DOCKETED

Docket Number:	09-AFC-08C
Project Title:	Genesis Solar Energy Project
TN #:	211676
Document Title:	Spring 2015 Post-Construction Monitoring Report
Description:	Quarterly Post-Construction Monitoring Report according to the Bird and Bat Conservation Strategy (BBCS)
Filer:	Anwar Ali
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	5/31/2016 12:34:59 PM
Docketed Date:	5/31/2016

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

2015 Spring Report

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December 9, 2015

EXECUTIVE SUMMARY

Avian and bat monitoring surveys were conducted from March 05 to May 31, 2015 (the spring season) at Genesis Solar Energy Project (Project) 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 represents the first seasonal report for the first year of monitoring, and summarizes monitoring methods and results for those surveys based on the procedures and requirements specified in the BBCS.

Standardized carcass searches were conducted 1) in the solar field, consisting of a random stratified 30% sample of solar troughs 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 the equivalent of 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 from the southernmost Project fence to Wiley's Well reststop, which co-occur with the Project access road. Searches were conducted within the spring season at intervals of approximately seven days.

All bird and bat fatalities and injuries 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, 53 avian detections (including 2 stranded birds) were made, while there were no detections of bats.

According to specifications of the BBCS, avian detections were categorized by likely diurnal or nocturnal migration behavior, ecological guild (e.g., raptors, songbirds, etc.), facility component, 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 input into a fatality estimator model (Huso 2010) to provide a preliminary estimate of the number of fatalities that occurred at the Project during the reporting period adjusted for sources of bias. The estimate is considered preliminary because the annual report may pool information from bias trials and other data across seasons which could affect seasonal estimates.

Carcass persistence was influenced by carcass size. Small carcasses (0-100 g) had a 42.4% chance of persisting through the 7-day search interval, medium carcasses (101 – 999 g) had a 72.4% chance, and large carcasses (1000+ g) had an 84.5% chance. Mean removal time for small, medium, and large carcasses was 2.0, 7.3 and 14.6 days, respectively. In the solar field searcher efficiency was 92.3% over all carcass size classes. Along the gen-tie and distribution lines, searcher efficiency was influenced by carcass size: 42.9% for small birds, 100% for medium birds, and 100% for large birds.

Using the Huso (2010) fatality estimator model, during the spring period 2015, there were an estimated total 234 fatalities (90% confidence interval [CI]: 124 - 430) at the Project. Of these, 55 fatalities (23.4%) were estimated for the SCAs, 44 fatalities (18.6%) were estimated for the

fence, 9 fatalities (4.0%) were estimated for evaporation ponds, 5 fatalities (2.2%) were estimated for power blocks, and 121 fatalities (51.8%; 90% CI: 32 - 307) were estimated for the gen-tie and distribution lines and project road. An estimated 113 (90% CI: 60 – 188) fatalities (0.065/acre, 0.434/nameplate MW) occurred for all components associated with both solar units (SCAs, power block, evaporation ponds, and along the perimeter fence, combined).

STUDY PARTICIPANTS

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REPORT REFERENCE

Western Ecosystems Technology, Inc. (WEST). 2015. Post-construction monitoring at the Genesis Solar Energy Project, Riverside County, California. 2015 Spring Report. 31 pp.

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1.0 INTRODUCTION

1.1 Project Background

The Genesis Solar Energy Project (referred to in this report as "Project") consists of two solar power electrical generating facilities (Units 1 and 2) with a combined net capacity of 250 megawatts. 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. Linear facilities include a transmission 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 (728 hectares [ha]). The solar field and associated structures comprise 1,727 acres (699 ha) and linear facilities comprise 93 acres (38 ha). The Project is located on land managed by the Bureau of Land Management (BLM) 25 miles (40 kilometers [km]) west of Blythe, in Riverside County, California (Figure 1).

1.2 Monitoring Plan Overview and Goals

A Bird and Bat Conservation Strategy (2015; “BBCS”) was prepared by the Project proponent in collaboration with the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), California Energy Commission (CEC), and Bureau of Land Management (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 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, they 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 including the generation (gen-tie) line, perimeter fence and other features of the Project that may result in injury and fatality.
2. Determine whether there are spatial and temporal/seasonal patterns of mortality associated with project infrastructure (e.g., different fatality 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 first seasonal report for the first year of monitoring summarizing monitoring methods and results for avian and bat fatalities 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 covers the 2015 spring season, which includes the period from March 01 to May 31, 2015. As stated in the approved BBCS, this seasonal report includes the observed fatality rates broken out by likely diurnal, and likely nocturnal species, and for ecological guilds of interest (e.g., raptors, water-associated birds, passerines), for each of the facility types and suspected causes of death. Species composition of carcasses and the results of the bias trials are also reported. This report presents information related to the spatial distribution of carcasses, but no formal statistical analysis will be conducted until the end of the monitoring year, given the limited data presently available.

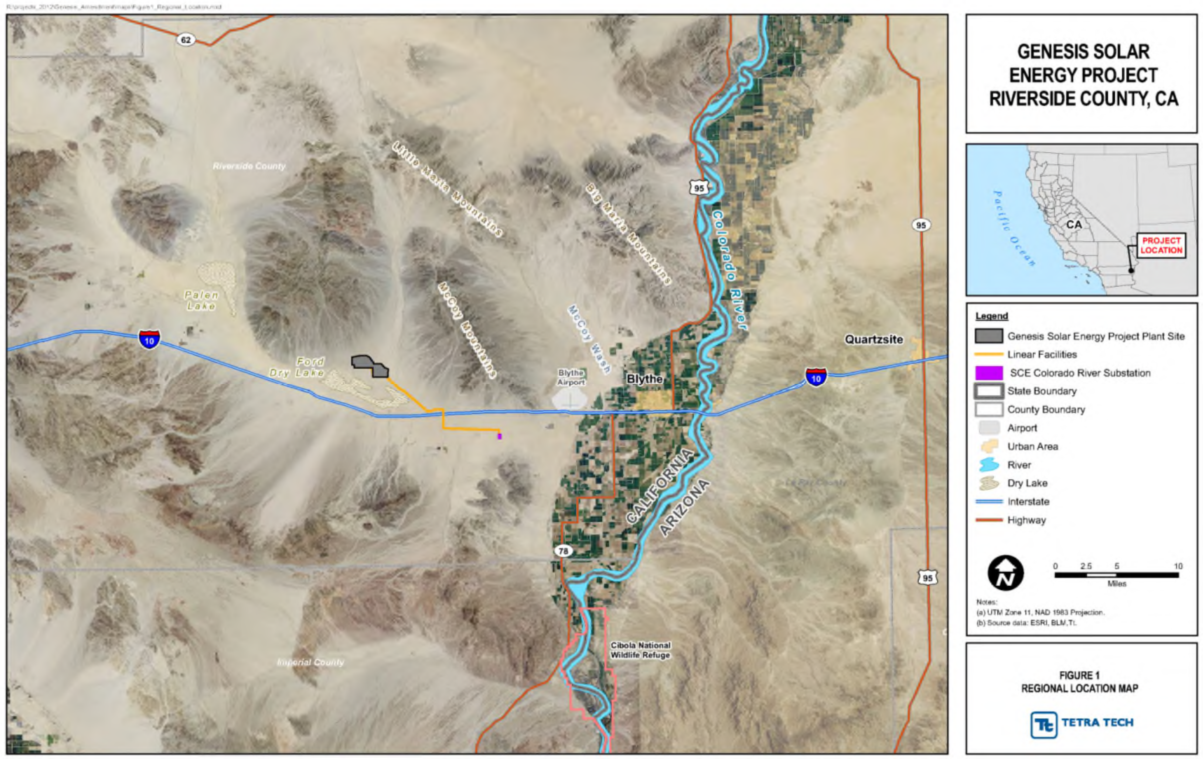

Figure 1. Genesis Solar Energy Project vicinity map, Riverside County, California.

2.0 METHODS

The BBCS describes the methods by which monitoring and certain analyses, including compilation of the overall fatality estimate, will occur. Below is an abridged description (see BBCS for detailed methods).

2.1 Standardized Carcass Searches

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. This section also describes the methods for conducting carcass removal and searcher efficiency trials; how data were reported and analyzed; and the methods for producing fatality estimates for the Project.

2.1.1 Areas Surveyed

Standardized carcass 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 2 and 3); the “fenceline” defined as the perimeter fences for each unit (100% of the total length of fence; Figures 2 and 3); and the gen-tie and distribution lines (25% of the total length of each line from the Project fence to Wiley’s Well rest stop; Figure 4). Table 1 provides the total area of each component as well as the percent of each component that was searched.

To ensure a balanced distribution of plots in solar collector assemblies, each unit was divided into blocks, and each block was sampled using a systematic sample of 30% of pairs of rows with a random starting point. This sampling design ensures that survey plots were not spatially clumped.

