2016	8-24h	brown-headed cowbird	NA	clear	S	10	17
100616-RA-02	10/6/2016	0-8h	Brewer's sparrow	11	clear	NW	8	18
083116-SH-02	8/31/2016	0-8h	Brewer's sparrow	8	clear	NW	5	6
092116-LG-01	9/21/2016	8-24h	cinnamon teal	NA	raining	N	5	16
120816-SN-01	12/8/2016	8-24h	canyon bat	NA	clear	NW	8	18
062216-SH-02	6/22/2016	0-8h	canyon bat	2	clear	S	14	14
100316-SH-01	10/3/2016	8-24h	Cooper's hawk	NA	clear	NW	10	20
110416-RA-02	11/4/2016	0-8h	common loon	NA	clear	N	2	7
083116-SN-01	8/31/2016	0-8h	common yellowthroat	9	clear	S	7	13
083016-SH-02	8/30/2016	0-8h	common yellowthroat	9	clear	N	6	7
122316-SN-01	12/23/2016	0-8h	eared grebe	NA	rain	NE	4	7
062116-SN-02	6/21/2016	0-8h	eared grebe	270	clear	S	12	23
042716-EP-03	4/27/2016	8-24h	eared grebe	NA	clear	SW	5	21
030716-FM-01	3/7/2016	8-24h	Eurasian collared-dove	NA	clear	SW	16	32
062116-SN-01	6/21/2016	8-24h	green heron	165	clear	W	9	22
071316-SH-02	7/13/2016	0-8h	greater roadrunner	NA	clear	S	14	24
042916-JPG-01	4/29/2016	0-8h	lazuli bunting	16	clear	NW	5	8
063016-SN-02	6/30/2016	0-8h	lesser nighthawk	NA	clear	S	8	8
092616-ST-01	9/26/2016	0-8h	Lincoln's sparrow	11	clear	N	5	21
100716-RA-02	10/7/2016	0-8h	Lincoln's sparrow	NA	clear	SW	4	9
092316-SN-01	9/23/2016	0-8h	Lincoln's sparrow	17	clear	N	12	22
072916-SN-02	7/29/2016	8-24h	mourning dove	93	clear	S	7	17
080916-SN-01	8/9/2016	8-24h	mourning dove	102	clear	S	13	14
081816-SN-03	8/18/2016	8-24h	mourning dove	NA	wind	S	11	20
031716-EP-01	3/17/2016	0-8h	mourning dove	NA	clear	SE	3	7

Table C. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather	Wind direction	Wind speed	Max wind speed
013017-JKP-01	1/30/2017	0-8h	northern harrier	NA	clear	W	3	6
030716-FM-02	3/7/2016	0-8h	Pallid bat	NA	clear	SW	16	32
012617-SN-01	1/26/2017	8-24h	Pacific loon	NA	clear	NW	7	14
110316-RA-01	11/3/2016	8-24h	ruby-crowned kinglet	6	clear	NW	9	16
101916-CH-01	10/19/2016	8-24h	Sagebrush sparrow	17	clear	NW	7	12
100616-RA-01	10/6/2016	8-24h	Savannah sparrow	15	clear	NW	8	18
033016-JPG-02	3/30/2016	0-8h	Savannah sparrow	16	clear	NW	2	5
101116-ST-01	10/11/2016	8-24h	unidentified bird (small)	NA	clear	NE	1	7
102016-SH-01	10/20/2016	0-8h	western grebe	NA	wind	NW	10	12
103116-RA-02	10/31/2016	0-8h	western grebe	NA	clear	NE	6	15
101116-ST-02	10/11/2016	8-24h	western meadowlark	64	clear	NE	1	7
092616-CH-01	9/26/2016	0-8h	western tanager	23	clear	N	5	21
033016-JPG-01	3/30/2016	0-8h	yellow-rumped warbler	12	clear	NW	2	5

Appendix D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for All Avian Detections Made during Standardized Carcass Searches and Incidentally, by Species, during the 2016 – 2017 Monitoring Year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California

Table D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for all avian detections (those made during standardized carcass searches and incidentally) during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. LB = large sized bird; MB = medium sized bird; SB = small sized bird

Common Name	4-Letter Species Code	Scientific Name	Guild	Migration Behavior*	Size
American coot	AMCO	*Fulica americana*	Rails/Coots	nocturnal	MB
ash-throated flycatcher	ATFL	*Myiarchus cinerascens*	Flycatchers	resident	SB
barn swallow	BARS	*Hirundo rustica*	Swallows	diurnal	SB
black phoebe	BLPH	*Sayornis nigricans*	Flycatchers	diurnal/nocturnal	SB
blue-winged teal	BWTE	*Anas discors*	Waterfowl	nocturnal	MB
Brewer's blackbird	BRBL	*Euphagus cyanocephalus*	Blackbirds/Orioles	diurnal	SB
Brewer's sparrow	BRSP	*Spizella breweri*	Grassland/Sparrows	nocturnal	SB
brown-headed cowbird	BHCO	*Molothrus ater*	Blackbirds/Orioles	diurnal	SB
Bullock's oriole	BUOR	*Icterus bullockii*	Blackbirds/Orioles	nocturnal	SB
burrowing owl	BUOW	*Athene cunicularia*	Owls	resident	MB
canyon bat	CNBA	*Parastrellus hesperus*	Bats	NA	BAT
cinnamon teal	CITE	*Anas cyanoptera*	Waterfowl	nocturnal	MB
cliff swallow	CLSW	*Petrochelidon pyrrhonota*	Swallows	diurnal	SB
common loon	COLO	*Gavia immer*	Loons/Grebes	diurnal	LB

