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IVANPAH SOLAR ELECTRIC GENERATING SYSTEM
AVIAN & BAT MONITORING PLAN

2015 SUMMER REPORT

Prepared for:

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Executive Summary

Avian and bat monitoring surveys were conducted from 25 May 2015 to 17 August 2015 (the summer season) at the Ivanpah Solar Electric Generating System facility (referred to in this report as "Ivanpah" or "Project") in accordance with the Project's Avian & Bat Monitoring and Management Plan (Plan). Specifically, avian point count surveys, raptor/large bird surveys, facility monitoring for avian detections, searcher efficiency trials, and carcass persistence trials were conducted. This report represents the second "quarterly" (i.e., seasonal) report for the second year of monitoring (or sixth overall quarterly report). Western EcoSystems Technology (WEST) Inc. performed 100% of the monitoring effort for the 2015 summer season.

During avian point count surveys, a total of 29 bird species were recorded. Species richness was highest on the upper desert bajada grid (21 species), slightly lower on the lower desert bajada grid (16 species), and lowest in the three heliostat grids (13 species). Avian abundance was highest on the two desert bajada grids, with 193 observations on the lower bajada grids and 348 on the upper bajada grids. Abundance was lower in the three heliostat grids, with 56 observations in Unit 1, 25 observations in Unit 2, and 46 observations in Unit 3.

During raptor and large bird surveys, four raptor species and two other large bird species, including common raven and turkey vulture, were observed and identifiable. Common ravens comprised 62.5% of all raptor and large bird detections.

Avian and bat fatality monitoring searches were conducted in 1) the "tower area", consisting of the power block and inner high-density (HD) heliostats surrounding each power block on approximately 154 acres, which was surveyed with 100% coverage; 2) the "heliostat area", consisting of the inner and outer heliostat segments outside of the inner HD heliostats on approximately 2,991 acres, which was surveyed with 24.1% coverage (720 acres) in randomly selected arc-shaped plots; 3) the "fenceline", consisting of the perimeter fences, which was 100% surveyed; 4) the "collector line", consisting of the Unit 3 electrical transmission line, which also was 100% surveyed; and 5) offsite transects. Overall, approximately 29.2% of the facility was searched (not including the offsite transects, which are outside the facility). Searches were conducted within the summer season at intervals of approximately 21 days.

All bird and bat fatalities and injuries, referred to as "detections" in this report, including those found incidentally and during standardized facility searches, were documented and categorized as singed, collision, other project causes or unknown based on examination with a binocular microscope and evidence collected from the location of the detection. During the period 25 May – 17 August 2015, a total of 0 bat fatalities, and 112 avian detections (including 7 injured birds), were found.

According to the specifications of the Plan, the number of avian detections were categorized by facility search area and cause. These avian fatality search results, along with searcher efficiency carcass persistence rates from trials conducted onsite, were input into a fatality estimator model (Huso 2010) to provide an estimate of the fatalities for the facility.

Using the fatality estimator model, during the period 25 May – 17 August 2015, there were an estimated 454 fatalities (34.6%) from known causes and 860 fatalities (65.4%) from unknown causes. Of the known causes, 303 fatalities (66.7%) were estimated for the 2,991-acre heliostat area and 135 fatalities (29.7%) were estimated for the 154-acre tower area. Detections of known causes in the other areas were too low to provide separate estimates. Overall, based on the monitoring results and estimates for known causes for the 2015 summer season, the effect of the Project on birds will not rise above the "low" category.

Of the unknown causes, 62 fatalities (7.2%) were estimated for the tower area, and 752 fatalities (87.4%) were estimated for the heliostat area, and 46 (5.3%) were estimated for the fenceline area; detections of unknown causes in the other areas were too low to provide separate estimates. Driving this estimate was a large number of feather spots (35) comprising over half (66.0%) of all unknown-cause detections, which may lead to an over-estimate of fatalities with unknown cause.

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Section 1.0 Introduction

1.1 Project Background

The Ivanpah Solar Electric Generating System (referred to in this report as "Ivanpah" or "Project") consists of three solar power electrical generating facilities (Units 1, 2, and 3) with a combined net capacity of 377 megawatts. Each unit includes a central power tower with an air cooled condenser (ACC) and associated electrical generating equipment, surrounded by a heliostat array that reflects sunlight to a boiler at the top of the power tower. Ivanpah is located on approximately 1,457 hectares (3,600 acres) of Bureau of Land Management (BLM) land west of Interstate 15 near the town of Nipton in San Bernardino County, California (Figure 1). Construction was initiated in 2010 and completed in late 2013.

1.2 Monitoring Plan Overview and Goals

An Avian & Bat Monitoring and Management Plan (2013; "Plan") 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 the operation of the Project. Final agency acceptance of the Plan occurred in November 2013. The Plan is also intended to: 1) satisfy the BLM Right-of-Way (ROW) Permit requirement that the proponent develop an avian plan as well as a Migratory Bird Treaty Act (MBTA) Conservation Agreement; 2) satisfy the requirements for the Avian & Bat Monitoring and Management Plan approved by the CEC for Ivanpah per CEC Condition of Certification BIO-21; and 3) achieve the avian and bat protection objectives of the USFWS in relation to the MBTA, Bald and Golden Eagle Protection Act (Eagle Act), and Federal Endangered Species Act (FESA), including preparing written records of the actions that have been taken to avoid, minimize, and compensate for potential adverse impacts to avian and bat species. By developing a proactive management plan in close consultation with the USFWS and other relevant state and federal agencies, Project proponents can effectively comply with the intent of the federal MBTA, Eagle Act, FESA, and relevant state regulations (USFWS 2012).

The Plan details the onsite and offsite surveys to be conducted and the data analysis and reporting processes that will be implemented by Ivanpah in collaboration with the USFWS, CDFW, CEC, and BLM and supports four main goals and associated objectives. As identified in the Plan, they are:

Goal 1. Identify Collision Risks: Risks will be identified by monitoring and identifying avian mortality and injury associated with facility structure collisions.

Objective 1. Estimate collision-related avian mortality and injury with the following facility structures, using empirical data to calculate facility-wide mortality and injury rates:

- Power towers
- Perimeter fences

- Heliostats
- Project transmission line (Unit 3 collector line)

Goal 2. Identify Solar Flux Risks: Risks from flux will be assessed by monitoring and identifying avian mortality and injury associated with solar flux generated by the facility.

- Objective 2: Estimate flux-related avian mortality and injury using empirical data to calculate facility-wide mortality and injury rates.

Goal 3. Identify Patterns of Avian Use at the Facility: Patterns of avian use will be assessed by conducting onsite and offsite surveys to document avian species composition onsite and offsite, compare abundance in representative habitats onsite and offsite, and document changes in avian use in these areas over time.

- Objective 3: Document patterns of collision- or flux-related mortality/injury associated with species, age/sex, season, weather, and visibility.
- Objective 4: Document spatial patterns associated with collision- or flux-related mortality/injury.
- Objective 7. Document use patterns of various avian species, including migratory birds, raptors, and golden eagles, particularly the seasonal variation of bird communities through breeding, migratory, and overwintering periods.

Goal 4. Provide a Framework for Management of and Response to Risks: The designation and description of the functioning of the Technical Advisory Committee (TAC) provides a management and decision framework for the identification and implementation of potential adaptive management measures.

- Objective 5: Provide quantitative information for developing and implementing adaptive management responses commensurate with identified impacts.
- Objective 6: Provide a framework for the TAC to jointly review, characterize, and recommend responses, based on monitoring results, to the appropriate lead agency representatives.

1.3 Purpose of This Report

This report represents the second "quarterly" (i.e., seasonal) report for the second year of monitoring (or, the sixth quarterly report) summarizing monitoring methods and results for avian and bat fatalities and injuries based on the procedures and requirements specified in the USFWS-accepted Plan and as required by CEC Condition of Certification BIO-21. This report covers the 2015 summer season, which includes the period from 25 May – 17 August, 2015.

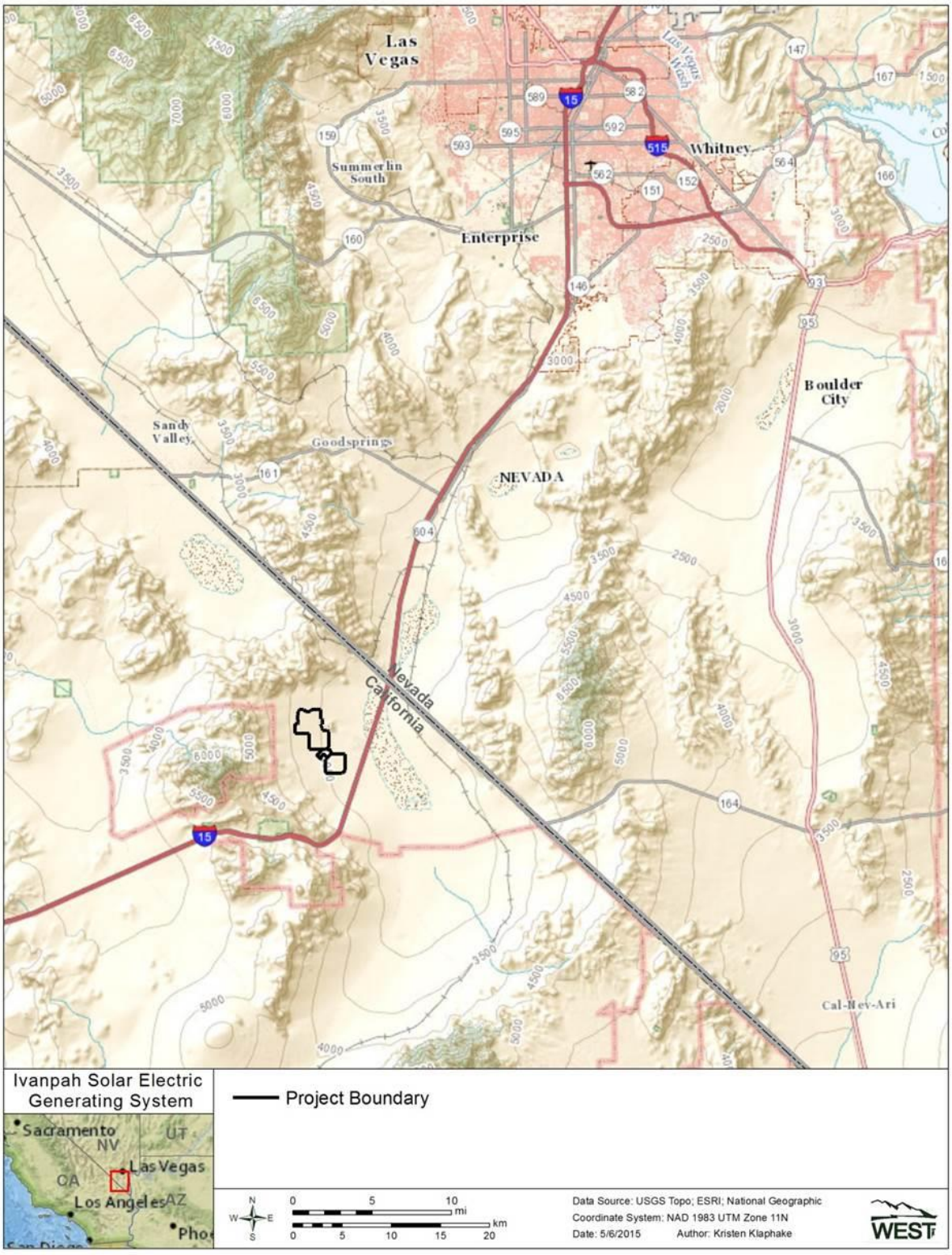

Figure 1. Ivanpah Vicinity Map.

Section 2.0 Methods

The Plan describes the methods by which monitoring and certain analyses, including compilation of the overall fatality estimate, occurred. Below is an abridged description of methods (see Plan for detailed methods), with greater detail provided when methods differ from original Plan.

2.1 Avian Use Monitoring

Methods for monitoring avian use of the Project and nearby desert areas, as well as the methods for monitoring the occurrence of raptors and other large birds on and around the facility are described in this section.

2.1.1 Avian Monitoring Surveys

Avian use surveys were conducted using standard, variable-radius point counts to assess bird use of the vegetated areas within the heliostat fields associated with each unit as well as nearby (offsite) areas of desert habitat. Eighty survey points (Figure 2) were surveyed by CEC- and BLM-approved avian biologists. In accordance with the Plan, these 80 points were randomly selected from within the following five survey areas:

1. 20 points within an approximately 2.59 square-kilometer (1-square-mile) study area located in Unit 1, within the lower bajada environment of the facility.
2. 20 points within an approximately 2.59 square-kilometer offsite study area located in comparable lower bajada environment as far as practicable from (and south of) the Unit 1 fenceline.
3. 10 points within an approximately 1.29 square-kilometer (0.5-square-mile) study area located in Unit 2, within the upper bajada environment.
4. 10 points within an approximately 1.29 square-kilometer (0.5-square-mile) located in Unit 3, in the upper bajada portion of the facility.
5. 20 points within an approximately 2.59 square-kilometer (1.0-square-mile) offsite study area located in comparable upper bajada environment and as far as practicable from (and southwest of) the Unit 3 fenceline.

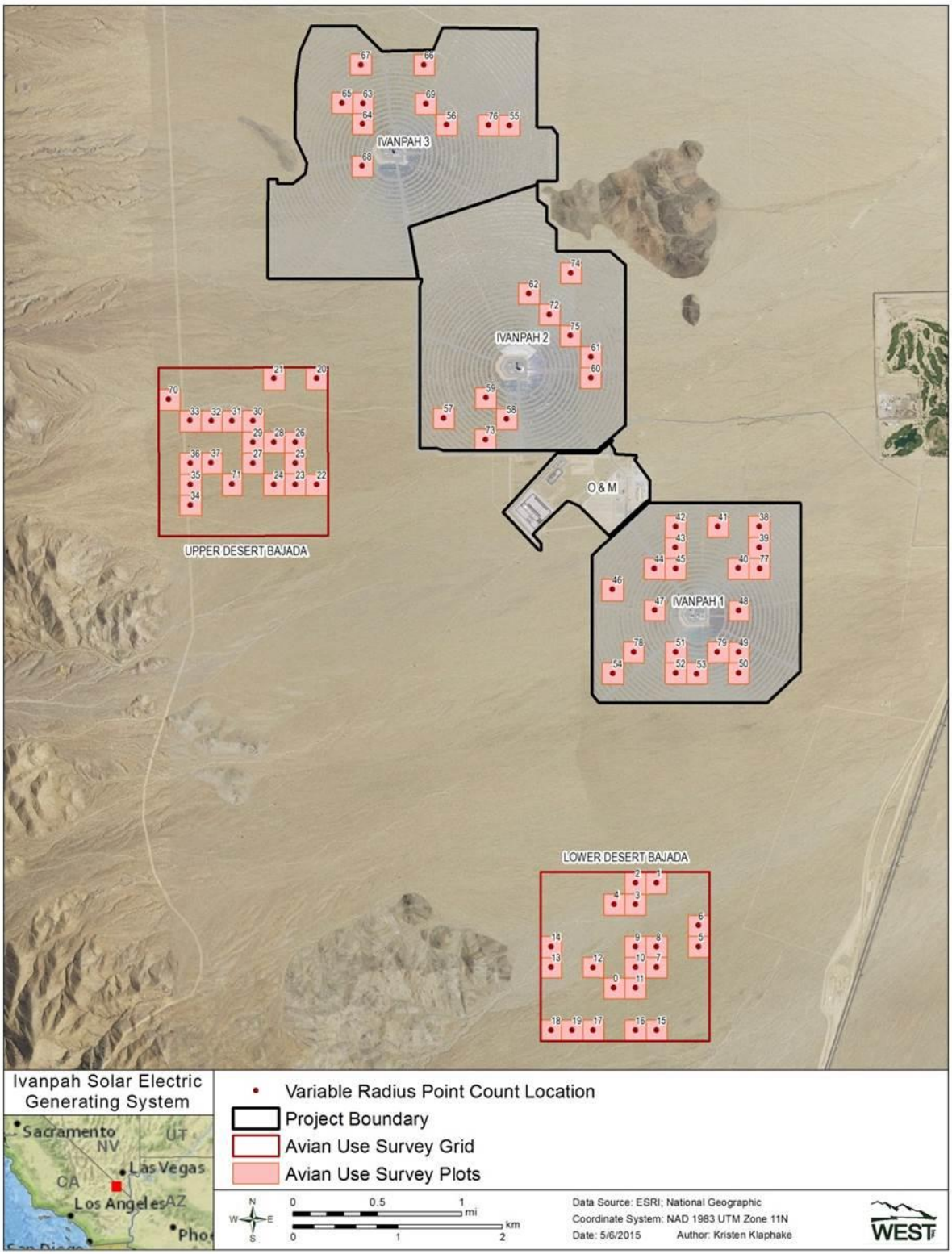

Figure 2. Avian Use Monitoring Survey Locations.

Each survey area described above was divided into 200-m by 200-m square areas to create distinct sample plots. Within each survey area, either 10 or 20 (as indicated above) avian use survey points were randomly selected from the sample plots, resulting in 20 point counts per 2.59 square kilometer for each habitat type in the facility and off-site areas, with each count location affording a minimum, non-overlapping survey radius of 100 m. Points were surveyed for 10 minutes each, and were conducted between first light and three hours after sunrise.

The Plan prescribes that avian use surveys are conducted once per month during June, July, August. To report avian use results consistent with fatality monitoring results, only the surveys conducted during the 2015 summer reporting period (25 May – 17 August, 2015) have been included in this report.

Data Analysis. According to the Plan, all birds heard or seen at each point up to 100 meters from the observer will be recorded to document species occurrence and estimate abundance. Thus, all birds observed are used to calculate species richness and abundance. Results for species composition (number of species recorded) and avian abundance (number of observations) are presented by survey area. For visualization of results, data from Unit 2 and Unit 3 are combined because these areas had 10 survey points compared to 20 survey points in other areas. Thus, when combined, Unit 2 and Unit 3 have an equivalent number of points to the other areas and results can be compared. In addition to the number of points in each survey area, the ability to compare results among survey areas depends on the number of visits. Mean use (number of birds/survey) are presented to standardize data among survey areas to account for unequal number of visits per survey area.

Avian abundance metrics such as total observations can help describe patterns in bird occurrence, especially when sampling effort is equal among survey areas. However, because survey effort differed among survey areas, and bird detectability varies among species (i.e., some birds are more easily detected then others) and could differ between the heliostat area and desert bajada area, other analytical methods may be more appropriate to examine patterns in bird use among survey areas (Buckland et al. 1993). As a result, program Distance 6.0 (Thomas et al. 2010) was used to evaluate avian densities for the heliostat area and desert bajada areas. Densities were calculated based on birds observed using the plots, only; thus, birds flying over or transitioning through the plot were not included in the density analysis.

The Cornell Lab of Ornithology's BirdCast website (www.birdcast.info) provides a regional migration forecast and a regional migration analysis, and uses two types of data; observations submitted voluntarily by birdwatchers through the eBird website (www.ebird.org) and radar data from over 140 weather stations. Taken together, these data can be used to examine trends in bird migration in summer and fall over broad geographic scales. BirdCast provides two data summaries: 1) a regional summary that uses radar and weather data to interpret bird movements and reports a range of migration amounts (e.g., light through heavy) based on the radar measurements used to compare the reflectivity of a remote object (decibels of Z value or dBZ); and 2) a list of 'species on the move' showing common migrant birds reported by birdwatchers in eBird with arrival and departure dates. Thus, the species on the move data relies on birdwatchers reporting observations, and birding 'hotspots' are likely overrepresented in the dataset compared to rural and less visited areas. The regional summaries provided in BirdCast are broad, and the West region includes Washington, Oregon, California, Idaho, Nevada, Utah, Arizona, Montana, Wyoming, Colorado, and New Mexico. Therefore, the BirdCast West regional migration analysis was examined for every week during the 2015 summer season for specific mentions of California or Desert

Southwest (what this region encompasses is undefined). Additionally, the BirdCast West regional migration analysis was examined for a distinct fall migration start date.

2.1.2 Raptor/Large Bird Monitoring Surveys

Surveys were conducted from each of eight points to assess raptor/large bird use of the facility and offsite project areas (Figure 3). The locations of the points relative to those described in the Plan are discussed in the Fall 2014 report.

Each point was surveyed for 4 hours per survey (except during weather hazards or other circumstances that required suspending the survey) using unlimited-distance point count methodology. CEC and BLM-approved avian biologists performed these surveys using binoculars and spotting scopes, recording detailed location and flight path data for all observed raptors and large birds, including shorebirds, waterfowl, and common raven (*Corvus corax*). The Plan specifies that surveys for raptors and other large birds be conducted twice per month during all months except summer (June – August). To report raptor and large bird results consistent with fatality monitoring results, only the surveys conducted during the 2015 summer reporting period (25 May – 17 August 2015) were included in this report.

Data Analysis. Results for species composition (number of species), abundance (number of observations), and habitat use (location of the observation) are presented in Section 3.2. Although all raptors and large birds are recorded to an unlimited sight distance, according to the Plan, observations within 800 meters will be used for standardized assessments and comparison of mean use (number of observations/survey hour) for raptors and large birds. Based on the location of the bird observation, the habitat was classified as Ivanpah facilities (anywhere perched or flying over a part of the Project), desert, golf course, or mountains. The Clark Mountain Range lies to the North, West, and South of the Project with the foothills being approximately 3.2 km from the closest raptor and large bird survey point. Thus, given the distance to the mountains, raptors and other large birds likely had a lower detectability than those observed within 800 meters. In addition, Section 3.2 provides information on the number of individuals of these species observed perched versus those in flight, as well as the heights at which flying birds were recorded. Due to the long duration of each survey and the mobility of these birds, it was not always possible to track individuals throughout a survey to avoid counting the same individuals multiple times. Consequently, results of large bird use monitoring surveys are reported as the number of observations rather than individuals.

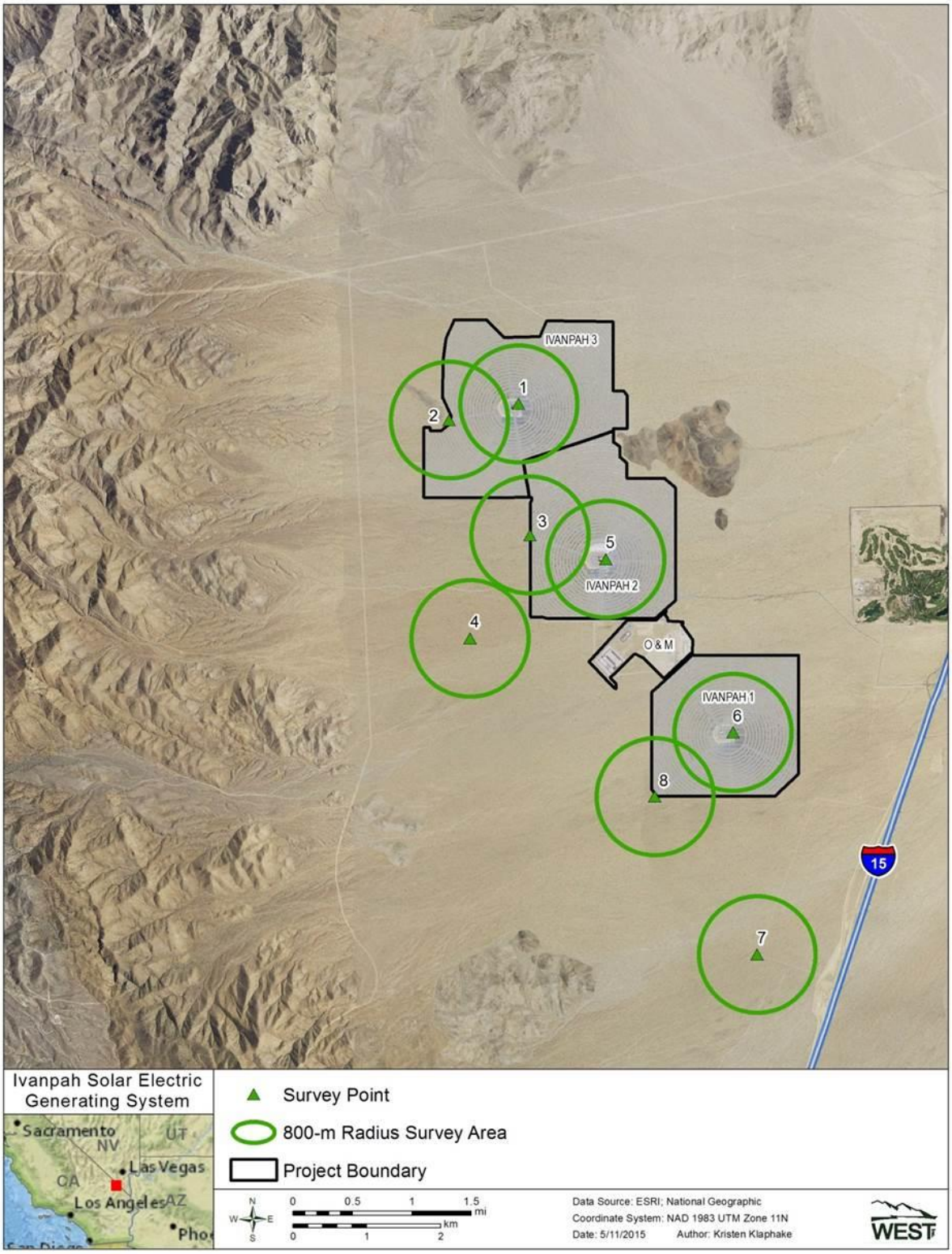

Figure 3. Raptor and Large Bird Use Monitoring Survey Locations.