2.1.2 Search Frequency and Timing

The spring survey season includes the period from March 01 through May 31, 2015. Standardized searches occurred at 7-day intervals beginning March 05, 2015. All project components included in standardized searches were surveyed 13 times. All searches took place during daylight hours from 06:30 to 17:00.

As specified in the approved Genesis BBCS, the average spring search interval was 6.8 days (median 7 days) for all Project components included in standardized carcass searches. Slight variation in search interval was anticipated due to weather and logistical delays.

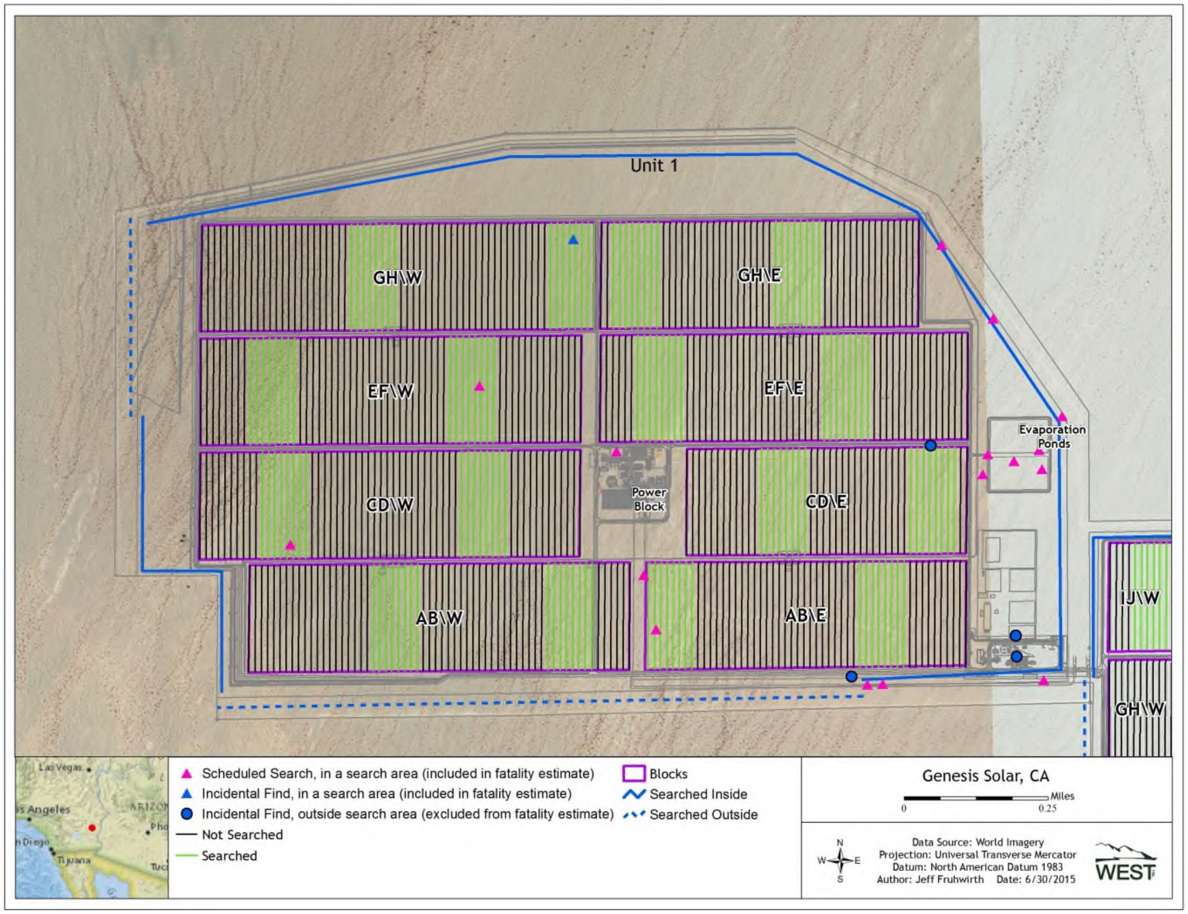

Figure 2. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 1 of the Genesis Solar Energy Project spring 2015.

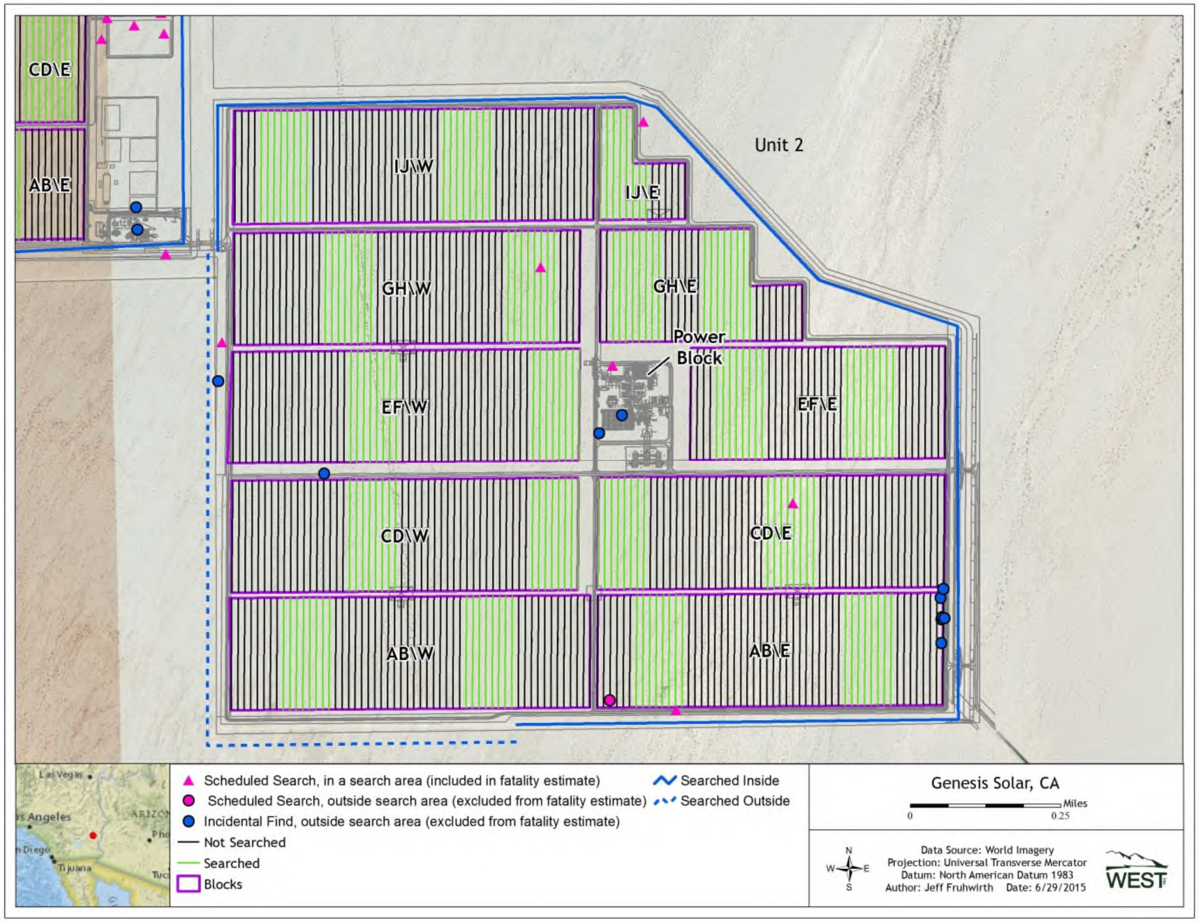

Figure 3. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 2 of the Genesis Solar Energy Project during spring 2015.

Table 1. Areas included in standardized carcass searches at the Genesis Solar Energy Project during spring 2015.