Table D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for all avian detections (those made during standardized carcass searches and incidentally) during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. LB = large sized bird; MB = medium sized bird; SB = small sized bird

Common Name	4-Letter Species Code	Scientific Name	Guild	Migration Behavior*	Size
common poorwill	COPO	*Phalaenoptilus nuttallii*	Goatsuckers	nocturnal	SB
common yellowthroat	COYE	*Geothlypis trichas*	Warblers	nocturnal	SB
Cooper's hawk	COHA	*Accipiter cooperii*	Accipiters	diurnal	MB
curve-billed thrasher	CBTH	*Toxostoma curvirostre*	Mimids	diurnal/nocturnal	SB
eared grebe	EAGR	*Podiceps nigricollis*	Loons/Grebes	nocturnal	MB
Eurasian collared-dove	ECDO	*Streptopelia decaocto*	Doves/Pigeons	resident	MB
great blue heron	GBHE	*Ardea herodias*	Waterbirds	resident	LB
greater roadrunner	GRRO	*Geococcyx californianus*	Cuckoos	resident	MB
green-tailed towhee	GTTO	*Pipilo chlorurus*	Grassland/Sparrows	resident	SB
green heron	GRHE	*Butorides virescens*	Waterbirds	resident	MB
horned lark	HOLA	*Eremophila alpestris*	Grassland/Sparrows	resident	SB
Inca dove	INDO	*Columbina inca*	Doves/Pigeons	resident	SB
killdeer	KILL	*Charadrius vociferus*	Shorebirds	diurnal/nocturnal	MB
lazuli bunting	LAZB	*Passerina amoena*	Tanagers	nocturnal	SB
least sandpiper	LESA	*Calidris minutilla*	Shorebirds	diurnal/nocturnal	SB
lesser nighthawk	LENI	*Chordeiles acutipennis*	Goatsuckers	diurnal	SB

Table D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for all avian detections (those made during standardized carcass searches and incidentally) during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. LB = large sized bird; MB = medium sized bird; SB = small sized bird

Common Name	4-Letter Species Code	Scientific Name	Guild	Migration Behavior*	Size
Lincoln's sparrow	LISP	*Melospiza lincolnii*	Grassland/Sparrows	nocturnal	SB
mallard	MALL	*Anas platyrhynchos*	Waterfowl	diurnal/nocturnal	LB
mourning dove	MODO	*Zenaida macroura*	Doves/Pigeons	diurnal/nocturnal	MB
northern harrier	NOHA	*Circus cyaneus*	Northern Harrier	diurnal	MB
northern mockingbird	NOMO	*Mimus polyglottos*	Mimids	resident	SB
northern pintail	NOPI	*Anas acuta*	Waterfowl	nocturnal	MB
northern rough-winged swallow	NRWS	*Stelgidopteryx serripennis*	Swallows	diurnal	SB
orange-crowned warbler	OCWA	*Oreothlypis celata*	Warblers	nocturnal	SB
Pacific loon	PALO	*Gavia pacifica*	Loons/Grebes	diurnal	LB
Pallid bat	PABA	*Antrozous pallidus*	Bats	NA	BAT
red-winged blackbird	RWBL	*Agelaius phoeniceus*	Blackbirds/Orioles	diurnal	SB
rock pigeon	ROPI	*Columba livia*	Doves/Pigeons	resident	MB
ruby-crowned kinglet	RCKI	*Regulus calendula*	Gnatcatchers/Kinglet	nocturnal	SB
ruddy duck	RUDU	*Oxyura jamaicensis*	Waterfowl	nocturnal	MB
Sagebrush sparrow	SAGS	*Artemisiospiza nevadensis*	Grassland/Sparrows	nocturnal	SB

Table D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for all avian detections (those made during standardized carcass searches and incidentally) during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. LB = large sized bird; MB = medium sized bird; SB = small sized bird