2.2 Facility Monitoring

This section describes areas surveyed, the timing and frequency of the searches, and the methods by which standardized searches were conducted to identify dead/injured birds and bats (hereafter detections) at the Project. This section also describes the methods for conducting carcass persistence and searcher efficiency trials; how data were reported and analyzed for incidental detections; and the methods for producing fatality estimates for the Project.

2.2.1 Standardized Searches

2.2.1.1 Areas Surveyed

Per the Plan, monitoring was conducted in the "tower area", defined as the power block (the area consisting of the tower, the ACC unit, the associated control building, and immediately adjacent areas defined by the ring road and berm/slopes surrounding these facilities) and inner high-density (HD) heliostats surrounding each power block (100% survey coverage); the "heliostat area", defined as the inner and outer heliostat segments outside of the inner HD heliostats (24.1% survey coverage in randomly selected arc-shaped plots); the "fenceline" defined as the unit perimeter fences and common logistics area (CLA) fence (100% survey coverage); the "collector line", defined as the Unit 3 electrical transmission line (100% survey coverage); and offsite transects. Table 1 provides the acreage searched within each of these areas, as well as the percent of the facility comprised by these search areas. Overall, approximately 29.2% of the Project (not including the offsite transects, which are outside the facility) was searched (Figure 4).

To ensure a balanced distribution of heliostat field survey plots, each unit was divided into inner and outer heliostat fields, and approximately 20% of each sub-area was randomly selected for monitoring. This stratified random sampling design ensures that survey plots will not be clustered or biased in any distance or direction from the towers.

Table 1. Monitoring Areas, 2015 summer season.

Area	Acreage Searched	Percent of Facility
Tower Area	154	4.80%
Heliostat Area	720	22.40%
Fenceline	39	1.20%
Collector Line	26	0.80%
Offsite Transects	7	NA*
Total	939	29.20%

*NA = Not applicable as offsite survey areas are located outside of the facility

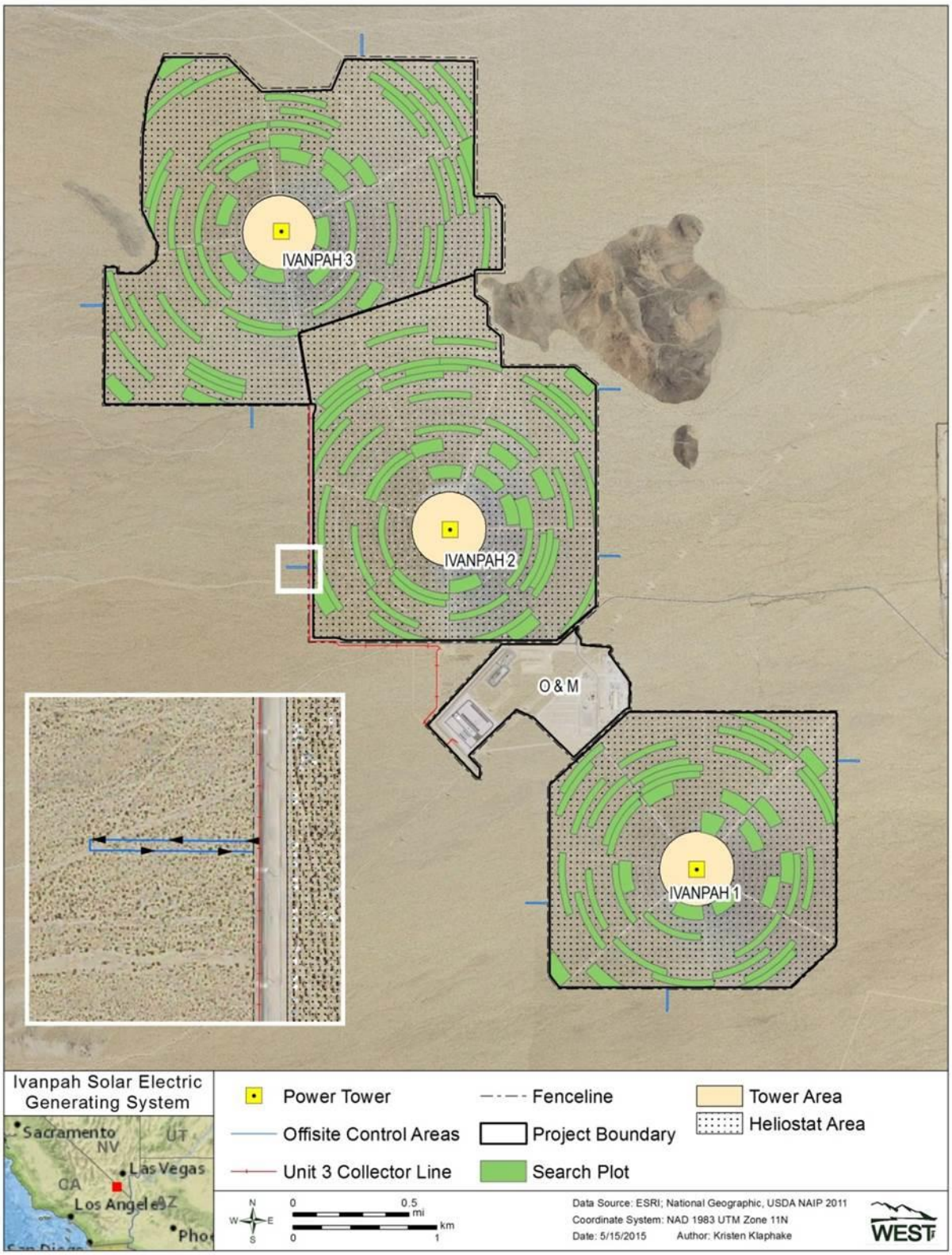

Figure 4. Ivanpah Search Areas.

2.2.1.2 Search Frequency and Timing

Standardized searches occurred at each unit on a 21-day interval through the 2015 summer season. Variation in search interval was anticipated to occur due to the transition from a 7-day search interval to a 21-day search interval between seasons of differing length. All survey areas of each unit were visited a total of five times during the 2015 summer season.

2.2.1.3 Search Methods

Biologists performed surveys in the tower area, fenceline, offsite transects, collector line, and plots in the heliostat. Standardized walking surveys for fatalities were performed by CEC and BLM-approved biologists, in accordance with the methods outlined in the Plan. In the heliostat area, a pair of biologists walked a total of four transects oriented longitudinally along the complete length of each arc-plot, with the ring roads serving as the outer boundaries of each arc plot (Figure 5). While walking each transect, biologists walked a narrow search section approximately 10 meters (m) wide. Within the power block, biologists walked through and around the power tower and ACC unit looking for dead and injured birds and bats, and walked transects through the gravel surrounding the structures to achieve 100% coverage within physically accessible areas. Within the inner HD heliostats surrounding each power block, biologists walked transects to ensure 100% coverage. Thus, the tower area, comprising the area within 260 m of each tower, was completely covered during each survey, excepting any areas that were physically inaccessible or unsafe to survey. Inaccessible areas were, to the extent possible, scanned using binoculars. Along the fenceline, a 6-m wide transect was surveyed, centered on the fence itself (i.e., 3 m on either side of the fence). The collector line was surveyed using a 30-m wide transect (i.e., 15 m on either side of the center line). Offsite transects were surveyed along two randomly selected 152-m long transects, separated by approximately 10 m extending outward from, and back to, the unit perimeter fence at nine locations (three per unit), including the north, east, south, and west borders of the facility.

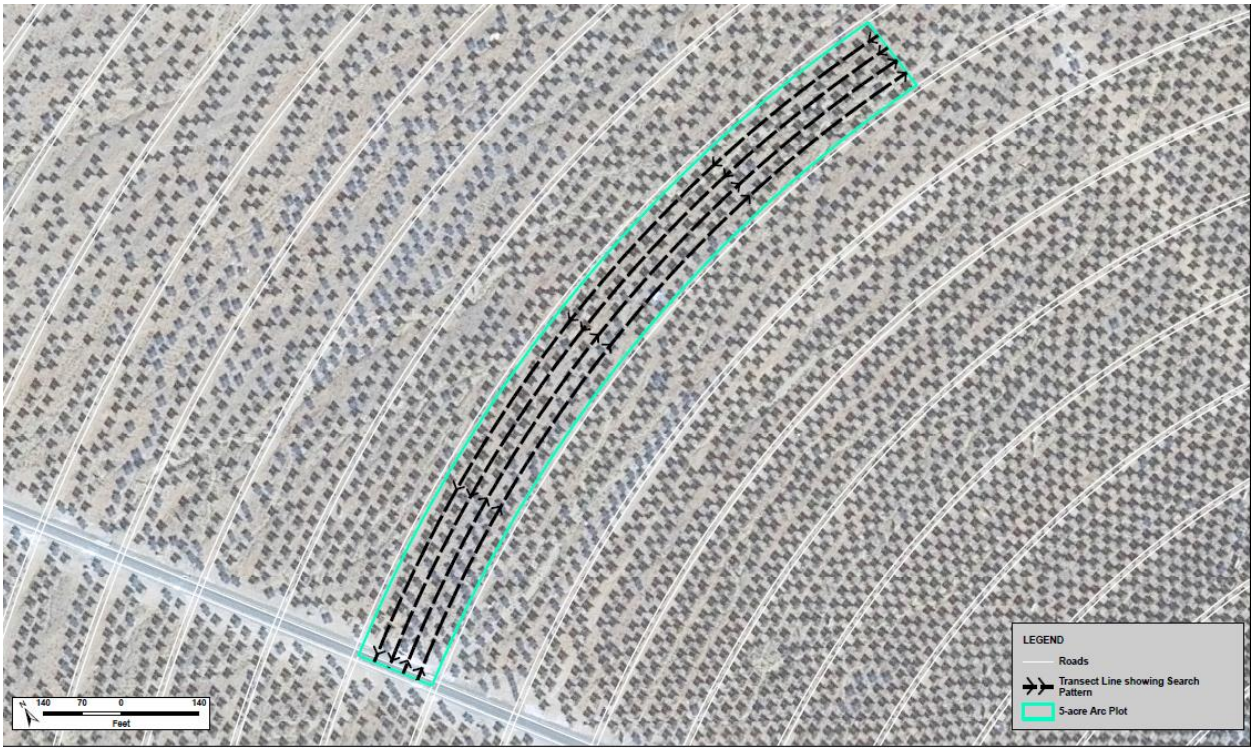

Figure 5. Monitoring Search Pattern for Arc Plots.

Carcass and Feather Spot Examination. Every carcass and feather spot was examined visually by a CEC and BLM-approved biologist for evidence of singeing or collision. Singeing to feathers can occur when a bird enters the flux around the power tower. When no obvious evidence of singeing or collision were evident to the naked eye, the carcass or feather spot was then examined using an AmScope SE306R-AZ-E2 20X-40X-80X Digital Binocular Stereo Microscope. When singed detections involving carcasses (as opposed to only feather spots) were found, the singeing was assigned a grade based on Kagan et al. (2014), as follows.

- Grade 1 – curling of less than 50% of the flight feathers
- Grade 2 – curling of 50% or more of the flight feathers
- Grade 3 – curling and visible charring of contour feathers

Kagan et al. (2014) originally found no singeing of contour feathers in the absence of curling of 50% or more of the flight feathers. In contrast, we have found singeing of contour feathers with curling of less than 50% of flight feathers, and in the absence of curling or singeing of any flight feathers. We therefore assigned grade 3 independent of grades 1 and 2.

When a carcass was detected, biologists looked for evidence of collision, including obvious physical trauma or detection adjacent to a heliostat with a bird-strike imprint, smudge mark, and/or feathers on or near the surface of the mirror. If there was no evidence of collision or singeing (e.g., charring, curling, or melting of feathers), as confirmed through microscopic examination, the cause of injury or fatality was listed as "unknown".

For the purpose of these surveys, feather spots were considered detections when they met the following criteria:

At least two or more primary flight feathers, 5 or more tail feathers, or 10 or more feathers of any type concentrated together in an area 1-m^2 or smaller (Smallwood 2007), without any bone, beak, or significant amounts of flesh or skin.

In some cases, an individual detection was broken up into aggregations of feathers that would meet the criteria for a feather spot, but with pieces of the carcass that contained bone or significant amounts of flesh or skin also present. In these cases, the detection was categorized as a partial carcass (rather than a feather spot), per the "feather spot" definition above.

2.2.2 Carcass Persistence Trials

Carcass persistence trials were performed throughout the 2015 summer monitoring season. At the request of the TAC, the number of trials conducted during the summer season was increased compared to previous monitoring periods. A total of 48 trials were conducted, divided among small (N=33) and large (N=15) bird carcasses. The facility contains vegetated and unvegetated areas that could affect the ability to detect a carcass or the amount of time a carcass persists until it is scavenged. The tower area (power block and inner high density (HD) heliostat area), where most singed detections occur, is

unvegetated; all other areas are considered vegetated. In order to examine carcass persistence times for vegetated and unvegetated areas, carcasses were also distributed through the facility, with 34 carcasses placed in the unvegetated tower area, and 14 carcasses placed in the vegetated heliostat area, along fence lines, or underneath the collection line. Non-native species were used for both size classes; Coturnix quail (*Coturnix japonica*) were used for small carcass trials, and either ring-necked pheasant (*Phasianus colchicus*) or mallard (*Anas platyrhynchos*) were used for all large birds trials conducted during the 2015 summer monitoring season. A camera was placed at each carcass to record the time of scavenging and the scavenging species.

2.2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the 2015 summer monitoring season, and at the request of the TAC, the number of trials conducted was increased compared to previous monitoring periods. A total of 83 searcher efficiency trials (30 small birds, 26 large birds, and 27 feather spots) were conducted during the 2015 summer monitoring season. Carcasses and feather spots were placed in various vegetation heights and in areas that had different soil and vegetation color values to represent the range of conditions under which searches occur. Trials were placed in the heliostat area, along fence lines, and in the tower areas of all three units; however, no trials were placed in the ACC building since detection probability is assumed to be 100% in this area of the power block. Ground cover underneath the overhead lines is similar to that of the heliostat fields and fence lines, therefore no searcher efficiency trials were placed in the collector line survey area. Overall, 44 trial carcasses/feather spots were placed in the tower area and 39 trial carcasses were placed in vegetated areas in the heliostat area or along fenceline area.

2.2.4 Incidental Reporting

Some detections were outside standardized search areas, or were within search areas but not during standardized searches. Such detections were found by the Project's designated biologists and operational personnel. These detections were reported in accordance with the facility's Wildlife Incident Reporting System (described in Section 3.4 of the Plan) and were considered "incidental" detections. Data on these incidental detections were reported in the SPUT permit database. As described in Section 2.2.5, incidental data were included in the fatality estimates when they were found in areas covered during standardized surveys (e.g., tower area or along the fenceline) during time periods in which those areas were being searched. Incidental detections from outside the survey areas or during time periods in which areas are not being searched are not included in the fatality estimates; however, all detections regardless of the method or source of detection are reported in the SPUT permit database.

2.2.5 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 heliostats versus cleared areas around towers). 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 expressed 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).

The bias correction factors r and p are estimated by covariates that may influence the detectability and persistence of each carcass, such as carcass size, presence of vegetation, and stage of decay or scavenging (i.e., feather spot versus carcass). For this study, the Huso estimator was used to correct for detection and scavenging bias; the estimator was demonstrated to perform well under a variety of conditions (Huso 2010). The Huso model was developed in the context of estimating fatalities for post-construction fatality studies at wind energy facilities; however, the Huso estimator is suitable for other sources of anthropogenic avian mortality, including power lines and utility scale solar facilities (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 5th and upper 95th 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.

Estimating Carcass Persistence Times. Measurements of carcass persistence rates are often subject to censoring. In this context, censoring refers to the fact that a value (e.g., days a carcass is present before being removed) may not be known exactly, but 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 was available to be found for between 7 and 10 days. This carcass would be considered "interval censored". Similarly, if a carcass lasts the entire six-week trial period, that carcass is "right censored"—we know the carcass lasted at least six weeks, but it could have persisted longer. Due to the fact that camera traps (e.g., cameras that automatically document activity at the trial carcass) were used for carcass persistence trials, the majority of scavenging times were known precisely, and the data were not censored. However, when cameras failed to record the moment of scavenging, interval censoring was applied.

There are four commonly used distributions implemented in the survival models used to estimate the value of r : exponential, Weibull, loglogistic, and lognormal. These four distributions exhibit varying degrees of flexibility in order to model a wide variety of removal time distributions. Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model fit to carcass persistence data. The exact time of death for detected fatalities is usually unknown, so the probability of persistence cannot be calculated exactly for each carcass; however, it can be estimated from the selected survival model and bootstrapped to obtain a range of estimates of r for each carcass. In the 2013 – 2014 winter through 2014 – 2015 winter reports, carcass size was included as a covariate in one

carcass persistence model. Beginning 2015 spring individual models were fit for small birds and large birds due to the distinct difference in carcass persistence time between the two size classes. See Section 5.1.2 for details on the model fitting procedure.

Estimating Searcher Efficiency. Searcher efficiency, or the proportion of carcasses detected, *p*, is represented most simply by the following equation:

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

Model Selection for Searcher Efficiency Trials. The Plan states that searcher efficiency trials will be conducted during each season in which vegetation differs from the prior season, because changes in vegetative cover may affect carcass detectability. *A priori* decisions were not made regarding whether vegetative cover would differ between seasons, but rather, searcher efficiency trials were conducted in all season. Following the completion of fall searcher efficiency trials, there was sufficient cumulative data for the year to assess whether searcher efficiency differed significantly by project area (e.g., unvegetated tower area versus vegetated heliostat area), season, and/or carcass size. The nearly complete lack of vegetation cover in the tower area suggested that searcher efficiency may be higher in the tower area than in other project areas. If this hypothesis were true, accounting for this difference in searcher efficiency across project areas would be important for producing accurate fatality estimates.

To evaluate various hypotheses regarding differences in carcass detectability among project areas, seasons, and/or carcass size, logistic regression models were fit to searcher efficiency data and corrected Akaike's Information Criteria (AICc) was used to compare models. The project area was defined using two categories to reflect the suspected differences in searcher efficiency due to differences in vegetation cover: the tower area, which consists of the power block and the inner HD heliostats, and other areas, which consists of all other project areas not included in the tower area. Models were constructed for year, carcass size, project area, and the interaction of project area and carcass size, and compared to the null model (Table 15). There were too few trials of some carcass sizes in some seasons to consider a model with season and carcass size combined. The data for this analysis included all human searcher efficiency trials of carcasses from the beginning of trials in the winter 2013 – 2014 season through the 2015 summer season.

Fatality Estimates. Per Section 3.1 of the Plan, estimates for the number of detections in the tower area components (i.e., the power block and inner HD heliostats) are reported separately and combined, because 100% of these areas was searched. Power block and inner HD estimates were calculated separately due to the inclusion of many more incidental observations from the power block. A separate estimate was produced for the heliostat area (the inner and outer heliostat segments combined), in which 24.1% of the total area was searched. Fatality estimates reported in the inner/outer heliostat areas were adjusted to account for the unsearched area in the inner/outer heliostat areas (i.e., divided by 0.241).

The ACC buildings are only marginally accessible to scavengers from the outside; therefore, they act primarily as a closed system with a scavenging rate that approaches zero. Furthermore, carcasses are, generally, visible against the industrial backgrounds. Thus, the fatalities found in the ACC were not adjusted using the Huso estimator; rather, raw counts of ACC detections were added to fatality estimates

for the power block. All detections within the ACC buildings were assigned as having a known cause of fatality, whether or not they showed evidence of singeing or collision.

Within the power block, during the 2015 summer season, incidental detections accounted for 32.1% of the detections recorded. Thus, as treated in previous analyses, incidentals found within the power block were included in estimates, but handled differently from other fatalities. To reflect the high human activity in the power block—and frequent observation of the areas within the power block—the search interval for these detections was set to one day.

In previous seasons, incidental detections found outside of the power block but within standardized search areas were partially processed in the field and left in place to give searchers the opportunity to discover the carcass on the next scheduled search. As approved by the TAC, this method was discontinued beginning in the 2015 spring season to prevent the scenario where an incidental detection is recorded, left in place, but scavenged before the next standard search and no carcass is associated with the data. In the 2015 summer season, incidental detections found outside of the power block, but within standardized search areas were removed from field and included in fatality estimates under the conservative assumption that the search interval was the time between the last search of the area and the time of incidental discovery.

All fatality estimators have limitations, particularly when fatality counts are low. In particular, when detections are five or fewer, regardless of survey effort, estimates and confidence intervals can be subject to uncontrolled bias and must be interpreted with caution (Korner-Nievergelt et. al 2011). Rather than report estimates with little inferential value, no estimates were provided for combinations of covariates (e.g. size, location, cause) resulting in five or fewer detections.

The fatality estimator accounts for imperfect detection probability by using bias trials to estimate searcher efficiency. The Huso estimator is constructed under the assumption that searchers have a single opportunity to discover a carcass. Therefore, if a carcass is missed on the first search it was available, then found on the next search, it will effectively be over-counted. The method typically used to overcome multiple-detection-bias is to exclude any detection determined to likely be older than the search interval. Each detection made during the 2015 summer season was evaluated for exclusion from the estimator based on the observed time since death (i.e., the length of time between an animal's death and when the detection was discovered), and the search interval associated with that detection. For example, if a detection determined to have been on the ground for > 1 week was made in the inner HD of Unit 2, which had been searched 7 days earlier, that carcass would be excluded from analysis.

To correctly account for searcher efficiency in the fatality estimate model, when partial carcasses are initially identified as feather spots by the observer in the field, they are modeled (in the fatality estimates) as a feather spot. In other words, the primary means of identification of the detection (feather spot, small carcass, or large carcass) is the appropriate classification to utilize in the modeled estimates. The primary identification approach is appropriate since different searcher efficiency rates are estimated for feather spots as opposed to carcasses. Because searcher efficiency is an important component of the fatality estimator, what the surveyors detect first (i.e., feather spot versus a complete or partial carcass) influences how that detection should be included in the model. Such detections are noted in Appendix A as "partial carcass + feather spot" in the "Description of Carcass/Injury" column.

2.3 Deterrence Measures

Ivanpah commenced an investigation of the use of various deterrence measures to reduce avian mortality at the facility in 2013. These initial investigations combined with the results of the monitoring conducted during 2014 resulted in a list of potential deterrence measures for adaptive management. The list of deterrence measures has been updated, and progress reports towards deterrence implementation have been provided to the TAC on a periodic basis.

2.3.1 Avian Measures

Several deterrence measures have been implemented at Unit 1 for birds, including installation of LED lighting that is not attractive to insects and deterrence spikes on the lighting fixtures along with avian chemosensory and sonic deterrence systems. Specifically, new ground-level LED lighting and spikes were installed 5 February 2015. As approved by the TAC, a chemosensory deterrence measure commercially known as BirdBuffer, was deployed on 12 October 2014, and a sonic deterrence measure commercially known as BirdGard, was deployed on 13 March 2015. The chemosensory deterrence measure is hypothesized to deter resident species, since the deterrent induces a conditioned response over time, and the sonic deterrence measure is hypothesized to deter transient and migrant species, as the sounds produced by the system are thought to startle and deter subjects. Together, the combination of BirdBuffer and BirdGard systems are intended to deter avian species from entering this area associated with elevated flux mortality.

2.3.2 Bat Measures

Bat fatalities were detected primarily in the ACC, and as the ACC provides a roosting location, a Binary Acoustic Technology Ultrasonic Bat Deterrence was tested at Unit 3. The bat deterrence measure is not designed to elicit a fear response in bats, but is designed to interfere with the echolocation capabilities of bats. As bats navigate utilizing sonar, the method deployed "jams" the sonar signals and bats species avoid the area as a result of the inherent difficulties to navigate under these conditions. Although bats can adjust echolocation under jamming conditions, the use of broadband ultrasound requires bats to shift frequencies to avoid overlap that interferes with echolocation and therefore deters within the area subject to broadband ultrasound (Arnett, et al, 2013). As a result of the broadband ultrasonic signal and the inherent "jamming" effect, adaptation to the deterrence measure is minimal. The deterrence measure has been installed at all Units, and the installation dates are as follows: 10 September 2014 at Unit 1, 23 April 2015 at Unit 2, and 23 April at Unit 3.

Section 3.0 Avian Use and Raptor/Large Bird Monitoring Survey Results

3.1 Avian Use Monitoring

During the 2015 summer season, a total of 270 avian use counts were conducted across all survey areas and points. Survey effort among survey areas was as follows: upper bajada = 60 counts, lower bajada = 60 counts, Unit 1= 60 counts, Unit 2 and Unit 3 combined = 70 counts. Mean use (birds/survey) is presented to account for unequal survey effort among survey areas.

3.1.1 Species Richness

A total of 29 bird species were recorded during avian use surveys during the 2015 summer season. Species richness was highest in the upper bajada desert (21 species), followed by the lower bajada desert (16 species). Species richness was lower in the heliostat grids, with 9 species observed in Unit 1, 8 in Unit 2, and 7 in Unit 3 (with 10 unique species in Units 2 and 3 combined; Figure 6).