Project Component	Total Size	Units	Percent of Component Searched
SCAs	920	rows of solar troughs	30.4
Unit 1	460	rows of solar troughs	27.8
Unit 2	460	rows of solar troughs	33.0
ACC units	0.9	hectares	100
Power block (perimeter)	0.8	kilometers	100
Evaporation ponds	3.1	hectares	100
Distribution line	8.4	kilometers	25.0
Generation Tie line	8.4	kilometers	25.0
Fence	14.5	kilometers	100

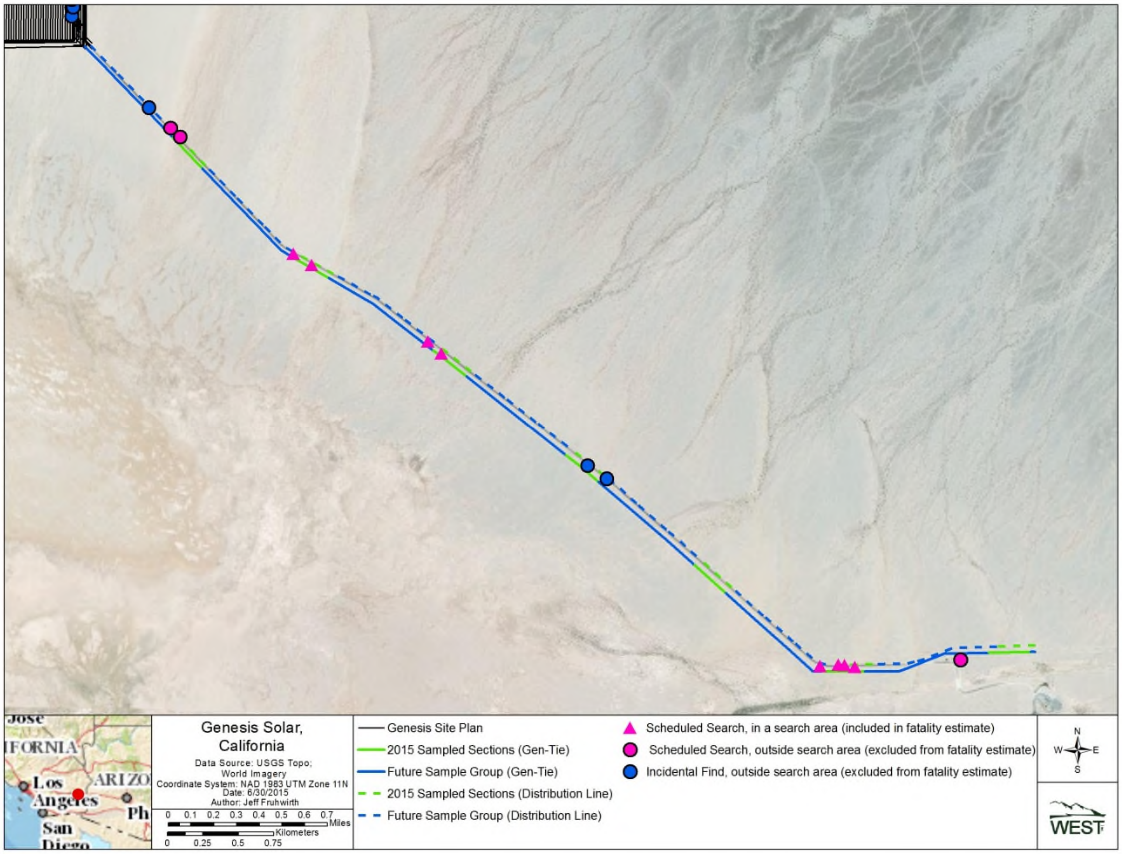

Figure 4. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance activities) along the distribution and generation tie lines and Project access road at the Genesis Solar Energy Project during spring 2015. Detailed maps of detections along both lines and the road are presented in Appendix C.

2.1.3 Search Methods

Standardized carcass searches were performed by CEC and BLM-approved biologists, in accordance with methods outlined in the BBCS.

Within the solar collector assemblies, 280 solar troughs (30.4% of the total number of troughs) were surveyed by vehicle. Biologists slowly drove (≤5 mph) parallel to troughs and centered between rows, searching ahead and to the driver's side of the vehicle for bird and bat carcasses. Biologists scanned out to a perpendicular distance of approximately 30 m, or the ground area encompassing two rows of solar troughs.

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 powerblock. Beneath ACC units, biologists walked four evenly-spaced transects through the gravel. The search area for the power block is defined as the 0.8 km of perimeter of each power block, and the area of the interior power block that was available for visual inspection from the periphery.

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. Binoculars or a spotting scope were used to scan across the top of the netting and the surface of each pond.

An area equivalent to the entire length of fenceline (approximately 12 miles) was searched by vehicle. Biologists searched an approximately 1.5 to 2.5 miles (2.4 km) along drivable sections of the outside of the fence, and the remaining 9.5 to 10.5 miles (16.9 km) were surveyed from the inside of the fence (Figures 2 and 3). Travel speed was below five mph while searching.

The gen-tie and distribution lines were surveyed using a 15-m wide strip transect (i.e., 7.5 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 carcasses. Biologists slowly walked every fourth 300-ft segment of each line, scanning for dead or injured birds or bats within 7.5 m (24.6 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, vehicles along the road, predation, or some combination thereof.

Once a carcass was detected, it was then photographed, and data were recorded according to specifications outlined in section 6.0 of the approved Genesis BBCS. Carcasses detected before amendment of the WEST California Scientific Collecting Permit (Permit # 3790) were covered and secured in place until permission was granted from California Department of Fish and Wildlife to handle carcasses on April 21, 2015. Since that date, all carcasses have been retrieved from their location on the ground, labeled, and placed in a freezer on site.

For each detection, suspected cause of death was assigned based on evidence available from the detection, evidence available on Project infrastructure, and proximity of the detection to Project infrastructure. Detections that had evidence of scavenging and lacked evidence on Project infrastructure were assigned as “unknown” because it can’t be determined whether the event was caused by predation or interaction with project infrastructure. Detections that were intact (i.e., no evidence of scavenging) and located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines) had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is substantial uncertainty associated with cause of death assignments because no events were directly observed. Detections assigned to the “unknown” category were included in fatality estimates if they were located within standardized carcass search areas.

2.2 Carcass Persistence Trials

Carcass persistence trials were conducted throughout the spring period. Carcasses from three size classes (small [0-100 g], medium [101-999], and large [1000+ g]) were used for trials. The small size class comprised house sparrows (*Passer domesticus*) and 2-3 week old coturnix quail (*Coturnix coturnix*), the medium size class comprised rock pigeons (*Columba livia*), and the large size class comprised hen mallard (*Anas platyrhynchos*) and hen ring-necked pheasant (*Phasianus colchicus*).

2.2.1 Carcass Persistence Data Collection

To quantify carcass persistence rates, 15 small, 10 medium, and five large carcasses were randomly placed and monitored within the SCAs (including the fence line), and the same number of each size class were placed along the gen-tie and distribution lines, for a total of 60 carcass persistence trials at Genesis during the spring 2015 season, as specified in the approved Genesis BBCS. Fifteen carcasses within the Project fence (within SCAs and along the fence and perimeter of power blocks) and four carcasses along the gen-tie and distribution lines were monitored using motion-triggered digital trail cameras, while the remaining 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 fatality. Fewer carcasses along the gen-tie and distribution lines were monitored with cameras because of theft and vandalism concerns. 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 also placed (eight within the Project fence, and four along the gen-tie and distribution lines). Periodic ground-based checking of carcasses with trail cameras also occured 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 bias caused by scavenger swamping (Smallwood 2007, Smallwood et al. 2010), carcass-persistence specimens were distributed across the entire Project, not just in areas subject to standard searches, and trials were initiated in small numbers on four different dates throughout the spring season.

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 known exactly, but is known to be within a finite range. For example, suppose a carcass was checked on day 7 and was present, and was checked again on day 10, but was found to be missing. The exact time until removal is unknown; however, it is known that the carcass became unavailable at some point between 7 and 10 days. This carcass would be considered “interval censored”. Similarly, if a 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 and Grambsch 2000).

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 a carcass is unscavenged and available to be found at the end of the search interval (*r)*: 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. Akaike’s Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model to observed carcass persistence data.

2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the spring period. Carcasses from three size classes (small, medium, and large) were used for trials. The small size class comprised house sparrows and 2-3 week old coturnix quail, the medium size class comprised rock pigeons, and the large size class comprised hen mallards and hen ring-necked pheasants.

2.3.1 Searcher Efficiency Data Collection

A total of 60 searcher efficiency trial carcasses (i.e., 15 small birds, 10 medium birds, and five large birds within SCAs, power blocks, and along the perimeter fence, and the same number of each size class along the gen-tie and distribution lines) were placed at the Project during the 2015 spring season, as agreed upon in section 6.4 of the approved Genesis BBCS. Locations for trials were chosen by taking a randomized sample of all locations included in standardized carcass searches. Trials were placed in various vegetation heights and in areas that had different soil and vegetation colors and values to represent the range of conditions under which searches occur. They were placed in all areas where standardized searches occur except the evaporation ponds.

2.3.2 Estimating Searcher Efficiency

There were insufficient data for the spring season to assess whether searcher efficiency differed by Project component (e.g., SCAs/fence/power block [SCAs] versus gen-tie/distribution line [overhead lines]). As a result searcher efficiency was assumed to differ between the two areas and was estimated separately for SCAs and overhead lines. The nearly complete lack of vegetation cover in the SCAs suggests that searcher efficiency may be higher in the SCAs than along the gen-tie and distribution lines where vegetation cover is greater. If this hypothesis is true, accounting for this difference in searcher efficiency across Project components will be important for producing accurate fatality estimates at the end of the monitoring year.