Common Name	4-Letter Species Code	Scientific Name	Guild	Migration Behavior*	Size
Savannah sparrow	SAVS	*Passerculus sandwichensis*	Grassland/Sparrows	nocturnal	SB
snowy egret	SNEG	*Egretta thula*	Waterbirds	nocturnal	MB
song sparrow	SOSP	*Melospiza melodia*	Grassland/Sparrows	resident	SB
tree swallow	TRES	*Tachycineta bicolor*	Swallows	diurnal	SB
unidentified bird (small)	UNID	*NA*	Unidentified Birds	NA	SB
unidentified bird (unknown size)	UNBD	*NA*	Unidentified Birds	NA	UNK
unidentified dove	UNDV	*Columbina spp*	Doves/Pigeons	NA	SB
unidentified duck	UNDU	*NA*	Waterfowl	NA	MB
unidentified grebe	UNGR	*NA*	Loons/Grebes	NA	MB
unidentified gull	UNGU	*NA*	Gulls/Terns	NA	LB
unidentified sparrow	UNSP	*NA*	Grassland/Sparrows	NA	SB
unidentified teal	TEAL	*Anas spp*	Waterfowl	NA	MB
unidentified warbler	UNWA	*NA*	Warblers	NA	SB
western grebe	WEGR	*Aechmophorus occidentalis*	Loons/Grebes	nocturnal	LB
western kingbird	WEKI	*Tyrannus verticalis*	Flycatchers	diurnal	SB

Table D. Guild, Migration Behavior, Four-Letter Species Codes, Scientific Names, and Sizes for all avian detections (those made during standardized carcass searches and incidentally) during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California. LB = large sized bird; MB = medium sized bird; SB = small sized bird

Common Name	4-Letter Species Code	Scientific Name	Guild	Migration Behavior*	Size
western meadowlark	WEME	*Sturnella neglecta*	Blackbirds/Orioles	diurnal	SB
western tanager	WETA	*Piranga ludoviciana*	Tanagers	nocturnal	SB
yellow-breasted Chat	YBCH	*Icteria virens*	Warblers	nocturnal	SB
yellow-headed blackbird	YHBL	*Xanthocephalus xanthocephalus*	Blackbirds/Orioles	diurnal	SB
yellow-rumped warbler	YRWA	*Setophaga coronata*	Warblers	nocturnal	SB
yellow warbler	YWAR	*Setophaga petechia*	Warblers	nocturnal	SB

* See literature cited for migration behavior references; information for most species was taken from the respective species accounts found in Birds of North America (BNA) Online (http://bna.birds.cornell.edu/bna/); where information on migration behavior was lacking in BNA accounts, Evans and Mellinger (1999), Newton (2008), or Murray (2004) were used.

Appendix E. Scavengers Observed at the Carcass Persistence Trial Carcasses during the 2016 – 2017 Monitoring Year (February 29, 2016 – February 28, 2017) at the Genesis Solar Energy Project, Riverside County, California

Figure D-1. Kit fox observed at a carcass persistence trial carcass during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Figure D-2. Coyote observed at a carcass persistence trial carcass during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Figure D-3. Common raven observed at a carcass persistence trial carcass during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Figure D-4. Turkey vultures observed at a carcass persistence trial carcass during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Figure D-5. American kestrel observed at a carcass persistence trial carcass during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Appendix F. Correction Factors and Bird and Bat Estimated Fatality Rates at the Genesis Solar Energy Project during the 2016 - 2017 Monitoring Year (February 29, 2016 – February 28, 2017)

Table F-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

		Small birds		Medium birds		Large birds		Bats	
	Parameter	Mean	90% CI	Mean	90% CI	Mean	90% CI	Mean	90% CI
Proportion of Area Searched									
	Fence	1	-	1	-	1	-	1	-
	Overhead Lines	0.25	-	0.25	-	0.25	-	0.25	-
	Ponds	1	-	1	-	1	-	1	-
	Power Blocks	1	-	1	-	1	-	1	-
	SCAs	0.51	-	0.51	-	0.51	-	0.51	-
Searcher Efficiency (unable to provide CI when all trials were found)									
	Fence, Power Blocks and Overhead Lines	0.84	0.76 – 0.92	0.93	0.86 – 0.98	1.00	-	-	-
	SCAs	0.61	0.51 – 0.70	0.88	0.79 – 0.95	0.88	0.77 – 0.96	-	-
Average Probability of Carcass Persistence to the Next Search (average search interval 7.0 during migration, and 19.1 during non-migration seasons)									
Year 1	**Solar Field**								
Year 1	Spring	0.62	0.53 – 0.69	0.83	0.75 – 0.89	0.97	0.94 – 0.99	0.62	0.53 – 0.69
Year 1	Summer	0.37	0.30 – 0.45	0.82	0.74 – 0.89	0.97	0.94 – 0.99	0.37	0.30 – 0.45
Year 1	Fall	0.45	0.36 – 0.54	0.68	0.57 – 0.77	1.00	0.99 – 1.00	0.45	0.36 – 0.54
Year 1	Winter	0.28	0.22 – 0.36	0.52	0.42 – 0.63	0.89	0.80 – 0.96	0.28	0.22 – 0.36
Year 1	**Overhead Lines**								
Year 1	Spring	0.34	0.27 – 0.42	0.68	0.57 – 0.77	0.68	0.53 – 0.81	0.34	0.27 – 0.42
Year 1	Summer	0.18	0.13 – 0.23	0.67	0.56 – 0.76	0.67	0.51 – 0.81	0.18	0.13 – 0.23
Year 1	Fall	0.22	0.16 – 0.28	0.49	0.38 – 0.59	0.88	0.78 – 0.95	0.22	0.16 – 0.28
Year 1	Winter	0.12	0.09 – 0.17	0.34	0.23 – 0.45	0.43	0.27 – 0.60	0.12	0.09 – 0.17
Year 2	**Solar Field**								
Year 2	Spring	0.50	0.42 – 0.57	0.62	0.54 – 0.71	0.92	0.87 – 0.97	0.50	0.42 – 0.57
Year 2	Summer	0.28	0.23 – 0.34	0.61	0.52 – 0.70	0.92	0.85 – 0.97	0.28	0.23 – 0.34
Year 2	Fall	0.34	0.28 – 0.41	0.43	0.35 – 0.51	0.99	0.96 – 1.00	0.34	0.28 – 0.41
Year 2	Winter	0.20	0.16 – 0.25	0.29	0.22 – 0.37	0.77	0.67 – 0.88	0.20	0.16 – 0.25
Year 2	**Overhead Lines**								
Year 2	Spring	0.25	0.19 – 0.32	0.43	0.34 – 0.53	0.50	0.37 – 0.63	0.25	0.19 – 0.32
Year 2	Summer	0.12	0.09 – 0.16	0.42	0.32 – 0.51	0.49	0.31 – 0.65	0.12	0.09 – 0.16

