DOCKETED

Docket Number:	07-AFC-05C
Project Title:	Ivanpah Solar Electric Generating System (Compliance)
TN #:	202617
Document Title:	Avian & Bat Monitoring Plan; 2013-2014 Winter Report
Description:	N/A
Filer:	Joe Douglas
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	6/26/2014 1:10:29 PM
Docketed Date:	6/26/2014

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IVANPAH SOLAR ELECTRIC GENERATING SYSTEM AVIAN & BAT MONITORING PLAN

2013-2014 WINTER REPORT (29 OCTOBER 2013 – 21 MARCH 2014)

Project # 2802-07

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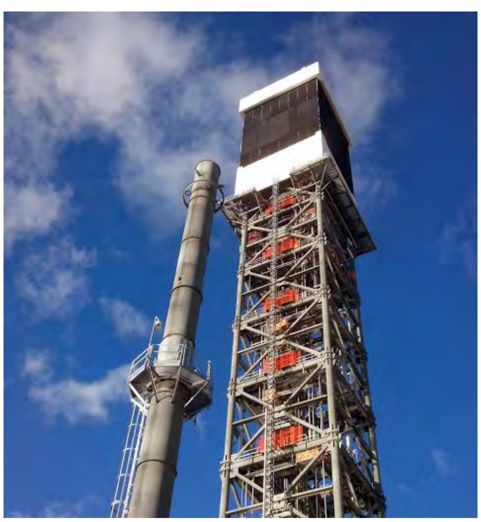

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Executive Summary

Avian monitoring surveys were conducted from 29 October 2013 to 21 March 2014 (the winter season) at the Ivanpah Solar Electric Generating System (Ivanpah) facility in accordance with the Project's Avian & Bat Monitoring and Management Plan (Plan). Specifically, facility monitoring for avian detections, scavenger and carcass removal trials, avian point count surveys, and large raptor surveys were conducted. This report represents the first "quarterly" (i.e., seasonal) report to be provided to the Technical Advisory Committee (TAC) summarizing monitoring methods and results for those surveys based on the procedures and requirements specified in the Plan.

Avian monitoring was conducted in 1) the "tower area", defined as the power block and inner high-density (HD) heliostats surrounding each power block; these areas, which comprised 154 acres or 4.9% of the facility, were surveyed with 100% coverage; 2) the "heliostat area", defined as the inner and outer heliostat segments outside of the inner HD heliostats; these areas, which comprised 720 acres or 22.9% of the facility, were surveyed with 20% coverage in randomly selected arc-shaped plots; 3) the "fenceline", consisting of the perimeter fences, which were 100% surveyed; 4) the "collector line", which consisted of the Unit 3 Collector Line, also 100% surveyed; and 5) offsite "control areas". Searches were conducted within the winter season at intervals averaging 26-27 days (range 24-29 days, median = 26 days). The timing of searches was phased in accordance with commencement of operation of the units, with Unit 1 becoming operational first, followed by Unit 3, and then Unit 2. By 27 January 2014, the standardized searches (defined as the formal searches performed per the Plan) were being conducted at all three units. In addition, throughout operations, the facility implemented its required Wildlife Incident Reporting System, through which site workers report "incidental detections" which comprise bird or bat injuries or fatalities that were observed spatially or temporally outside of the formal search protocol used to determine a fatality estimate. Bird and bat fatalities and injuries found during the scheduled fatality searches are called detections. According to the specifications of the Plan, detections were input into a fatality estimator equation (model) to provide an estimate of the fatalities for the facility.

During the period 29 October 2013 – 21 March 2014, a total of five injured birds, and five bat fatalities and 91 avian fatalities (38 of which were feather spots), were detected. Feather spots were not full or even partial carcasses, but rather consisted of groups of feathers composed of at least two or more primary flight feathers, five or more tail feathers, or 10 or more feathers of any type concentrated together in an area 1 m^2 or smaller, or feathers with any skin, flesh, or bone attached. Four bat detections and 61 avian detections occurred during standardized searches and 30 avian detections and one bat detection were made incidentally while performing other Project-related activities. The species detected were made up of 30 avian species and four bat species. Species that are permanent residents in the Ivanpah Valley (i.e., residing there year-round) accounted for 66.7% of the total detections on the site during the 2013-2014 winter season, with nonbreeding-season residents (those species that breed outside the Ivanpah Valley but winter in the Project vicinity) accounting for 15.6% of total detections. The only breeding-season resident species (i.e., a species that normally does not over-winter in the Project vicinity, but that breeds there) detected was Costa's hummingbird (*Calypte costae*), which begins breeding in the Ivanpah area in late winter; Costa's hummingbird detections represented 3.1% of all detections. With respect to foraging guilds, obligate and facultative granivores (i.e., birds that eat seeds most or all of the time) accounted for 43.8% of all detections, followed by insectivores (16.7%), carnivores (14.6%), nectarivores (10.4%), and waterbirds (4.2%).

Of the 96 avian detections during the 2013-2014 winter season, 24 fatalities (13 carcasses and 11 feather spots, together 25%) and three injured birds showed signs of singed feather damage from flux effects. Twenty-three of 27 detections (85.2%) showing signs of flux occurred in the tower area. Evidence of collision (primarily with heliostats) was observed in the case of 14 detections (14.6%). The five bats were all detected in and adjacent to the ACC, but the cause of death is unknown. The cause of injury or mortality for the remaining 55 detections (57.3%) could not be confirmed, mainly because the evidence of mortality was limited to feather spots; however, none of these detections with unknown causes of mortality displayed evidence of flux effects or observable evidence of collision. Thirty-eight (39.6%) of the 96 detections consisted only of feather spots. Because singed feathers are readily observable, fatalities for which the cause of death is unconfirmed are likely to have resulted from predation, collision, or illness. The ratio of feather spots to carcasses was substantially lower in the power block. It is possible that this finding results from the rapidity with which carcasses around the tower are detected by people, so that there is less time for scavenging that would result in feather spots; the relocation of power block carcasses by scavengers; or the removal of feather spots around the power block by the wind, which may affect the relatively open power block area disproportionately compared to the rest of the solar field. The large proportion of feather spots among the detections for the site as a whole may inflate the fatality estimate as a result of the potential for multiple feather spots resulting from one fatality, feather spots resulting from predation not associated with the facility, or other causes. Investigating the cause of feather spots, and whether they actually result from Project-related fatalities or natural predation, would help to elucidate whether fatality estimates are being inflated by feather spots from predation.

Of the 27 avian detections showing signs of flux effects, 24 (85.2 %) were recorded in the relatively limited area composed of the tower area; one feather spot with flux effects was in the inner heliostat segments, and one feather spot and one injured bird with flux effects were detected at the fenceline. The monitoring information indicates that flux-related effects occur overwhelmingly in the immediate vicinity of the towers.

Carcass removal trials and searcher efficiency trials were conducted to model the fatality estimate. Carcass persistence ranged from less than one day, in the case of a single carcass, to a full six-week trial period in the case of the seven carcasses whose remains persisted throughout the trial. Although all large carcasses were detected and at least partially eaten by scavengers, the scavengers left enough of the carcass in six of seven large-carcass trials that the remains would have been detectable and considered a fatality if detected during the standardized searches. In contrast, small carcasses tended to be more completely removed, with only one of 14 small carcasses leaving remains that persisted for the entire six-week trial. Assuming conservatively a 42-day persistence for the carcasses that persisted for the six-week trial period, mean carcass persistence was 10.1

days for small carcasses and 37.2 days for large carcasses. In comparison, the assumptions used in the power analysis in the Plan were 7.4 days for small birds and 21.8 days for large birds. Scavenging rates and discovery rates of carcasses and feather spots in the tower area are likely different from those within the heliostat area resulting from differing features and increased human activity; therefore, because the majority of detections occur in this area, carcass removal trials should be conducted in the tower area separate from those in the heliostat area.

Human searcher efficiency averaged 35.7% for small birds and 42.8% for large birds. Although human searcher efficiency rates were somewhat lower than the target rates assumed in the Plan, evidence shows that human efficiency rates are improving over time as we adapt our search pattern to the site-specific conditions and the dedicated search personnel gain more experience with this site. In addition, on 18-28 March 2014, we conducted a detection efficiency trial using detection dogs. Three detection dog teams (handler and dog) surveyed 23 selected arc plots within all three tower units. At each arc plot, between zero and six avian fatalities, consisting of full carcasses (n=53) and feather spots (n=32) of non-native birds, were placed by a field assistant. The dog handler then guided the trained detection dogs through a survey of the arc plots containing the planted fatalities. The overall detection efficiency was 69% (i.e., 69% of planted fatalities were detected by the dogs). Overall dog team searcher efficiency was 68% for small birds (n=44) and 71% for large birds (n=41). The monitoring approach in the Plan assumed searcher efficiency rates of 55% for small birds and 69% for large birds. The results of the detection dog trial demonstrate that detection dog teams achieved mean searcher efficiencies 8% greater for small birds and 2% greater for large birds than those described in the underlying assumptions of the Plan. Therefore, incorporation of detection dog teams into the monitoring regime, as approved by the TAC in the 20 May 2014 meeting, will increase the overall efficiency of fatality detection, improving the precision of fatality estimates.

There was no obvious temporal clumping of detections during the winter season, and the species composition of the detections throughout the solar plant was generally similar to that observed using the heliostat grids, as identified during avian use surveys discussed below, preliminarily suggesting that there is not a bias towards a particular avian guild. Fatality estimates for this single 2013-2014 winter season are limited by the low number of detections within various categories, such as guild, location, or cause of mortality. During the period 29 October 2013 to 21 March 2014, total estimated numbers of fatalities attributable to the project, which are those with evidence of flux or collision effects, were 81 (90% confidence interval estimates 47-180) in the tower area; 111 (90% confidence interval estimates 49-272) in the heliostat area; and eight (90% confidence interval estimates 4-14) in the fenceline area. Caution is necessary when drawing conclusions from the 2013-2014 winter season monitoring results because of the unequal sampling effort across units for part of the season and the relatively small number of the detections relative to the several Project elements of interest (e.g., heliostat fields, tower, fenceline, and powerlines). After four quarters of combined data, we anticipate that sample sizes will increase to exceed five fatalities per guild or location, and when this sample size is achieved, statistically robust fatality estimates for species by size, guild, area, and cause of death will be possible. Nevertheless, the relative magnitude of the fatality estimates among the three search areas (tower area, heliostat area, and fenceline) matches the pattern of detections observed. In proportion to unit area, fatality estimates suggest the highest densities of fatalities in the tower area, where the majority of flux fatalities also occur.

Of the 96 avian detections and five bat detections, 30 avian detections and one bat detection were made incidentally. Thus, incidental detections represented a large percentage (31.3% for birds and 20% for bats) of the detections. This demonstrates that the Ivanpah Wildlife Incident Reporting System, described in Section 3.4 of the Plan, is functioning well. However, a number of these incidental detections were retrieved from the power block, and the retrieval of incidental detections from the power block can confound accurate fatality estimates for this area because the "search effort" involved in the detection of incidental detections is not quantifiable and is subject to considerable spatial and temporal variability. Because incidental detections are retrieved at random intervals, we cannot properly assess the search interval of detected carcasses, or searcher efficiency of personnel finding fatalities in these areas, which are both critical model parameters when estimating fatalities. While obtaining data on any fatalities as soon as possible is important, a change in the policy of retrieving these carcasses when they are detected incidentally would improve the accuracy of fatality estimates.

In addition to the facility monitoring, avian point count surveys and large raptor surveys were conducted. Seven avian use surveys were conducted using variable-radius point counts at each of 80 survey points, including 40 points in heliostat arrays and 40 points in desert bajada habitats. A total of 23 bird species were recorded during these surveys. Species richness was the same on the two desert bajada grids (12 species each) and slightly lower in the heliostat grids (nine species in Unit 1 and eight in Unit 3). Bird abundance was substantially higher on the upper bajada grid southwest of Unit 3 (502 detections) than on the lower bajada grid south of Unit 1 (193 detections), and the two heliostat units had substantially lower abundance than either of the two desert bajada grids (75 detections in Unit 1 and 51 in Unit 3). Estimated avian densities were 2.1 birds/hectare in the heliostat units and 10.2 birds/hectare in the offsite desert bajada habitats. Thus, while the vegetation in the heliostat arrays does provide habitat for some birds, it is evidently not as suitable or preferable to birds as the surrounding desert vegetation. As a result, the presence of vegetation within the heliostat arrays is not expected to result in substantial increases in the risk of facility-related fatalities, and there is no evidence of a general attraction of birds to the heliostat arrays, as compared to the surrounding desert. As expected, comparison of the most abundant bird species that were recorded during avian use surveys to the species most frequently recorded as detections reveals more similarity between detections and birds using the heliostat grids (as identified during avian use surveys) than between detections and birds using the desert bajada habitats.