To evaluate hypotheses regarding differences in carcass detectability among carcass size and visibility classes, logistic regression models were fit to searcher efficiency data and AICc was used to compare models. Models including effects of carcass size (3 classes) and visibility index (2 classes) were compared to each other and the null model. The two visibility classes present at the Project site are: easy (defined as ≥ 90% bare ground [BG]; vegetation <6" tall) and moderate (defined as 26-89% BG; vegetation <6" tall). However, within the SCAs the moderate visibility class has a very limited spatial extent (approximately 10%) due to management aimed at minimizing vegetation cover and thus, was represented by only two trial carcasses during the reporting period. Rather than eliminating the two carcasses in the moderate class from the analysis of searcher efficiency, we assumed there were no differences in searcher efficiency between the two visibility classes in the SCAs this spring, and the set of candidate models for searcher efficiency (within the SCAs only) did not include tests of the hypothesis that searcher efficiency varied between visibility classes.. The spatial extent of the moderate visibility class in the SCAs is roughly equal to its representation in the sample of searcher efficiency carcasses (2 of 30, or 6.7%).

Once the best model was chosen and appropriate classes identified, searcher efficiency, or the proportion of carcasses detected, *p,* was calculated for each class using the following equation:

$$p = \frac{Number\ of\ Carcasses\ Observed}{Number\ of\ Carcasses\ Available}$$

The data for this analysis included all searcher efficiency trial carcasses from the spring 2015 season.

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 fatalities 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 2010, Korner-Nievergelt 2011). All of these fatality estimation methods share a similar underlying model. Generally, the fatality estimation for a given site may be written as:

$$F=C/rp,$$

where F is the total number of fatalities, C is the number fatalities detected and included in fatality estimation, r is the probability a carcass is unscavenged and available to be found at the end of the search interval, and p is the probability of detecting a carcass (Huso 2010).

All fatality estimates were calculated using the Huso estimator, as well as 90% confidence using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. A total of 1,000 bootstrap replicates were used. 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% confidence interval on all estimates.

2.5 Incidental Reporting

Some detections were 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 SPUT Avian Injury and Mortality Report Forms March – May 2015. All detections made in search areas were included in fatality estimates, regardless of whether they were detected incidentally or during searches.

3.0 MONITORING RESULTS

3.1 Summary of Avian Detections

During spring 2015, a total of 53 avian detections (including stranded birds and incidentals) of 23 identified species were recorded (Table 2). The most numerous detection of an identified species was Wilson's warbler (*Cardellina pusilla*), but with only three detections. Most detections (n = 22, or 41.5% of total detections) occurred beneath overhead lines (Figures 2, 3, and 4; Tables 2, 3, and 4), but those detections along the gen-tie and distribution lines are co-located with the road. Additionally, of the 22 detections beneath the overhead lines, 27.3% (or 6 detections) were feather spots. Thirty-five (66.0%) detections were made during standardized carcass searches and 18 (34.0%) were documented as incidentals.

Table 2. Number of individual bird detections, by species, during spring 2015 at the Genesis Solar Energy Project, Riverside County, California.

Common Name	Scientific Name	Migration Behavior*	Guild	Count	Project Component
American kestrel	*Falco sparverius*	resident	falcons	1	Powerblock
barn owl	*Tyto alba*	unresolved	owls	1	Fence
Brewer's blackbird	*Euphagus cyanocephalus*	diurnal	blackbirds/ orioles	1	Overhead lines/Road
Brewer's sparrow	*Spizella breweri*	nocturnal	grassland/ sparrows	2	Overhead lines SCA
bufflehead	*Bucephala albeola*	nocturnal	waterbirds/ waterfowl	1	Storage units
common loon	*Gavia immer*	diurnal	waterbirds/ waterfowl	2	SCA
Eurasian collared-dove	*Streptopelia decaocto*	resident	doves/pigeons	1	Powerblock
European starling	*Sturnus vulgaris*	variable	blackbirds/ orioles	1	Powerblock
great-tailed grackle	*Quiscalus mexicanus*	resident	blackbirds/ orioles	1	Water Treatment Plant
killdeer	*Charadrius vociferus*	variable	shorebirds	1	Evaporation pond
lazuli bunting	*Passerina amoena*	nocturnal	tanagers	2	Overhead lines

Table 2. Number of individual bird detections, by species, during spring 2015 at the Genesis Solar Energy Project, Riverside County, California.

Common Name	Scientific Name	Migration Behavior*	Guild	Count	Project Component
lesser goldfinch	*Spinus psaltria*	resident	finches/ crossbills	1	Evaporation pond
mallard	*Anas platyrhynchos*	variable	waterbirds/ waterfowl	1	Fence
mourning dove	*Zenaida macroura*	variable	doves/pigeons	2	Overhead lines
Nashville warbler	*Oreothlypis ruficapilla*	nocturnal	warblers	2	Overhead lines
orange-crowned warbler	*Oreothlypis celata*	nocturnal	warblers	1	Overhead lines
prairie falcon	*Falco mexicanus*	resident	falcons	1	Overhead lines/Road
Savannah sparrow	*Passerculus sandwichensis*	nocturnal	grassland/ sparrows	1	SCA
Townsend's warbler	*Setophaga townsendi*	unresolved	warblers	2	Overhead lines SCA
unidentified bird (medium)	–	unknown	unidentified birds	1	Evaporation pond
unidentified bird (small)	–	unknown	unidentified birds	1	SCA
unidentified bird (unknown size)	–	unknown	unidentified birds	13	Fence (7) Overhead lines (3) Evaporation pond (1)

Table 2. Number of individual bird detections, by species, during spring 2015 at the Genesis Solar Energy Project, Riverside County, California.

Common Name	Scientific Name	Migration Behavior*	Guild	Count	Project Component
					Powerblock (1) SCA (1)
unidentified merganser	*Mergus spp.*	unknown	waterbirds/ waterfowl	1	Evaporation pond
unidentified passerine	–	unknown	passerines	1	Overhead lines
unidentified sandpiper	–	unknown	shorebirds	1	Evaporation pond
unidentified sparrow	–	unknown	grassland/ sparrows	1	Overhead lines
unidentified warbler	–	unknown	warblers	1	Overhead lines/Road
western tanager	*Piranga ludoviciana*	nocturnal	tanagers	2	Overhead lines
western wood-pewee	*Contopus sordidulus*	nocturnal	flycatchers	1	SCA
Wilson's warbler	*Cardellina pusilla*	nocturnal	warblers	3	Overhead lines
yellow warbler	*Setophaga petechia*	nocturnal	warblers	2	Fence
Total				**53**	

* 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, Newton (2008) or Murray (2004) were used.

3.2 Temporal Patterns of Avian Detections

The number of detections recorded daily during spring 2015 ranged from zero to seven (Figure 5). The period from March 22 to May 17 was characterized by peaks in detections with a high on April 24. This event was reported to agencies per Special Purpose Utilities Permit Condition H(c). There was less variation in the number of detections per day after April 24. The number of detections per day represents those discovered during standardized carcass searches and incidentally.

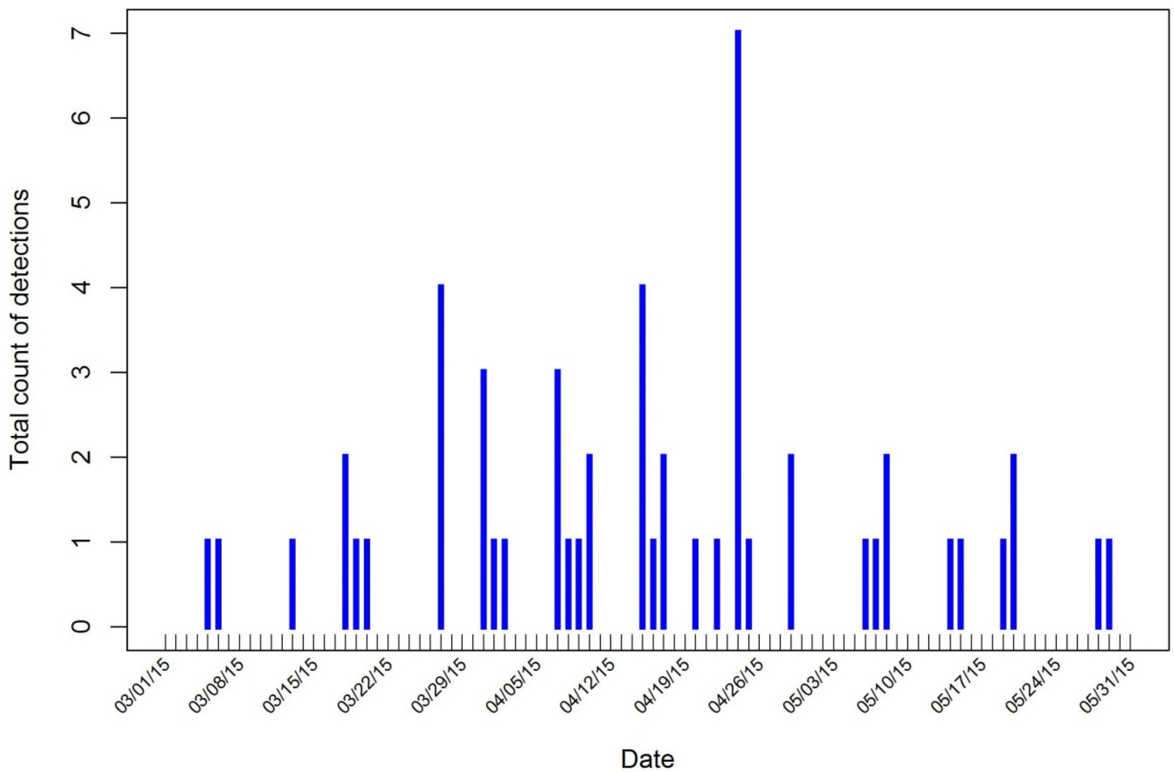

Figure 5. Total number of detections by date during spring 2015 at the Genesis Solar Energy Project, Riverside County, California.