Table F-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

	Small birds		Medium birds		Large birds		Bats	
Parameter	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Fall	0.16	0.12 – 0.20	0.27	0.19 – 0.33	0.76	0.64 – 0.87	0.16	0.12 – 0.20
Winter	0.09	0.06 – 0.11	0.16	0.10 – 0.23	0.26	0.17 – 0.36	0.09	0.06 – 0.11
Observed Carcass Counts Included in Adjustment (Counts of fatalities along the fence, power block and ponds have no variance because all components at the facility were searched)								
Spring								
Fence	3	-	4	-	1	-	0	-
Overhead Lines	1	0 – 3	0	-	0	-	0	-
Ponds	0	-	5	-	0	-	0	-
Power Blocks	2	2 – 2	1	-	0	-	0	-
SCAs	0	-	4	1 – 7	0	-	0	-
Summer								
Fence	2	-	0	-	2	-	1	-
Overhead Lines	2	0 – 4	0	-	0	-	0	-
Ponds	6	-	2		0		3	
Power Blocks	9	-	9	-	0	-	0	-
SCAs	3	0 – 7	4	1 – 7	2	0 – 4	0	-
Fall								
Fence	6	-	6	-	0	-	0	-
Overhead Lines	4	0 – 8	1	0 – 3	0	-	0	-
Ponds	1	-	5	-	0	-	0	-
Power Blocks	11	-	4	-	0	-	0	-
SCAs	5	2 – 9	12	6 – 19	2	0 – 5	0	-
Winter								
Fence	2	-	9	-	1	-	0	-
Overhead Lines	1	0 – 3	0	-	0	-	0	-
Ponds	1	-	2	-	0	-	1	-
Power Blocks	2	-	0	-	1	-	1	-
SCAs	0	-	1	0 – 3	1	0 – 3	0	-
Average Probability of Carcass Availability and Detected (Searcher efficiency * average probability of carcass persistence)								
Solar Field								

Table F-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Parameter	Small birds Mean	Small birds 90% CI	Medium birds Mean	Medium birds 90% CI	Large birds Mean	Large birds 90% CI	Bats Mean	Bats 90% CI
Spring	0.30	0.24 – 0.63	0.54	0.46 – 0.63	0.81	0.70 – 0.91	0.30	0.24 – 0.63
Summer	0.17	0.13 – 0.21	0.53	0.43 – 0.63	0.81	0.68 – 0.91	0.17	0.13 – 0.21
Fall	0.21	0.16 – 0.26	0.38	0.30 – 0.46	0.86	0.75 – 0.96	0.21	0.16 – 0.26
Winter	0.12	0.09 – 0.16	0.25	0.18 – 0.33	0.68	0.56 – 0.80	0.12	0.09 – 0.16
Overhead Lines								
Spring	0.21	0.16 – 0.27	0.40	0.31 – 0.50	0.50	0.37 – 0.63	0.21	0.16 – 0.27
Summer	0.10	0.08 – 0.14	0.39	0.30 – 0.48	0.49	0.32 – 0.65		
Fall	0.13	0.10 – 0.17	0.25	0.18 – 0.31	0.76	0.64 – 0.87		
Winter	0.07	0.05 – 0.09	0.15	0.09 – 0.22	0.26	0.17 – 0.36		
Overall Probability of Detection and Availability (searcher efficiency * average probability of carcass availability * proportion of area searched)								
SCAs								
Spring	0.15	0.12 – 0.18	0.27	0.23 – 0.32	0.41	0.35 – 0.46	0.15	0.12 – 0.18
Summer	0.09	0.07 – 0.11	0.27	0.22 – 0.32	0.41	0.35 – 0.46	0.09	0.07 – 0.11
Fall	0.11	0.08 – 0.13	0.19	0.18 – 0.23	0.43	0.38 – 0.48	0.11	0.08 – 0.13
Winter	0.06	0.05 – 0.08	0.13	0.09 – 0.17	0.34	0.28 – 0.41	0.06	0.05 – 0.08
Overhead Lines								
Spring	0.05	0.04 – 0.07	0.10	0.08 – 0.10	0.12	0.09 – 0.16	0.05	0.04 – 0.07
Summer	0.02	0.02 – 0.03	0.10	0.07 – 0.12	0.12	0.08 – 0.16	0.02	0.02 – 0.03
Fall	0.03	0.02 – 0.04	0.06	0.04 – 0.08	0.19	0.16 – 0.22	0.03	0.02 – 0.04
Winter	0.02	0.01 – 0.02	0.04	0.02 – 0.05	0.06	0.04 – 0.09	0.02	0.01 – 0.02
Adjusted Fatality Estimates (carcass count / overall probability of detection and availability)								
Spring	**30.52**	**7.96 – 64.89**	**31.53**	**16.33 – 49.13**	***1.10***	***(1) – 3.25***	**-**	**-**
Fence	*6.99*	*(3) – 12.96*	*7.1*	*(4) – 13.70*	*1.1*	*(1) – 3.25*	-	-
Overhead Lines	*18.76*	*(1) – 52.22*	-	-	-	-	-	-
Ponds	-	-	*8.68*	*(5) – 18.90*	-	-	-	-
Power Blocks	*4.77*	*4.07 – 5.84*	*1.19*	*(1) – 2.48*	-	-	-	-
SCAs	-	-	*14.56*	*(4) – 27.39*	-	-	-	-
Summer	**128.76**	**65.54 – 203.46**	**30.68**	**18.58 – 46.28**	***7.07***	***(4) – 13.39***	***16.85***	***(4) – 33.97***
Fence	*7.85*	*(2) – 18.22*	-	-	*2.13*	*(2) – 4.36*	*5.52*	*(1) – 14.90*