Seven surveys for raptors and other large birds were conducted at each of eight points (one on the east and west sides of each of the power units and two offsite points). During these surveys, six raptor species and two other large bird species (common raven and ring-billed gull) were identified. Common ravens comprised 56.8% of all large bird detections. Overall abundance of raptors and other large birds was higher on the eastern points than on the western points. Most golden eagle observations were of birds near the mountains; this species was recorded less frequently in the desert, and none were observed at the Ivanpah facilities themselves during formal surveys. The only observation of a golden eagle over the Ivanpah facilities was of a bird observed incidentally on 5 February 2014, when an adult was observed soaring more than 500 m above the ground, heading eastward from an area over the heliostats of Unit 2 toward and beyond Metamorphic Hill. Within the Ivanpah facility, the majority of large birds (most of which were ravens) seen in flight were observed in lower height categories (i.e., below 200 meters [m] above ground level [agl]). In surrounding offsite areas, most observations of large birds occurred in the highest category (>200 m agl).

According to Section 5.3 of the Plan, quarterly reports are required to categorize potential migratory bird mortality issues at Ivanpah 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.

The 2013-2014 winter results indicate that the potential migratory bird mortality during this season would be categorized as low. Total detections of any one species represent a very small proportion of local, regional, or national populations.

Based on our experience conducting the surveys and our findings for the winter quarter, we have the following recommendations for changes in the approach to future monitoring:

(1) Searcher efficiency trials and carcass removal trials should be conducted separately for the tower area, as compared to the heliostat area, for use in fatality estimates. We will begin conducting such separate trials in summer 2014.
(2) To increase overall searcher efficiency, detection dog teams at Ivanpah should be used to complement searches by avian ecologists at the facility. Section 2.1.1 of the Plan allows for the use of trained search dogs for monitoring if determined to be appropriate by the TAC and approved by the USFWS.[1]
(3) We recommend changing the policy regarding the removal of incidental detections in the power block area. Data on such detections should be taken when the birds or bats are detected, but if carcasses are allowed to remain in place until the following search (with the understanding that some carcasses may be removed by scavengers before that search occurs), fatality estimation for the power block will be more accurate.

[1] Note: the use of detection dog teams was approved by the TAC at its May meeting.

(4) Investigation of the causes of feather spots, and whether they represent Project-related mortality or natural predation, would help to refine the estimates of Project-related fatalities.

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Appendices

Appendix A. Individual Avian and Bat Detections A-1

Section 1.0 Introduction

1.1 Project Background

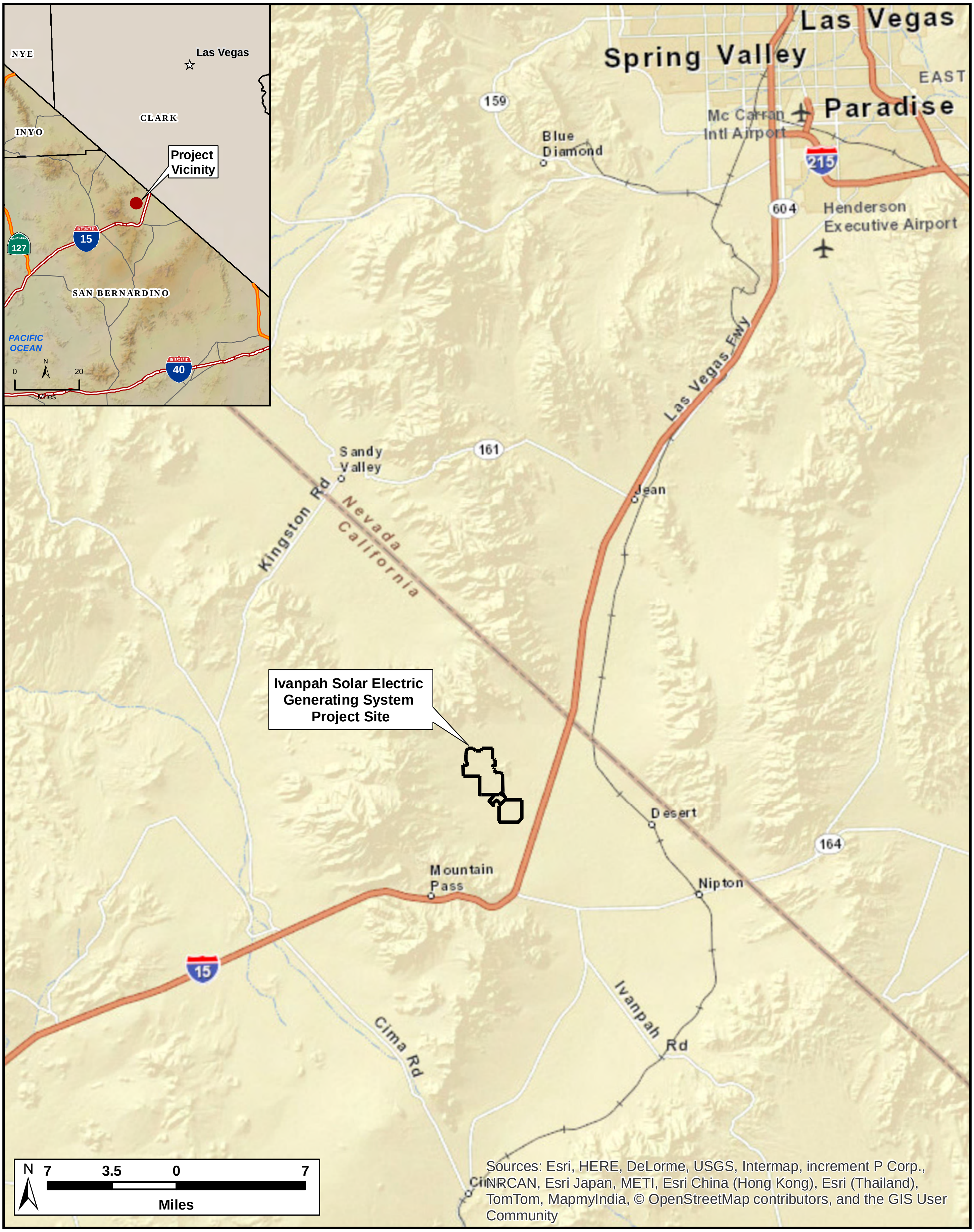
The Ivanpah Solar Electric Generating System (Ivanpah) consists of three solar power electrical generating facilities (Units 1, 2, and 3) with a combined net capacity of 377 megawatts. Each unit includes a central power tower with an air cooled condenser (ACC) and associated electrical generating equipment. This central area is surrounded by a heliostat array that reflects sunlight to a boiler at the top of the tower. Ivanpah is located on approximately 1,457 hectares (3,600 acres) of Bureau of Land Management (BLM) land west of Interstate 15 near 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 BLM to guide comprehensive monitoring of impacts to birds and bats associated with the operation of the facility. 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 Ivanpah team develop an avian plan as well as a Migratory Bird Treaty Act (MBTA) Conservation Agreement; 2) satisfy the requirements for an 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 by numbers 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.



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 1 Ivanpah Vicinity Map.mxd

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Figure 1: Ivanpah Vicinity Map
Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)
June 2014

- 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 and injury associated with species, age/sex, season, weather, and visibility.
- Objective 4. Document spatial patterns associated with collision- or flux-related mortality and 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 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 first "quarterly" (i.e., seasonal) report summarizing monitoring methods and results for avian and bat injuries and fatalities 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 2013-2014 winter season, which includes the period from 29 October 2013 through 21 March 2014.

Section 2.0 Methods

The Plan describes the methods by which monitoring and certain analyses, such as compiling the overall fatality estimate, will occur. Below, these methods are described only briefly (because they are included in the Plan), with more detailed descriptions of any refinements that were necessary as the Plan was implemented in the field.

2.1 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 and injured birds and bats at the facility. This section also describes the methods for conducting carcass removal and searcher efficiency trials; how data were reported and analyzed for incidental detections; and the methods for producing fatality estimates for the facility. Not including any data management or analysis, approximately 1,790 person-hours were spent conducting standardized monitoring searches and performing carcass removal and searcher efficiency trials.

2.1.1 Standardized Searches

2.1.1.1 Areas Surveyed

Per the Plan, monitoring searches were conducted in the "tower area", defined as the power block and inner high-density (HD) heliostats surrounding each power block, both of which were surveyed with 100% coverage; the "heliostat area", defined as the inner and outer heliostat segments outside of the inner HD heliostats, which were surveyed with 20% coverage in randomly selected arc-shaped plots; the "fenceline" consisting of the perimeter fences (100%); the "collector line", which consisted of the Unit 3 Collector Line (100%); and offsite control areas. 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 30.1% of the facility (not including the offsite control area, which is outside the facility) was searched. All these areas are depicted on Figure 2.

Table 1. Monitoring Areas, 29 October 2013 – 21 March 2014.

Area	Acreage Searched (ac)	Percent of Facility
Tower Area	154	4.9%
Heliostat Area	720	22.9
Fenceline	39	1.2%
Collector Line	26	0.8%
Offsite Control Area	7	NA*
Total Search Area	**948**	**30.1%**

* NA = Not applicable, because the offsite control areas are located outside the facility

N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 2 Ivanpah Search Areas.mxd

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Figure 2: Ivanpah Search Areas
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2.1.1.2 Search Frequency and Timing

The first searches in all units were clearance surveys, during which the search areas were cleared. Standardized searches within each unit commenced prior to, or concurrent with, the commencement of operation of each unit. Because commencement of operations was phased among the three units, searching was also phased, resulting in more searches conducted for Unit 1 (the first unit to become operational) than Unit 3 (the second unit to become operational), and the least number of searches for Unit 2, which was the last unit to become operational. According to the Plan, winter searches of each area were to be conducted at intervals of 25 days. In order to avoid scheduling searches on Christmas and Thanksgiving days, and because some surveys were delayed to address safety concerns related to high winds, the median 2013-2014 winter search interval was 26 days (range 24 to 29) for the three solar units. Although this is a slightly longer-than-planned interval, the fatality estimator (Huso 2010) is designed to accommodate slight variability in the search interval by incorporating the exact interval for each search. Furthermore, the summer 2014 search intervals are planned to average between 21 and 22 days, making the average combined winter and summer intervals less than 25 days for these seasons.

The first standardized searches at Ivanpah (defined as the formal searches performed per the Plan) occurred in Unit 1 between 30 October and 7 November. The offsite control areas, tower area, and heliostat area for this unit were all searched a total of six times during this period. Unit 3 was the second unit to become operational and thus to be searched. The clearance search for the fence occurred on 27 November, and all other clearance searches for Unit 3 occurred during the week of 9 December. In total, after clearance, the Unit 3 control areas were searched four times during this reporting period, and the fence of Unit 3 was searched five times. The tower area was searched on the same day as one another, and each was searched four times during this period. The inner and outer arc plot segments of Unit 3 were all searched four times each. Due to the amount of area included in the outer arc plot segments, these were searched on consecutive days, whenever possible. On 27 February, searches in the outer arc plot segments were suspended for safety reasons due to high winds. These searches were made up over the next two weeks.

The clearance searches for Unit 2 occurred during the week of 8 January, and subsequent searches then commenced the week of 27 January. The fenceline was originally searched on 27 November. In total, the fenceline was searched four times during the winter season. The control areas were searched three times during this period. The tower area, heliostat area, and collector line were each searched three times during the winter season.