3.3 Spatial Distribution of Avian Detections

3.3.1 Detections by Project Component

During spring 2015, detections were documented from the SCAs, power block or ACC unit within the power block, evaporation ponds, perimeter fence, gen-tie and distribution lines, road, water treatment plant, and storage units (Tables 2, 3, and 4). Of the 39 detections within the solar units 22 (56.4%) were detected in Unit 1, and 17 (43.6%) in Unit 2.

Table 3. Total avian detections by Project component and detection category during spring 2015 at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Carcass search	Incidental	Percent of Total
Fence	10	1	20.8
Overhead lines/road	11	11	41.5
Pond	6	0	11.3
Powerblock	2	2	7.5
SCA	6	2	15.1
Storage Units	0	1	1.9
Water Treatment Plant	0	1	1.9
Percent of Total	66.0	34.0	100.0

Table 4. Total avian detections (including incidentals) by Project component and suspected cause of death during spring 2015 at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Suspected Cause of Death*					Percent of Total
	Collision	Drowned	Entangled	Predation	Unknown	
Fence	2	0	0	0	9	20.8
Other	0	0	0	0	2	3.8
Overhead lines/road	14	0	0	1	7	41.5
Pond	2	0	2	0	2	11.3
Powerblock	2	2	0	0	0	7.5
SCA	2	0	0	0	6	15.1
Percent of Total	41.5	3.8	3.8	1.9	49.1	100.0

* 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 had evidence of scavenging and lacked evidence on Project infrastructure were assigned as “unknown” because it can’t be determined whether the event was caused by predation or interaction with project infrastructure. Detections that were intact (i.e., no evidence of scavenging) and located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines) had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is some uncertainy associated with cause of death assignments because no events were directly observed.

3.3.2 Feather Spot Detections

Seventeen (32.1%) of the 53 detections consisted only of feather spots. Along the fence, nine detections (81.8%) were feather spots. Six detections (27.3%) along gen-tie and distribution lines and road were feather spots. One detection (16.7%) at the evaporation ponds and one detaction (12.5%) at the SCAs were feather spots. None of the detections at power blocks were feather spots.

3.4 Detections of Stranded Birds

Two birds were detected during the reporting period that were alive and uninjured but unable to take flight. A common loon was discovered by WEST field lead Pam Bullard on March 31 beneath the SCAs on the east side of Unit 1 near the evaporation ponds. A second common loon was detected by Genesis operations personnel on April 20 beneath the SCAs on the west side of Unit 1, north of the power block. Both of these birds were examined for injuries and when none were observed, were successfully released at Lake Tamarisk. Both individuals are included in this report (including the fatality analysis) as detections, resulting in a conservative estimate of fatalities.

3.5 Summary of Bat Detections

No bats were detected during the spring 2015 season.

3.6 Carcass Persistence Trials

Based on carcass persistence data from the spring 2015 season, 64 survival models were compared for relative quality using the corrected AICc score, as suggested in Huso (2010). The AICc score provides a relative measure of model fit and parsimony among a selection of candidate models, and provides a framework for testing hypotheses regarding which factors contribute to carcass persistence rates. Carcass size was tested as a potentially important variable, as larger carcasses tend to persist longer and may be more likely to leave feather spots which persist for long durations, whereas smaller carcasses may be more likely to be completely removed. Project component (SCAs/fence, generation-tie line) was also included as a potentially important variable.

The model with lowest AICc is typically chosen as the "best" model relative to other models tested; however, any model within two AICc points of the best model is considered competitive with the best model (Burnham and Anderson 2004). The top six models had ΔAICc values <2. Ultimately, the loglogistic model that included an effect of carcass size but no effect of component was chosen as the most parsimonious of the top models (Appendix B). The chosen model predicted that 42.4% of small carcasses, 72.4% of medium carcasses, and 84.5% of large carcasses persisted for a standard 7-day search interval. Mean removal time for small carcasses was 2.0 days, for medium carcasses was 7.3 days, and for large carcasses was 14.6 days (Appendix B). Estimates of proportion of carcasses remaining as a function of days since carcass placement are provided in Figure 6.

3.7 Searcher Efficiency Trials

During the 2015 spring season, a total of 60 searcher efficiency trials (30 small, 20 medium, and 10 large birds) were placed at the Project. Overall, 19 trials were placed in the SCAs, eight trials were placed along perimeter fences (inner and outer perimeters), and three trials were placed at power blocks (along perimeter and beneath ACC units). Thirteen trials were placed along the gen-tie and 17 were placed along the distribution lines. Fifty-five trials were available to be found, and five trials disappeared before the searcher efficiency trial began (two in the SCAs, two along the fence, and one along the gen-tie line). Two observers conducted searches at the Project during spring. Searcher efficiency trials were conducted on each observer in approximate proportion to the number of searches they conducted at the Project, as follows: Sarah Nichols (number of trials available to be found: 24) and Anika Mahoney (31). All trials were included in estimation of searcher efficiency.

In the SCAs, the null model was chosen as the best model to estimate searcher efficiency. Searcher efficiency rate in the SCAs was 92.3% (24 found of 26 available to be found) and was similar across carcass size classes. Along overhead lines searcher effiency was 42.9% for small birds, 100% for medium birds, and 100% for large birds (21 found of 29 available to be found).

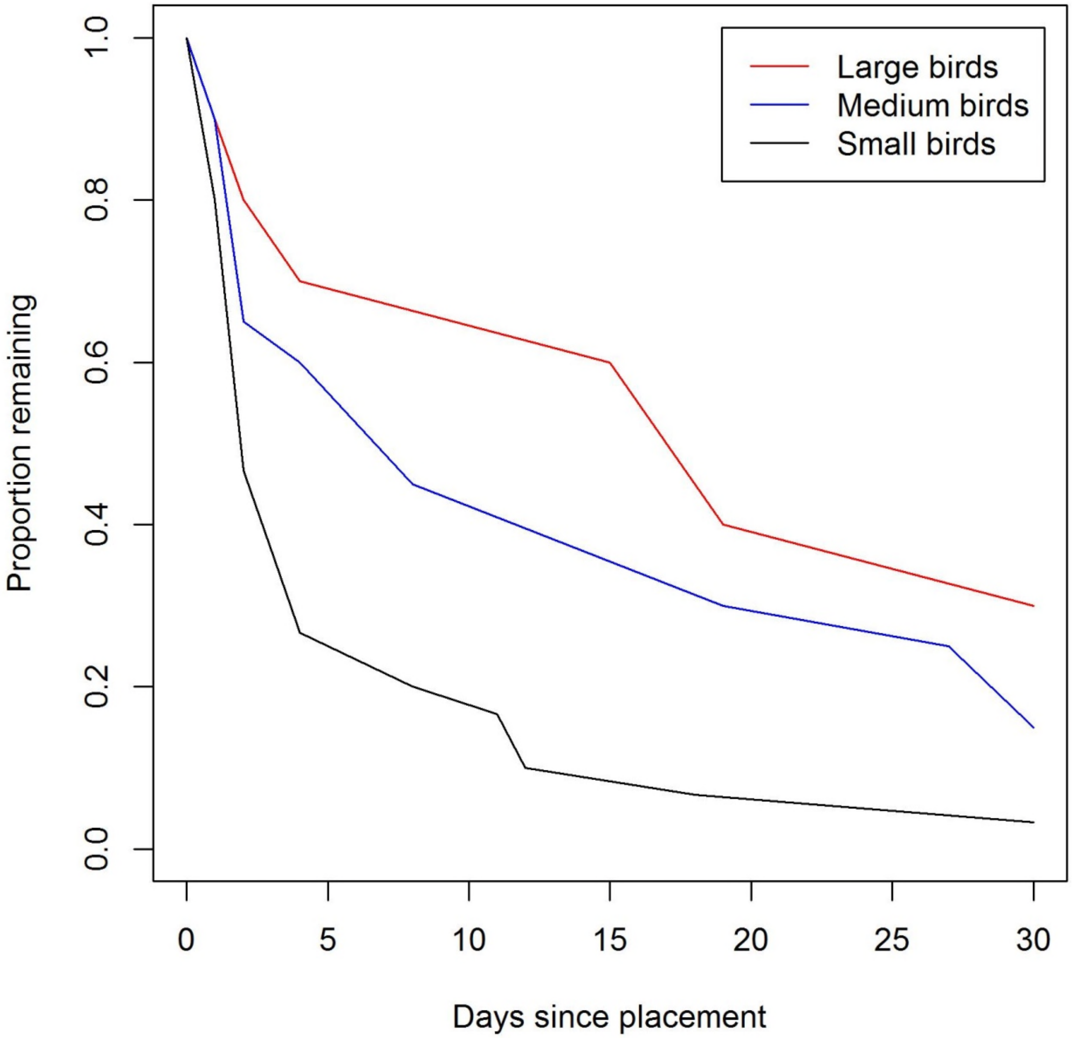

Figure 6. Proportion of trial carcasses remaining as a function of days since placement and carcass size class (n = 30, 20, and 10 for small, medium, and large size classes, respectively) during spring 2015 at the Genesis Solar Energy Project in Riverside County, California.