Table F-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during the 2016 – 2017 monitoring year (February 29, 2016 – February 28, 2017).

Parameter	Small birds Mean	Small birds 90% CI	Medium birds Mean	Medium birds 90% CI	Large birds Mean	Large birds 90% CI	Bats Mean	Bats 90% CI
Overhead Lines	*38.00*	*(2) – 80.74*	-	-	-	-	-	-
Ponds	27.00	8.00 – 50.68	*3.86*	*(2) – 8.41*	-	-	*11.33*	*(3) – 25.43*
Power Blocks	20.73	(10) – 42.11	11.47	(9) – 15.67	-	-	-	-
SCAs	*35.18*	*(3) – 85.66*	*15.35*	*4.09 – 29.39*	*4.94*	*(2) – 10.80*	-	-
Fall	**299.49**	**138.00 – 519.36**	**76.76**	**42.60 – 123.20**	***4.59***	***(2) – 10.53***	**-**	**-**
Fence	34.28	14.00 – 59.06	*7.13*	*2.16 – 13.07*	-	-	-	-
Overhead Lines	*158*	*(5) – 356.01*	-	-	-	-	-	-
Ponds	*6.92*	*5.66 – 8.89*	*9.95*	*4.58 – 16.64*	-	-	-	-
Power Blocks	43.18	30.78 – 59.60	*1.35*	*(1) – 2.91*	-	-	-	-
SCAs	57.12	20.27 – 103.29	58.33	25.45 – 101.69	4.59	(2) – 10.53	-	-
Winter	**85.08**	**42.71 – 145.08**	**24.02**	**10.63 – 43.13**	***4.6***	***(3) – 9.77***	***7.71***	***(2) – 15.81***
Fence	27.37	8.98 – 50.86	*15.89*	*7.11 – 27.29*	1.08	(1) – 3.08	-	-
Overhead Lines	*25.34*	*(1) – 71.42*	-	-	-	-	-	-
Ponds	*6.3*	*(1) – 14.26*	*8.14*	*(2) – 19.62*	-	-	6.30	(1) – 14.26
Power Blocks	*9.57*	*6.31 – 13.63*	-	-	1.01	(1) – 2.04	1.42	(1) – 2.99
SCAs	*16.5*	*(2) – 38.79*	-	-	2.51	(1) – 7.69	-	-
FACILITY OVERALL	**543.84**	**334.79 – 818.43**	**163**	**120.67 – 217.11**	**17.35**	**9.18 – 26.37**	**24.56**	**1.50 – 48.09**

[1] Adjusted fatality values in italics are considered unreliable due to low counts of carcasses (n <= 5); small bird estimates include unidentified species of unknown size; lower bounds in parentheses are actual counts when bootstrap analysis indicated a lower bound lower than the number of observations in the analysis.

Table F-2. Detections excluded from the 2016 - 2017 estimated fatality analysis at the Genesis Solar Energy Project, Riverside County, California due to 1) having been detected outside of a regular search area or 2) having an estimated carcass age that is twice that of the actual search interval and hence violating assumptions of the Huso estimator.