2.1.1.3 Search Methods

Standardized searches for fatalities were performed by CEC and BLM-approved biologists conducting pedestrian surveys in accordance with the methods outlined in the Plan. We found that searcher efficiency was enhanced when a pair of searchers 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 3). Since the searcher efficiency was enhanced in accordance with the goals of the plan, this refinement was

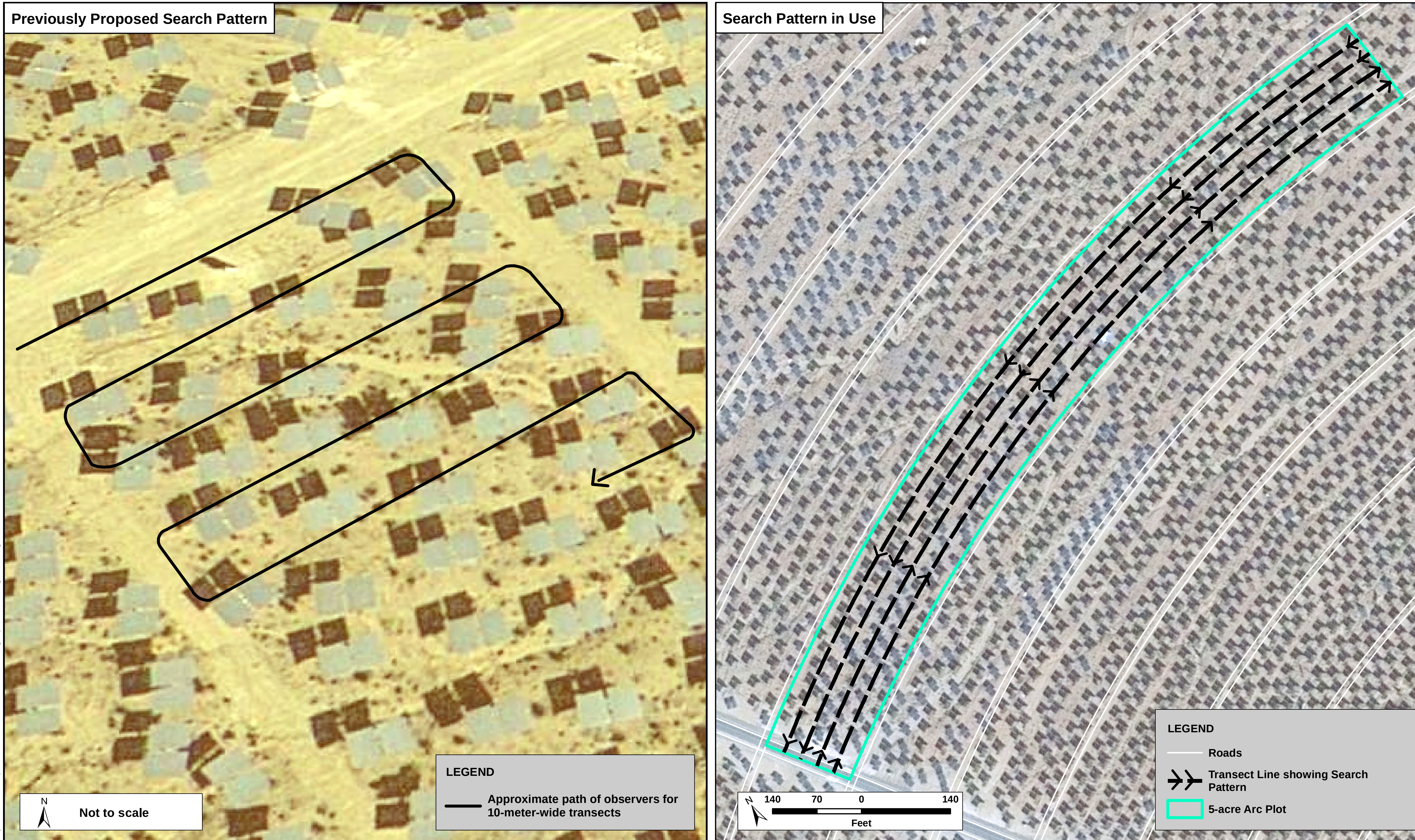

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Figure 3: Monitoring Search Pattern for Arc Plots
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N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 3 Monitoring Search Pattern for Arc Plots.mxd implemented throughout the Project site in lieu of the initially proposed patter in the Plan. While walking each transect, searchers walked a narrow search section approximately 10 meters (m) wide.

Otherwise, searches were performed exactly as described in the Plan. Within the heliostat area, 20% of each heliostat field was surveyed using randomly distributed 2.02-hectare (5-acre) arc plots. Within the power block (i.e., 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), biologists walked through and around the 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 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. 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 Unit 3 Collector Line was surveyed using a 30-m wide transect (i.e., 15 m on either side of the center line). Offsite surveys were conducted along two randomly selected 152-m long control areas, separated by approximately 10 m extending outward from the perimeter fence and back to the facility at nine locations, including the north, east, south, and west borders of facility.

In early March 2014, toward the end of the 2013-2014 winter monitoring season, Kagan et al. (2014) issued a report that included a grading system for characterizing flux effects, based on the percentage and types of feathers showing flux effects. Subsequent to the issuance of that report, when flux-related detections involving carcasses (as opposed to only feather spots) were found, the flux effects were assigned a grade according to 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

Retroactively, we assigned grades to flux-related detections prior to early March when sufficient detail was available (e.g., in photos or monitoring data) to allow us to make such assignments.

For the purpose of these surveys, feather spots were considered detections when they consisted of at least two or more primary flight feathers, five or more tail feathers, or 10 or more feathers of any type concentrated together in an area 1 m^2 or smaller (Smallwood 2007), or if any skin, flesh, or bone was attached to the feathers.

2.1.2 Carcass Removal Trials

In accordance with the Plan, we set out carcasses on a bi-weekly basis (i.e., every other week) for carcass removal trials. For both carcass removal trials and searcher efficiency trials (discussed below) and as per the terms of the USFWS Special Purpose Utility (SPUT) permit, during the winter quarter we were authorized to use only non-native species. Therefore, we used four species of non-native birds: European starlings (*Sturnus* *vulgaris*), house sparrows (*Passer domesticus*), rock pigeons (*Columbia livia*), and ring-necked pheasants (*Phasianus colchicus*). We classified bird size as follows: ≤100 grams (g) were classified as small, and >100 g were classified as large. As a result, European starlings and house sparrows, which average <100 g, were used to represent small birds, while rock pigeons and ring-necked pheasants, which are >100 g, were used to represent large birds. We conducted 21 carcass removal trials during the 2013-2014 winter season, using eight large carcasses and 13 small carcasses.

We conducted carcass removal trials in accordance with the Plan and applicable permits; however, we also added monitoring for any feather spots resulting from those placed carcasses that were left behind after scavenging. Because feather spots often persist for searchers to find long after scavenging, monitoring both feather spots and carcasses provides a more accurate measure of persistence.

2.1.3 Searcher Efficiency Trials

In accordance with the searcher efficiency trials described in the Plan, we placed 29 carcasses during the winter season using 15 small carcasses and 14 large carcasses in various vegetation heights and with various contrast to soil and vegetation to represent the range of conditions under which searches occur. One of the small carcasses disappeared (e.g., it may have been scavenged) before the searcher efficiency trial, leaving a sample size of 14 small and 14 large carcasses included in the trials.

2.1.4 Incidental Reporting

Some detections (defined as a dead or injured bat or bird) were outside standardized search areas, or were within search areas but not during standardized searches. Such detections were found by H. T. Harvey & Associates staff, the Project's designated biologists, or operational personnel. These detections, which were reported in accordance with the facility's Wildlife Incident Reporting System described in Section 3.4 of the Plan, were considered "incidental" detections. Thus, an "incidental detection" is a bird or bat found dead or injured in a time or place other than the standardized searches that are conducted according to the Plan. Data on such birds and bats were collected separately and reported in the SPUT permit database; as described in Section 2.1.5, incidental data in the tower area and along the fenceline were included in the fatality estimates.

2.1.5 Fatality Estimator

Animals die at an unknown rate which must be inferred from regular searches of a site. Carcasses also persist for varying amounts of time and are imperfectly detected by searchers. For these reasons, it is often inappropriate to draw conclusions based on the raw number of fatalities in an open system. The desire to estimate fatalities given these variables has driven the development of several fatality estimation statistical methods (e.g., see Johnson et al. 2003, Smallwood 2007, and Huso 2010). All of these fatality estimation methods share a similar underlying model. Generally, the fatality estimation for a given site may be written as:

$$F=C/rp,$$

where the number of fatalities, *F*, is the quotient of the number of carcasses detected, *C,* over the product of carcasses left unscavenged, *r*, and the proportion that an observer sees, *p* (Huso 2010).

The inputs for *r* and *p* are estimated in subgroups of covariates that will influence the detectability and persistence of each carcass, such as carcass size, vegetation height, and stage of decay or scavenging (i.e., feather spot versus carcass). Given the tendency for many fatality models to underestimate site-wide fatalities, we chose to use a fatality estimator written by M. Huso (2010), which was shown to outperform previous fatality estimation models by more accurately accounting for imperfect detectability. This model, *The Fatality Estimator*, was developed to estimate fatalities primarily for wind energy projects; however, it can be applied to other sources of fatalities including power lines and solar projects (Huso 2010). The estimator uses this conceptual framework of fatalities, combined with bootstrapping from models of *r* and *p* to calculate variances and confidence intervals for the estimates of fatalities. Bootstrapping is a statistical method used to create a distribution to assign measures of variance to estimates for data where the underlying distribution is either unknown or cannot be represented algebraically (Efron and Tibshirani 1986). Bootstrapping resamples the data with replacement, several thousand times, to create a distribution that may be used to infer information about the sample mean.

Estimating Carcass Removal Times. Measurements of carcass removal rates typically include one or more censoring values. A censoring value is used in statistics when a value is only partially known. For example, if a carcass was checked on day 7 and was present, and was checked again on day 10, but was found to be missing, then the date of scavenging is unknown, and an interval censor would be used. Because we used camera traps, the majority of scavenging times were known precisely, and the data was not censored. However, when cameras failed to record the moment of scavenging, we applied interval censoring.

There are four commonly used distributions of survival models that can be used in the fatality estimator for a value of *r:* exponential, Weibull, loglogistic, and lognormal. These four distributions have different rates and shapes of decay curves that attempt to model the survival of carcasses over a given search interval. We used Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) to rank the fit of each survival model to our carcass removal trial data. Because the time of death for detected fatalities is usually unknown, the probability of persistence cannot be calculated exactly for each carcass, but it can be estimated from the selected survival model and bootstrapped to obtain a range of estimates of *r* for each carcass.

Estimating Searcher Efficiency. Searcher efficiency, or the proportion of fatalities that an observer sees, p, is represented most simply by the following equation:

$$p = \frac{NumberObserved}{NumberAvailable}$$

Because the 2013-2014 winter season was the first season in which searcher efficiency trials were performed at Ivanpah, the sample size is not yet large enough to allow us to investigate the effects of variables such as bird size and vegetation cover, but we intend to look at these variables in future seasons as the sample size increases.

Making Estimates by Unit and Time. Because units became operational at different times, and thus searches were not performed over the entire season at all three units, it was not possible to run a site-wide estimate of fatalities for the entire season. Instead, we ran a site-wide estimate for the period that all three units were searched (27 January – 21 March), and we ran estimates for the precursory periods (prior to 27 January) individually for Units 1 and 3, which became operational prior to Unit 2. We ran an estimate for the tower area components (i.e., the power block and inner HD heliostat areas) together, because 100% of this area was searched, and we ran a separate estimate for the heliostat area, in which 20% of the total area was searched. Further, these two areas represent different habitats and they have different risks to birds and bats. Note that no detections prior to the start of standardized surveys in a given unit (e.g., detections during clearance surveys or incidental detections before standardized surveys began) could be included in the fatality estimator, which is designed to estimate fatalities from standardized surveys.

The ACC units are only marginally accessible to scavengers from the outside; therefore, they act primarily as a closed system with a scavenging rate that approaches zero. Because of this, we did not use the fatality estimator equation to determine the numbers of fatalities at the ACC units; rather, we included the raw numbers, which we believe are representative of the fatality population within the ACC units, in the overall fatality estimates for the tower area.

Within the tower area and along the fenceline, a large percentage of the detections were found incidentally. Incidentals are typically not included in fatality estimates due to the sporadic, unpredictable nature of such reports and unaccounted for search effort. However, because these detections accounted for such a large proportion of the detections recorded during the 2013-2014 winter season, we included them in our estimate for the power block and the fenceline. We adjusted the search interval for incidental detections on the power block to one day to reflect the high human use in these areas and thus the high probability that monitoring or operational personnel would see and report any highly visible fatality in these areas. Because of the carcass removal policies within the power block, no carcass removal trials were conducted during the winter period. Rather, carcass removal values for the other project areas were pooled and averaged and the mean carcass removal rates were used for this first winter period. Search intervals for incidental detections in the inner HD areas consisted of the time since the previous fatality survey in those areas.