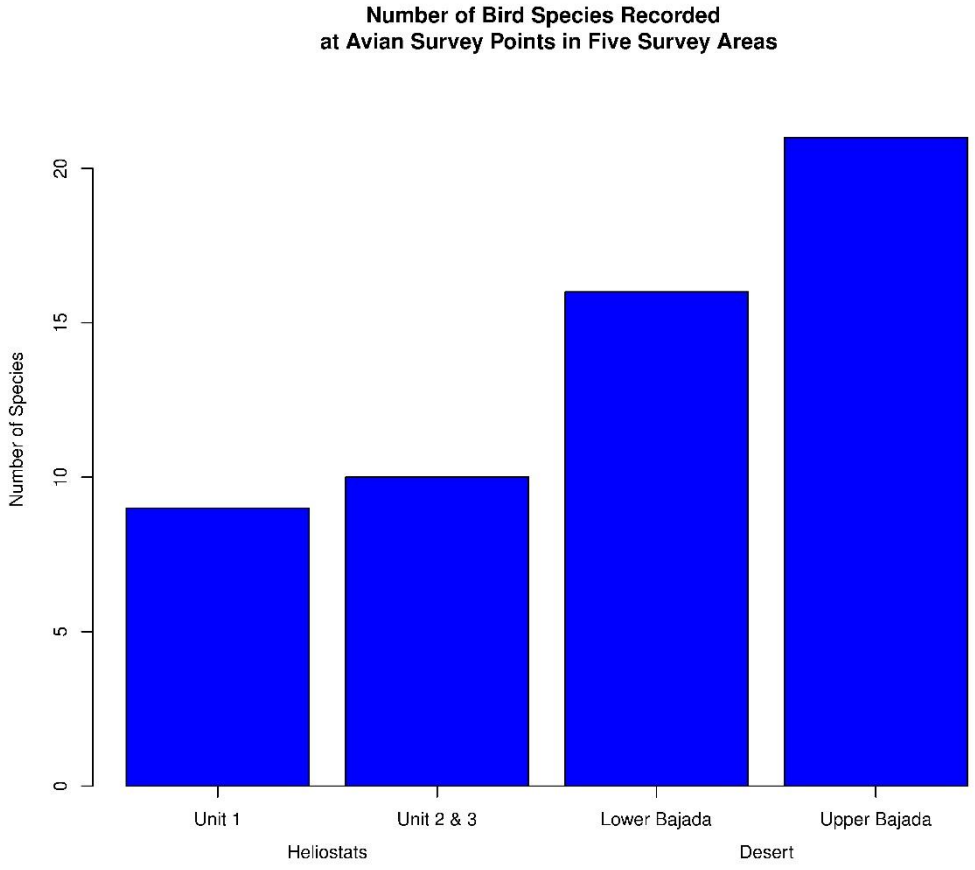

Figure 6. Number of Bird Species Recorded at Avian Survey Points on Five Survey Areas.

3.1.2 Avian Abundance and Density

A total of 668 observations were recorded during avian use surveys (Table 2a), with 541 observations on the desert bajada survey areas (81.0% of total observations). As with species richness, avian abundance was highest on the two desert bajada grids (348 observations on the upper bajada and 193 observations on the lower bajada). The three heliostat arrays had lower avian abundance, with 56 observations in Unit 1, and 71 in Unit 2 and Unit 3 combined (25 observations in Unit 2, and 46 observations in Unit 3; Figure 7). The most frequently detected species in the lower and upper desert bajada was the black-throated sparrow (42.0% of observations on the desert bajada survey areas); black-throated sparrow was the most frequently detected species in the heliostat area (25.2% of observations on the heliostat survey areas).

Avian mean use (birds/survey) was highest in the desert bajada survey areas, and lowest in Unit 2 and Unit 3 (Table 2b). Mean use at Unit 1 was higher than the other solar units, but a single species did not account for most of the activity at this Unit. Mean use in the desert bajada survey areas was influenced by several species including black-throated sparrow, cactus wren, LeConte's thrasher, loggerhead shrike, and black-tailed gnatcatcher (Table 2b). Of the five species with the highest mean use, all had higher use at the desert bajada areas, and two species, LeConte's thrasher and black-tailed gnatcatcher, did not occur at the heliostat area (Table 2b).

In order to accurately calculate density, a distance sampling analysis requires a fairly large amount of data. Due to the low number of individuals recorded for most species during these surveys (owing to the naturally low abundance of birds in the habitat surveyed), it was not possible to obtain reliable density estimates on a species-by-species basis. Even when data were pooled within a 20-point grid, sample sizes were insufficient to allow for determination of reliable density estimates within a grid (e.g., to allow for comparisons between the two 20-point heliostat grids or the two 20-point desert habitat grids). Under the assumption that the two heliostat grids were more similar to each other (in terms of habitat and resident bird communities) than to either of the desert bajada grids, and making the same assumption with respect to the two desert bajada grids, we pooled data from the 40 heliostat points and compared bird densities to data from the 40 pooled desert bajada points.

The density of birds using desert bajada survey areas (2.07 birds/hectare) was greater than the density of birds using the heliostat survey areas (0.35 birds/hectare). Furthermore, the 95% confidence intervals around density estimates for each habitat type did not overlap, thus providing statistical evidence that bird density in the desert bajada survey areas was significantly higher than bird density in the heliostat survey area (Table 3).

Table 2a. Avian Use Survey Results – Number of Observations by Species and Survey Grid.

Species	Unit 1	Unit 2	Unit 3	Upper Bajada	Lower Bajada	Total
black-throated sparrow	17	11	4	148	79	259
cactus wren	5	1	6	78	39	129
Le Conte's thrasher	0	0	0	29	13	42
loggerhead shrike	7	2	1	18	9	37
black-tailed gnatcatcher	0	0	0	18	6	24
rock pigeon	0	0	21	0	0	21
horned lark	5	6	7	2	0	20
ash-throated flycatcher	1	0	0	11	6	18
Bewick's wren	0	0	0	7	10	17
Gambel's quail	0	0	0	0	12	12
house finch	4	1	3	1	3	12
common raven	8	2	0	1	0	11
verdin	0	0	0	9	2	11
blue-gray gnatcatcher	0	0	0	4	6	10
crissal thrasher	0	0	0	6	2	8
unidentified swallow	4	0	0	1	0	5
tree swallow	3	0	0	1	0	4
California quail	0	0	0	0	3	3
ladder-backed woodpecker	0	0	0	3	0	3
mourning dove	0	1	0	1	1	3
Say's phoebe	0	0	0	3	0	3
greater roadrunner	0	0	0	2	0	2
lesser nighthawk	0	0	0	2	0	2
unidentified woodpecker	0	0	2	0	0	2
American avocet	0	0	1	0	0	1
American kestrel	1	0	0	0	0	1
greater yellowlegs	0	1	0	0	0	1
northern mockingbird	0	0	0	1	0	1
red-tailed hawk	0	0	0	1	0	1
Scott's oriole	0	0	0	0	1	1
unidentified bird (medium)	0	0	1	0	0	1
unidentified bird (small)	1	0	0	0	0	1
unidentified passerine	0	0	0	1	0	1
violet-green swallow	0	0	0	0	1	1
Total	56	25	46	348	193	668

Table 2b. Avian Use Survey Results – Mean use (Birds/Survey) by Species and Survey Grid.

Species	Unit 1	Unit 2	Unit 3	Upper Bajada	Lower Bajada	Total
black-throated sparrow	0.283	0.157	0.057	2.467	1.317	4.281
cactus wren	0.083	0.014	0.086	1.3	0.65	2.133
Le Conte's thrasher	0	0	0	0.483	0.217	0.7
loggerhead shrike	0.117	0.029	0.014	0.3	0.15	0.61
black-tailed gnatcatcher	0	0	0	0.3	0.1	0.4
horned lark	0.083	0.086	0.1	0.033	0	0.302
ash-throated flycatcher	0.017	0	0	0.183	0.1	0.3
rock pigeon	0	0	0.3	0	0	0.3
Bewick's wren	0	0	0	0.117	0.167	0.284
Gambel's quail	0	0	0	0	0.2	0.2
house finch	0.067	0.014	0.043	0.017	0.05	0.191
verdin	0	0	0	0.15	0.033	0.183
common raven	0.133	0.029	0	0.017	0	0.179
blue-gray gnatcatcher	0	0	0	0.067	0.1	0.167
crissal thrasher	0	0	0	0.1	0.033	0.133
unidentified swallow	0.067	0	0	0.017	0	0.084
tree swallow	0.05	0	0	0.017	0	0.067
California quail	0	0	0	0	0.05	0.05
ladder-backed woodpecker	0	0	0	0.05	0	0.05
Say's phoebe	0	0	0	0.05	0	0.05
mourning dove	0	0.014	0	0.017	0.017	0.048
greater roadrunner	0	0	0	0.033	0	0.033
lesser nighthawk	0	0	0	0.033	0	0.033
unidentified woodpecker	0	0	0.029	0	0	0.029
American kestrel	0.017	0	0	0	0	0.017
northern mockingbird	0	0	0	0.017	0	0.017
red-tailed hawk	0	0	0	0.017	0	0.017
Scott's oriole	0	0	0	0	0.017	0.017
unidentified bird (small)	0.017	0	0	0	0	0.017
unidentified passerine	0	0	0	0.017	0	0.017
violet-green swallow	0	0	0	0	0.017	0.017
American avocet	0	0	0.014	0	0	0.014
greater yellowlegs	0	0.014	0	0	0	0.014
unidentified bird (medium)	0	0	0.014	0	0	0.014
Total	0.934	0.357	0.657	5.802	3.218	10.97

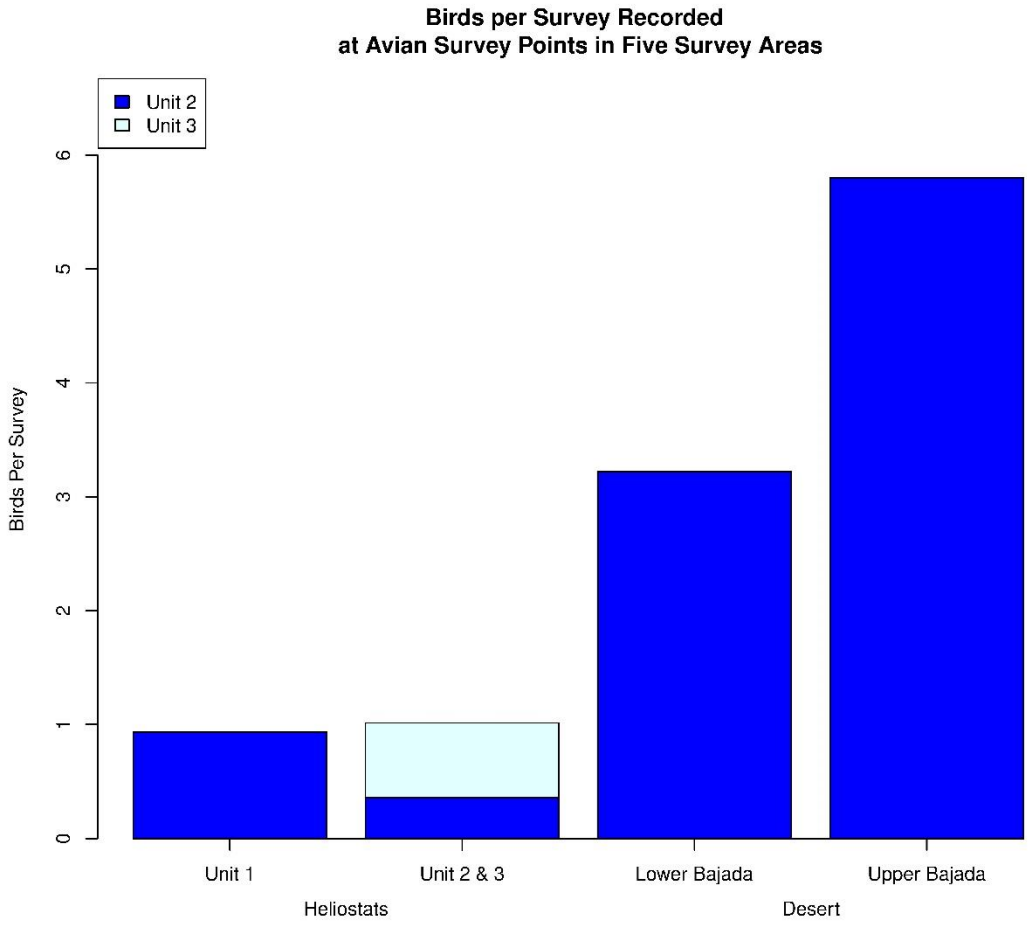

Figure 7. Mean Use (Birds/Survey) Recorded at Avian Survey Points on Five Survey Areas.

Table 3. Avian Density Estimates for Heliostat vs. Desert Bajada Survey Area (Derived Using Program DISTANCE).

Stratum	Estimate (birds/hectare)	%Coefficient of Variation	95% Confidence Interval Low	95% Confidence Interval High
Desert				
Half-normal/Cosine adjustment order 2	2.069	33.98	410.29	1.080
Heliostats				
Half-normal/No Cosine adjustment	0.355	19.14	78.85	0.243

3.2 Raptor and Large Bird Use Monitoring

During the 2015 summer season, a total of 37 surveys were conducted at the eight survey points for a total of 115.5 hours. As the fatality monitoring period did not include the first full or last month of the survey period, the number of surveys per point is as follows: 1 = 4, 2 = 5, 3 = 4, 4 = 5, 5 = 3, 6 = 5, 7 = 3, 8 = 2. Mean use (birds/survey hour) is presented to account for unequal survey effort among points.

3.2.1 General Species Composition, Abundance, and Habitat Use

During the surveys, three identifiable raptor species and two other large bird species were observed and identifiable Table 4). A total of 80 observations of raptors and large birds were recorded to unlimited distance (Table 4).

Table 4. Raptor/Large Bird Point Count Results Summary (Number of Total Observations).

Species	Ivanpah Facilities	Off Site - Desert	Total	Species Composition
common raven	40	10	50	62.5
red-tailed hawk	4	11	15	18.8
turkey vulture	0	8	8	10
American kestrel	5	0	5	6.2
golden eagle	1	0	1	1.2
unidentified large bird	1	0	1	1.2
Total	51	29	80	100%

Common ravens comprised 62.5% of all large bird observations detected during raptor/large bird surveys. Common ravens were observed more frequently at Ivanpah facilities (80.0% of common raven observations) than in the nearby desert (20.0% of common raven observations); none were observed toward the mountains. The second most frequently observed raptor or large bird was red-tailed hawk (*Buteo jamaicensis*), which accounted for 18.8% of raptor and large bird observations. Most red-tailed hawks were observed over the desert (73.3% of red-tailed hawk observations). American kestrels (*Falco sparverius*) were only observed at Ivanpah facilities (100% of American kestrel observations); none were observed in the mountains although this falcon's small size makes very distant observations difficult. One golden eagle (*Aquila chrysaetos*) observation was recorded at Ivanpah facilities outside of the 800 m observation circle flying over the heliostat area. Additionally, there was one incidental observation of golden eagles recorded outside of standard raptor surveys. Two golden eagles, one adult and one subadult, were seen flying over the southwest corner of the Unit 3 outer heliostat segments, before soaring west into the desert. No other raptors or large birds were recorded incidentally during the 2015 summer season.

Mean use (birds/survey hour) within 800 meters was highest for common raven among raptors and large birds observed during surveys (Table 5). Common raven mean use was nearly six times higher than all other raptors and large birds at the Ivanpah facilities and just over two times higher in the desert, respectively.

Table 5. Raptor/Large Bird Mean Use (Birds/Survey Hour) within 800 meters.

Species	Desert	Ivanpah Facilities
American kestrel	0	0.292
common raven	0.607	2.477
red-tailed hawk	0	0.125
turkey vulture	0.30	0

Per Section 2.3 of the Plan, the height of flight above ground level (agl) was recorded in one of the following categories:

- 0 = < 10 m agl, (within the heliostat collision-risk zone)
- 1 = 10–100 m agl, (between the height of the heliostat collision-risk zone and the height of the elevated solar flux risk zone in areas closer to the power towers)
- 2 = 100–200 m agl (within the elevated solar flux risk zone in areas closer to the power towers (primary boiler area at 120–140 m agl))
- 3 = > 200 m agl (above the elevated solar flux risk zone)

For raptors and large birds observed within 800 meters during surveys, more birds were observed in-flight (80.0% of observations) compared to perched (20.0% of observations; Table 6) at the Ivanpah facilities. Outside of the Ivanpah facilities, two perched birds were observed. Over seventy-five percent of all in-flight observations were at or below 100 m agl for all raptors and large birds.

Table 6. Flight Heights of Raptors/Other Large Birds within 800 meters.

	Outside Ivanpah Facilities Flight Height Category						At Ivanpah Facilities Flight Height Category					
Species	0	1	2	3	Perched	Total	0	1	2	3	Perched	Total
American kestrel	0	0	0	0	0	0	2	2	0	0	0	4
common raven	0	3	1	0	2	6	10	12	2	0	10	34
red-tailed hawk	0	0	0	0	0	0	0	0	2	0	0	2
turkey vulture	0	1	1	1	0	3	0	0	0	0	0	0
Total	0	4	2	1	2	9	12	14	4	0	10	40

3.2.2 Raptor and Large Bird Distribution

Common raven was the most numerous raptor or large bird recorded within 800 meters, (Table 7a). The second most abundant raptor or large bird was American kestrel. Raptor and large bird mean use was highest at points 5 and 6 and lowest at point 8 (Table 7b).

Table 7a. Raptor/Large Bird Point Count Results By Survey Point within 800 meters.

Species	1	2	3	4	5	6	7	8	Total
American kestrel	0	0	0	0	2	2	0	0	4
common raven	4	3	3	1	14	13	3	0	41
red-tailed hawk	0	0	0	0	0	2	0	0	2
turkey vulture	0	0	0	3	0	0	0	0	3
Sum	4	3	3	4	16	17	3	0	50

Table 7b. Raptor/Large Bird Mean Use within 800 meters (Birds/survey hour)

Species	1	2	3	4	5	6	7	8
American kestrel	0	0	0	0	0.167	0.125	0	0
common raven	0.333	0.162	0.261	0.1	1.166	0.812	0.25	0
red-tailed hawk	0	0	0	0	0	0.125	0	0
turkey vulture	0	0	0	0.3	0	0	0	0
Sum	0.333	0.162	0.261	0.4	1.333	1.062	0.25	0

Figures 8 through 15 depict the results of raptor surveys in terms of the locations of birds observed; number of individuals; whether the birds were flying or perched; and flight direction (for flying birds). All observations for the entire season are shown on a single figure for each of the eight survey points to document locations and concentrations, if any, of raptor and other large bird activity.

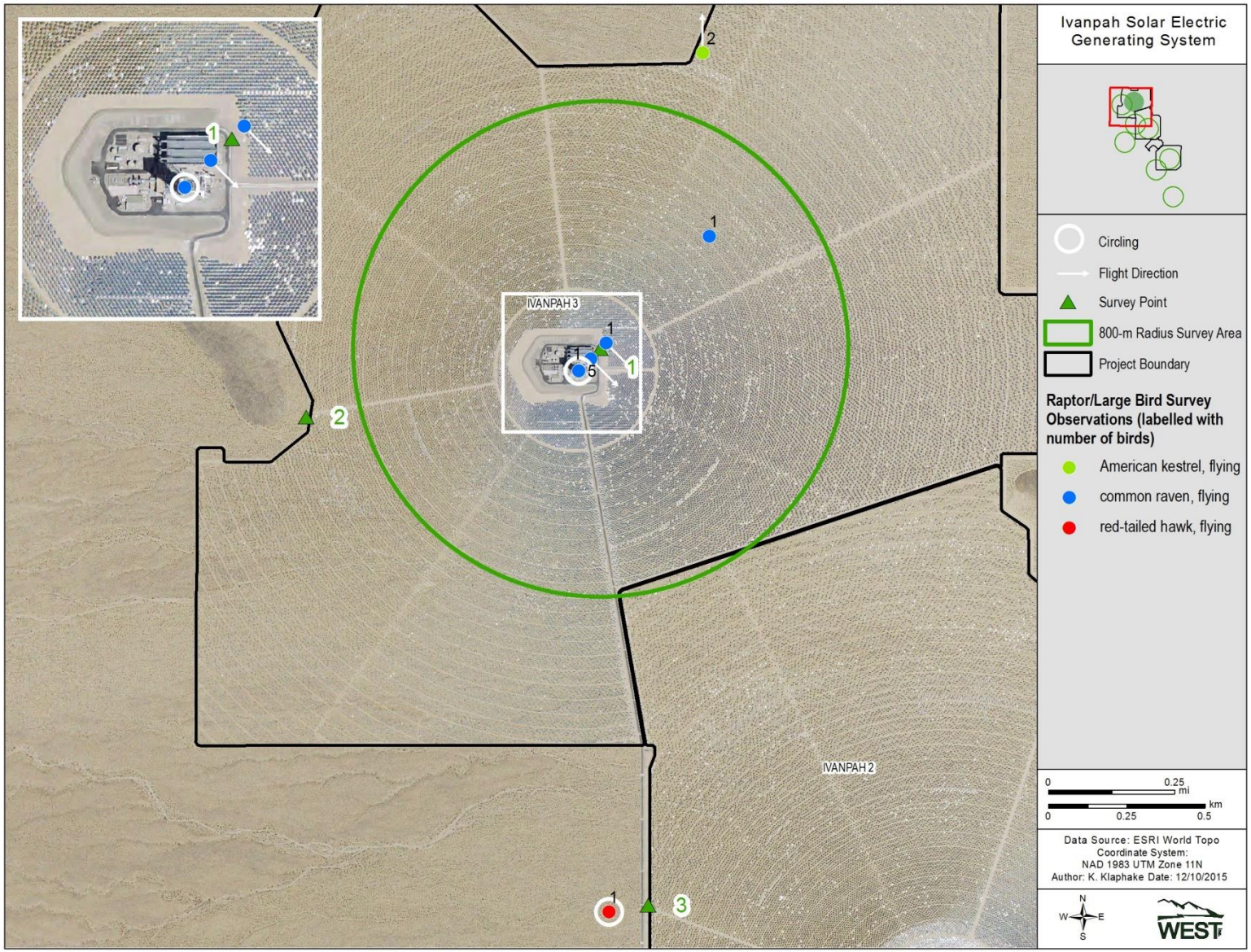

Figure 8. Raptor/Large Bird Survey Observations from Survey Point 1, 2015 Summer.

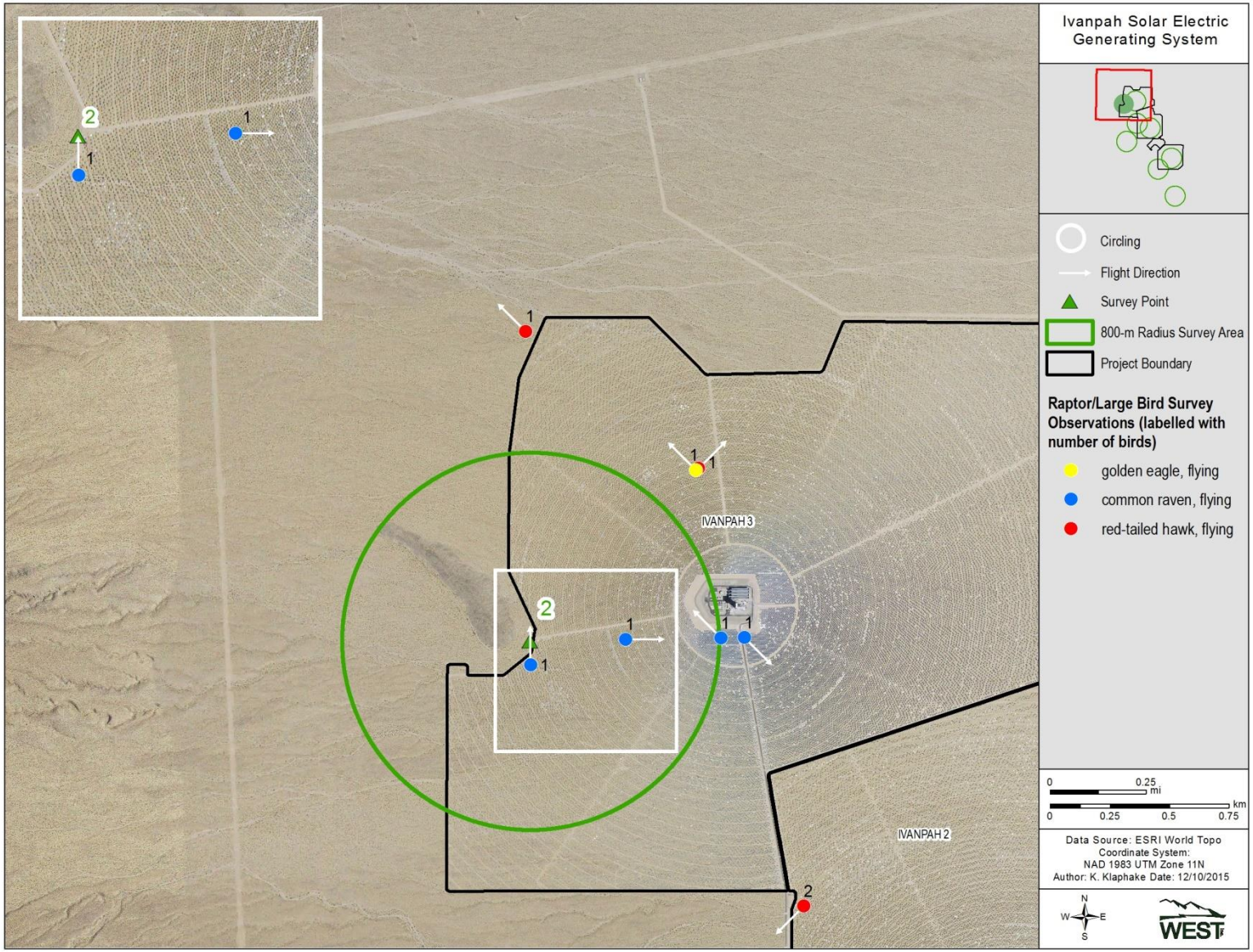

Figure 9. Raptor/Large Bird Survey Observations from Survey Point 2, 2015 Summer.