Location	Small birds	Medium birds	Large birds	Unidentified birds	Bats
Buildings	12	2	1	0	2
Fence	3	1	0	0	0
Overhead Lines	0	0	0	0	0
Ponds	0	0	0	1	0
Power Blocks	15	3	0	0	2
SCAs	4	6	4	0	0
Total:	34	12	5	1	4

Appendix G. Searcher efficiency rates, overall probability of detection, and overall probability of detection and availability at the SCAs by size and season during the first (March 1, 2015 – February 28, 2016) and second (February 29, 2016 – February 28, 2017) monitoring years at the Genesis Solar Energy Project, Riverside County, California.

Appendix G. Searcher efficiency rates, overall probability of detection (searcher efficiency * proportion or area searched), and overall probability of detection and availability (searcher efficiency * average probability of carcass availability * proportion of area searched) at the SCAs by size and season during the first (March 1, 2015 – February 28, 2016) and second (February 29, 2016 – February 28, 2017) monitoring years at the Genesis Solar Energy Project, Riverside County, California. Proportion of area searched changed from 30% to 50.5% at the SCAs during the second year of monitoring, while the proportion of area searched remained the same at the fence, power blocks and overhead lines. SB = small bird; MB = medium bird; LB = large bird

Size	Season	Searcher Efficiency Rate		Overall Probability of Detection		Overall Probability of Detection and Availability	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
SB	spring	0.80	0.61	0.24	0.31	0.14	0.15
MB		0.95	0.88	0.29	0.44	0.18	0.27
LB		0.96	0.88	0.29	0.44	0.28	0.41
SB	summer	0.93	0.61	0.28	0.31	0.10	0.09
MB		0.98	0.88	0.30	0.44	0.23	0.27
LB		0.99	0.88	0.30	0.44	0.28	0.41
SB	fall	0.80	0.61	0.24	0.31	0.14	0.11
MB		0.95	0.88	0.29	0.44	0.18	0.19
LB		0.96	0.88	0.29	0.44	0.29	0.43
SB	winter	0.93	0.61	0.28	0.31	0.10	0.06
MB		0.98	0.88	0.30	0.44	0.13	0.13
LB		0.99	0.88	0.30	0.44	0.28	0.34

Appendix H. Locations of detections at the evaporation ponds at the Genesis Solar Energy Project before and after wire removal