Because the fatality estimator is not appropriate for estimating rare events, we only present estimates for project elements or groupings of more than 5 detections. The fatality estimator accounts for imperfect searcher efficiency, so fatalities that are not detected during a given search are still represented statistically. However, because of this, if a previously missed fatality is detected on a subsequent search, it will essentially be double-counted, and cause the overall fatality estimate to be falsely inflated. Therefore, any detections determined to be significantly older than the search interval were removed from the estimator (Huso 2010).

2.2 Avian Use Monitoring

This section describes the methods for monitoring of use of the solar plant and nearby desert areas for avian use, as well as the methods for monitoring occurrence of raptors and other large birds on and around the facility. More than 93 hours of field observation time for avian use surveys and 224 hours of field observation time for raptor/large bird monitoring were performed during the 2013-2014 winter season.

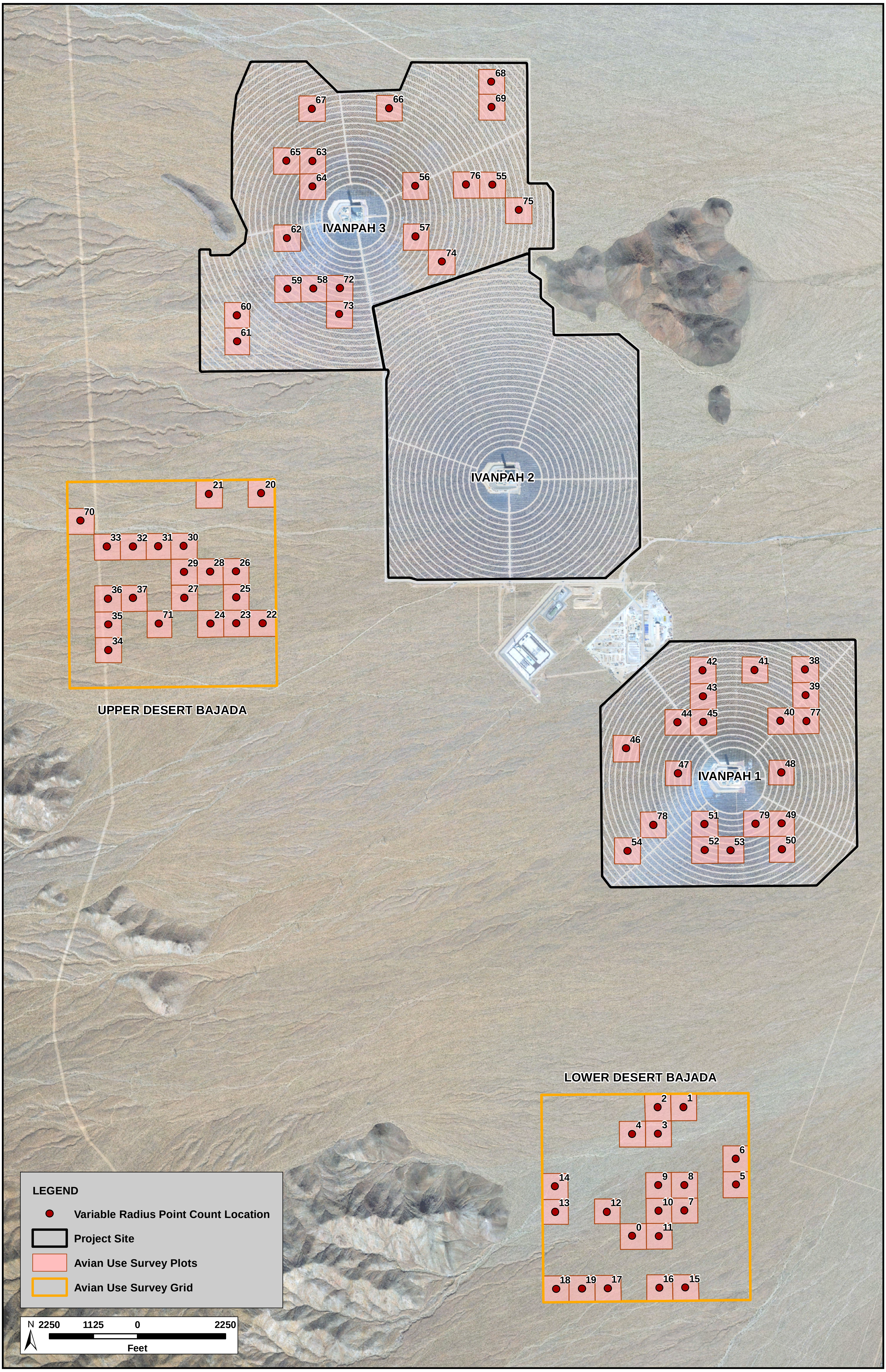
2.2.1 Avian Monitoring Surveys

Avian use surveys were conducted using standard, variable-radius point counts to assess bird use of the vegetated areas within the heliostat fields and nearby offsite areas within desert habitats. The 80 survey points identified in the Plan, and shown on Figure 4, were surveyed a total of seven times each during the winter period by a CEC and BLM-approved avian ecologist.

According to the text of the Plan, these 80 points were to be randomly selected from within the following five study 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 fence line.
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 located in Unit 3, in the upper bajada portion of the facility.
5. 20 points within an approximately 2.59 square-kilometer offsite study area located in comparable upper bajada environment and as far as practicable from (and southwest of) the Unit 3 fence line.

Our 2013-2014 winter season surveys were conducted according to Figure 8 of the Plan, which depicts 20 points in Unit 3 and zero in Unit 2; thus, the points we surveyed during the winter season are depicted on Figure 8 of the Plan and Figure 4 of the current report. Habitat differences are minor between Units 2 and 3, and therefore we believe that the 20 points in Unit 3 are representative of habitat conditions in both Units 2 and 3. Nevertheless, we will adjust our approach for surveys starting in summer 2014 to reflect the text of the Plan by randomly selecting 10 of the 20 points in Unit 3 that we surveyed in the 2013-2014 winter season, excluding those from future surveys, and randomly selecting 10 points within a grid in Unit 2 for surveys.



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 4 Avian Use Monitoring Survey Locations.mxd

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Figure 4: Avian Use Monitoring Survey Locations
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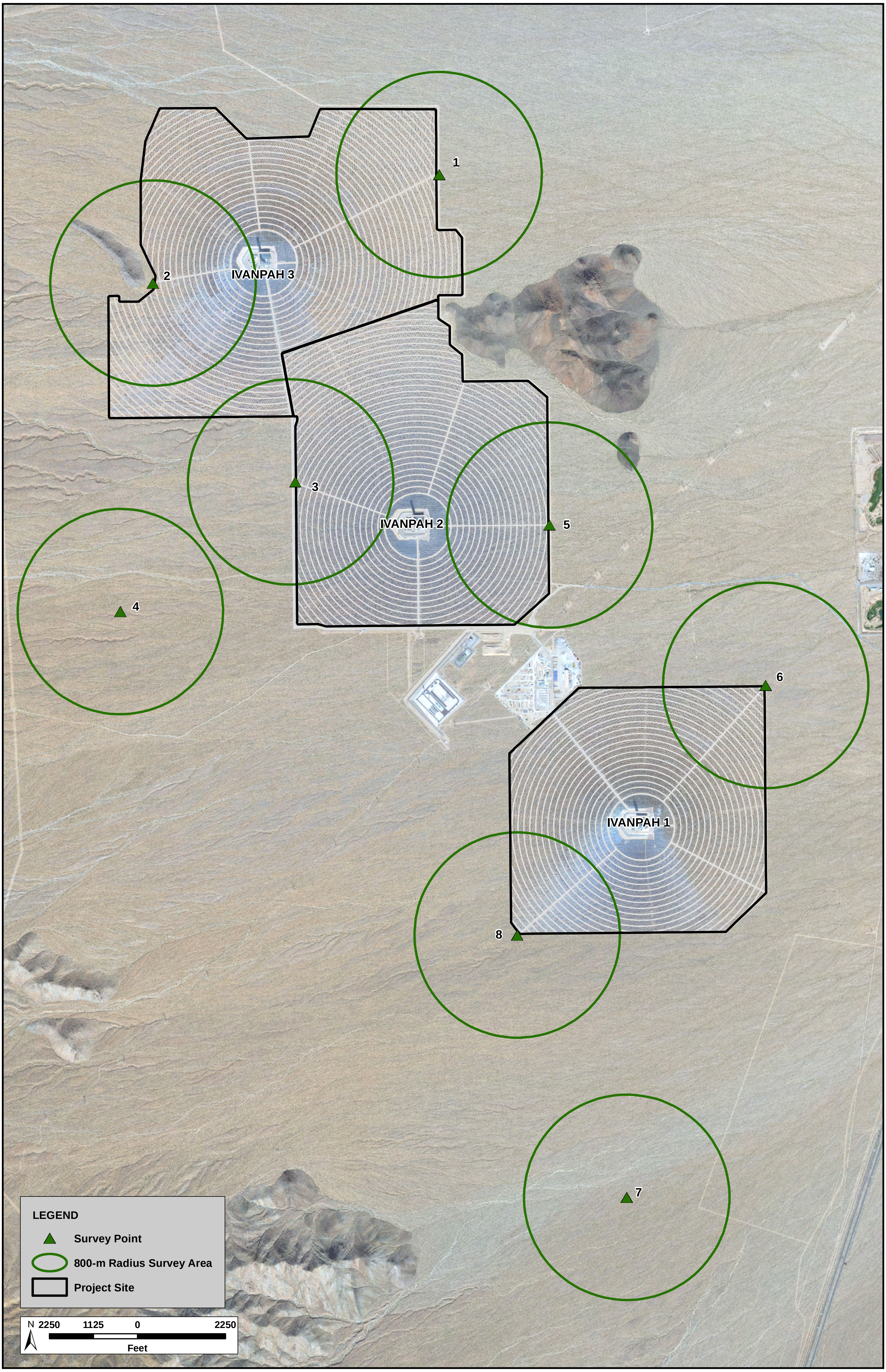
Each of the areas described above was gridded into 200-m by 200-m square areas to define distinct sample plots. Within each study area, the 20 avian use survey points were randomly selected from the sample plots, resulting in 20 point counts per 2.59 square kilometer for each habitat type in the facility and control areas, with each count location affording a minimum, non-overlapping survey radius of 100 m.

The Plan specifies that avian use surveys are to be conducted once per month during December-February and twice per month during the periods September-November and March-May. In accordance with this schedule, we conducted a total of seven surveys (two in November, one each in December, January, and February, and two in March) for the 2013-2014 winter season.

Using distance-sampling techniques such as variable-radius point count methods, determination of bird densities is not as straightforward as simply calculating the mean number of individuals observed in each survey area (Buckland et al. 1993). Rather, the density distributions of the survey data (i.e., assessing density as a function of distance from each point) have to be considered in determining densities. Determining such density distributions typically requires a fairly large amount of data, especially when using programs such as Distance 6.0 (Thomas et al. 2010) to estimate bird densities. Due to the low number of individuals of any given species recorded during these surveys (owing to the naturally low abundance of winter birds in the habitats surveys), it was not possible to obtain reliable density estimates on a species-by-species basis for the 2013-2014 winter season. 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 one 20-point heliostat grid and the other, or between on 20-point desert habitat control grid and the other). However, when data from the 40 heliostat points were pooled, and data from the 40 desert points were pooled, overall sample sizes for the heliostat arrays vs. the offsite desert habitats were large enough to provide reliable density estimates in each of these general habitat types using the program Distance 6.0. These comparisons are appropriate per the Plan, which states that avian use studies will concentrate on species composition and abundance, with a focus on comparison between the on- and offsite areas.

2.2.2 Raptor/Large Bird Monitoring Surveys

Surveys for raptors and other large birds were conducted from each of eight points as identified in the Plan and shown on Figure 5. These surveys were conducted using unlimited-distance point counts to assess use of the facility and offsite study areas. CEC and BLM-approved avian ecologists performed these surveys using binoculars and spotting scopes to identify raptors and other large birds, such as gulls (*Larus* spp.) and common ravens (*Corvus corax*) observed during a 4-hour survey period. The Plan specifies that surveys for raptors and other large birds be conducted twice per month during winter; therefore, we conducted a total of seven surveys during the winter season.



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 5 Raptor and Large Bird Use Monitoring Survey Locations.mxd

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Figure 5: Raptor and Large Bird Use Monitoring Survey Locations
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Section 3.0 Monitoring Results

3.1 Avian and Bat Detections

The following section describes the basic descriptions and distributions of the detection data. The summary provides the numbers and species list of these detections. Bird and bat detections are also described by their temporal distribution, their migratory or residency status, and by foraging guild.