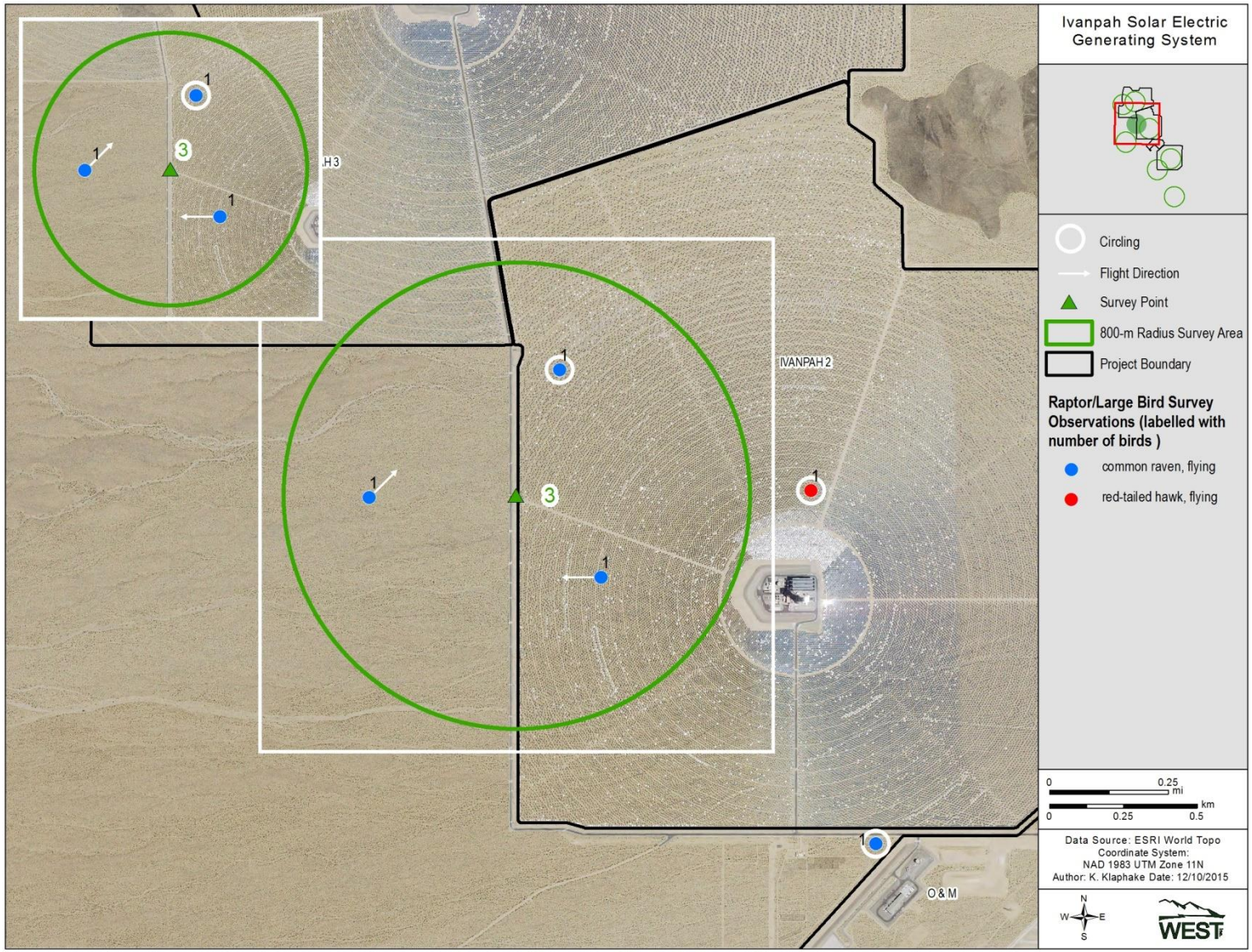

Figure 10. Raptor/Large Bird Survey Observations from Survey Point 3, 2015 Summer.

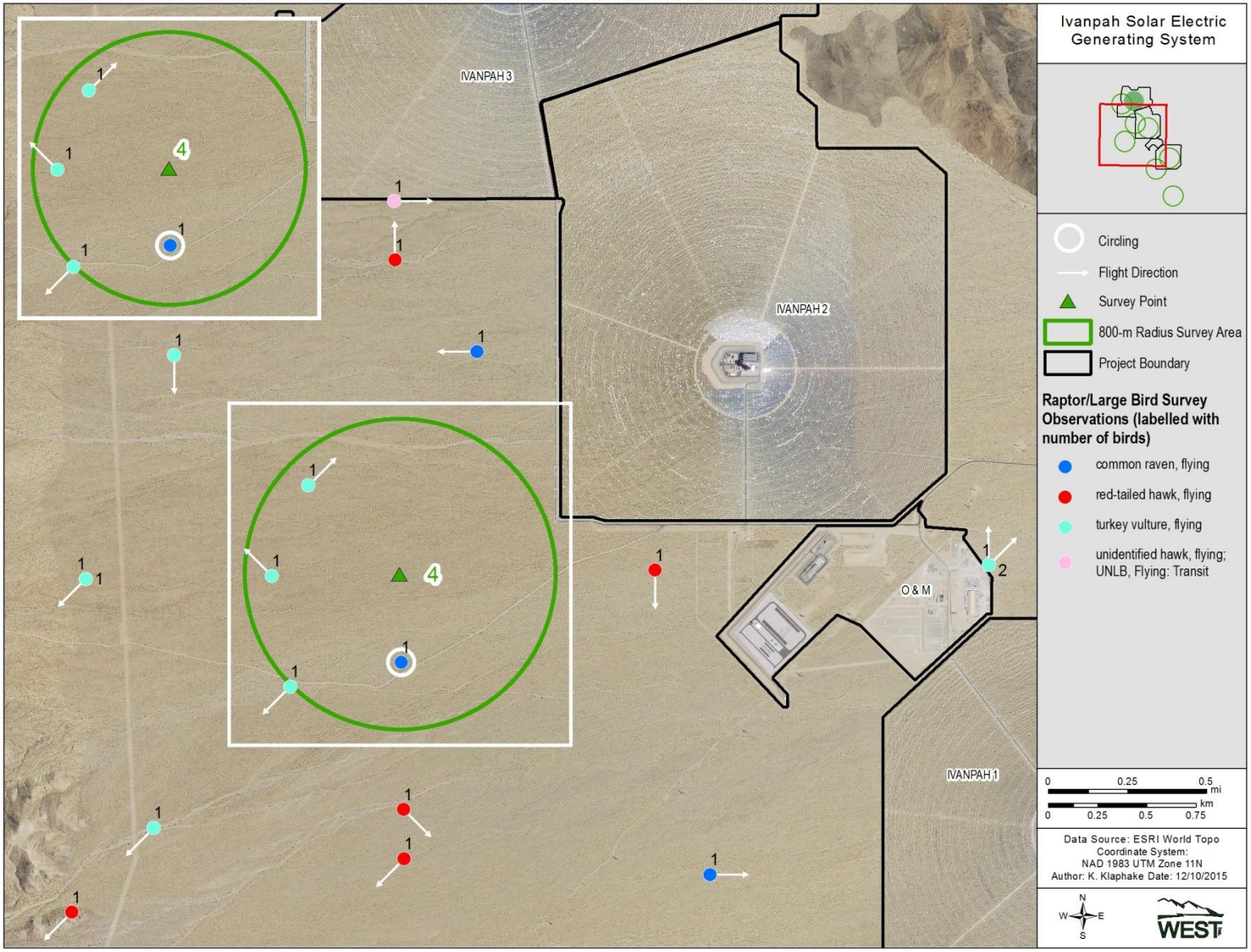

Figure 11. Raptor/Large Bird Survey Observations from Survey Point 4, 2015 Summer.

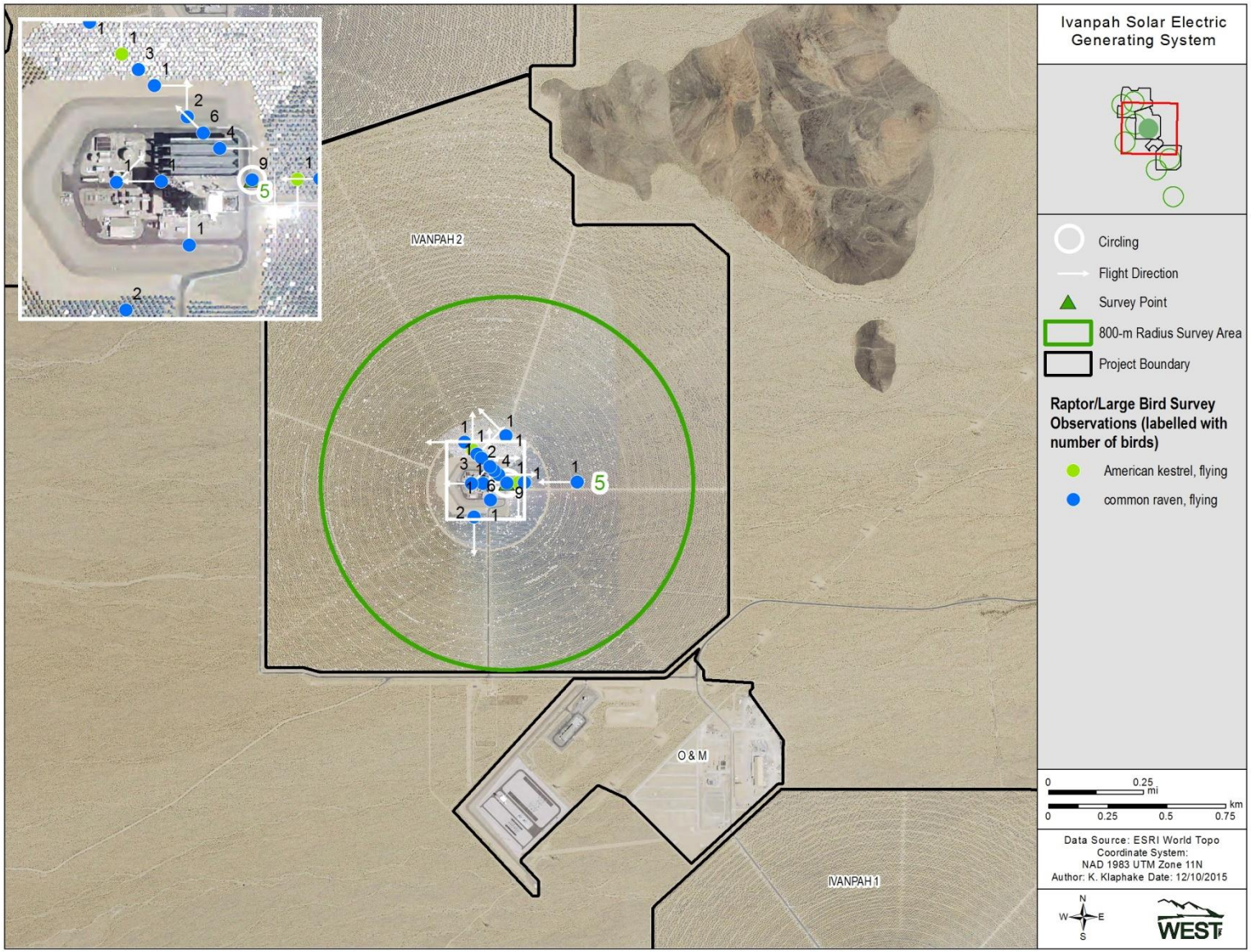

Figure 12. Raptor/Large Bird Survey Observations from Survey Point 5, 2015 Summer.

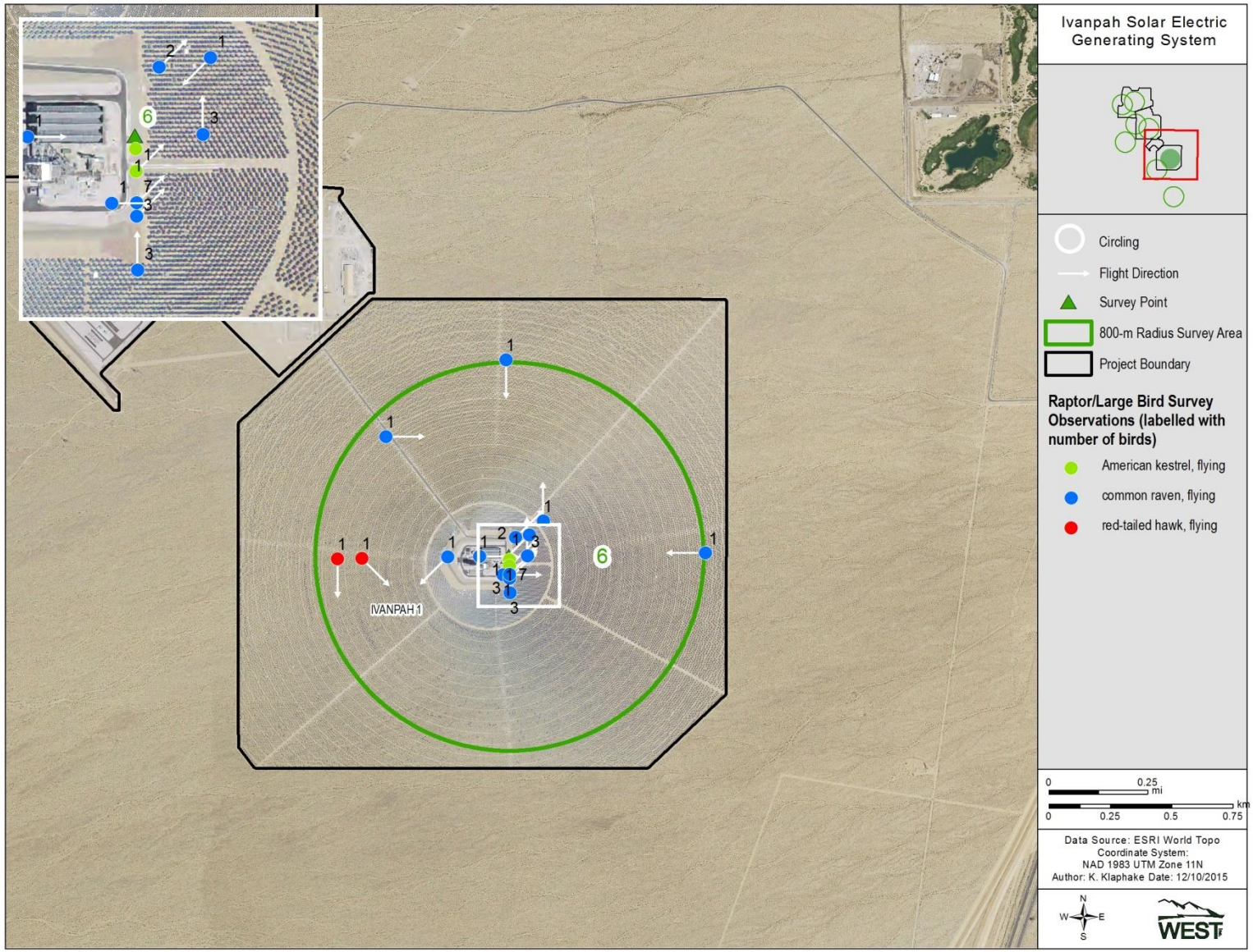

Figure 13. Raptor/Large Bird Survey Observations from Survey Point 6, 2015 Summer.

Figure 14. Raptor/Large Bird Survey Observations from Survey Point 7, 2015 Summer.

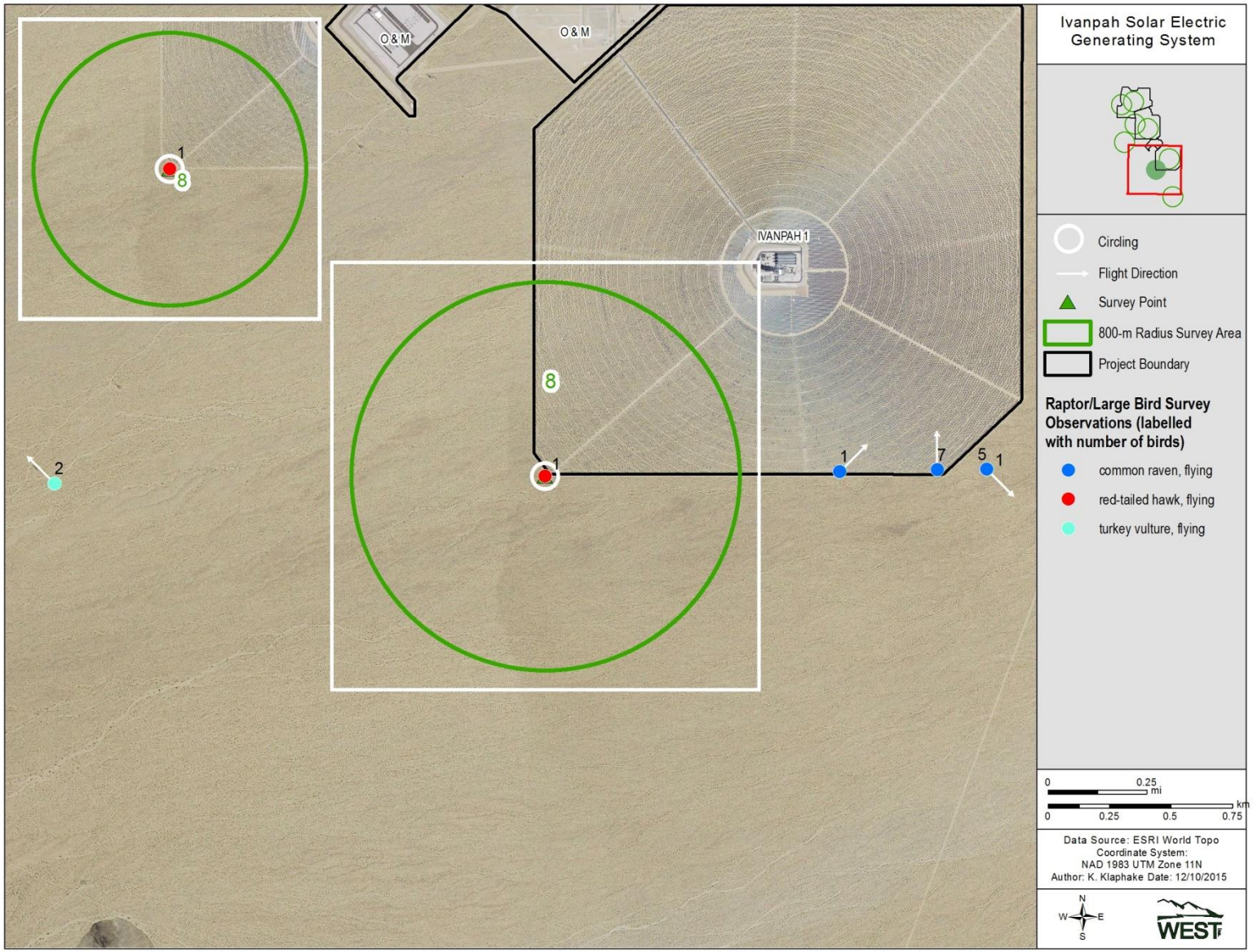

Figure 15. Raptor/Large Bird Survey Observations from Survey Point 8, Summer 2015.

Section 4.0 Monitoring Results

4.1 Summary of Avian Detections

The average search interval was 21.6 days (range 18 to 25, median 21 days) during the 2015 summer season for the three solar units. Variation in search interval was anticipated to occur due to the transition from a 7-day search interval to a 21-day search interval between seasons of differing length, and delayed searches due to site conditions or holidays. During the 2015 summer season, a total of 112 avian detections (including injured birds and incidentals), including 35 identified species (Table 8) were recorded. Approximately 53% of detections were small passerines, while 47.3% of detections were identifiable as non-passerine. Of all detections, 9.8% were unable to be identified to a species level. The most numerous detection of an identified species was greater roadrunner followed by black-throated sparrow.

Table 8. Number of Individual Bird Detections, by Species, 2015 summer season.

Common Name	Scientific Name	Injuries	Fatalities	Small passerine?
greater roadrunner	*Geococcyx californianus*	0	15	No
black-throated sparrow	*Amphispiza bilineata*	0	11	Yes
mourning dove	*Zenaida macroura*	0	9	No
cliff swallow	*Petrochelidon pyrrhonota*	0	6	Yes
unidentified swallow		0	5	Yes
northern rough-winged swallow	*Stelgidopteryx serripennis*	0	5	Yes
lesser nighthawk	*Chordeiles acutipennis*	2	4	No
house finch	*Haemorhous mexicanus*	1	4	Yes
tree swallow	*Tachycineta bicolor*	0	4	Yes
American kestrel	*Falco sparverius*	0	4	No
unidentified hummingbird		0	4	No
horned lark	*Eremophila alpestris*	0	3	Yes
loggerhead shrike	*Lanius ludovicianus*	0	3	Yes
Costa's hummingbird	*Calypte costae*	0	3	No
common raven	*Corvus corax*	0	2	No
unidentified passerine		0	2	Yes
Wilson's warbler	*Cardellina pusilla*	1	2	Yes
western tanager	*Piranga ludoviciana*	0	2	Yes
Anna's hummingbird	*Calypte anna*	0	2	No
rufous hummingbird	*Selasphorus rufus*	0	2	No
unidentified bird (small)		0	2	No
verdin	*Auriparus flaviceps*	0	1	Yes
cactus wren	*Campylorhynchus brunneicapillus*	0	1	Yes
brown-headed cowbird	*Molothrus ater*	0	1	Yes

Common Name	Scientific Name	Injuries	Fatalities	Small passerine?
ash-throated flycatcher	*Myiarchus cinerascens*	0	1	Yes
Lucy's warbler	*Oreothlypis luciae*	0	1	Yes
black-tailed gnatcatcher	*Polioptila melanura*	0	1	Yes
hermit warbler	*Setophaga occidentalis*	0	1	Yes
yellow warbler	*Setophaga petechia*	0	1	Yes
violet-green swallow	*Tachycineta thalassina*	0	1	Yes
white-crowned sparrow	*Zonotrichia leucophrys*	0	1	Yes
American coot	*Fulica americana*	0	1	No
red-tailed hawk	*Buteo jamaicensis*	1	0	No
peregrine falcon	*Falco peregrinus*	1	0	No
blue-winged teal	*Anas discors*	1	0	No
Total		7	105	NA*

*NA – Not Applicable

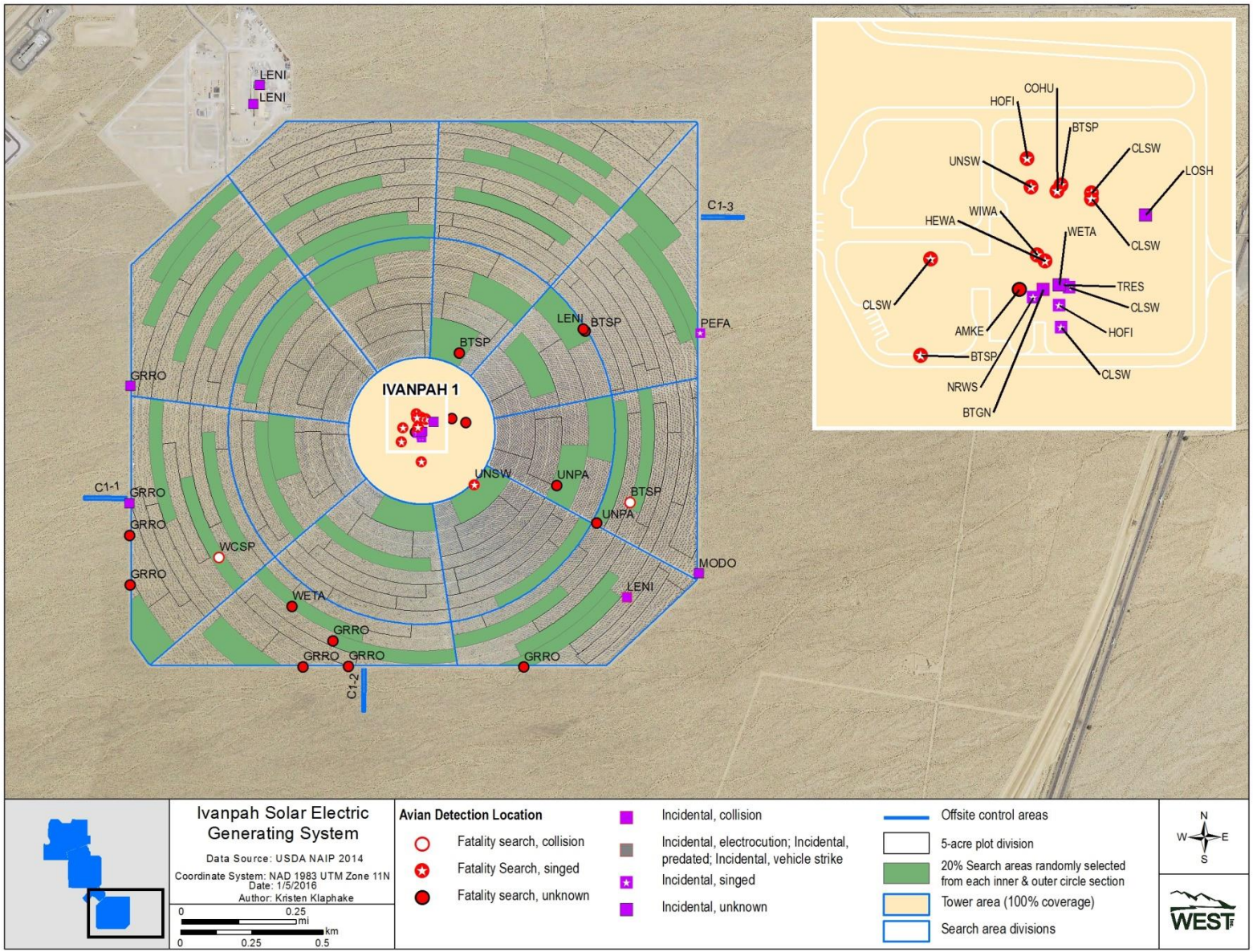

Figure 16. Ivanpah 1 Detections.