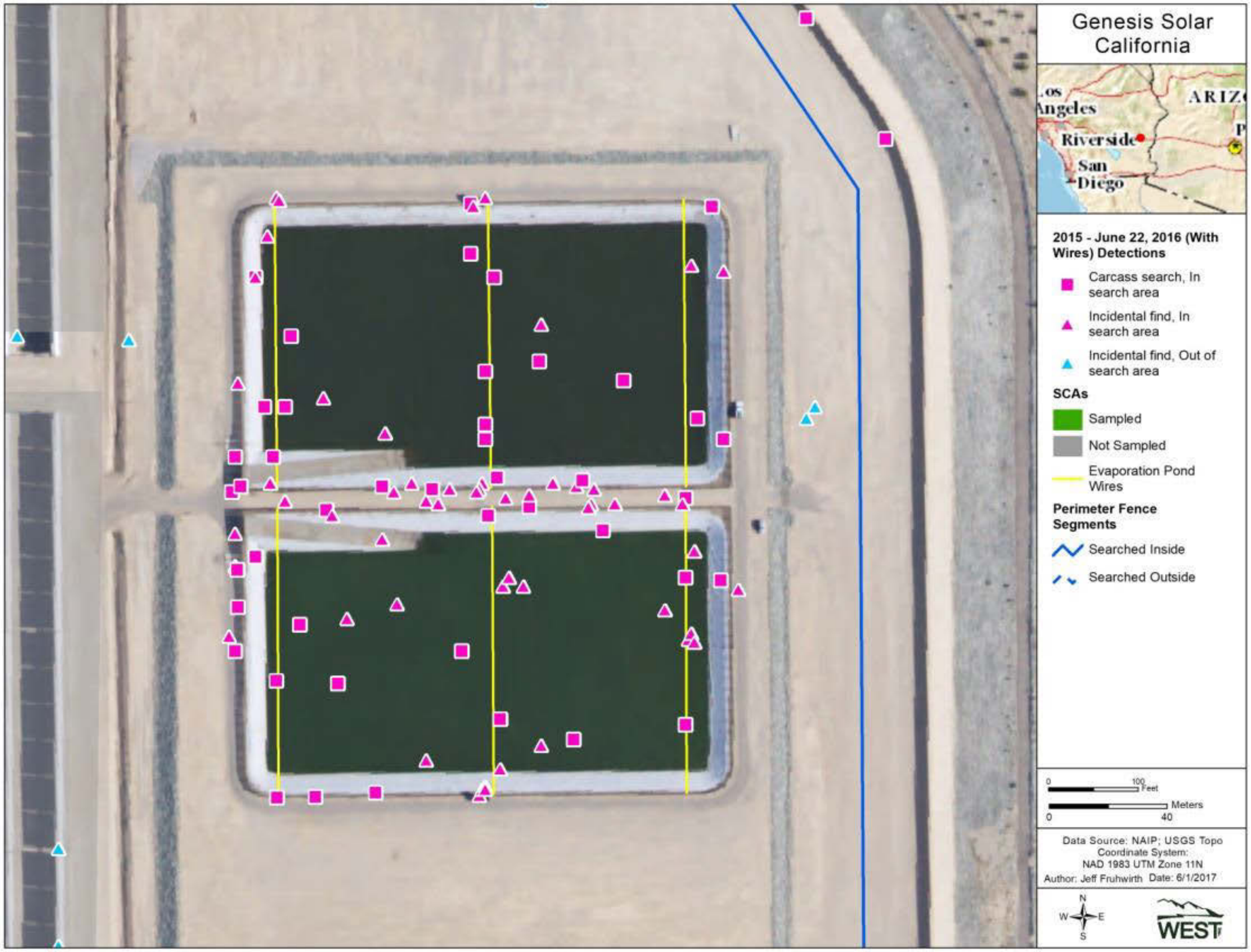

Figure G-1. Locations of detections at the evaporation ponds at the Genesis Solar Energy Project before wire removal, from the start of the first monitoring year (March 1, 2015) through July 22, 2016.

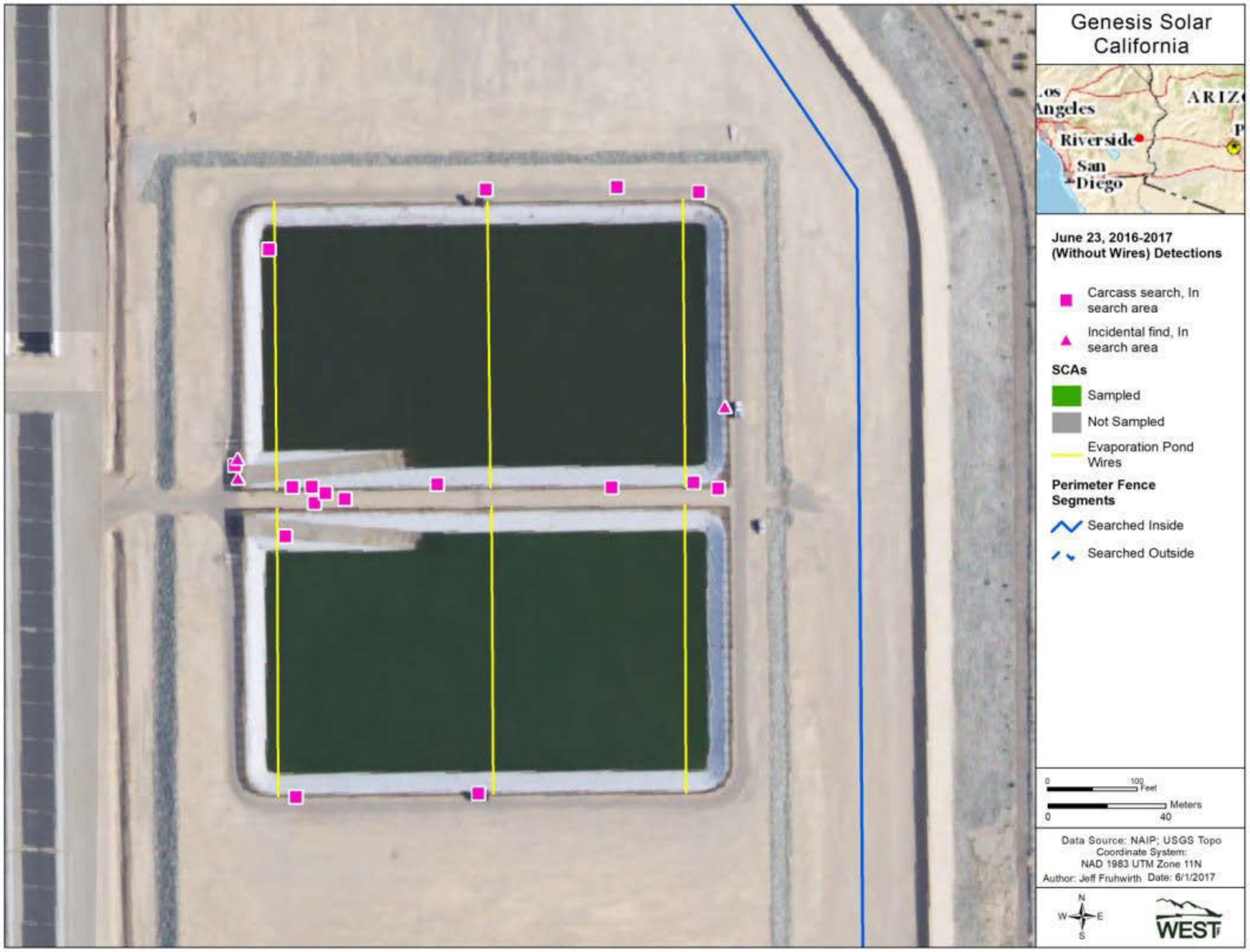

Figure G-2. Locations of detections at the evaporation ponds at the Genesis Solar Energy Project after wire removal, July 23, 2016 through the end of the second year of monitoring (February 28, 2017).