3.1.1 Summary of Avian and Bat Detections

During the period 29 October 2013 – 21 March 2014, a total of five injured birds, and five bat fatalities and 91 avian fatalities, were detected. The species detected were made up of 30 avian species and four bat species. Mourning doves (*Zenaida macroura*) and unidentified feather spots collectively comprised 30% of the avian detections. The total number of detections is listed by species in Table 2 below. Appendix A includes additional data on these birds and bats. Figures 6, 7, 8, and 9 depict the locations of the bird detections in Units 1, 2, and 3, and outside the units, respectively.

Table 2. Number of Individual Bird and Bat Detections, by Species, 29 October 2013 – 21 March 2014.

Common Name	Scientific Name	Species Code*	No. of Injuries	No. of Fatalities
Birds				
Mourning Dove	*Zenaida macroura*	MODO		19
Unidentifiable feather spot		UNKN		8
Yellow-rumped Warbler	*Setophaga coronata*	YRWA		8
Anna's Hummingbird	*Calypte anna*	ANHU		7
Greater Roadrunner	*Geococcyx californianus*	GRRO		6
American Kestrel	*Falco sparverius*	AMKE		4
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL		4
Western Meadowlark	*Sturnella neglecta*	WEME		3
American Pipit	*Anthus rubescens*	AMPI		3
Costa's Hummingbird	*Calypte costae*	COHU		3
Great-tailed Grackle	*Quiscalus mexicanus*	GTGR	1	3
American Coot	*Fulica americana*	AMCO		2
Unknown Blackbird		Blackbird sp.		2
House Finch	*Haemorhous mexicanus*	HOFI		2
Northern Flicker	*Colaptes auratus*	NOFL		2
Rock Pigeon	*Columba livia*	ROPI		2
Black-and-white Warbler	*Mniotilta varia*	BWWA		1
Black-throated Sparrow	*Amphispiza bilineata*	BTSP		1
Cactus Wren	*Campylorhynchus brunneicapillus*	CACW		1
Common Yellowthroat	*Geothlypis trichas*	COYE		1
Horned Lark	*Eremophila alpestris*	HOLA		1
Loggerhead Shrike	*Lanius ludovicianus*	LOSH		1
Savannah Sparrow	*Passerculus sandwichensis*	SASP		1
Say's Phoebe	*Sayornis saya*	SAPH		1
Spotted Sandpiper	*Actitis macularius*	SPSA		1

Townsend's Warbler	*Setophaga townsendi*	TOWA		1
Western Tanager	*Piranga ludoviciana*	WETA		1
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP		1
White-throated Swift	*Aeronautes saxatalis*	WTSW		1
Common Loon	*Gavia immer*	COLO	1	
Common Raven	*Corvus corax*	CORA	2	
Double-crested Cormorant	*Phalacrocorax auritus*	DCCO	1	
Bats				
California Myotis	*Myotis californicus*			1
Western Small-footed Bat	*Myotis ciliolabrum*			1
Canyon Bat	*Parastrellus hesperus*			1
Pallid Bat	*Antrozous pallidus*			1
Bat sp.				1

* Species code refers to the code (usually a four-letter designation) by which the bird species are referred on Figures 6-9.

3.1.2 Avian Detections by Temporal Occurrence Group and Foraging Guild

To provide information on how birds recorded as detections might use the Ivanpah site, both temporally (i.e., during which seasons and for what duration) and in terms of the resources on the site that birds could utilize, we categorized all bird detections by temporal occurrence group and foraging guild.

3.1.2.1 Avian Detections by Temporal Occurrence Group

Avian detections were categorized as representing one of four temporal occurrence groups, as follows:

- Permanent residents – species that are present in the Ivanpah Valley year-round
- Breeding-season residents – species that are present in the Ivanpah Valley only during the breeding season and during migration between breeding and wintering areas but which generally do not winter here (or are very rare in winter)
- Nonbreeding-season residents – species that are present in the Ivanpah Valley only during the nonbreeding season and during migration between breeding and wintering areas but which do not occur here during the breeding season
- Transients – species that are present in the Ivanpah Valley only during migration between breeding and wintering areas

Bird species were categorized according to these groups based on published and Internet information regarding their breeding and wintering ranges, and our knowledge of their breeding and wintering ranges.

Species that are permanent residents in the Ivanpah Valley accounted for 66.7% of the total detections on the site during the 2013-2014 winter season (Figure 10), with nonbreeding-season residents accounting for 15.6% of total detections. The only breeding-season resident species detected was Costa's hummingbird (*Calypte costae*), which begins breeding in the Ivanpah area in late winter; Costa's hummingbird detections represented 3.1% of all detections. The remaining detections represented transient species (6.3%) and remains (often limited feather spots) that could not be identified to species (8.3%). Figure 11 indicates the temporal

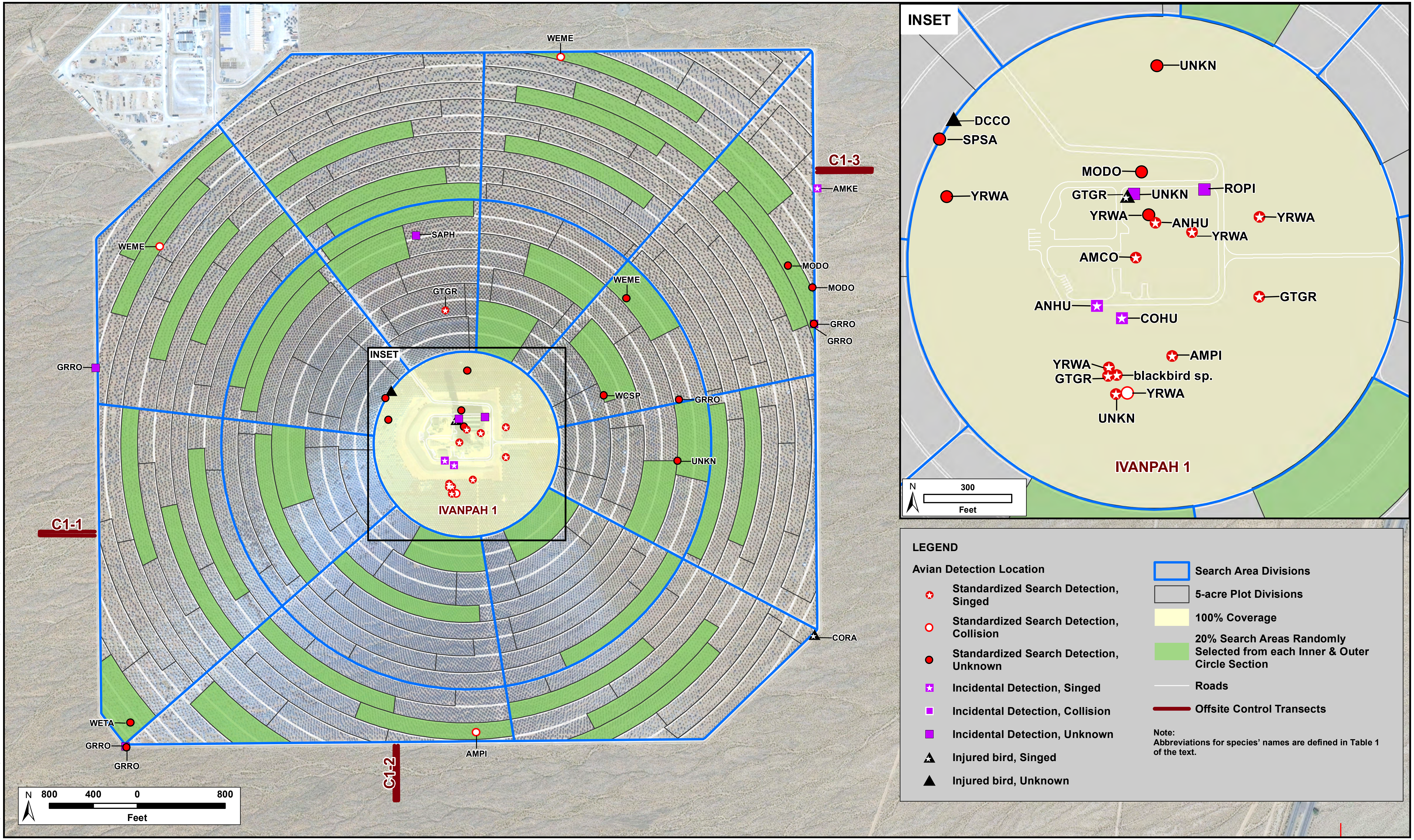

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Figure 6: Ivanpah 1 Detections

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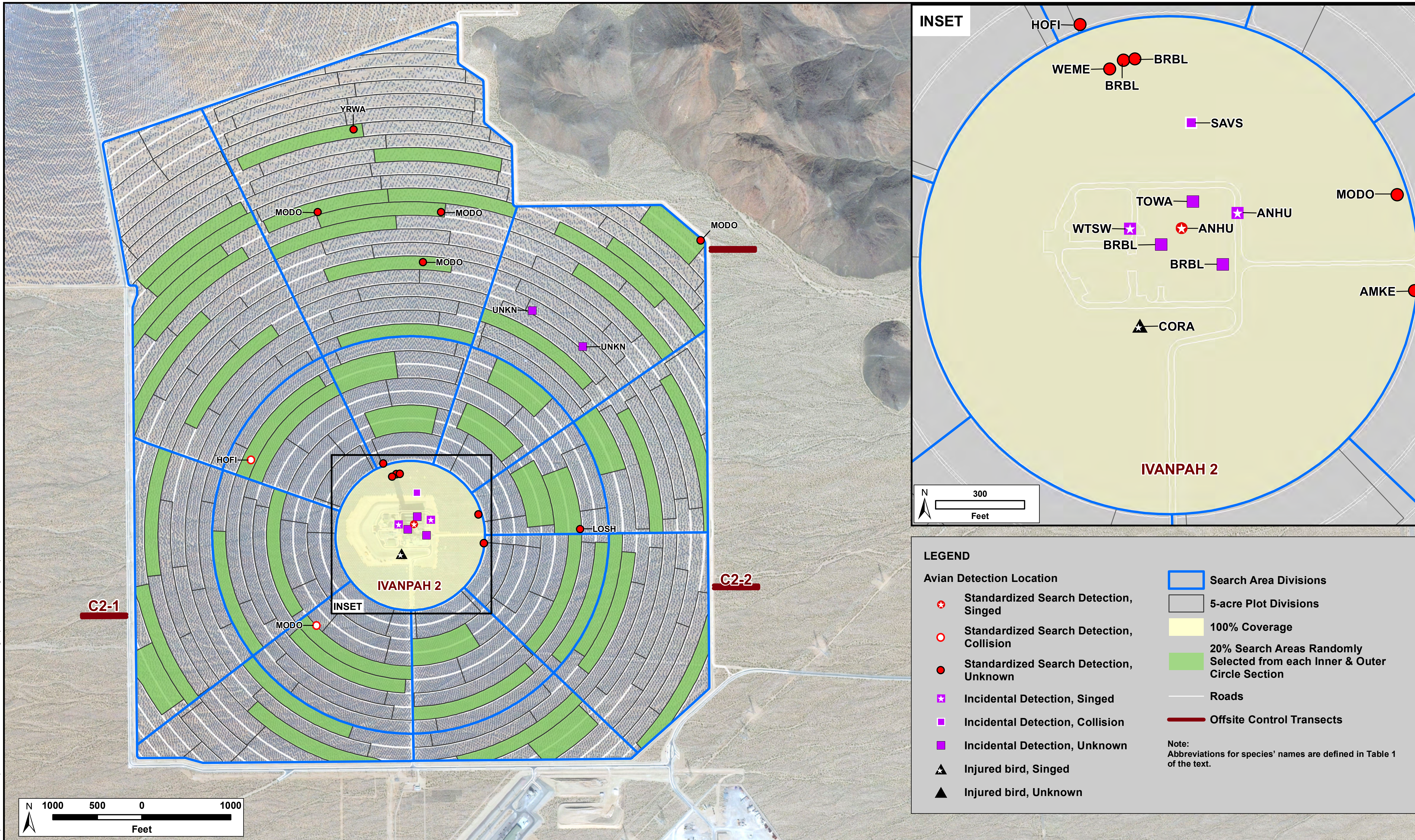