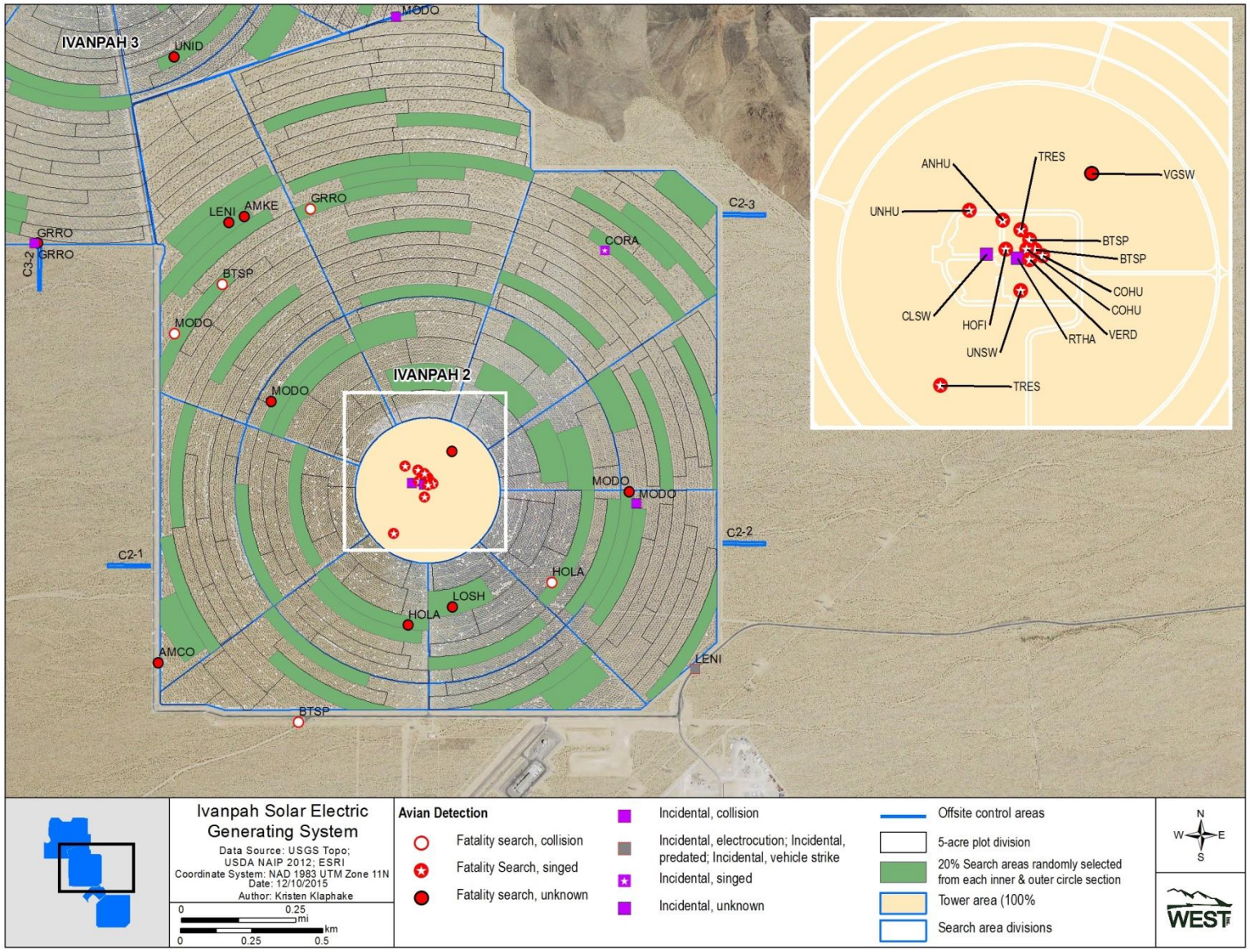

Figure 17. Ivanpah 2 Detections.

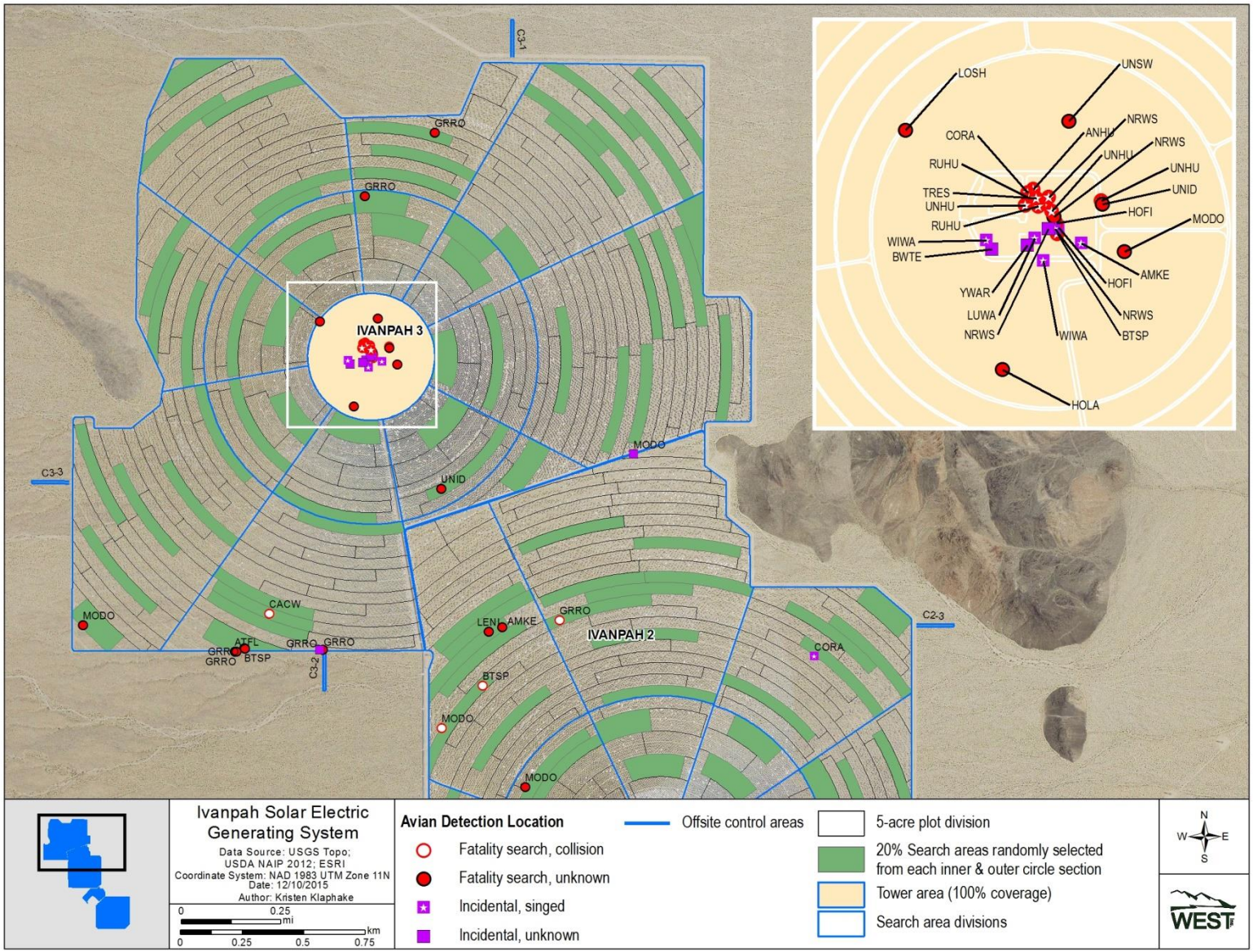

Figure 18. Ivanpah 3 Detections.

4.1.1 Temporal Patterns of Avian Detections

The number of detections reported per day varied during the 2015 summer season (Figure 19). The period from 25 May through 27 June was characterized by few detections per day with a high of 7 detections on one day during this period. The period from 28 June through 17 August 2015 was characterized by one peak in detections with a high of 9 detections on 28 July 2015. The number of detections per day represents the accumulation of detections over the search interval minus those detected incidentally and removed between searches. Thus, to better understand if search interval or the area that was searched influences the number of detections reported per day, the tower area and heliostat area were examined separately (Figure 19). Peaks in the number of detections per day were associated with tower area searches. In other words, peaks in detections depended on the day a tower area was searched, and based on the 21-day search interval the long elapsed time between searches resulted in 10 or more detections on four days.

BirdCast began monitoring fall migration on 14 August 2015 and the last standardized survey of the summer season was on 17 August 2015. Thus, comparison of BirdCast results and detections per day are not discussed.

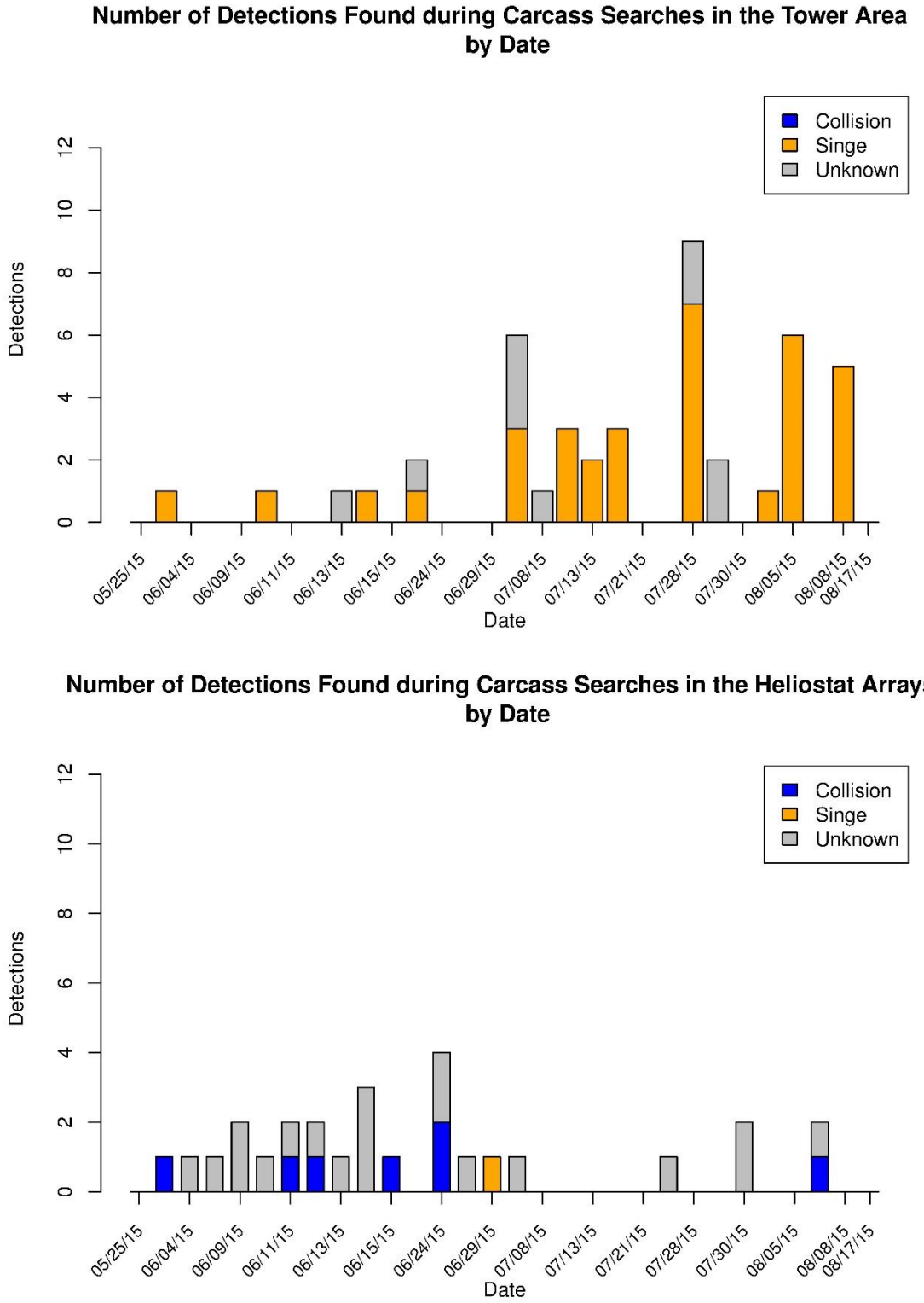

Figure 19. Number of Detections on Each Survey Date, 25 May – 17 August 2015.

4.1.2 Summary of Injured Birds

Seven injured birds were detected during the 2015 summer season (Table 9). Two of the injured birds were released alive off-site and one was released alive on-site. Three of the injured birds died on site and one was transported to the Ojai Raptor Center on 22 July 2015, where it was subsequently euthanized on 6 September 2015.

Table 9. Avian Injuries Detected 25 May – 17 August 2015.

Date	Species	Age	Sex	Suspected Cause of Injury	Flux Grade*	Fate
6/28/2015	red-tailed hawk	Juvenile	Unknown	Unknown	NA	Released off site
7/21/2015	lesser nighthawk	Juvenile	Female	Collision	NA	Released on site
7/22/2015	peregrine falcon	Adult	Unknown	Singed	2/3	Euthanized at rehab on 9/6/15
7/29/2015	house finch	Unknown	Unknown	Singed	2/3	Died on site
7/29/2015	lesser nighthawk	Adult	Male	Unknown	NA	Died on site
8/12/2015	blue-winged teal	Unknown	Unknown	Unknown	NA	Released off site
8/12/2015	Wilson's warbler	Adult	Male	Singed	2/3	Died on site

* See section 2.2.1.3 for a description of flux grade. NA = not applicable as there is no evidence of singeing.

4.1.3 Comparison of Avian Use Survey Results to Fatality Detections

There were 29 bird species were recorded during avian use surveys, and there were 31 identifiable species were recorded as detections during fatality monitoring. Comparison of the most frequently observed species on the avian use surveys at the heliostats to the species most frequently recorded as detections did not show a clear pattern of association. Of identified species, the most frequently observed species during avian use counts differed between the heliostat area and desert area, with few exceptions. Black-throated sparrow, rock pigeon and horned lark were the most frequently observed species in the heliostat area, while black-throated sparrow, cactus wren and Le Conte's thrasher were the most frequently observed in the desert area (Table 10). The most common species observed in the heliostat area, black-throated sparrow, accounted for 11.1% of detections; the second and third most common species in the heliostat area accounted for 3% of detections. In the desert bajada survey areas, black-throated sparrow was also the most common species, while the next two most common species observed at the desert bajada survey areas either accounted for less than 1.0% of detections (cactus wren) or were not recorded as detections (Le Conte's thrasher).

Table 10. Comparison of the Most Abundant Bird Species Recorded as Detections and Recorded During Avian Use Surveys for Identified Species Only.

Detections		Avian Use Survey - Heliostats		Avian Use Survey - Desert	
Species	Percent of Total	Species	Percent of Total	Species	Percent of Total
greater roadrunner	15.2	black-throated sparrow	26.9	black-throated sparrow	42.1
black-throated sparrow	11.1	rock pigeon	17.6	cactus wren	21.7
mourning dove	9.1	horned lark	15.1	Le Conte's thrasher	7.8
cliff swallow	6.1	cactus wren	10.1	loggerhead shrike	5
northern rough-winged swallow	5.1	common raven	8.4	black-tailed gnatcatcher	4.5
lesser nighthawk	6.1	loggerhead shrike	8.4	ash-throated flycatcher	3.2
house finch	5.1	house finch	6.7	Bewick's wren	3.2
tree swallow	4	tree swallow	2.5	Gambel's quail	2.2
American kestrel	4	American avocet	0.8	verdin	2
horned lark	3	American kestrel	0.8	blue-gray gnatcatcher	1.9
loggerhead shrike	3	ash-throated flycatcher	0.8	crissal thrasher	1.5
Costa's hummingbird	3	greater yellowlegs	0.8	house finch	0.7
common raven	2	mourning dove	0.8	California quail	0.6

4.1.4 Summary of Bat Detections

No bats were detected during fatality searches or incidentally during the 2015 summer season.

4.2 Locations of Avian Detections

4.2.1 Detections by Project Area

During 2015 summer season, of the 112 total detections, 61 detections (54.5%) were recorded at the tower area, 31 detections (27.7%) were recorded over the much larger heliostat area, 14 (12.5%) detections were recorded at the perimeter fence, 5 detections were recorded outside of the survey areas on other project lands (4.5%), and 1 detection was recorded within the survey area associated with the collector line (0.9%; Table 11). No detections were recorded in the offsite transects.

Table 11. Locations of Bird Detections, 25 May – 17 August 2015.

Location	Carcasses	Injuries	Percent of Total
Tower Area	57	4	54.5%
Heliostat Area	30	1	27.7%
Fenceline	13	1	12.5%
Collector Line	1	0	0.9%
Other Project Lands	4	1	4.5%
Total	105	7	

Table 12. Locations of Bird Detections by Cause, 25 May – 17 August 2015.

Location	Singeing	Collision	Other – Vehicle Strike	Unknown	Total
Tower Area	45	1	0	16	62
Heliostat Area	2	8	0	21	31
Fenceline	1	0	0	13	14
Collector Line	0	1	0	0	1
Other Project Lands	0	0	1	3	4
Total	48	10	1	53	112

4.3 Cause of Injury or Fatality

The following section describes the number of detections with evidence of singeing or collision; the number from other known causes; the number for which cause of injury or fatality is unknown; and the spatial distributions of detections with these causes. Figure 20 shows the distribution of detections by cause.

4.3.1 Singeing Effects

Of the 112 avian detections during the 2015 summer season, 48 detections (42.9%) showed signs of singed feather damage, and 93.8% of singed detections were recorded in the tower area (Table 12). Two singed detections were found in the heliostat area, and one singed detection was found at the fenceline.

4.3.2 Collisions

Of the 112 avian detections, evidence of collision was observed in the case of 10 (8.9%), and collision detections were found in the tower area, heliostat area, and under the collector line, with 80.0% located in the heliostat area. As described in Section 2.2.1.3, the evidence that was used to classify these detections as collisions was obvious physical trauma, proximity to heliostats that had smudge marks, body imprints, and/or feathers on or near the surface of the mirror (although birds that collide with structures do not always leave visible evidence).

4.3.3 Other Known Causes

One avian detection (less than 1.0% of all detections) without evidence of singeing or collision effects was determined to have been struck by a vehicle. A lesser nighthawk was found on Colosseum Road, intact, with trauma suggesting an impact trauma. There were no signs of singeing.

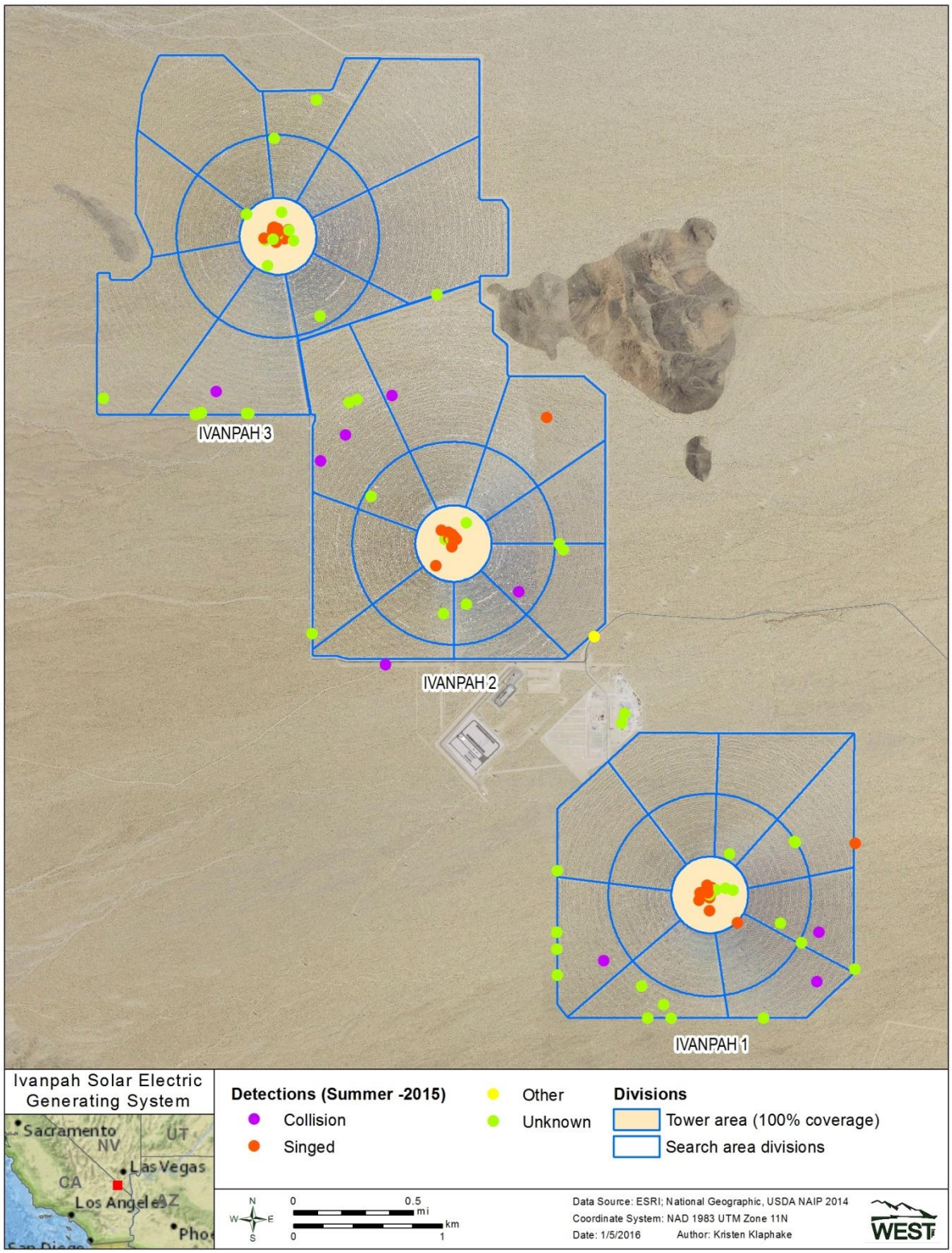

Figure 20. Locations of Singed and Unsinged Detections within Solar Units.

4.3.4 Detections of Unknown Cause

Of the 112 avian detections, evidence of singeing, collision, or other cause could not be assigned for 53 detections (47.3%; Table 12). Per the Plan section 2.1, these detections cannot be presumed without a reasonable doubt to be caused by the facility; see Section 6.2 of this report for further discussion. Of the unknown cause detections, 21 (39.6%) were recorded in the heliostat area; 16 (30.2%) were recorded in the tower area, 13 (24.5%) were found at the fenceline, and 3 (5.6%) were found at other project lands. Unknown cause detections showed no external evidence of collision effects, and microscopic analysis did not indicate signs of singeing.

4.4 Types of Detections

Forty-one of the 112 detections (36.6%) consisted only of feather spots (Table 13a). Of the total detections located at the fenceline, 78.6% were feather spots, and feather spots accounted for 64.8% of total detections at the inner and outer heliostats areas. The percentage of feather spot detections was lower in the tower area (16.4%), and at the collector line (0%). Evidence of singeing was noted through direct and microscopic examination on 3 of these 41 feather spots; evidence of collision (i.e., an impact imprint on a nearby mirror) was noted in the case of 3 other feather spots. Otherwise, the causes of the feather spots for the other 35 detections are unknown (Table 13b).

Table 13a. Percent Composition Feather Spots to Carcasses Relative to Site Locations.

Location	Carcasses	Feather Spot	Total	Percent Feather Spot*
Tower Area	51	10	61	16.4%
Heliostat Area	11	20	31	64.8%
Fenceline	3	11	14	78.6%
Collector Line	1	0	1	0%
Other Project Lands	5	0	5	0%
Total	71	41	112	36.6%

*Total percent feather spot is total feather spots divided by total detections.

Table 13b. Percent Composition Feather Spots to Carcasses Relative to Cause.

Cause	Carcasses	Feather Spots	Total Detections	Percent Feather Spot*
Collision	7	3	10	30%
Singed	45	3	48	6.2%
Other – vehicle strike	1	0	1	0%
Unknown	18	35	53	66%
Total	71	41	112	36.6%

*Total percent feather spot is total feather spots divided by total detections.

Section 5.0 Fatality Estimation

This section utilizes the detection data as described in Section 4 to develop an overall fatality estimate in accordance with the Plan. The total estimate for the entire facility is presented separately for fatalities with evidence of singeing or collision effects, or for detections in the ACC buildings, and fatalities of unknown cause. Following presentation of the total fatality estimates, estimates are provided separately for the tower area, heliostat area, and fenceline.