Any differences in searcher efficiency that may exist between the two visibility classes present in the SCA's do not seem to have an important effect on overall searcher efficiency because of the low representation of the moderate visibility class at the Project. The narrow 90% confidence limits associated with searcher efficiency estimates in the SCA's (0.85 – 1.00; Appendix B) suggests that pooling carcasses across visibility classes contributes little to the variation associated with estimates of searcher efficiency.

3.8 Fatality Estimates

Fatality estimates were calculated separately for each component (SCAs, power blocks, fence, evaporation ponds, and overhead lines/road). Ultimately, one detection was excluded from the fatality analysis because it was mummified and estimated to be older than the 7-day search interval (Huso 2010), and five detections were excluded because they were found outside standardized search areas. Only one of the 18 detections that were found incidentally was in a standardized search area, consequently, 17 incidental detections were excluded from the fatality analysis.

During spring 2015, there were an estimated total 234 fatalities (90% confidence interval [CI]: 124 – 430) at the Project (Appendix B). Of these, 55 fatalities (23.4%) were estimated for the SCAs, 44 fatalities (18.6%) were estimated for the fence, 9 fatalities (4.0%) were estimated for evaporation ponds, 5 fatalities (2.2%) were estimated for power blocks, and 121 fatalities (51.8%; 90% CI: 32 - 307) were estimated for the gen-tie and distribution lines and project road (Appendix B). An estimated 113 (90% CI: 60 – 188) fatalities (0.065/acre, 0.434/MW) occurred for all components associated with each solar unit (SCAs, power block, evaporation ponds, and along the perimeter fence, combined). Estimates made for components where fewer than 5 carcasses were observed should be interpreted with caution because variance of the estimate is unreliable with small sample sizes. Other projects (e.g., Ivanpah) are not reporting estimates when carcass counts are low. However, the TAG has asked for both the estimates and confidence intervals for this project with the appropriate caveat added. A complete list of estimates for each Project component and carcass size class with confidence intervals is presented in Appendix B.

4.0 DISCUSSION

The 2015 spring season represented the first season of standardized monitoring at Genesis per the BBCS. Searcher efficiency trials and carcass removal trials were conducted concurrently at the SCAs, power blocks, fencelines, and along the gen-tie and distribution lines. Data from these trials were used to produce fatality estimates adjusted for searcher efficiency and carcass persistence bias. Although these estimates were produced from a statistically robust sample, only limited inference may be drawn from a single season of data. These results should be considered preliminary because estimating carcass persistence, searcher efficiency, and adjusted numbers of fatalities within each season represents information based on a limited sample size. As more data are collected throughout the monitoring year (and additional quality assurance/quality control measures occur, for example characterizing feather spots to species or size class), data from all seasons may be pooled. At that time, an information-theoretic approach will be used to test data for seasonal effects retrospectively. This approach will include a test of multiple competing hypotheses (e.g., that there is a single estimate of searcher efficiency for all seasons; that there are estimates of searcher efficiency specific to each season; or that there are additive or interactive effects of season and project component), By using all of the data collected up to the point at which the analysis occurs, estimates of searcher efficiency and carcass persistence will be based on a larger, more informative sample, and patterns in the data can be teased apart by comparing the fit of models with different effects to the data. By using a larger sample, variance estimates will likely be reduced , , but because seasonal estimates will be produced from the much larger annual data set, they may differ from what is reported here.

4.1 Carcass Persistence and Searcher Efficiency Trials

The degree to which carcasses persist on the landscape depends on a variety of factors reflecting seasonal and inter-annual variation in habitat, climate, and the scavenger community. The composition and activity patterns of the scavenger community often vary seasonally as birds migrate, new juvenile birds and mammals join the local population, and mammalian scavengers variably hibernate or estivate. The scavenger community may also vary substantially from year to year because of variation in annual reproduction and survival related to changes in landscape condition. Climatic conditions that vary seasonally and annually also may contribute to variation in carcass decay and removal rates due to variation in temperatures, solar insolation, wind patterns, and the frequency of flooding events. Thus, rates of carcass persistence reported here should be interpreted cautiously as they may change over the coming months.

Searcher efficiency was influenced by carcass size, but it is not yet clear if there may be an effect of habitat visibility class due to limited sample sizes. In the SCAs, searcher efficiency was high regardless of carcass size and this is likely influenced by the limited vegetation cover beneath solar troughs. Beneath overhead lines outside the Project fence vegetation cover is higher, but our analysis did not support the hypothesis that visibility class is a factor in searcher efficiency along the lines. Carcass size influenced searcher efficiency, but was relatively high over all carcass size classes (72.4%).

Searcher efficiency trials for this Project will be repeated seasonally. The desert landscape in which this Project is located generally changes little with the seasons, save for brief periods following winter and spring rains when floods may occur and blooming plants may flourish. A recent meta-analysis involving data from more than 70 wind-energy projects suggested that including habitat visibility class as a predictive variable generally eliminated any otherwise apparent seasonal effects on searcher efficiency (Smallwood 2013). Further, the possibility exists that searcher efficiency varies seasonally in some cover types but not others. Data from searcher efficiency trials conducted over the coming seasons will therefore continue to be tested for effects of habitat visibility class rather than effects of season.

4.2 Distribution of Fatalities and Fatality Estimates

The number of detections was highest during the middle of the spring monitoring period, and decreased at the end of May. The peak in number of detections on April 24 may have been influenced by weather conditions the preceding night. Winds were recorded from the southwest ranging from 20-30 mph from approximately 2000 hrs on April 23 to 1600 hrs on April 24, and were associated with changing cloud cover (Weather Underground, Blythe, CA).

Detections attributed to an unknown cause accounted for approximately 50% of all detections during the 2015 spring season, and the distribution of the unknown cause detections varied by project component with 34.6% occurring in association with the perimeter fence. Of the 11 detections made along the fence, 81.8% were feather spots. Determining a cause of mortality from a feather spot is challenging because there is rarely visible evidence available on which to determine a cause of death. Thus, feather spots with an unknown cause of mortality could be encountered anywhere birds occur, and an unknown cause of a sizeable proportion of the carcasses is not unique to the Project. Further, game cameras trained on carcasses for carcass persistence trials at the Project have documented multiple feather spots originating from a single trial carcass. Ravens and turkey vultures, and possibly roadrunners, dislodge feathers from their attachment to the skin during the scavenging process. There are a very large number of potential feather spots present on a single bird carcass (because a feather spot is defined as at least two or more primary flight feathers, at least five or more tail feathers, or two primaries within five meters (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 meter). The large proportion of feather spots (32%) among the detections for the Project as a whole may inflate the fatality estimate when unknown cause detections are included based on the potential for multiple feather spots resulting from one fatality, feather spots resulting from predation not associated with the facility, or other causes.

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Appendix A. Weather Conditions and Body Weights Associated with Avian Detections Estimated to be Less Than 24 Hours Old during spring 2015

Table A-1. Weather conditions and body weights associated with avian detections estimated to be less than 24 hours old during spring 2015 at Genesis Solar Energy Project, Riverside County, California.