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Figure 7: Ivanpah 2 Detections

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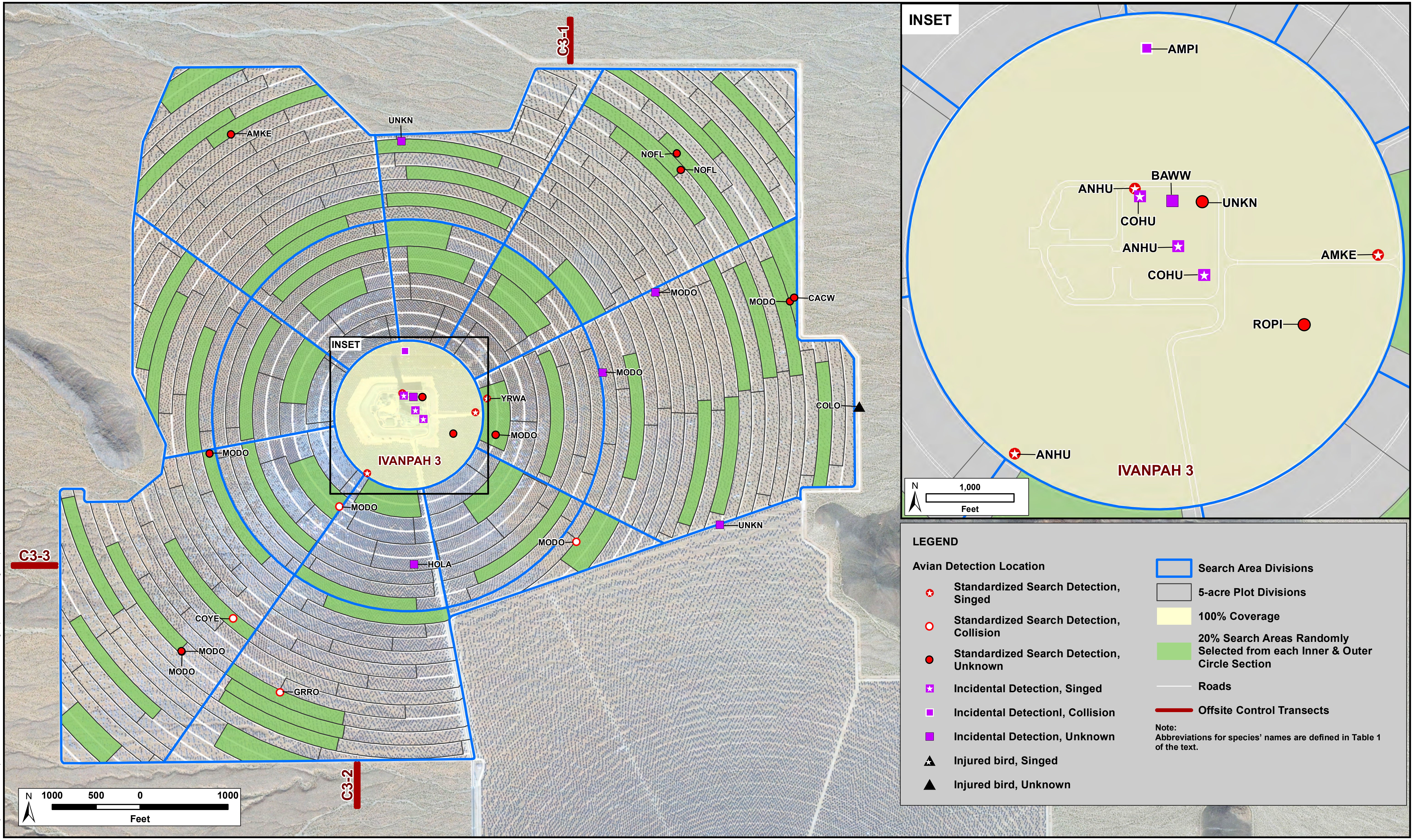

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Figure 8: Ivanpah 3 Detections

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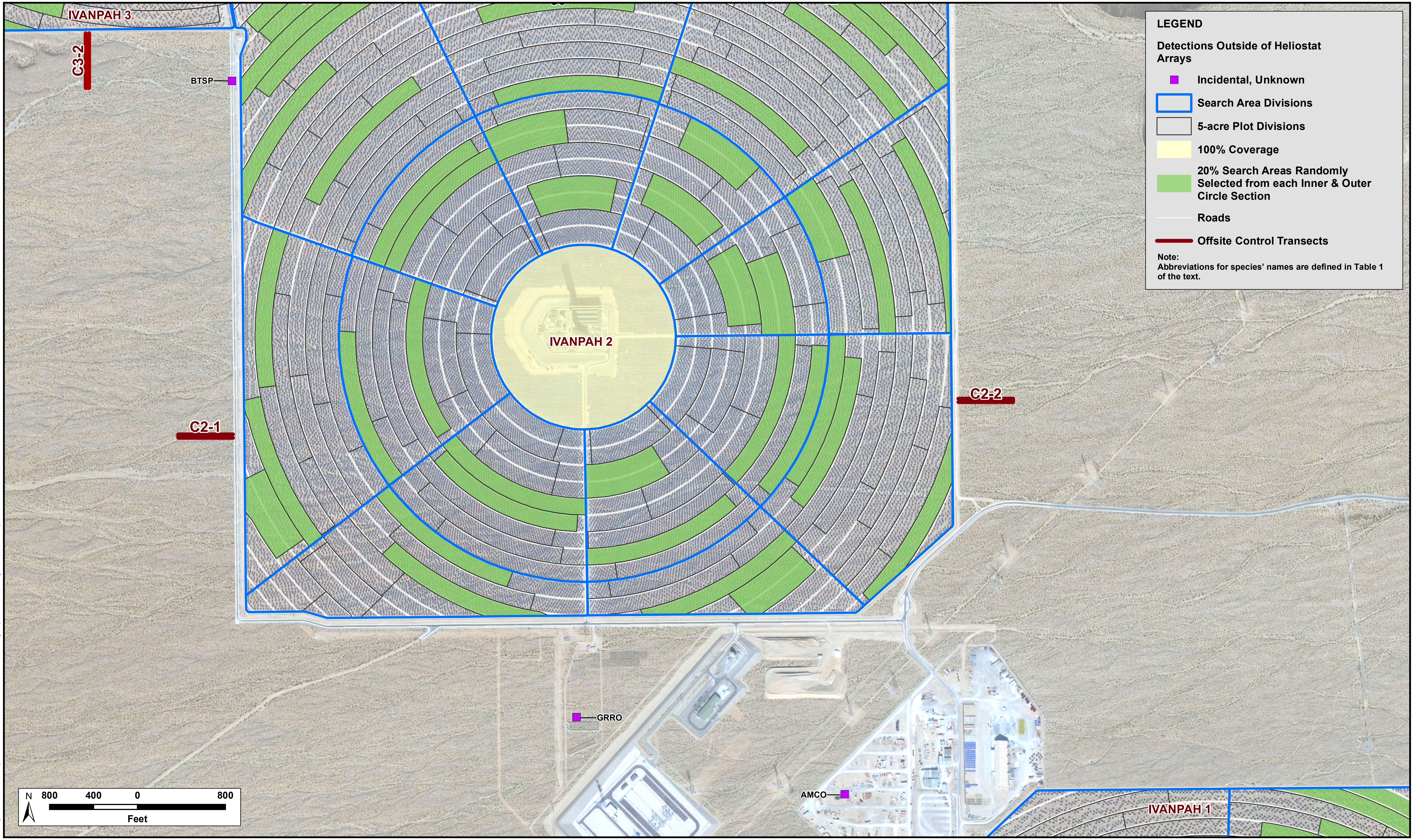

N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 9 Incidental Ivanpah Detections Found Outside of Solar Units.mxd

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Figure 9: Incidental Ivanpah Detections Found Outside of Solar Units

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Figure 10. Percent of Detections in Each of Five Temporal Occurrence Groups.

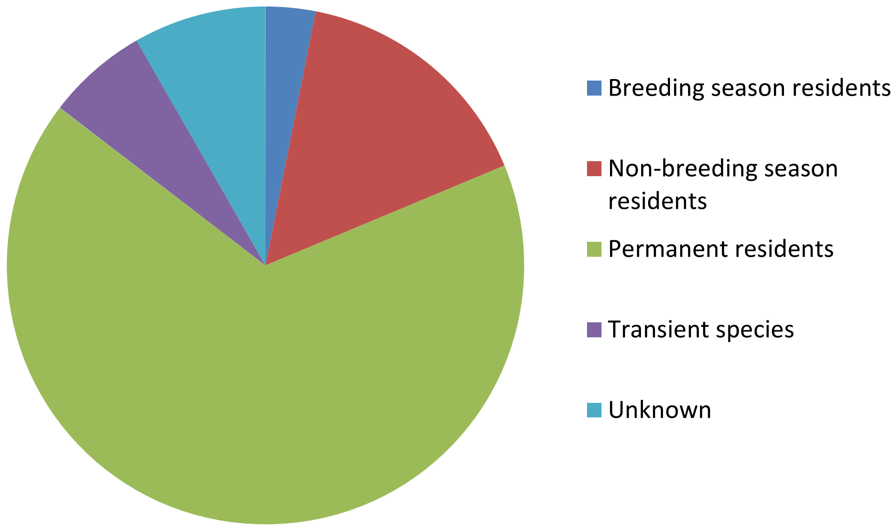
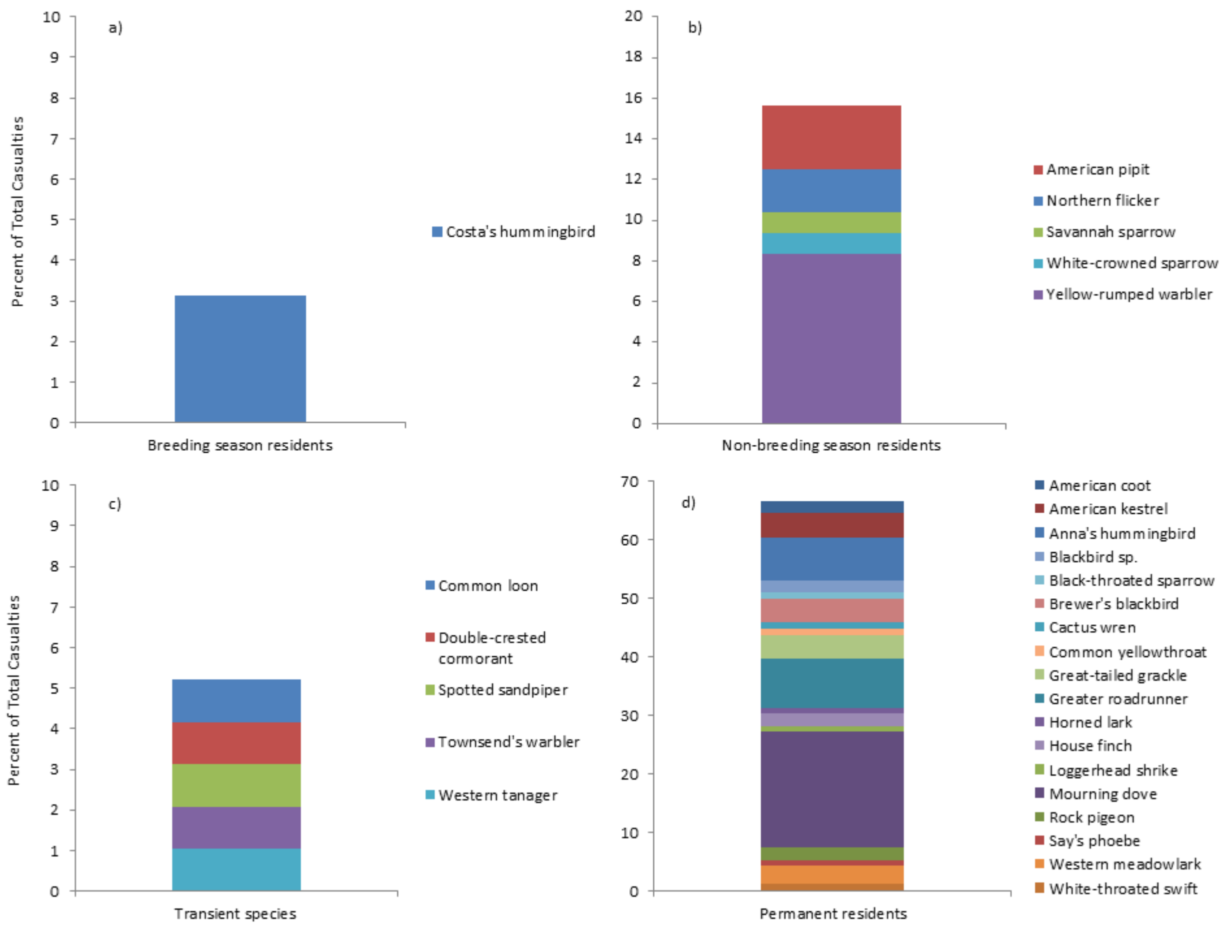


Figure 11. Percent of Detections Belonging to Individual Species by Temporal Occurrence Groups. Panels show: a) breeding-season residents, b) nonbreeding-season residents, c) transient species, and d) permanent residents. Unknown passerines are not shown.



occurrence groups to which each species was assigned and depicts the percentage of total detections represented by each species.