5.1 Estimating Model Parameters

5.1.1 Carcass persistence Trials

A total of 48 carcass persistence trials were conducted during the 2015 summer monitoring season and were used to model carcass persistence time. The trials included 33 small birds and 15 large birds distributed throughout the facility. Consistent with previous seasons, scavengers included common ravens (*Corvus corax*, N = 28), desert kit fox (*Vulpes macrotis*; N=15), white-tailed antelope squirrels (*Ammospermophilus leucurus*; N=3), greater roadrunner (*Geococcyx californianus*; N=7), desert woodrat (N=1), and ants (N=1). Carcass persistence ranged from less than one day in the case of 16 small carcasses, to the full six-week trial length in the case of 13 large bird carcasses and 1 small bird carcasses (Figures 21 and 22).

Carcass persistence data from 87 trials performed during the first year of monitoring (29 October 2013 – 20 October 2014), and 47 trials performed during the 2015 spring season, were also used to model carcass persistence time. The trials from the first year of monitoring included 30 large bird carcasses and 57 small bird carcasses. Carcasses were placed at the power block and inner HD heliostats of the tower area and inner and outer heliostat segments of the heliostat area, along the fenceline, under the collector line, and on offsite transects. Scavenger species included common ravens (N=22), desert kit fox (*Vulpes macrotis*; N=15), white-tailed antelope squirrels (*Ammospermophilus leucurus*; N=11), greater roadrunner (*Geococcyx californianus*; N=1), turkey vulture (N=1), and an unidentified canid (N=1). For the remaining 27 scavenged carcasses (six carcasses were not scavenged), the scavenger species was not captured on camera. Details on the 47 trials (15 large birds and 32 small birds) performed during the 2015 spring season can be found in the 2015 spring report (WEST, Inc. 2015a).

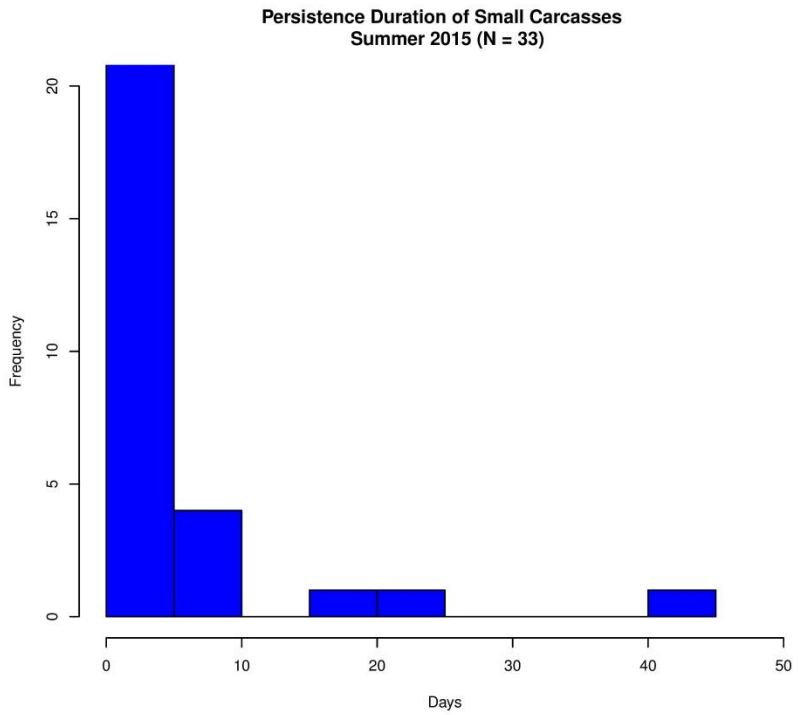

Figure 21. Persistence Durations for Small Carcasses Placed for Carcass Persistence Trials.

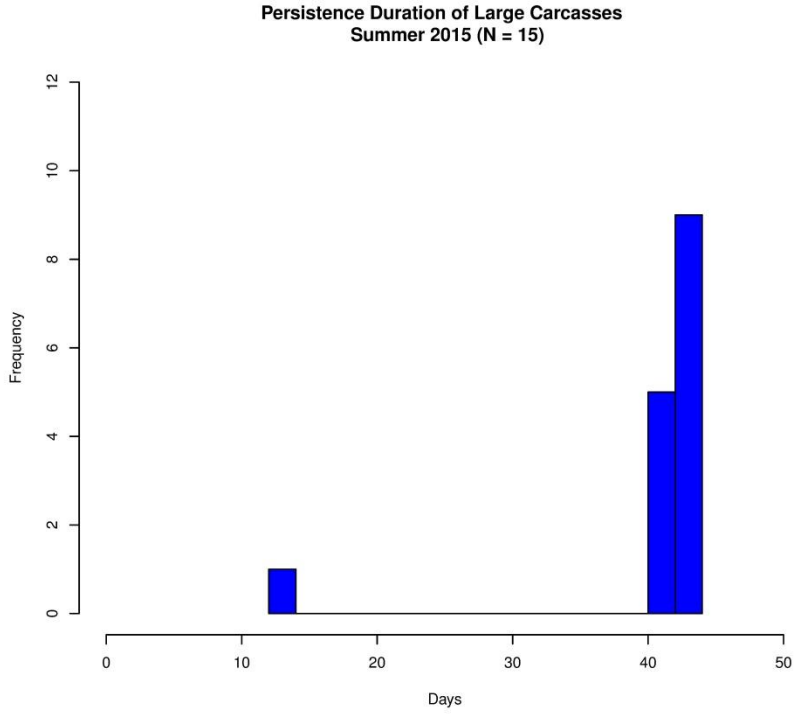

Figure 22. Persistence Durations for Large Carcasses Placed for Carcass Persistence Trials.

5.1.2 Model Selection for Carcass Persistence Distribution

The cumulative dataset, with six seasons of data suggests that the removal process for small birds and large birds is markedly different. Therefore, in contrast to the first year of reporting, two separate carcass persistence models were fit to this dataset: one for small birds and one for large birds. Specifically, large birds consistently persist for long periods of time (typically greater than six weeks), while small birds tend to be removed with days or hours, and exhibit seasonal variability. Fitting separate models by size allows for more flexibility, enabling different distributions with different shapes to be fit to the small bird and large bird data, respectively.

Based on the carcass persistence data pooled from 2015 spring and summer, and the first year of study, 16 survival models were compared for the small bird and large bird datasets, respectively. Models were compared for relative explanatory power using the corrected Akaike information criterion (AICc) score (Akaike 1973), as suggested in Huso (2010). AICc provides a relative measure of model fit and parsimony among a selection of candidate models. Season was considered as a possible covariate due to cyclical variation in scavenging pressure and environmental conditions associated with seasons. Year was also incorporated as a covariate to assess whether respective seasons could be pooled across the first two years (i.e. combine 2014 summer with 2015 summer persistence trial results). To achieve the necessary sample size, 2013-2014 winter and 2014 spring carcass persistence trials were pooled for the purposes of carcass persistence modeling. At the conclusion of the first year of monitoring, the location of a carcass (unvegetated tower area or the vegetated heliostat area, along fence line, and under collector line) was not present in the top models for carcass persistence (H.T. Harvey and Associates 2015b). Thus, carcass location was not included as a covariate for this report.

The model with lowest AICc is typically chosen as the "best-fit" model relative to other models tested; however, any model within two AICc point of the best model is considered strongly supported (Burnham and Anderson 2004). For small birds the loglogistic and lognormal, models that included season, had ΔAICc values ≤ 2; for large birds, the exponential, Weibull, loglogistic, and lognormal models with intercept only, and the exponential model with a seasons covariate had ΔAICc values ≤ 2 (Tables 14a, b). Ultimately, a loglogistic model with a season covariate was chosen for small birds, and an exponential model with no covariates was chosen for large birds. Thus, the selected model for small birds can be interpreted to use data from both 2014 and 2015 summer to estimate persistence probability. For large birds, the top model does not have any temporal covariates, and thus uses all large bird data collected to date to estimate persistence probability. The chosen models predicted 18.7% of small carcasses persisted for a standard 21-day search interval in 2015 summer; and 96.5% of large bird carcasses persisted for a standard 21 day search interval.

Table 14a. AICc Values for Small Bird Carcass Persistence Models

Small Bird Trials			
Covariates	Distribution	AICc	Δ AICc
Season	loglogistic	609.24	0
Season	lognormal	609.57	0.33
Year + Season	loglogistic	611.23	1.99
Year + Season	lognormal	611.75	2.51
Season	weibull	615.83	6.59
Intercept Only	lognormal	617.7	8.46
Year + Season	weibull	618.05	8.81
Intercept Only	loglogistic	618.1	8.86
Year + Season + Year*Season	loglogistic	618.11	8.87
Year + Season + Year*Season	lognormal	618.63	9.39
Year + Season + Year*Season	weibull	624.92	15.68
Intercept Only	weibull	626.71	17.47
Season	exponential	695.16	85.92
Year + Season	exponential	697.29	88.05
Year + Season + Year*Season	exponential	704.04	94.8
Intercept Only	exponential	726.68	117.44

Table 14b. AICc Values for Large Bird Carcass Persistence Models

Large Bird Trials			
Covariates	Distribution	AICc	Δ AICc
Intercept Only	exponential	97	0
Intercept Only	weibull	97.96	0.96
Intercept Only	loglogistic	98.03	1.03
Intercept Only	lognormal	98.15	1.15
Season	exponential	98.34	1.34
Season	weibull	99.62	2.62
Season	loglogistic	99.75	2.75
Season	lognormal	99.87	2.87
Year + Season	exponential	100.72	3.72
Year + Season	weibull	102.1	5.1
Year + Season	loglogistic	102.23	5.23
Year + Season	lognormal	102.35	5.35
Year + Season + Year*Season	exponential	108.43	11.43
Year + Season + Year*Season	weibull	110.11	13.11
Year + Season + Year*Season	loglogistic	110.24	13.24
Year + Season + Year*Season	lognormal	110.36	13.36

5.1.3 Searcher Efficiency Trials

During the 2015 summer monitoring season, a total of 71 searcher efficiency trials (27 small birds, 20 large birds, and 24 feather spots) were conducted. Of the 71 trial carcasses placed, 62 (22 small carcasses,

18 large carcasses, and 22 feather spots) were available to be found; 9 carcasses (5 small carcasses, 2 large carcass, and 2 feather spots) were removed from the trial location before searchers had an opportunity to detect the carcass.

An additional 179 searcher efficiency trials from the first year of study were included in searcher efficiency model building. Of 179 trials from the first year of monitoring, 168 were not removed and thus available to be found by a searcher. The top searcher efficiency models from the full first year of monitoring included size and project area (unvegetated tower area versus the vegetated heliostat area, along fence lines, and under collector line) covariates, but not season. Consistent with the findings of the first year of monitoring, season was not explicitly included as a covariate in candidate searcher efficiency models; however, due to personnel changes which occurred at the conclusion of the 2014 – 2015 winter season, it was necessary to measure potential differences in searcher efficiency between new personnel and original personnel. Therefore, a "year" covariate was included in candidate models to capture any differences between personnel groups.

The best model for searcher efficiency included project area (disaggregated to vegetated and unvegetated) and carcass size with an AICc value 1.94 points lower than the second best model, which included size, project area, and year (Table 15). Although the second best model was slightly less than 2 AICc point from the best model, the year covariate in that model was not significantly different from zero (*p-value = 0.72*). Thus, the most supported searcher efficiency model included covariates for project area (unvegetated tower area and vegetated heliostat area, along fence line, and under collector line) and carcass size. As a result, searcher efficiency rates were pooled across all seasons and personnel groups but were separated by project area (disaggregated to vegetated and unvegetated) and carcass size. Table 16 provides the searcher efficiency rates.

Overall searcher efficiency rates applied to 2015 summer detection data were higher in the unvegetated areas including the tower area. In unvegetated areas, searcher efficiency was 69% for small birds, 82% for large birds, and 62% for feather spots. In the vegetated heliostat area, offsite transects, fencelines, and collector line, searcher efficiency was 42% for small birds, 60% for large birds, and 35% for feather spots.

Table 15. Covariates, AICc Values, and ΔAICc values for Searcher Efficiency Models of Carcasses. Data consist of all searcher efficiency trials for carcasses from the initiation of trials through 17 August 2015.

Covariates	AICc	ΔAICc
Size + Project Area	405.79	0.00
Size + Project Area + Year	407.73	1.94
Size*Project Area	408.57	2.77
Size + Size*Project Area	408.57	2.77
Project Area + Size*Project Area	408.57	2.77
Size + Project Area + Size*Project Area	408.57	2.77
Year + Size*Project Area	410.49	4.70
Size + Year + Size*Project Area	410.49	4.70
Project Area + Year + Size*Project Area	410.49	4.70
Size + Project Area + Year + Size*Project Area	410.49	4.70
Project Area	414.24	8.45
Project Area + Year	416.27	10.48
Size	425.75	19.96
Size + Year	426.81	21.01
Intercept Only	433.17	27.38
Year	433.76	27.97

Table 16. Human Searcher Efficiency Values for Size and Project Area Categories, All Seasons.

Size	Project Area	Found	Available	Placed	Estimated Searcher Efficiency (90% CI)
Feather spot	Tower area (Unvegetated)	22	67	67	0.62 (0.53-0.71)
Large bird	Tower area (Unvegetated)	35	55	62	0.82 (0.75-0.89)
Small bird	Tower area (Unvegetated)	23	57	75	0.69 (0.60-0.77)
Feather spot	Heliostat area (Vegetated)	31	48	50	0.35 (0.26-0.43)
Large bird	Heliostat area (Vegetated)	30	39	40	0.60 (0.51-0.69)
Small bird	Heliostat area (Vegetated)	34	48	56	0.42 (0.33-0.52)

5.2 Fatality Estimates of Known Causes for 2015 summer Monitoring

Fatality estimates were calculated separately for the tower area (power block and inner HD heliostats), heliostat area, collector line, and fencelines (unit perimeter and CLA fences). Note that estimates are not provided for factor combinations with five or fewer detections; thus, marginal totals (e.g. total singed, total known cause in the heliostat area, etc.) for the tables below may not reflect the sum of estimates within a given row or column (and are generally higher). For example, no estimate is provided for collision-related mortality in the tower area, because there were 5 or fewer collisions attributed detections (i.e. "N ≤ 5"). However, the total tower area estimate is greater than the estimate for singed fatalities in the tower area because the collision-related detections are included when estimating the *total* known cause fatalities (see Table 18).

5.3.1 Total Fatality Estimates for Known Causes

There were 59 bird detections where the cause of death or injury could be determined and were facility related, of which 47 were included in the fatality estimate model (Tables 17a and 17b); of these 47 detections, 19 were from the ACC. Detections within the ACC were added unadjusted to the estimator output to produce the total fatality estimate of known cause (Table 18, 19). There were 12 detections showing evidence of singeing, collision, or vehicle strike that were not included in the fatality estimates. Four detections were excluded because they were outside the standardized survey areas (three discovered incidentally in the tower area that are not part of the standard search pattern) and 8 were excluded because they were determined to be older than the search interval.

Table 17a. Number of Bird Detections Based on Known Causes in Each Project Element Included or Excluded from Fatality Estimates, by Cause.

	Included		Excluded			
Location	Collision	Singed	Collision	Singed	Other (Vehicle Strike)	Total
Tower Area	1	36	0	9	0	46
Heliostat Area	6	2	2	0	0	10
Fenceline	0	1	0	0	0	1
Collector Line	1	0	0	0	0	1
Other Project Lands	0	0	0	0	1	1
Total	8	39	2	9	1	59

Table 17b. Number of Bird Detections Based on Known Causes in Each Project Element Included or Excluded from Fatality Estimates, by Carcass Size.

	Included			Excluded			
Location	Large Birds	Small Birds	Raptors*	Large Birds	Small Birds	Raptors*	Total
Tower Area	1	36	0	0	8	1	46
Heliostat Area	3	5	0	0	2	0	10
Fenceline	0	0	1	0	0	0	1
Collector Line	0	1	0	0	0	0	1
Other Project Lands	0	0	0	0	1	0	1
Total	4	42	1	0	11	1	59

* All raptors are considered "Large Birds"

During the period 25 May – 17 August 2015 (101 days of monitoring), there were an estimated 454 fatalities (90% confidence interval 260-757) based on detections from known causes (i.e., singeing or collision, Table 19). Of these, 303 fatalities (66.7%) were estimated for the 2,991-acre heliostat area and 135 fatalities (29.7%) were estimated for the 154-acre tower area. Only one detection of known cause was found at the collector line and fenceline, respectively; therefore no estimates are provided for the collector line or fenceline.

Table 18. 2015 summer Season Avian Fatality Estimates by Cause and Project Element (with 90% Confidence Interval) Based on Detections of Known Causes Included in the Model.

Location	Collision	Singed	Total Estimate by Location†
Tower Area	N ≤ 5	133 (105-181)	135 (107-183)
Heliostat Area	246 (78-489)	N ≤ 5	303 (118-581)
Fenceline	0	N ≤ 5	N ≤ 5
Collector Line	N ≤ 5	0	N ≤ 5
Total Estimate by Cause†	262 (93-509)	190 (119-314)	454 (260-757)

* N ≤ 5 indicates that fewer than 5 detections and no fatality estimate is provided

† Rows and columns may not sum to estimated totals since estimates are not provided when 5 or fewer detections are recorded in a fatality category; however, detections from these categories *are included* in the total estimates.

Table 19. 2015 summer Season Avian Fatality Estimates by Carcass Size and Project Element (with 90% Confidence Interval) Based on Detections of Known Causes Included in the Model.

Location	Large Birds	Small Birds	Raptors	Total Estimate by Location†
Tower Area	N ≤ 5	133 (106-182)	0	135 (107-183)
Heliostat Area	N ≤ 5	271 (87-541)	0	303 (118-581)
Fenceline	0	0	N ≤ 5	N ≤ 5
Collector Line	0	N ≤ 5	0	N ≤ 5
Total Estimate by Size†	N ≤ 5	418 (220-717)	N ≤ 5	454 (260-757)

* N ≤ 5 indicates that fewer than 5 detections and no fatality estimate is provided

† Rows and columns may not sum to estimated totals since estimates are not provided when 5 or fewer detections are recorded in a fatality category; however, detections from these categories *are included* in the total estimates.

5.3.2 Fatality Estimate for Tower Area

Tables 18 and 19 present the fatality estimates for known causes within the tower area, broken down by cause or carcass size, respectively. A subset of the incidental detections in the power block were included within the tower area total estimate, due to the assumption of a daily search interval; those incidental detections in the power block which were determined to be older than 24 hours were not included in the fatality estimator. Estimates from the tower area should be interpreted with caution due to the inclusion of numerous incidental discoveries in the power block.

5.3.4 Fatality Estimate for Fenceline

The perimeter fencelines for all units, as well as the CIA fence, were surveyed throughout the 2015 summer period. As there was only one detection in this area, an adjusted estimate is not provided.

5.3.5 Fatality Estimate for Unit 3 Collector Line (Overhead Lines)

The Unit 3 collector line was searched during the 2015 summer monitoring season. As there was only one detection in this area, an adjusted estimate is not provided..

5.4 Fatality Estimates from Unknown Causes

Per Section 3.1 of the Plan, fatality estimates are also to be provided based on detections of birds that were injured or that died of unknown causes. Because no observable evidence of known causes (e.g., singeing, collision, entrapment, or predation) was noted in the case of these unknown detections, they cannot be clearly included in an estimate attributed to a specific cause. The methods for determining fatality estimates for these unknown detections are the same as those described in Section 5.2 for detections with direct evidence of the cause of the fatality (i.e., singeing, collision, or other).

There were 53 detections where the cause of death could not be determined, of which 43 were included in the fatality estimator (Tables 20a and 20b). The 10 unknown detections that were excluded from the

estimator included 4 detections outside of survey areas, and 6 detections determined to be older than the search interval.

Table 20a Number of Detections from Unknown Causes in Each Project Element, and Number Included in Fatality Estimates, by Cause.

Location	Included	Excluded	Total
Tower Area	15	1	16
Heliostat Area	16	5	21
Fenceline	12	1	13
Collector Line	0	0	0
Other Project Lands	0	3	3
Total	43	10	53

Table 20b. Number of Detections from Unknown Causes in Each Project Element, and Number Included in Fatality Estimates, by Carcass Size.

	Included			Excluded			
Location	Large Birds	Small Birds	Raptors*	Large Birds	Small Birds	Raptors*	Total
Tower Area	3	9	3	0	1	0	16
Heliostat Area	4	11	1	5	0	0	21
Fenceline	11	1	0	1	0	0	13
Collector Line	0	0	0	0	0	0	0
Other Project Lands	0	0	0	0	3	0	3
Total	18	21	4	6	4	0	53

* All raptors are considered large birds

5.4.1 Total Fatality Estimates from Unknown Causes

During the period of 25 May – 17 August 2015, the total estimate of fatalities from unknown cause was 860 (90% confidence interval 498-1495; Table 21). A total of 62 (90% confidence interval 49-84) were attributed to the tower area, 752 (90% confidence interval 398-1373) in the heliostat area, and 46 (90% confidence interval 37-61) along fencelines. Five or fewer detections were recorded at the collector line, therefore no estimates are provided for this project component. Of the estimated unknown cause fatalities, small birds accounted for 88.8% of the estimated fatalities (Table 22).

Table 21. Site-Wide Fatality Estimates from Unknown Causes (with 90% Confidence Interval) by Location, 25 May – 17 August 2015.

Project Area	Estimate (90% CI)
Tower Area	62 (49-84)
Heliostat Area	752 (398-1373)
Fenceline	46 (37-61)
Collector Line	0
Total Estimate†	860 (498-1495)

* N ≤ 5 indicates that fewer than 5 detections and no fatality estimate is provided

† Rows and columns may not sum to estimated totals since estimates are not provided when 5 or fewer detections are recorded in a fatality category; however, detections from these categories *are included* in the total estimates.

Table 22. Site-Wide Fatality Estimates from Unknown Causes by Size (with 90% Confidence Interval) and Project Area, 25 May – 17 August 2015.

Location	Large Birds	Small Birds	Raptors	Total Estimate by Location†
Tower Area	9(8-10)	53 (41-76)	N ≤ 5	62 (49-84)
Heliostat Area	N ≤ 5	695 (348-1311)	N ≤ 5	752 (398-1373)
Fenceline	30 (25-39)	N ≤ 5	0	46 (37-61)
Collector line	0	0	0	0
Total Estimate by Size†	96 (58-147)	764 (410-1397)	N ≤ 5	860 (498-1495)

* N ≤ 5 indicates that fewer than 5 detections and no fatality estimate is provided

† Rows and columns may not sum to estimated totals since estimates are not provided when 5 or fewer detections are recorded in a fatality category; however, detections from these categories *are included* in the total estimates.

5.5 Golden Eagle Data Summary

Data related to golden eagle territory occupancy and reproductive success is being tracked by other entities, and such data, to the extent obtainable, is included in this report. As of 5 August 2015, new information has not been received regarding golden eagle monitoring efforts being performed near the Project. However, information for golden eagle activity data previously obtained is provided in the winter 2014 – 2015 winter report.

5.6 Regional Awareness Monitoring

As per the plan requirements, a communication protocol was implemented to monitor local veterinarians, game wardens, and wildlife rehabilitation facilities during facility operations to determine if significant new incidences of avian injury or fatality are reported to occur in the facility vicinity and region. During the 2015 summer season, a Project Designated Biologist contacted local wildlife rehabilitators who did not indicate an increase in avian fatalities or provide reports of receiving singed birds brought in by the public during the 2015 summer season.

Section 6.0 Discussion

The 2015 summer season represented the continuation of standardized monitoring of avian and bat detections and avian use of the Ivanpah site per the Avian & Bat Monitoring and Management Plan.

6.1 Temporal Patterns in Detections

The number of detections reported at the tower area was low throughout the summer period with a slight increase in late July. However, this increase is not likely associated with migration as BirdCast did not begin monitoring migration until 14 August, which is three days prior to the end of the 2015 summer season.

6.2 Spatial Patterns Detections and Fatality Estimates

The distribution of known cause detections varied by facility area. Of collision detections, 80% were located in the heliostat area consistent with the risk of the heliostats to birds. Of singed detections, 94% occurred in the tower area indicating that singed birds rarely transition outside of the tower area. Two of the three singed detections found outside of the tower area were feather spots that could have been moved away from the tower by scavengers. The remaining singed detection was of a live peregrine falcon, which could have moved away from the tower area to the fenceline. Unknown cause detections accounted for 47% of all detections during the 2015 summer season, and the distribution of the unknown cause detections varied by survey area with 70% occurring outside of the tower area, suggesting unknown cause detections were not associated with singed birds, as feather spots were closely examined for signs of singeing. Of the unknown cause detections, 66% were feather spots. Determining a cause of mortality from a feather spot is challenging because sources of mortality such as collision or predation would rarely leave visible evidence on the feathers as would flux effects. Thus, feather spots with an unknown cause of mortality could be encountered anywhere birds occur, and an unknown cause of mortality is not unique to the Project. Further, the large proportion of feather spots 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.

Section 7.0 Framework for Management and Risk Response

According to Section 5.3 of the Plan, migratory bird mortality at Ivanpah is categorized as high, medium, or low to provide an appropriate biological basis for TAC review and decision making, based on the following definitions:

1. "High: Estimated avian mortality or injury levels are facility-caused and likely to seriously and negatively affect local, regional, or national avian populations within a particular species or group of species."
2. "Medium: Estimated avian mortality or injury levels are facility-caused and have the potential to negatively affect local, regional, or national populations within a particular avian species or group of species."
3. "Low: Estimated avian mortality or injury levels that have minimal or no potential to negatively affect local, regional, or national populations within a particular species or group of species."