Appendix I. Adjusted fatality estimates during the Year 1 and Year 2 monitoring seasons at the Genesis Solar Energy Project

Table I-1. Adjusted fatality estimates by size and taxonomic groupings during the year 1 and year 2 monitoring seasons at the Genesis Solar Energy Project, Riverside County, California

Size/Group	Detections (carcass search and incidental)	Total Adjusted Fatalities	90% CI
YEAR 1			
Bats	13	26	10 – 46
Large Birds	17	20	8 – 36
Medium Birds	214	562	423 – 744
Small Birds	156	925	674 – 1,347
Passerines	145	900	664 – 1,302
All water-associated birds	147	372	263 – 518
Diurnal raptors	9	8	3 – 14
YEAR 2			
Bats	10	25	(6) - 48
Large Birds	15	17	(10) – 26
Medium Birds	64	163	121 – 217
Small Birds and (unknown)	109 (7)	544	335 – 818
Passerines	92	440	239 – 715
All water-associated birds	64	153	112 – 207
Diurnal Raptors	2	5	*(2) – 13*

Table I-2. Estimated number of fatalities within the solar field and along the overhead lines (using Huso estimator model) at the Genesis Solar Energy Project during the the year 1 and year 2 monitoring seasons.

	Project Component	Actual Detections (carcass search and incidental)	Huso Estimates (fatalities)	90% CI	Huso Estimates (fatalities/acre or /km)	Huso Estimates (fatalities/mw)
YEAR 1						
Birds	Solar Field	347	**997**	817 – 1,240	0.58/acre	3.99
	Overhead Lines	40	**510**	278 – 894	30,36/km	2.04
Bats	Solar Field	13	**26**	10 – 46	0.02/acre	0.10
	Overhead Lines	0	**-**	-	-	-
YEAR 2						
Birds	Solar Field	186	**484**	380 – 611	0.28/acre	1.90
	Overhead Lines	9	**240**	53 – 469	14/km	0.96
Bats	Solar Field	10	**25**	*(6) – 48*	0.01/acre	0.10
	Overhead Lines	0	-	-	-	-

Table I-3. Adjusted fatality estimates by guild and component type for the the year 1 and year 2 monitoring seasons at the Genesis Solar Energy Project, Riverside County, California. Confidence intervals in italics are considered unreliable due to low detection counts.

Guild	Fence	90% CI	Overhead Lines	90% CI	Ponds	90% CI	Power Blocks	90% CI	SCAs	90% CI	Overall	90% CI
YEAR 1												
Passerines	40	21 – 62	429	189 – 807	57	21 – 105	47	10 – 99	328	227 – 453	900	664 – 1302
All water-associated birds	16	6 – 28	14	6 – 33	123	28 – 255	10	4 – 17	210	150 – 283	372	263 – 518
All birds	85	54 - 128	510	278 - 894	183	71 - 338	81	35 - 144	648	518 - 818	1507	1214 - 1952
Diurnal raptors	2	*(1) – 7*	-	-	-	-	6	2 – 11	-	-	8	3 – 14
Bats	-	-	-	-	4	*(2) – 13*	15	4 – 30	7	*(1) – 21*	26	10 – 46
YEAR 2												
Passerines	59	29 – 97	222	23 – 462	20	(4) – 44	59	40 – 81	80	36 – 142	440	239 – 715
All water-associated birds	19	(11) – 28	-	-	35	29 – 42	7	6 – 8	92	53 – 143	153	112 – 207
All birds	111	73 – 153	240	53 – 469	71	44 - 105	93	63 - 130	209	134 - 308	724	511 – 1,005
Diurnal raptors	4	*(1) – 12*	-	-	-	-	*1*	*(1) – 3* -	-	-	*5*	*(2) – 13*
Bats	6	*1 – 15*	-	-	18	*4 - 40*	*1*	*(1) – 39*		-	25	(6) – 48

Table 16. Adjusted fatality estimates by passerine group and component type for the year 1 and year 2 monitoring seasons at the Genesis Solar Energy Project, Riverside County, California. Confidence intervals in italics are considered unreliable due to low detection counts.

Guild	Fence	90% CI	Overhead Lines	90% CI	Ponds	90% CI	Power Blocks	90% CI	SCAs	90% CI	Overall	90% CI
YEAR 1 Passerines												
Resident	8	*0 – 18*	118	23 – 283	23	2 – 51	16	(7) – 41	136	86 – 196	302	179 – 481
Nocturnal	6	*2 – 13*	177	62 – 363	-	-	12	(5) – 31	20	*(2) – 49*	216	101 – 408
Diurnal	-	-	-	-	2	*(1) – 6*	6	*(3) - 15*	-	-	8	*1 - 18*
YEAR 2 Passerines												
Resident	3	*(1) – 10*	-	-	-	-	-	-	-	-	3	*(1) – 10*
Nocturnal	6	*(2) – 12*	160	23 – 325	-	-	10	*(4) – 22*	6	*(1) – 18*	182	47 – 353
Diurnal	14	*(4) – 31*	37	*(1) – 104*	-	-	23	16 – 32	10	*(1) – 29*	83	33 – 157