Because the commencement of operations among the units was phased, survey effort increased from 29 October 2013, when the winter period began, until 27 January 2014, when surveys were being conducted at equal effort in all three solar units. As a result, any temporal patterns in the abundance of detections would be masked by unequal survey effort. In addition, the numbers of detections during any particular survey period remained relatively low and varied little through the season. With the exception of eight detections recorded at Unit 1 on 30 October 2013, the only dates on which four or more detections were recorded were 25 November 2013 (five detections), 20 December 2013 (four detections), and 21 March 2014 (four detections). Thus, there was no obvious temporal clumping of detections recorded during the winter season, and no analysis of temporal patterns could be performed.

3.1.2.2 Avian Detections by Foraging Guild

We also categorized all detections within the search area by foraging guild, with all waterbirds lumped into one "waterbird" category. As indicated in Figure 12, obligate and facultative granivores (i.e., birds that eat seeds most or all of the time) accounted for the largest percentage of detections. Waterbirds accounted for the smallest percentage of detections, with just four individuals detected during the 2013-2014 winter season. Figure 13 indicates the foraging guilds to which each species was assigned and depicts the percentage of total detections represented by each species.

Figure 12. Percent of Total Detections in Each of Seven Foraging Guilds.

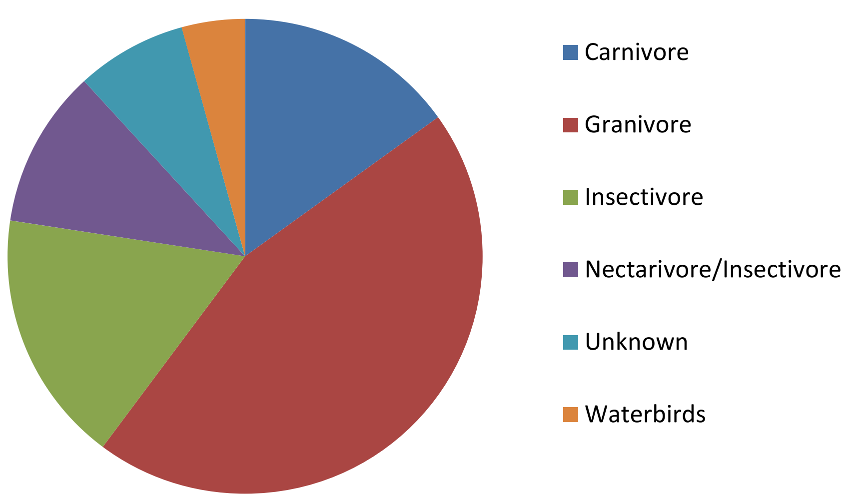
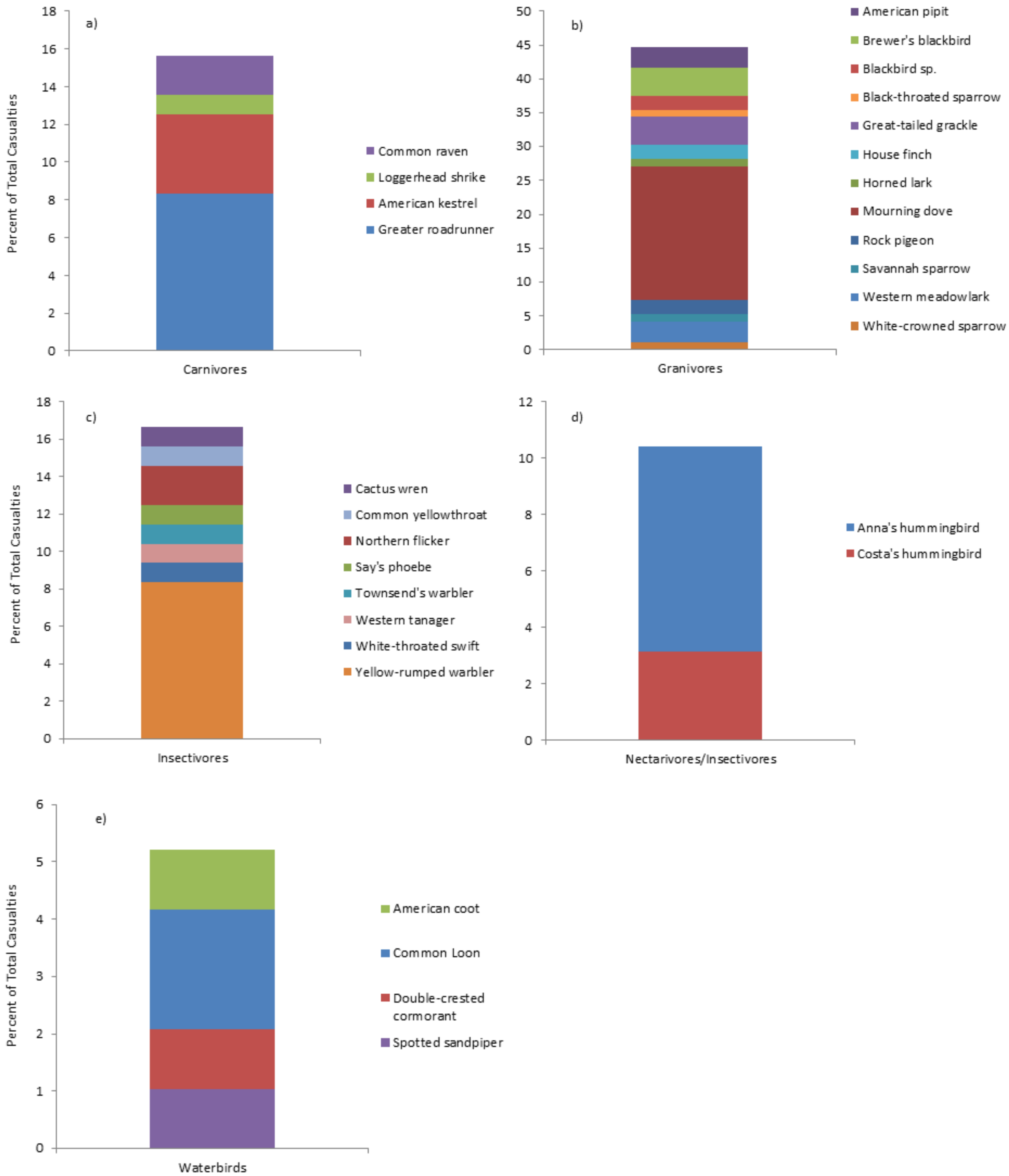


Figure 13. Percent of Detections Belonging to Individual Species by Foraging Guild. Panels show: a) carnivores, b) granivores, c) insectivores, d) nectarivores/insectivores, and e) waterbirds. Unknown passerines are not shown.*



* In panel "b", granivores include species that are granivorous in the winter and insectivorous in the summer. In panel "a", common ravens are grouped with carnivores although they may also act as scavengers. In panel "c", white-throated swifts are aerial insectivores, while all other listed species are terrestrial insectivores.

3.1.3 Injured Birds

Five injured birds were detected during this reporting period. A common loon (*Gavia immer*) was detected with minor foot abrasions and cholla cactus spines in its foot and breast on 29 October. On 30 October, a great-tailed grackle (*Quiscalus mexicanus*) was detected with singed feathers indicating flux effects. On 7 March, a common raven was detected with flux effects present on its primaries, secondaries, and tail feathers. On 17 March, a second common raven was detected along the fence to Unit 1 with signs of flux effects on its wings, tails, and body contour feathers. On 19 March, a double-crested cormorant (*Phalacrocorax auritus*) with no external injuries was detected on the berm of Power Block 1. With the exception of the common loon and double-crested cormorant, both of which were cared for and released at the Primm Valley Golf Course, all injured birds detected during this reporting period were transferred to a wildlife rehabilitation center on the same day they were detected.

3.1.4 Foraging Guilds and Spatial and Temporal Distribution for Bats

Five bat detections representing four species (California myotis [*Myotis californicus*], western small-footed bat [*Myotis ciliolabrum*], canyon bat [*Parastrellus hesperus*], and pallid bat [*Antrozous pallidus*]) were detected during this reporting period (Table 3). All bat detections were within or immediately adjacent to the ACC buildings. The California myotis, western small-footed bat, and canyon bat are high-frequency emitting bats that typically forage aerially in close proximity to cluttered habitats (i.e., near shrubs, trees, and other objects). The pallid bat typically gleans non-flying prey from the ground, but it can also forage aerially (Johnston and Fenton 2001). All four species are year-round residents.

Table 3. Summary of Bat Fatalities, 29 October 2013 – 21 March 2014.

Species	Date	Location
California Myotis	3/3/14	Unit 2 ACC
Western Small-footed Bat	2/3/14	Unit 2 ACC
Canyon Bat	1/2/14	Unit 3 ACC
Pallid Bat	11/26/13	Unit 3 ACC
Bat sp.	1/27/14	Unit 3 ACC

3.1.5 Incidental Fatalities

A total of 30 incidental avian detections and one incidental bat detection were recorded during this quarter. Twenty-seven of these avian detections and the bat detection were within the solar units (Figures 6, 7, and 8). The other three detections were in areas of the Project site outside of the solar units, including a desert kit fox (*Vulpes macrotis arsipus*) shelter site, a desert tortoise (*Gopherus agassizii*) pen, and the entrance road to Unit 3 (Figure 9).

3.1.6 Fatalities Found During Standardized Searches

During the course of 2013-2014 winter season standardized searches, searchers found 61 bird detections and five bat detections (Figures 6, 7, and 8). Feathers from two detections (2014-14-Ivanpah and 2014-30-

Ivanpah) found during regularly scheduled searches were previously detected incidentally on 20 November 2013 and 25 November 2014 and documented as 2013-84-Ivanpah and 2013-88-Ivanpah. During preparation of this report, it was discovered that in each case, these detections were double counted. Because all four incidents have been reported in to the Ivanpah SPUT report, we are including mention of both duplicate incidents in this report. However, only the two incidental detections originally found in November 2013 will be used in the fatality estimate, in order to avoid inflating the estimate. The outcome was that the total number of avian detections during regularly scheduled surveys was 61 individuals.

3.2 Locations of Avian Detections

As indicated in Table 4, 48 detections (50%) were in the relatively limited tower area. This 260-m radius area consisted of the area that was searched with 100% coverage due to proximity to the towers. Thirty-nine detections (40.6%) were detected over the much larger area composed of the inner and outer heliostats. Otherwise, detections were only along the fenceline (6.3%) and on Project lands outside the standardized search areas, such as a kit fox shelter site, a desert tortoise pen, and the entrance road to Unit 3 (Figure 9). No detections were noted within the survey areas associated with the Unit 3 Collector Line or the offsite control areas.

Table 4. Locations of Bird Detections, 29 October 2013 – 21 March 2014.

Location	No. of Injuries	No. of Fatalities
Power Block	3	21
Inner HD Heliostats	0	24
Inner Heliostat Segments	0	11
Outer Heliostat Segments	0	28
Perimeter Fence	2	4
Unit 3 Collector Line	0	0
Offsite Control Areas	0	0
Other Project Lands	0	3

Of the 93 detections within the solar units, 39 (41.9%) were detected in Unit 1, 24 (25.8%) in Unit 2, and 30 (32.3%) in Unit 3. Because the commencement of operations among the units was phased, unequal survey effort was applied to the three units. The relative number of total detections in the three units reflects the relative duration of operations and the relative number of searches performed during the 2013-2014 winter season, with Unit 1 operational (and surveyed) the longest and Unit 2 operational (and surveyed) for the shortest duration. During the period in which all three units were operational and being surveyed with equal effort (i.e., 27 January – 21 March 2014), detections numbered 10 in Unit 1, 16 in Unit 2, and 17 in Unit 3. Due to the brevity of the period in which all three units were operational and being surveyed, the relatively low numbers of detections recorded during that period, and the relatively low differences in numbers of detections among units during that period, no meaningful conclusions could be drawn from relative abundance of detections among the units during the 2013-2014 winter season.