Only limited conclusions can be drawn from the 2015 summer season fatality data owing to the low numbers of detections within "a particular species or group of species"; however, the results indicate that the potential migratory bird mortality by species or groups of species from this project would be categorized as low. A more complete analysis will be conducted for the annual report. Approximately 53% of the detections were small passerines, and in general small passerines are short-lived, have high reproductive output, and their population growth rates are less sensitive to changes in survival rates than to changes in reproductive rates (Stahl and Oli 2006). Therefore, mortality of most small passerine species is expected to have negligible effects on population dynamics.

None of the 12 species represented by three or more detections is particularly rare locally, regionally, or nationally. Rather, all 12 species are relatively abundant and widespread in the western U.S. Thus, the magnitude of detections of these species at the Project during the 2015 summer season does not rise above the "low" category. Special-status species recorded as detections were 1 yellow warbler and 1 Lucy's warbler (both California species of special concern) and one peregrine falcon (California fully protected species, federal and state ESA delisted).

Yellow warblers are one of the most abundant warblers in North America and occur as both migrants and summer residents in California (Shuford and Gardali 2008). Yellow warblers occur in the Mojave Desert as common migrants, but they typically do not breed there. An estimated 600,000 yellow warblers occur within California and an estimated 34,000,000 occur in the United States (Partners in Flight Science Committee 2013). The single yellow warbler detected represents a very small proportion of these populations; thus, the estimated yellow warbler fatalities during the 2015 summer season does not rise above the "low" category, as loss of this magnitude would have a minimal effect on populations at all geographic scales (local, regional, national or global).

Lucy's warblers are one of the most abundant warblers in North America and occur as both migrants and summer residents in California (Shuford and Gardali 2008). Lucy's warblers breed in streamside vegetation or in vegetation near usually dry drainage areas primarily along the Colorado River in

California. An estimated 2,000,000 Lucy's warbler occur in the United States (Partners in Flight Science Committee 2013). As the Partners in Flight population estimates are developed from breeding bird survey (BBS) routes, some species that are not widespread or occur in areas that lack BBS routes might be underrepresented in the population database. Thus, no population estimate is provided Lucy's warbler in California, but Lucy's warbler is known to breed along the Colorado River. The single Lucy's warbler detected represents a very small proportion of the known population; thus, the estimated Lucy's warbler fatalities during the 2015 summer season does not rise above the "low" category, as loss of this magnitude would have a minimal effect on populations at all geographic scales (local, regional, national or global).

The peregrine falcon is a California fully protected species, and was federally delisted in 1999, (64 FR 46542–46558) and state delisted in 2009 (California Fish and Game Commission 2009). According to the USFWS Peregrine Falcon Fact Sheet, "In August 1999, the U.S. Fish and Wildlife Service removed the American peregrine falcon from the list of endangered and threatened species, marking one of the most dramatic successes of the Endangered Species Act" (USFWS 2006). According to the CDFW status review in 2008 that supported the state delisting, the peregrine falcon had recovered in California sufficiently to support delisting, finding that the breeding population size increased dramatically by 2008, as the threat by pesticides has been largely removed, though some hotspots remain (Comrack and Longdon 2008). Per the status review, the Project is not located in the breeding range (see Table 1 and Figure 1, Comrack and Longdon 2008). Currently, the CDFW California Natural Diversity Database (2015) ranks peregrine falcon in California as "G4T4 S3S4". G4 indicates that at the global level, the species is "Apparently Secure", which is defined as "Uncommon but not rare; some cause for long-term concern due to declines or other factors". T4 indicates that at the subspecies level, the global condition is also "Apparently Secure." The S3S4 designation means that at the state level, the species falls in between Vulnerable and Apparently Secure. It is unclear if the individual was from the Nevada or California population. Nationwide, results show that there are about 3,000 breeding pairs (Green et al. 2006). No separate peregrine falcon population estimate is provided in California. Regardless, the increasing population overall and a state ranking that rises to Apparently Secure indicate that the loss of one individual from the population is unlikely to affect the regional, national, or global population.

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Appendix A. Individual Avian Detections.

USFWS #	Common Name	Species Code	How Found	Detection Date	Collection Date	Condition	Time Since Death/Injury	Description of Carcass/Injury	Cause of Death/Injury	Burn Grade	Unit	UTM Coordinates	Nearest Project Feature	SPUT Revisions
2015_232_ISEGS	Mourning Dove	MODO	Incidental	5/28/2015	5/28/2015	Broken up	3-6 days	Broken up carcas with feather spot. Scavenged torso with wings found, piece of skull, flesh with attached leg. Aditionally, 7 rectrices and several body feathers found. No evidence of singeing or collision.	Unknown	NA	2	638542, 3937516	heliostat	NA
2015_233_ISEGS	Wilson's Warbler	WIWA	Incidental	5/28/2015	5/28/2015	Dead, fresh (eyes moist)	0-8 hours	Whole carcass found. Singe and curling found on contour feathers of rump, lower chest, right shoulder, right wing coverts, and few secondaries of right wing.	Scorched or singed	1,3	3	637465, 3937866	Powerblock	NA
2015_234_ISEGS	Horned Lark	HOLA	Carcass Survey	6/3/2015	6/3/2015	Mummified	1 month +	Whole carcass, found in proximity of heliostat. No evidence of singeing (checked under scope)	Collision with solar panel/heliostat	NA	2	639092, 3935523	Heliostat	Updated 'Description of Carcass/Injury', 'Suspected cause of injury/mortality': Collision, and 'Level of certainty for suspected cause': Probable (>50%). Updated 09/30/2015 CJM
2015_235_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	6/3/2015	6/3/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 weeks	Whole carcass found. Evidence of curling on all major flight feathers, singeing on crown of head, nape, and both flanks. Flux grade effect 2 & 3.	Scorched or singed	2,3	2	638574, 3935934	Powerblock	NA
2015_236_ISEGS	Mourning Dove	MODO	Carcass Survey	6/4/2015	6/4/2015	Broken up	3-6 days	Whole wing found. No evidence of singeing or collision.	Unknown	NA	2	638102, 3936161	Heliostat	Updated 'Disposition': Freezer on site. Updated 09/30/2015 CJM
2015_237_ISEGS	Mourning Dove	MODO	Carcass Survey	6/5/2015	6/5/2015	Broken up	3-6 days	Broken up with feather spot. Partial right wing consisting of mostly primaries and secondaries with 75 body feathers. No evidence of singeing or collision.	Unknown	NA	2	639365, 3935843	Heliostat	NA
2015_238_ISEGS	Loggerhead Shrike	LOSH	Incidental	6/8/2015	6/8/2015	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. No evidence of collision or singeing (checked under scope)	Unknown	NA	1	640415, 3933522	ACC Building	NA
2015_239_ISEGS	Lesser Nighthawk	LENI	Carcass Survey	6/9/2015	6/9/2015	Feather spot	3-6 days	Feather spot size = large. 20 flight feathers consisiting of primaries, secondaries, and retrices, and 50+ body feathers. No evidence of singeing or collision.	Unknown	NA	1	640941, 3933846	Heliostat	NA
2015_240_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	6/9/2015	6/9/2015	Feather spot	2 weeks	Feathers spot = small. 5 rectrices and 7 primaries found. No evidence of singeing or collision.	Unknown	NA	1	640949, 3933840	Heliostat	NA
2015_241_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/9/2015	6/9/2015	Feather spot	7 days	Feather spot size= large. 6 retrices, 16 primaries, and 50+ body feathers collected. No evidence of singeing or collision.	Unknown	NA	1	639348, 3933122	Fencing	NA

2015_242_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/9/2015	6/9/2015	Feather spot	2 days	Feather spot size= large. 10 retrices, 26 primaries/secondaries, and 300+ body feathers collected. No evidence of singeing or collision.	Unknown	NA	1	639957, 3932660	Fencing	NA
2015_243_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/9/2015	6/9/2015	Feather spot	7 days	Feather spot size= large. 11 retrices, 20+ primaries/secondaries, and 100+ body feathers collected. No evidence of singeing or collision.	Unknown	NA	1	640116, 3932661	Fencing	NA
2015_244_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/9/2015	6/9/2015	Feather spot	7 days	Feather spot size= large. 9 retrices, 30 primaries/secondaries, and 50+ body feathers collected. No evidence of singeing or collision.	Unknown	NA	1	640733, 3932659	Fencing	NA
2015_245_ISEGS	Unknown Passerine	UNPA	Carcass Survey	6/10/2015	6/10/2015	Feather spot	2 weeks	Feather spot = small. 18 flight feathers, 30+ body feathers in 1m square area. No evidence of singe or collision.	Unknown	NA	1	640848, 3933298	heliostat	NA
2015_246_ISEGS	Cliff Swallow	CLSW	Carcass Survey	6/10/2015	6/10/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	7 days	Intact carcass. Singed, flux grade 2 & 3, on majority of flight feathers (wing and tail both) and entirety of head, crown, and scapulars.	Scorched or singed	2,3	1	640388, 3933533	ACC Building	NA
2015_247_ISEGS	Unknown Passerine	UNPA	Carcass Survey	6/11/2015	6/11/2015	Feather spot	3-6 days	Feather spot size= small. 7 flight feathers and ~ 50 body feathers, uppertail coverts. No evidence of singeing or collision (checked under scope).	Unknown	NA	1	640990, 3933165	Heliostat	NA
2015_248_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	6/11/2015	6/11/2015	Dead, fresh (eyes moist)	0-8 hours	Whole carcass found. Evidence of collision by heliostat imprint and tip of broken bill. No singeing.	Collision with solar panel/heliostat	NA	1	641107, 3933238	Heliostat	NA
2015_249_ISEGS	White-Crowned Sparrow	WCSP	Carcass Survey	6/12/2015	6/12/2015	Feather spot	2 weeks	Feather spot size = small. 17 flight feathers, 100+ body feathers. Found 2m from heliostat with imprint matching species size. No singe.	Collision with solar panel/heliostat	NA	1	639662, 3933045	Heliostat	NA
2015_250_ISEGS	Western Tanager	WETA	Carcass Survey	6/12/2015	6/12/2015	Feather spot	2 weeks	Feather spot = small. 8 retrices, 7 primaries, 9 secondaries, 50+ body feathers. No singe.	Unknown	NA	1	639918, 3932873	Heliostat	NA
2015_251_ISEGS	Horned Lark	HOLA	Carcass Survey	6/13/2015	6/13/2015	Mummified	2 weeks	Whole carcass. Designated mummified due to dessication, appears to have been subjected to high insect activity and extreme heat. No evidence of singe or collision.	Unknown	NA	3	637406, 3937709	Heliostat	NA
2015_252_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/13/2015	6/13/2015	Feather spot	3 weeks	Feather spot size= large. 35+ body feathers. No evidence of singe or collision. Nest located inside heliostat- feather and eggshell fragments scattered to comprise feather spot.	Unknown	NA	3	637449, 3938563	Heliostat	NA
2015_253_ISEGS	Mourning Dove	MODO	Carcass Survey	6/14/2015	6/14/2015	Feather spot	1 month +	Feather spot = large.	Unknown	NA	3	636303, 3936818	Heliostat	NA
2015_254_ISEGS	Unknown	UNID	Carcass Survey	6/14/2015	6/14/2015	Feather spot	2 weeks	Feather spot size = small. 11 body feathers. No evidence of singe or collision.	Unknown	NA	3	637760, 3937373	Heliostat	NA

2015_255_ISEGS	Anna's Hummingbird	ANHU	Carcass Survey	6/14/2015	6/14/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 weeks	Whole carcass. Flux grade 2 & 3 singe on majority of dorsal side, head, and all flight feathers. Bill broken at upper mandible, suggesting collision after singe event.	Scorched or singed	2,3	3	637451, 3937969	ACC Building	NA
2015_256_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	6/14/2015	6/14/2015	Feather spot	1 month +	Feather spot size = large. 5 tail feathers, 4 body, 3 wing feathers. No evidence of singe or collision.	Unknown	NA	3	637735, 3938822	Heliostat	NA
2015_257_ISEGS	Cactus Wren	CACW	Carcass Survey	6/15/2015	6/15/2015	Dead, fresh (eyes moist)	0-8 hours	Bill bent at tip and dried blood present. Matching imprint found on nearest heliostat. No singe.	Collision with solar panel/heliostat	NA	3	637062, 3936865	Heliostat	NA
2015_258_ISEGS	Greater Roadrunner	GRRO	Incidental	6/15/2015	6/15/2015	Feather spot	2 weeks	Feather spot size = large. 14 flight feathers, 200+ body feathers. No singe.	Unknown	NA	3	637267, 3936719	Fencing	NA
2015_259_ISEGS	Lucy's Warbler	LUWA	Incidental	6/18/2015	6/18/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling on secondaries and primaries of flight feathers, singeing present on retcrices, top of head, nape, and back. Flux grade effect 2 &3.	Scorched or singed	2,3	3	637453, 3937898	Powerblock	NA
2015_260_ISEGS	Tree Swallow	TRES	Incidental	6/19/2015	6/19/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Evidence of curling on outer primaries on both wings and slight singeing on retrices. Flux grade effect 1.	Scorched or singed	1	1	640374, 3933487	Solar Concentrating Tower	NA
2015_261_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	6/23/2015	6/23/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass found. Evidence of singeing on tips of tail feathers. Flux grade effect 1.	Scorched or singed	1	3	637482, 3937912	Solar Concentrating Tower	NA
2015_262_ISEGS	Violet-green Swallow	VGSW	Carcass Survey	6/23/2015	6/23/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass found. No evidence of singeing or collision.	Unknown	NA	2	638740, 3935984	Heliostat	NA
2015_263_ISEGS	House Finch	HOFI	Carcass Survey	6/23/2015	6/23/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass found. Evidence of curling on 5 primaries on left wing. Flux grade effect 1.	Scorched or singed	1	2	638624, 3935881	Powerblock	NA
2015_264_ISEGS	American Coot	AMCO	Carcass Survey	6/23/2015	6/23/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 weeks	Whole carcass found. No evidence of singeing or collision.	Unknown	NA	2	637705, 3935241	Fencing	NA
2015_265_ISEGS	Mourning Dove	MODO	Carcass Survey	6/24/2015	6/24/2015	Feather spot	3-6 days	Feather spot consisting of 150 body feathers, 7 retrices, and 9 primaries/secondaries. Evidence of collision with found heliostat imprint. No singe.	Collision with solar panel/heliostat	NA	2	637762, 3936399	Heliostat	NA
2015_266_ISEGS	Loggerhead Shrike	LOSH	Carcass Survey	6/24/2015	6/24/2015	Feather spot	2 weeks	Feather Spot consisting of 11 retrices, 3 secondaries, 150 body feathers, some clumps of feathers attached by skin. No evidence of singeing or collision.	Unknown	NA	2	638742, 3935437	Heliostat	NA
2015_267_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	6/24/2015	6/24/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass found. Evidence of collision with upper and lower mandiable fractured and placement of found carcass under heliostat mirror. No singe.	Collision with solar panel/heliostat	NA	2	637930, 3936573	Heliostat	NA
2015_268_ISEGS	Cliff Swallow	CLSW	Incidental	6/24/2015	6/24/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	Whole carcass found. Evidence of curling on edges of all primaries and tail feathers, singeing on throat and upper chest.	Scorched or singed	2	1	640377, 3933486	Solar Concentrating Tower	NA

2015_269_ISEGS	Horned Lark	HOLA	Carcass Survey	6/24/2015	6/24/2015	Broken up	2 weeks	Broken up carcass consisting of tail, feathers with skin attached , torso including both wings, and 75 body feathers. No evidence of singeing or collision.	Unknown	NA	2	638585, 3935373	Heliostat	NA
2015_270_ISEGS	Lesser Nighthawk	LENI	Carcass Survey	6/25/2015	6/25/2015	Feather spot	2 weeks	Feather spot consisting of 5 primaries, 1 tertial, and 3 body feathers. No evidence of singeing or collision.	Unknown	NA	2	637954, 3936791	Heliostat	NA
2015_271_ISEGS	Mourning Dove	MODO	Incidental	6/26/2015	6/26/2015	Broken up	2 weeks	Broken up consisting of partial carcass, seperated wings, and some seperated feathers. No evidence of singeing or collision.	Unknown	NA	2	639389, 3935802	Heliostat	NA
2015_272_ISEGS	Greater Roadrunner	GRRO	Incidental	6/26/2015	6/26/2015	Feather spot	3-6 days	Feather spot consisting of 5 retrices, 20 primaries/secondaries, and 200+ body feathers. No evidence of singeing or collision.	Unknown	NA	1	639349, 3933648	Fencing	NA
2015_273_ISEGS	Greater Roadrunner	GRRO	Incidental	6/26/2015	6/26/2015	Broken up	2 days	Feather spot consisting of > 200 body feathers, 30 flight feathers, top of skull, and upper mandiable. No evidence of singeing or collision.	Unknown	NA	1	639346, 3933236	Fencing	NA
2015_274_ISEGS	Mourning Dove	MODO	Incidental	6/26/2015	6/26/2015	Broken up	2 weeks	Broken up. Whole carcass minus head with scattered feathers with attached skin. No evidence of singeing or collision.	Unknown	NA	1	641348, 3932990	Fencing	NA
2015_275_ISEGS	Red-tailed Hawk	RTHA	Incidental	6/28/2015	6/28/2015	Alive, injured	0-8 hours	No evidence of singe or collision. Bird appeared disoriented and dehydrated.	Unknown	NA	2	638639, 3935869	Powerblock	NA
2015_276_ISEGS	Unknown Swallow	UNSW	Carcass Survey	6/29/2015	6/29/2015	Broken up	2 weeks	Portion of left wing found. Three flight feathers, 5 coverts. All 3 discovered flight feathers with singe.	Scorched or singed	Unk	1	640560, 3933301	Heliostat	NA
2015_277_ISEGS	Cliff Swallow	CLSW	Carcass Survey	6/30/2015	6/30/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass found. Evidence of curling to all major flight feathers, singeing to top of head, throat, top of breast, and shoulders.	Scorched or singed	2,3	1	640388, 3933530	ACC Building	NA
2015_278_ISEGS	House Finch	HOFI	Carcass Survey	6/30/2015	6/30/2015	Mummified	2 weeks	Whole carcass found. Evidence of singeing to tips of inner primaries of left wing and coverts, curling present on chest feathers	Scorched or singed	1,3	1	640356, 3933550	ACC Building	NA
2015_279_ISEGS	American Kestrel	AMKE	Carcass Survey	6/30/2015	6/30/2015	Broken up	7 days	Broken up feather spot consisting of 11 primaries, 8 retrices, 25+ body feathers, 10 coverts and 2 partial wings attached by flesh. No evidence of singeing or collision.	Unknown	Unk	1	640352, 3933485	Powerblock	NA
2015_280_ISEGS	American Kestrel	AMKE	Carcass Survey	6/30/2015	6/30/2015	Broken up	3-6 days	Broken up carcass consisting of 2 wings, 2 legs with sacrum, section of vertebral column, with 12 retrices, 4 primaries, and 100+ contour feathers. No evidence of singeing or collision.	Unknown	NA	1	640530, 3933518	Heliostat	NA
2015_281_ISEGS	Mourning Dove	MODO	Carcass Survey	6/30/2015	6/30/2015	Broken up	2 weeks	Broken up carcass consisting of 2 wings, 2 legs, half of retrices, and >75 body feathers. No evidence of singeing or collision.	Unknown	NA	1	640481, 3933532	Heliostat	NA

2015_282_ISEGS	Unknown Swallow	UNSW	Carcass Survey	6/30/2015	6/30/2015	Broken up	2 weeks	Broken up feather spot consisting of 9 primaries, 4 secondaries, 5 body feathers, and section of left wing attached by flesh. Evidence of curling on primaries and secondaries.	Scorched or singed	Unk	1	648371, 3933498	Powerblock	NA
2015_283_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	6/30/2015	6/30/2015	Feather spot	2 weeks	Feather spot consisting of 10 primaries, 6 retrices, and 2 body feathers. No evidence of singeing or collision.	Unknown	NA	1	640507, 3933763	Heliostat	NA
2015_284_ISEGS	Cliff Swallow	CLSW	Incidental	7/1/2015	7/1/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	No singe or evidence of collision. Flesh pulled from body at flank and head, suggesting scavenging.	Unknown	NA	2	638597, 3935874	Powerblock	NA
2015_285_ISEGS	Lesser Nighthawk	LENI	Incidental	7/7/2015	7/7/2015	Dead, fresh (eyes moist)	0-8 hours	Whole carcass found by designated biologist on Coloseum Road with suspected evidence of vehicle strike. No evidence of singeing .	Vehicle Strike	NA	NA	639597, 3935219	Road	NA
2015_286_ISEGS	Mourning Dove	MODO	Carcass Survey	7/8/2015	7/8/2015	Feather spot	8-24 hours	Feather spot consisting of 100+ body feathers, 14 retrices, and 4 coverts. No evidence of singeing or collision.	Unknown	NA	3	637582, 3937879	Heliostat	NA
2015_287_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	7/9/2015	7/9/2015	Mummified	2 weeks	Whole carcass found. Evidence of curling to primaries, secondaries and retrices, singeing to head, nape, back, rump, and axilleries. Flux grade effect 2 & 3.	Scorched or singed	2,3	3	637549, 3937952	ACC Building	NA
2015_288_ISEGS	Rufous Hummingbird	RUHU	Carcass Survey	7/9/2015	7/9/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass found. Evidence of curling present on tips of retrices, singeing to left side of head. Flux grade effect 1 & 3.	Scorched or singed	1,3	3	637458, 3937944	ACC Building	NA
2015_289_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	7/9/2015	7/9/2015	Mummified	2 weeks	Whole carcass found. Evidence of curling to primaries, secondaries, retrices, singeing to flanks. Flux grade effect 2 & 3.	Scorched or singed	3-Feb	3	637439, 3937946	ACC Building	NA
2015_290_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/9/2015	7/9/2015	Mummified	2 weeks	Whole carcass found except right wing. No evidence of singeing or collision.	Unknown	NA	3	637472, 3937912	Solar Concentrating Tower	NA
2015_291_ISEGS	Verdin	VERD	Carcass Survey	7/13/2015	7/13/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	Carcass intact, excepting tail which was lost due to singe. Singed, flux grade 2&3, on all flight feathers and majority of dorsal area. No collision evidence.	Scorched or singed	3	2	638656, 3935867	Powerblock	NA
2015_292_ISEGS	Costa's Hummingbird	COHU	Carcass Survey	7/13/2015	7/13/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	7 days	Whole carcass with one wing and tail lost due to singe. Singed, flux grade 2&3, on remaining flight feathers and majority of body. Bill slightly bent, suggesting collision post-singe.	Scorched or singed	2,3	2	638674, 3935872	Powerblock	NA
2015_293_ISEGS	Costa's Hummingbird	COHU	Carcass Survey	7/20/2015	7/20/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Carcass, without tail. Flux grade 2&3. Singe on majority of body feathers. Singe and curl on all flight feathers.	Scorched or singed	2,3	1	640371, 3933534	ACC Building	NA
2015_294_ISEGS	Cliff Swallow	CLSW	Carcass Survey	7/20/2015	7/20/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Carcass with flux grade 2 & 3 singe on majority of flight feathers and both dorsal and ventral sides of body.	Scorched or singed	2,3	1	640308, 3933500	Powerblock	NA

2015_295_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	7/20/2015	7/20/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass with flux grade 1 & 3 singe on retrices and several primary flight feathers, throat and upper breast.	Scorched or singed	1,3	1	640303, 3933452	Powerblock	NA
2015_296_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	7/21/2015	7/21/2015	Feather spot	2 weeks	Feather spot consisting of 7 body, 4 retrices, 9 primaries, and 9 secondaries. No evidence of singeing or collision.	Unknown	Unk	1	639349, 3932948	Fencing	NA
2015_297_ISEGS	Lesser Nighthawk	LENI	Incidental	7/21/2015	7/21/2015	Alive, injured	0-8 hours	Injured bird found by WEST biologist as incidental while conducting CRT trail completion. Damage and blood were observed inside mouth, evidencing collision.	Collision with solar panel/heliostat	NA	1	641094, 3932906	Heliostat	Updated 'Description of Carcass/Injury', 'Suspected cause of injury/mortality': Collision, and 'Level of certainty for suspected cause': Valid (>90%). Updated 07/30/2015 CJM
2015_298_ISEGS	Cliff Swallow	CLSW	Incidental	7/22/2015	7/22/2015	Mummified	2 weeks	Whole carcass found in mummified state. Evidence of curling to all flight feathers, singeing to contour feathers on head, neck, back, rump, and chest.	Scorched or singed	2,3	1	640373, 3933466	Solar Concentrating Tower	NA
2015_299_ISEGS	Peregrine Falcon	PEFA	Incidental	7/22/2015	7/22/2015	Alive, injured	0-8 hours	Alive and with injury. Bird died in rehab (euthanized). Bird was returned to site on 9/15/2015 and processed on 9/16/2015.	Scorched or singed	2,3	1	641352, 3933833	Fencing	NA
2015_300_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	7/24/2015	7/24/2015	Feather spot	3-6 days	Feather spot: 1 rect, 13 body feathers. No evidence of singe.	Unknown	NA	1	640063, 3932751	Heliostat	NA
2015_301_ISEGS	Yellow Warbler	YWAR	Incidental	7/26/2015	7/26/2015	Broken up	8-24 hours	14 primaries, 2 secondaries, 3 tertials and associated coverts. Pieces of both wing with associated feathers. No evidence of collision or flux.	Unknown	Unk/NA	3	637442, 3937888	Power Block	NA
2015_302_ISEGS	Rufous Hummingbird	RUHU	Carcass Survey	7/28/2015	7/28/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Entire. Neck, back and rump singed. Singe on both wings.	Scorched or singed	2,3	3	637445, 3937956	Power Block	NA
2015_303_ISEGS	Tree Swallow	TRES	Carcass Survey	7/28/2015	7/28/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Entire. Tail and wings visibly curled with light singeing on nape and rump.	Scorched or singed	2,3	3	637455, 3937956	Power Block	NA
2015_304_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	7/28/2015	7/28/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Entire. Curling on both wings, as well as tail. Light singe on both sides of neck.	Scorched or singed	2,3	3	637473, 3937957	Power Block	NA
2015_305_ISEGS	Unknown Hummingbird	UNHU	Carcass Survey	7/28/2015	7/28/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Entire. Wings and tail curled with singeing on head, back and flanks. Grades 2 and 3 flux. Body crushed by vehicle.	Scorched or singed	2,3	3	637477, 3937937	Power Block	NA
2015_306_ISEGS	Common Raven	CORA	Carcass Survey	7/28/2015	7/28/2015	Feather spot	2 days	1 primary, 4 secondaries, 14 body feathers and coverts found. Feathers show singe and curling.	Scorched or singed	Unk	3	637443, 3937964	Power Block	NA
2015_307_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	7/28/2015	7/28/2015	Dead; fresh (eyes moist)	0-8 hours	Entire. Tail curled with singeing present on head, neck and upper breast.	Scorched or singed	1,3	3	637485, 3937905	Power Block	NA
2015_308_ISEGS	Northern Rough-winged Swallow	NRWS	Carcass Survey	7/28/2015	7/28/2015	Feather spot	3-6 days	2 primaries found. No evidence of collision or flux.	Unknown	NA	3	637480, 3937929	Power Block	NA
2015_309_ISEGS	Unknown	UNID	Carcass Survey	7/28/2015	7/28/2015	Mummified	2 weeks	Partial; spine, both femurs, and pelvis found. Bones picked clean and bleached white. No evidence of collision or flux.	Unknown	NA	3	637550, 3937947	Power Block	NA