Carcass ID	Date	Estimated time since death (hrs)	Species	Weight (g)	Weather Summary for Preceding 24 hrs
041515-NAWA-GENTIE-12-4	4/15/2015	8-24	Nashville warbler	–	VERY WINDY YESTERDAY EVENING AND THIS MORNING
041515-UNBI-GENTIE-24-1	4/15/2015	0-8	mourning dove	–	NA
040815-NAWA-GENTIE-12-1	4/8/2015	8-24	Nashville warbler	–	WINDY OVERNIGHT-THIS MORNING, CLEAR SKIES
042415-WETA-GENTIE-20-1	4/24/2015	8-24	western tanager	–	WINDY OVERNIGHT (TOO FRESH TO BE RELATED TO THE TORNADOS)
042415-LAZB-GENTIE-20-2	4/24/2015	8-24	lazuli bunting	8	WINDY OVERNIGHT (TOO FRESH TO BE TORNADO RELATED)
042415-TOWA-GENTIE-21-3	4/24/2015	8-24	Townsend's warbler	–	WINDY OVERNIGHT (TOO FRESH TO BE RELATED TO THE TORNADO)
042415-UNWA-GENTIE-20-4	4/24/2015	8-24	unidentified passerine	–	WINDY OVERNIGHT (SEEMS TO FRESH TO BE A RESULT OF THE TORNADO)
042415-WIWA-GENTIE-20-5	4/24/2015	8-24	Wilson's warbler	–	WINDY OVERNIGHT (TOO FRESH TO BE TORNADO RELATED)
042415-WIWA-GENTIE-20-6	4/24/2015	8-24	Wilson's warbler	–	WINDY OVERNIGHT (TOO FRESH TO BE TORNADO RELATED)
042415-LAZB-GENTIE-5-8	4/25/2015	8-24	lazuli bunting	–	WINDY OVERNIGHT (TOO FRESH TO BE TORNADO RELATED)
042915-BRBL-GENTIELINES-1	4/29/2015	8-24	Brewer's blackbird	65	NA
060315-MODO-GENTIE24-1	3/6/2015	0-8	mourning dove	–	HIGH- 75F; LOW-48F; WIND 16MPH; NO RAIN
031915-PRFA-GENTIE23-1	3/19/2015	8-24	prairie falcon	–	SPRINKLES. OVERCAST OVERNIGHT THRU 0900
050615-WETA-GENTIETOWER-38-1	5/6/2015	0-8	western tanager	20	RELATIVELY CALM WINDS, COOLER TEMPS FROM PRECEEDING WEEK
050815-YEWA-1-FENCE-E-INSIDE-1	5/8/2015	8-24	yellow warbler	9	WEATHER FRONT MOVED THROUGH, VERY WINDY,

					GUSTS UP TO 30MPH, FROM YESTERDAY AFTERNOON THROUGH LATE EVENING. COOLER TEMPS LAST SEVERAL DAYS
050815-YEWA-2-FENCE-W-OUTSIDE-2	5/8/2015	8-24	yellow warbler	9	WEATHER FRONT PASSING THROUGH, VERTY WINDY YESTERDAY AFTERNOON THROUGH THE LATE EVENING- GUSTS OF 30MPH
051515-UNWA-GENTIE-01	5/15/2015	0-8	unidentified warbler	11	WINDS GREATER THEN 30MPH PREVIOUS AFTERNOON/EVENING. A FRONT IS MOVING THROUGH THE AREA
052015-WIWA-GENTIE-08-1	5/20/2015	0-8	Wilson's warbler	6	CLEAR OVERNIGHT, CLOUDS MOVING IN THIS MORNING

Appendix B. Correction Factors and Bird Fatality Rates at the Genesis Solar Energy Project during spring of 2015.

Table B-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during spring of 2015. *Counts of fatalities on the power block and ponds have no variance because all components at the facility were searched. **For adjusted fatalities, lower bounds in parentheses are actual counts; bootstrap analysis indicated a lower bound of zero.

	Small birds		Medium birds		Large birds		Unknown size	
Parameter	**Mean**	**CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Search Area Adjustment								
Overhead lines	0.25	-	0.25	-	0.25	-	0.25	-
Fence	0.5	-	0.5	-	0.5	-	0.5	-
SCAs	0.30	-	0.30	-	0.30	-	0.30	-
Powerblock	1.00	-	1.00	-	1.00	-	1.00	-
Ponds	1.00	-	1.00	-	1.00	-	1.00	-
Observer Detection Rate								
Overhead lines	0.43	0.21 - 0.64	1.00	-	1.00	-	0.43	0.21 - 0.64
Fence	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1
SCAs	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1
Powerblock	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1
Ponds	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1	0.92	0.85 - 1
Average probability of carcass persistence to the next search								
All Areas	0.42	0.33 - 0.51	0.72	0.57 - 0.87	0.84	0.65 - 0.95	0.42	0.33 - 0.51
Observed Fatality Rates (Fatalities /Season)								
Overhead lines	4	1 - 7	2	0 - 6	0	-	1	0 - 3
Fence	1	0 - 3	0	-	1	0 - 3	7	2 - 13
SCAs	5	2 - 9	0	-	1	0 - 3	1	0 - 3
Powerblock*	1	-	0	-	0	-	1	-
Ponds*	0	-	2	-	1	-	2	-
Average Probability of Carcass Availability and Detected								
Overhead lines	0.18	0.09 - 0.29	0.72	0.57 - 0.87	0.84	0.65 - 0.95	0.18	0.09 - 0.29
Fence	0.39	0.3 - 0.48	0.67	0.51 - 0.81	0.78	0.6 - 0.9	0.39	0.3 - 0.48
SCAs	0.39	0.3 - 0.48	0.67	0.51 - 0.81	0.78	0.6 - 0.9	0.39	0.3 - 0.48
Powerblock	0.39	0.3 - 0.48	0.67	0.51 - 0.81	0.78	0.6 - 0.9	0.39	0.3 - 0.48
Ponds	0.39	0.3 - 0.48	0.67	0.51 - 0.81	0.78	0.6 - 0.9	0.39	0.3 - 0.48
Adjusted Fatality Estimates (Fatalities /Season)**								
Overhead lines	88.1	22.5 - 223.1	11.0	(2) - 31.14	0.0	-	22.0	(1) - 80.59
Fence	5.1	(1) - 14.06	0.0	-	2.6	(1) - 7.28	35.8	10.23 - 72.04
SCAs	42.0	15.65 – 77.98	0.0	-	4.2	(1) – 13.21	8.4	(1) - 24.01
Powerblock	2.6	2.07 - 3.34	0.0	-	0.0	-	2.6	2.07 - 3.34

Table B-1. Correction factors and estimated numbers of carcasses at the Genesis Solar Energy Generation Facility during spring of 2015. *Counts of fatalities on the power block and ponds have no variance because all components at the facility were searched. **For adjusted fatalities, lower bounds in parentheses are actual counts; bootstrap analysis indicated a lower bound of zero.

	Small birds		Medium birds		Large birds		Unknown size	
Parameter	**Mean**	**CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Ponds	0.0	-	3.0	2.47 - 3.93	1.3	1.11 - 1.67	5.1	4.13 - 6.68

Appendix C. Detailed Areas of Standardized Searches and Carcass Locations along the Distribution and Generation Tie Lines of the Genesis Solar Energy Project during spring 2015.

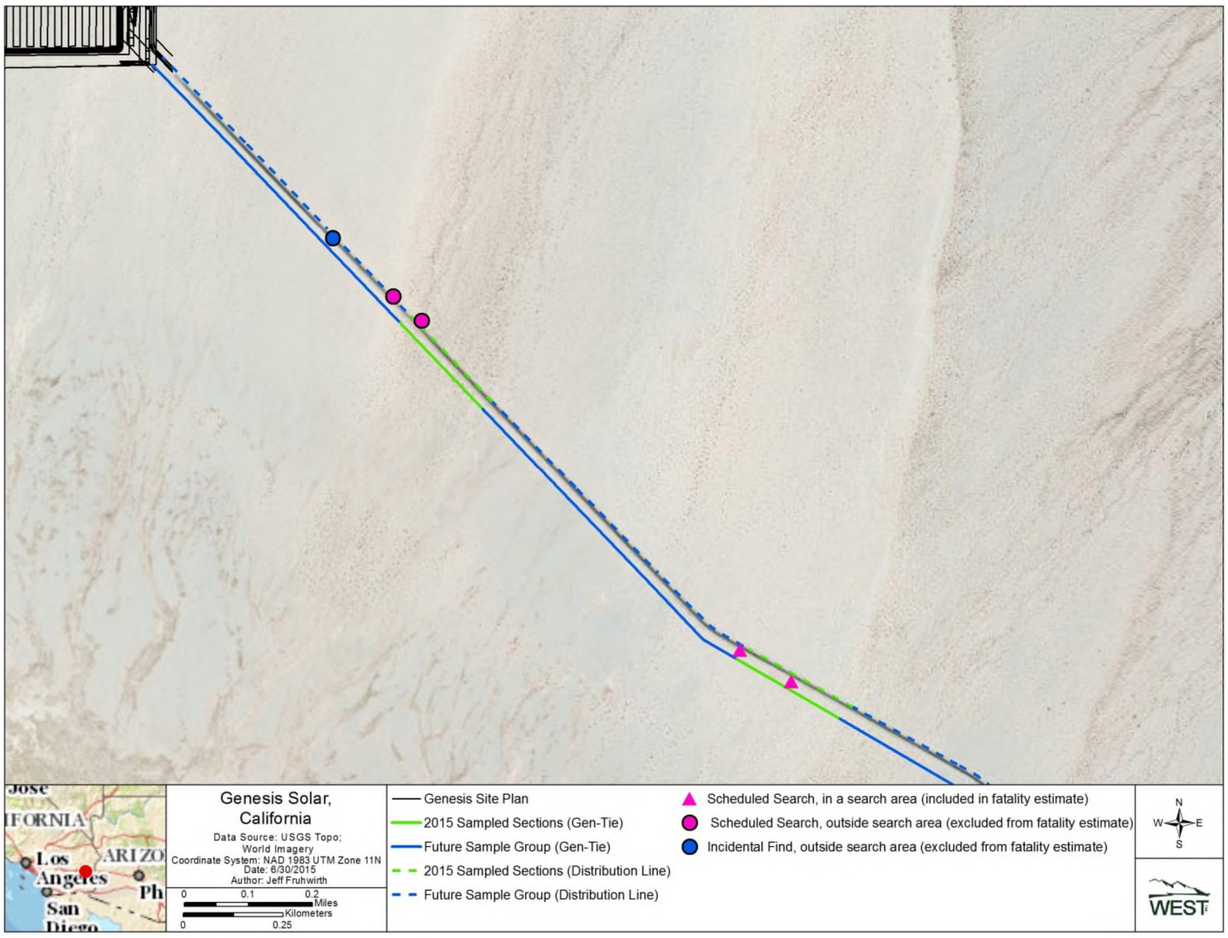

Figure C-1. Areas of standardized searches and carcass locations along two searched sections of the distribution and generation tie lines of the Genesis Solar Energy Project during spring 2015.

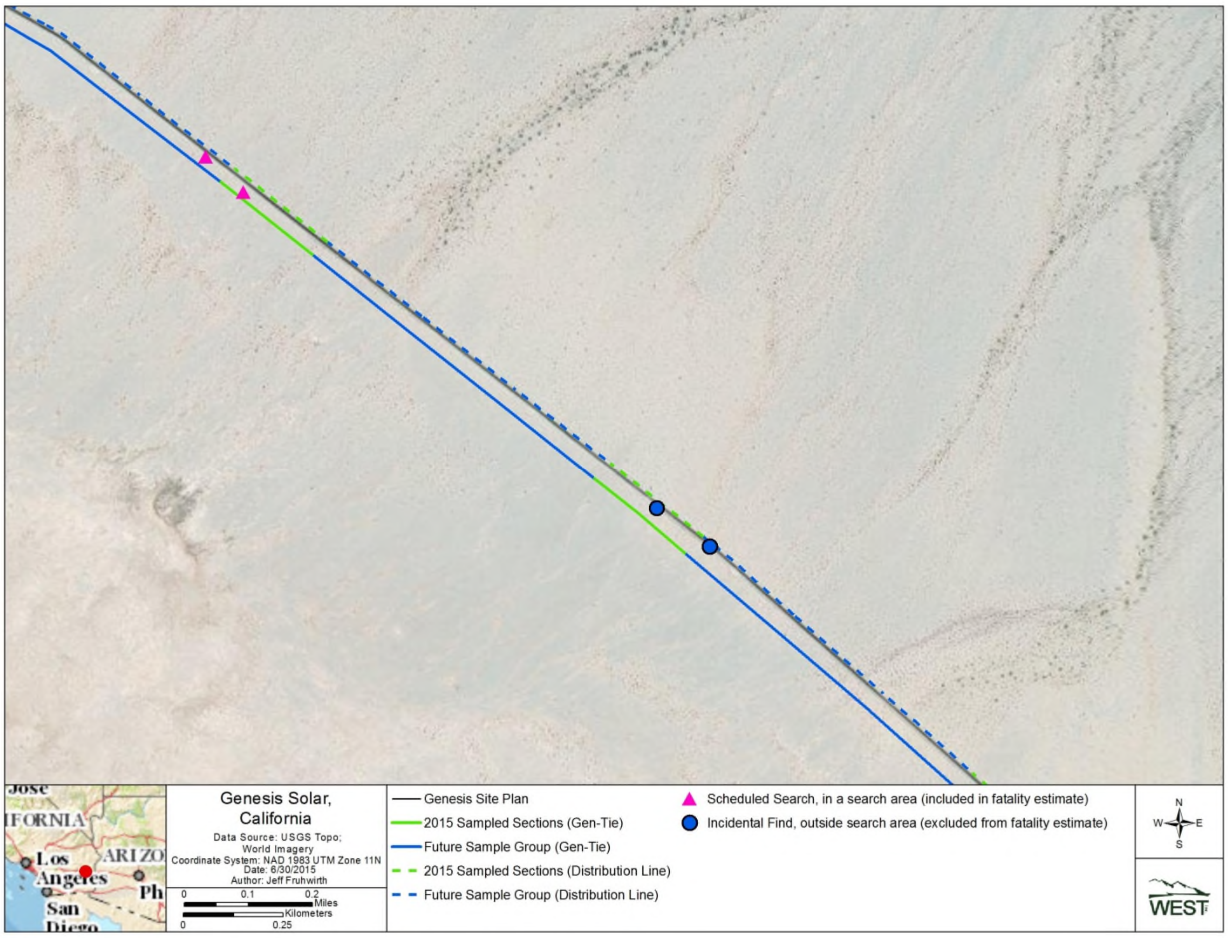

Figure C-2. Areas of standardized searches and carcass locations along two searched sections of the distribution and generation tie lines of the Genesis Solar Energy Project during spring 2015.

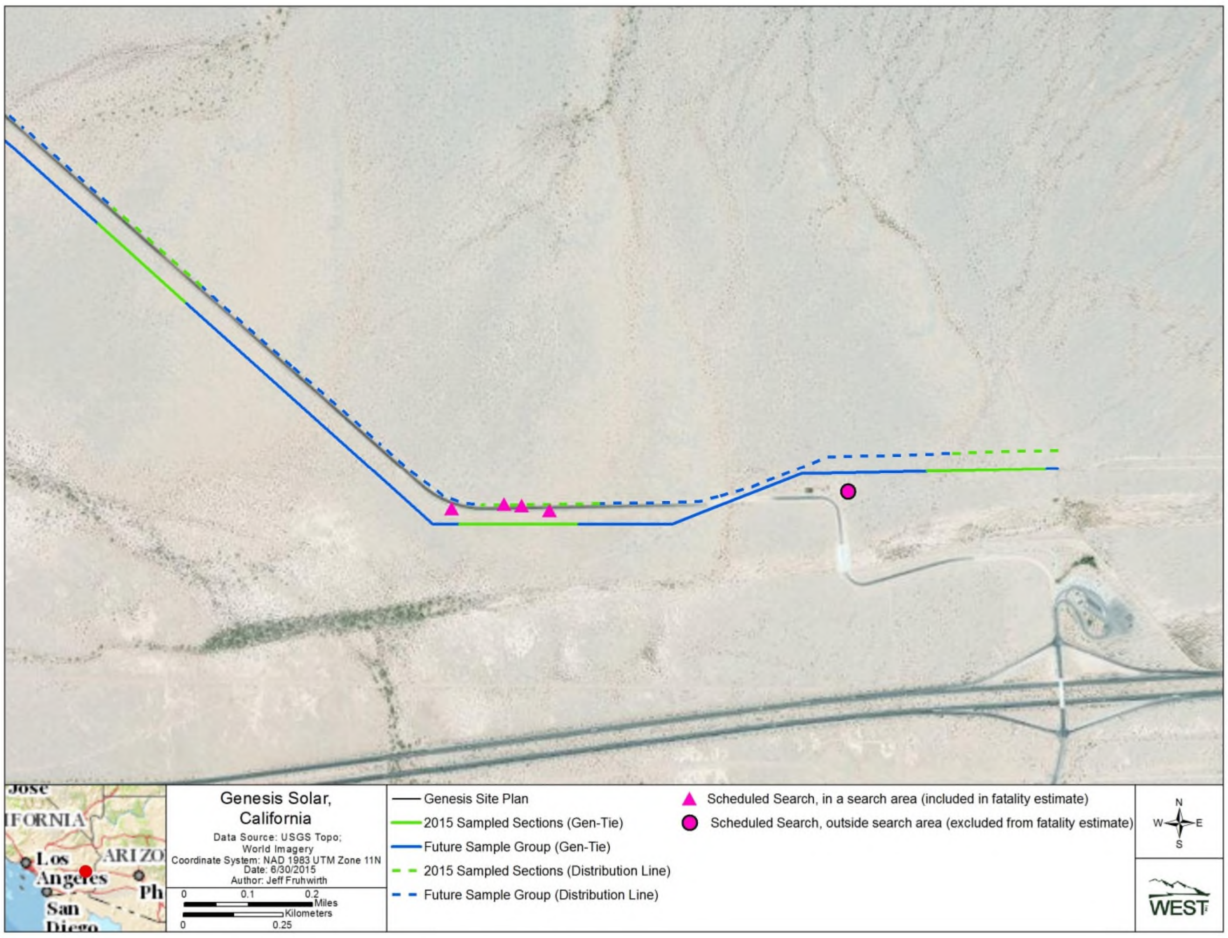

Figure C-3. Areas of standardized searches and carcass locations along three searched sections of the distribution and generation tie lines of the Genesis Solar Energy Project during spring 2015.