2015_310_ISEGS	House Finch	HOFI	Carcass Survey	7/28/2015	7/28/2015	Broken up	2 days	Disarticulated carcass found. All present flight feathers singed and culred. Grades 2 and 3 flux.	Scorched or singed	2,3	3	637484, 3937920	Power Block	NA
2015_311_ISEGS	Loggerhead Shrike	LOSH	Carcass Survey	7/29/2015	7/29/2015	Broken up	2 weeks	2 partial wings, loose feathers, primary section (p6-10), 1 partial secondary section. No evidence of collision or flux.	Unknown	NA	3	637266, 3938054	heliostat	NA
2015_312_ISEGS	Unknown Swallow	UNSW	Carcass Survey	7/29/2015	7/29/2015	Broken up	2 weeks	Partial right wing, body feathers connected with tissue, loose primary and secondaries from left wing: ~15 total primaries, 15+ contour, 2-3 retrices. No evidence of collision or singe.	Unknown	NA	3	637502, 3938067	heliostat	NA
2015_313_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	7/29/2015	7/29/2015	Feather spot	3-6 days	5 retrices, 25+ body feathers, 8 contour feathers. No evidence of collision or flux.	Unknown	NA	3	636927, 3936711	Fencing	NA
2015_314_ISEGS	Ash-Throated Flycatcher	ATFL	Carcass Survey	7/29/2015	7/29/2015	Feather spot	2 weeks	6 retrices, 6 primaries, 5 secondaries, >30 body feathers. No sign of collision or flux.	Unknown	NA	3	636921, 3936710	Fencing	NA
2015_315_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	7/29/2015	7/29/2015	Feather spot	2 weeks	8 rects, 6 primaries, <10 body feathers. No evidence of collision or flux.	Unknown	NA	3	637279, 3936719	Fencing	NA
2015_316_ISEGS	House Finch	HOFI	Incidental	7/29/2015	7/29/2015	Alive, injured	0-8 hours	Bird found alive. Grade 2&3 singe evident on dorsal body, crown of head, flanks, and curling on all wing and tail flight feathers. Charring in chest and undertail parts, bleeding from cloaca. No evidence of collision. Bird died in transit from tower to	Scorched or singed	2,3	1	640372, 3933477	Power Block	Updated 'Injured animal outcome': Bird died in transit to office lab. 11/10/2015 CJM
2015_317_ISEGS	Lesser Nighthawk	LENI	Incidental	7/29/2015	7/29/2015	Alive, injured	0-8 hours	Bird found alive. Severely emaciated body condition due to being trapped in HAB for several days. Bird died within a few hours of holding at lab.	Unknown	NA	3	639782, 3934639	HAB	NA
2015_318_ISEGS	Northern Rough-winged Swallow	NRWS	Incidental	7/30/2015	7/30/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	Entire. Left primary and secondary feathers curled, left coverts singed. No evidence of collision, grade 1 flux.	Scorched or singed	1	1	640359, 3933481	Power Block	NA
2015_319_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	7/30/2015	7/30/2015	Feather spot	3-6 days	15 primary, 10 secondary, 6 retrices, and 100+ body feathers. No evidence of collision or flux.	Unknown	NA	3	636962, 3936722	heliostat	NA
2015_320_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	7/30/2015	7/30/2015	Feather spot	2 weeks	8 retrices found. No evidence of collision or flux.	Unknown	NA	3	636960, 3936725	heliostat	NA
2015_321_ISEGS	Black-tailed Gnatcatcher	BTGN	Incidental	8/3/2015	8/3/2015	Dead; fresh (eyes moist)	0-8 hours	Whole carcass. Tip of bill cracked, indicating collision damage.	Collision with solar panel/heliostat	NA	1	640364, 3933485	Power Block	NA
2015_322_ISEGS	Lesser Nighthawk	LENI	Incidental	8/3/2015	8/3/2015	Dead, fresh (eyes moist)	8-24 hours	Whole carcass with no evidence of singe or collision.	Unknown	NA	NA	639804, 3934705	Project Building	NA
2015_323_ISEGS	Tree Swallow	TRES	Carcass Survey	8/4/2015	8/4/2015	Mummified	2 weeks	Whole carcass. Singed, flux grade 2. All primary feathers and both wings singed and curled.	Scorched or singed	2	2	638535, 3935696	heliostat	NA
2015_324_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	8/4/2015	8/4/2015	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Fresh blood, but without any obvious external injury. No singe. Found directly under overhead line.	collision (other)	NA	NA	638199, 3935032	Transmission Tower	NA

2015_325_ISEGS	Unknown Swallow	UNSW	Carcass Survey	8/5/2015	8/5/2015	Mummified	2 weeks	Partial carcass, missing tail and lower/ventral body. Singe extensive on all areas excepting throat. Skeleton exposed. Grade 2/3 flux.	Scorched or singed	2,3	2	638644, 3935825	Power Block	NA
2015_326_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	8/5/2015	8/5/2015	Dead, fresh (eyes moist)	8-24 hours	Entire. Left wing, tail, back, rump, face and chest singed. Grades 2/3 flux.	Scorched or singed	2,3	2	638664, 3935880	Power Block	NA
2015_327_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	8/5/2015	8/5/2015	Mummified	2 weeks	Entire. Extensive singe/charring on whole body, only chest and throat with light or no singe. Grades 2/3 flux.	Scorched or singed	2,3	2	638656, 3935894	Power Block	NA
2015_328_ISEGS	Tree Swallow	TRES	Carcass Survey	8/5/2015	8/5/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Entire. All flight feathers singed. Chest, left side of face and back singed. Grades 2/3 flux.	Scorched or singed	2,3	2	638644, 3935907	Power Block	NA
2015_329_ISEGS	Anna's Hummingbird	ANHU	Carcass Survey	8/5/2015	8/5/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	Entire. Singed on majority of dorsal, 75% of flight feathers curled. Grades 2/3 singeing.	Scorched or singed	2,3	2	638620, 3935920	Power Block	NA
2015_330_ISEGS	Costa's Hummingbird	COHU	Carcass Survey	8/5/2015	8/5/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	2 days	Entire. All flight feathers and majority of dorsal body singed. Ventral side with 25% singe. Bill shows warping from collision. Grades 2/3 singe.	Scorched or singed	2,3	2	638652, 3935881	Power Block	NA
2015_331_ISEGS	American Kestrel	AMKE	Incidental	8/5/2015	8/5/2015	Mummified	3-6 days	Entire. Singed feathers on head and nape. Grade 3 flux.	Scorched or singed	3	3	637520, 3937891	Power Block	NA
2015_332_ISEGS	Greater Roadrunner	GRRO	Carcass Survey	8/6/2015	8/6/2015	Mummified	2 weeks	Partial. Keel, body feathers, and tail feathers found caught in worm drive of heliostat.	Collision with solar panel/heliostat	NA	2	638242, 3936838	heliostat	NA
2015_333_ISEGS	American Kestrel	AMKE	Carcass Survey	8/6/2015	8/6/2015	Broken up	2 weeks	Partial. 11 retrices, left wing highly worn with single intact primary. No signs of collision or flux.	Unknown	NA	2	638008, 3936811	heliostat	NA
2015_334_ISEGS	House Finch	HOFI	Incidental	8/6/2015	8/6/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass, with singe grade 2&3 on all flight feathers, chest, back and head.	Scorched or singed	2,3	3	637487, 3937914	Powerblock	NA
2015_335_ISEGS	Common Raven	CORA	Incidental	8/7/2015	8/7/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	3-6 days	Whole carcass. Extensive singe on all contour feathers and flight feathers. Belly shows little singe but was rotted and damaged. Grades 2/3 flux.	Scorched or singed	2,3	2	639279, 3936692	Heliostat	NA
2015_336_ISEGS	Brown-headed cowbird	BHCO	Carcass Survey	8/8/2015	8/8/2015	Broken up	2 weeks	Partial. Wing found with 9 primaries intact and attached. Flight feathers curled.	Scorched or singed	Unk	1	640373, 3933382	Heliostat	NA
2015_337_ISEGS	Black-Throated Sparrow	BTSP	Carcass Survey	8/8/2015	8/8/2015	Dead, semi-fresh (eyes desiccated, rigor mortis)	8-24 hours	Whole carcass. Tail feathers completely singed and curled. Feather on both wings mostly singed and curled. Back feathers singed. Grades 2/3 flux.	Scorched or singed	2,3	1	640373, 3933537	Power Block	NA
2015_338_ISEGS	Unknown Swallow	UNSW	Carcass Survey	8/8/2015	8/8/2015	Broken up	3-6 days	Most of carcass recovered - ventral area, left leg and left wing detached but located. Flight feathers curled, body and flight feathers singed. Grades 2/3 flux.	Scorched or singed	2,3	1	640358, 3933536	Power Block	NA

2015_339_ISEGS	Wilson's Warbler	WIWA	Carcass Survey	8/8/2015	8/8/2015	Dead; fresh (eyes moist)	0-8 hours	Whole carcass. All flight feathers singed, many burned completely off. Heavy singe/char on left side of face, chest and back. Curling of contour feathers on head and back. Grades 2/3 flux.	Scorched or singed	2,3	1	640361, 3933502	Power Block	NA
2015_340_ISEGS	Hermit Warbler	HEWA	Carcass Survey	8/8/2015	8/8/2015	Dead, fresh (eyes moist)	0-8 hours	Whole carcass. Wings and tail feathers singed and curled. Singe on head, breast, belly and undertail. Grades 2/3 flux.	Scorched or singed	2,3	1	640365, 3933499	Power Block	NA
2015_341_ISEGS	Western Tanager	WETA	Incidental	8/11/2015	8/11/2015	Dead, fresh (eyes moist)	8-24 hours	Whole carcass. Not able to be retrieved due to location on tower exterior. No singe present. No sign of collision discernable from vantage point.	Unknown	NA	1	640372, 3933487	Powerblock	NA
2015_342_ISEGS	Blue-winged Teal	BWTE	Incidental	8/12/2015	8/12/2015	Alive, injured	8-24 hours	Alive. No sign of singe or collision. Bird appeared disoriented and unable to fly. Bird is being held until morning to determine most appropriate action/rehab. The bird was successfully released at 1501 in full health (13 August CJM)	Unknown	NA	3	637391, 3937882	Powerblock	'Description of Carcass/Injury', 'Injury Outcome': Bird released at 1501 in full health. Updated 08/13/2015 CJM
2015_343_ISEGS	Wilson's Warbler	WIWA	Incidental	8/12/2015	8/12/2015	Alive, injured	0-8 hours	Observed falling from sky. Bird with singe, flux grade 1, and curling of primaries and tail feathers. Bird is being held until morning to determine most appropriate action/rehab. Bird died while being held overnight.	Scorched or singed	1,3	3	637383, 3937895	Powerblock	'Description of Carcass/Injury', 'Disposition': Freezer on site, 'Injury Outcome': Bird died while being held overnight for observation. Returned to lab for processing. Updated 08/13/2015 CJM

Appendix B. Additional Detection Data for Fatality Estimates and Documentation of Fatality Estimates in Which Each Detection Was Included.

USFWS #	Species Code	Location	Distance from Tower (m)	Bird Size	Model Size	Cause of Death	How Found	Time Since Last Survey (days)	Used in Estimator	Tower Area	Power Block	Inner HD	Heliostat Area	Unit Fence	Collector Line	Estimator Notes
2015_232_ISEGS	MODO	Outer Segment	1683	Large	Large Carcass	unknown	Incidental	NA	No				X			Older than Search Interval
2015_233_ISEGS	WIWA	Power Block	53	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					
2015_234_ISEGS	HOLA	Inner Segment	590	Small	Small Carcass	collision	Fatality Search	23	No				X			Older than Search Interval
2015_235_ISEGS	UNHU	Power Block	125	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_236_ISEGS	MODO	Inner Segment	643	Large	Large Carcass	unknown	Fatality Search	22	Yes				X			
2015_237_ISEGS	MODO	Outer Segment	765	Large	Feather Spot	unknown	Fatality Search	23	Yes				X			
2015_238_ISEGS	LOSH	ACC	55	Small	Small Carcass	unknown	Incidental	1	Yes	X	X					
2015_239_ISEGS	LENI	Inner Segment	678	Small	Feather Spot	unknown	Fatality Search	21	Yes				X			
2015_240_ISEGS	BTSP	Inner Segment	669	Small	Feather Spot	unknown	Fatality Search	21	Yes				X			
2015_241_ISEGS	GRRO	Unit Fence	1084	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_242_ISEGS	GRRO	Unit Fence	916	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_243_ISEGS	GRRO	Unit Fence	861	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_244_ISEGS	GRRO	Unit Fence	905	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_245_ISEGS	UNPA	Inner Segment	517	Small	Feather Spot	unknown	Fatality Search	22	Yes				X			
2015_246_ISEGS	CLSW	ACC	49	Small	Small Carcass	singed	Fatality Search	22	Yes	X	X					
2015_247_ISEGS	UNPA	Outer Segment	696	Small	Feather Spot	unknown	Fatality Search	22	Yes				X			
2015_248_ISEGS	BTSP	Outer Segment	777	Small	Small Carcass	collision	Fatality Search	22	Yes				X			
2015_249_ISEGS	WCSP	Outer Segment	837	Small	Feather Spot	collision	Fatality Search	21	Yes				X			
2015_250_ISEGS	WETA	Outer Segment	732	Small	Feather Spot	unknown	Fatality Search	21	Yes				X			
2015_251_ISEGS	HOLA	Inner HD	219	Small	Small Carcass	unknown	Fatality Search	19	Yes	X		X				
2015_252_ISEGS	GRRO	Inner Segment	630	Large	Feather Spot	unknown	Fatality Search	19	No				X			Older than Search Interval
2015_253_ISEGS	MODO	Outer Segment	1606	Large	Feather Spot	unknown	Fatality Search	19	No				X			Older than Search Interval
2015_254_ISEGS	UNID	Inner Segment	603	Small	Feather Spot	unknown	Fatality Search	19	Yes				X			
2015_255_ISEGS	ANHU	ACC	66	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_256_ISEGS	GRRO	Outer Segment	944	Large	Feather Spot	unknown	Fatality Search	19	No				X			Older than Search Interval
2015_257_ISEGS	CACW	Outer Segment	1167	Small	Small Carcass	collision	Fatality Search	19	Yes				X			
2015_258_ISEGS	GRRO	Outside Search - Between FO & Fence	1237	Large	Feather Spot	unknown	Incidental	NA	No							Outside Standard Search Area
2015_259_ISEGS	LUWA	Power Block	38	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2015_260_ISEGS	TRES	Outside Search - Solar Tower	0	Small	Small Carcass	singed	Incidental	NA	No							Outside Standard Search Area
2015_261_ISEGS	NRWS	Outside Search - Tower, 4th Level,NE	0	Small	Small Carcass	singed	Incidental	NA	No							Outside Standard Search Area
2015_262_ISEGS	VGSW	Inner HD	161	Small	Small Carcass	unknown	Fatality Search	21	Yes	X		X				
2015_263_ISEGS	HOFI	ACC	50	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_264_ISEGS	AMCO	Unit Fence	1121	Large	Large Carcass	unknown	Fatality Search	21	Yes					X		
2015_265_ISEGS	MODO	Outer Segment	1054	Large	Feather Spot	collision	Fatality Search	20	Yes				X			
2015_266_ISEGS	LOSH	Inner Segment	391	Small	Feather Spot	unknown	Fatality Search	21	Yes				X			
2015_267_ISEGS	BTSP	Outer Segment	1032	Small	Small Carcass	collision	Fatality Search	20	Yes				X			
2015_268_ISEGS	CLSW	Outside Search - Tower, 4th Level	0	Small	Small Carcass	singed	Incidental	NA	No							Outside Standard Search Area
2015_269_ISEGS	HOLA	Inner Segment	487	Small	Small Carcass	unknown	Fatality Search	21	Yes				X			

2015_270_ISEGS	LENI	Outer Segment	1180	Small	Feather Spot	unknown	Fatality Search	21	Yes				X			
2015_271_ISEGS	MODO	Outer Segment	731	Large	Large Carcass	unknown	Incidental	NA	No				X			Older than Search Interval
2015_272_ISEGS	GRRO	Unit Fence	1039	Large	Feather Spot	unknown	Incidental	17	Yes					X		
2015_273_ISEGS	GRRO	Unit Fence	1046	Large	Feather Spot	unknown	Incidental	17	Yes					X		
2015_274_ISEGS	MODO	Unit Fence	1095	Large	Large Carcass	unknown	Incidental	17	Yes					X		
2015_275_ISEGS	RTHA	Power Block	32	Large	Large Carcass	unknown	Incidental	1(1)	Yes	X	X					
2015_276_ISEGS	UNSW	Inner Segment	261	Small	Small Carcass	singed	Fatality Search	19	Yes				X			
2015_277_ISEGS	CLSW	ACC	46	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_278_ISEGS	HOFI	ACC	66	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_279_ISEGS	AMKE	Power Block	0	Large	Feather Spot	unknown	Fatality Search	20	Yes	X	X					
2015_280_ISEGS	AMKE	Inner HD	160	Large	Large Carcass	unknown	Fatality Search	21	Yes	X		X				
2015_281_ISEGS	MODO	Inner HD	117	Large	Feather Spot	unknown	Fatality Search	21	Yes	X		X				
2015_282_ISEGS	UNSW	Power Block	12	Small	Feather Spot	singed	Fatality Search	20	Yes	X	X					
2015_283_ISEGS	BTSP	Inner Segment	300	Small	Feather Spot	unknown	Fatality Search	21	Yes				X			
2015_284_ISEGS	CLSW	Power Block	70	Small	Small Carcass	unknown	Incidental	1(1)	No	X	X					Older than Search Interval
2015_285_ISEGS	LENI	Outside Search - Colosseum Road	1120	Small	Small Carcass	vehicle strike	Incidental	NA	No							Outside Standard Search Area
2015_286_ISEGS	MODO	Inner HD	180	Large	Feather Spot	unknown	Fatality Search	25	Yes	X		X				
2015_287_ISEGS	UNHU	ACC	48	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2015_288_ISEGS	RUHU	ACC	41	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2015_289_ISEGS	UNHU	ACC	58	Small	Small Carcass	singed	Fatality Search	25	Yes	X	X					
2015_290_ISEGS	NRWS	Outside Search - NA	0	Small	Small Carcass	unknown	Incidental	NA	No							Outside Standard Search Area
2015_291_ISEGS	VERD	Power Block	22	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_292_ISEGS	COHU	Power Block	31	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_293_ISEGS	COHU	ACC	49	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_294_ISEGS	CLSW	Power Block	64	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_295_ISEGS	BTSP	Power Block	76	Small	Small Carcass	singed	Fatality Search	20	Yes	X	X					
2015_296_ISEGS	GRRO	Unit Fence	1150	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_297_ISEGS	LENI	Outer Segment	895	Small	Small Carcass	collision	Incidental	NA	No				X			Older than Search Interval
2015_298_ISEGS	CLSW	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2015_299_ISEGS	PEFA	Unit Fence	1056	Large	Large Carcass	singed	Incidental	22	Yes					X		
2015_300_ISEGS	GRRO	Outer Segment	790	Large	Feather Spot	unknown	Fatality Search	22	Yes				X			
2015_301_ISEGS	YWAR	Power Block	51	Small	Feather Spot	unknown	Incidental	1(1)	Yes	X	X					
2015_302_ISEGS	RUHU	ACC	59	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_303_ISEGS	TRES	ACC	52	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_304_ISEGS	NRWS	ACC	44	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_305_ISEGS	UNHU	Power Block	25	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_306_ISEGS	CORA	Power Block	65	Large	Feather Spot	singed	Fatality Search	19	Yes	X	X					
2015_307_ISEGS	BTSP	Power Block	9	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_308_ISEGS	NRWS	Power Block	16	Small	Feather Spot	unknown	Fatality Search	19	Yes	X	X					
2015_309_ISEGS	UNID	Power Block	70	Small	Small Carcass	unknown	Fatality Search	19	Yes	X	X					
2015_310_ISEGS	HOFI	Power Block	6	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_311_ISEGS	LOSH	Inner HD	260	Small	Feather Spot	unknown	Fatality Search	21	Yes	X		X				
2015_312_ISEGS	UNSW	Inner HD	153	Small	Feather Spot	unknown	Fatality Search	21	Yes	X		X				
2015_313_ISEGS	GRRO	Unit Fence	1320	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		

2015_314_ISEGS	ATFL	Unit Fence	1320	Small	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_315_ISEGS	GRRO	Unit Fence	1209	Large	Feather Spot	unknown	Fatality Search	21	Yes					X		
2015_316_ISEGS	HOFI	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2015_317_ISEGS	LENI	Outside Search - HAB	1297	Small	Small Carcass	unknown	Incidental	NA	No							Outside Standard Search Area
2015_318_ISEGS	NRWS	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2015_319_ISEGS	GRRO	Outer Segment	1269	Large	Feather Spot	unknown	Fatality Search	20	Yes				X			
2015_320_ISEGS	BTSP	Outer Segment	1267	Small	Feather Spot	unknown	Fatality Search	20	Yes				X			
2015_321_ISEGS	BTGN	Power Block	8	Small	Small Carcass	collision	Incidental	1(1)	Yes	X	X					
2015_322_ISEGS	LENI	Outside Search - Inside HAB Building	1386	Small	Small Carcass	unknown	Incidental	NA	No							Outside Standard Search Area
2015_323_ISEGS	TRES	Inner HD	170	Small	Small Carcass	singed	Fatality Search	23	Yes	X		X				
2015_324_ISEGS	BTSP	Collector Line	936	Small	Small Carcass	collision	Fatality Search	23	Yes						X	
2015_325_ISEGS	UNSW	Power Block	24	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_326_ISEGS	BTSP	ACC	36	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_327_ISEGS	BTSP	ACC	51	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_328_ISEGS	TRES	ACC	65	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_329_ISEGS	ANHU	ACC	86	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_330_ISEGS	COHU	ACC	37	Small	Small Carcass	singed	Fatality Search	23	Yes	X	X					
2015_331_ISEGS	AMKE	Power Block	48	Large	Large Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2015_332_ISEGS	GRRO	Outer Segment	1077	Large	Feather Spot	collision	Fatality Search	24	Yes				X			
2015_333_ISEGS	AMKE	Outer Segment	1125	Large	Feather Spot	unknown	Fatality Search	23	Yes				X			
2015_334_ISEGS	HOFI	Power Block	0	Small	Small Carcass	singed	Incidental	1(1)	No	X	X					Older than Search Interval
2015_335_ISEGS	CORA	Outer Segment	1070	Large	Large Carcass	singed	Incidental	24	Yes				X			
2015_336_ISEGS	BHCO	Inner HD	104	Small	Feather Spot	singed	Fatality Search	18	Yes	X		X				
2015_337_ISEGS	BTSP	ACC	48	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_338_ISEGS	UNSW	ACC	50	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_339_ISEGS	WIWA	Power Block	18	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_340_ISEGS	HEWA	Power Block	13	Small	Small Carcass	singed	Fatality Search	19	Yes	X	X					
2015_341_ISEGS	WETA	Power Block	0	Small	Small Carcass	unknown	Incidental	1(1)	Yes	X	X					
2015_342_ISEGS	BWTE	Power Block	104	Large	Large Carcass	unknown	Incidental	1(1)	Yes	X	X					
2015_343_ISEGS	WIWA	Power Block	101	Small	Small Carcass	singed	Incidental	1(1)	Yes	X	X					