3.3 Cause of Injury or Fatality

3.3.1 Solar Flux Effects

Of the 96 avian detections during the 2013-2014 winter season, 24 fatalities and three injured birds (28.1%) showed signs of singed feather damage from flux effects. Nine were large birds (>100 g) and 18 were small birds. Table 5 indicates the number of detections in various parts of the Project site with and without evidence of flux effects.

Table 5. Locations of Flux and Non-Flux Related Bird Detections, 29 October 2013 – 21 March 2014.

Location	No. of Detections with Evidence of Flux Effects	No. of Detections without Evidence of Flux Effects
Power Block	14	9
Inner HD Heliostats	9	13
Inner Heliostat Segments	2	12
Outer Heliostat Segments	0	28
Perimeter Fence	2	4
Unit 3 Collector Line	0	0
Offsite Control Areas	0	0
Other Project Lands	0	3

Figure 14 depicts the total number of detections involving evidence of singeing, evidence of confirmed collision, and unknown cause of injury or death by distance from the power towers. Detections with an "unknown" cause of injury death refer to those for which there was no evidence of singeing (e.g., charring, curling, or melting of feathers) or collision (e.g., obvious physical trauma or detection adjacent to a heliostat with a bird-strike imprint and/or feathers on the heliostat). Figure 15 provides these results for each of the three Project units. Figure 16 provides an overview of the geographic locations of each singed and unsinged detection within the solar units. For all three of these figures, the three incidental detections outside the solar units (none of which were singed) are not shown so that these figures focus on the solar units themselves.

Figure 14. **Number of Detections Associated with Flux Effects or Collisions and Unknown Injury/Fatality Sources by Distance from Towers. (Note: the two singed birds more than 1100 m from the towers included an injured common raven and an American kestrel feather spot.)**

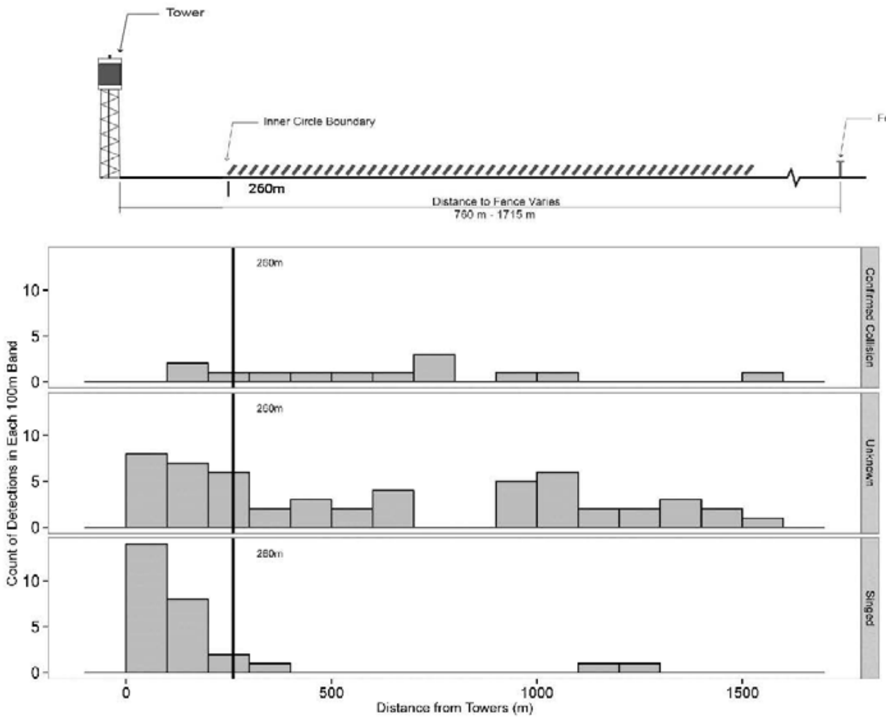
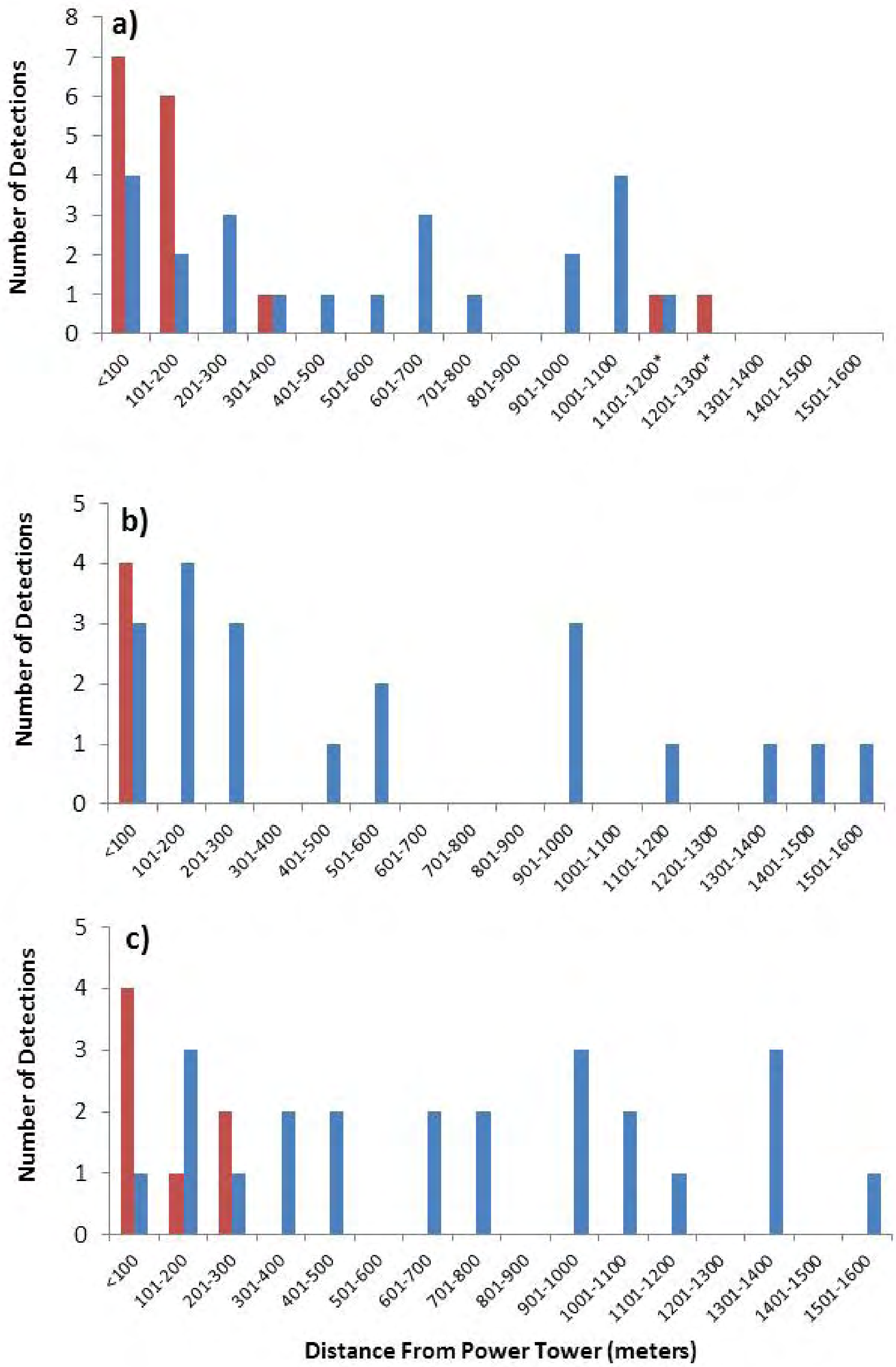
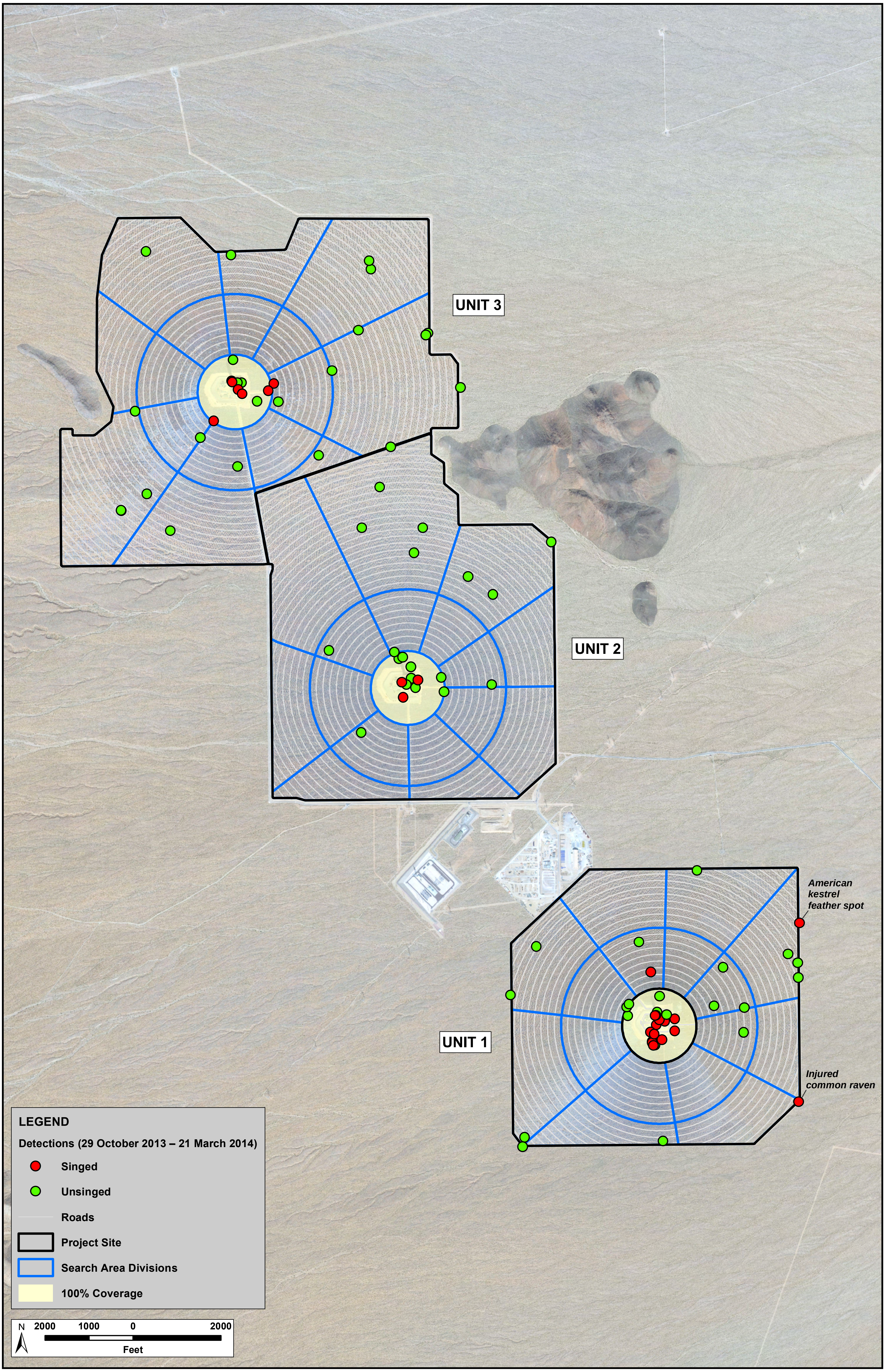


Figure 15. **Number of Total Detections Showing Evidence of Flux Effects or Not in Each Heliostat Unit. Panels show: a) Tower 1, b) Tower 2, and c) Tower 3. Detections are grouped by distance (100-m intervals) from each power tower and by flux effects (red) or collision/unknown (blue).**



* In panel "a", flux-related detections between 1101-1200 m and 1201-1300 m were found along the fenceline.



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Ecological Consultants

Figure 16: Locations of Singed and Unsinged Detections within Solar Units

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As indicated by these data, the vast majority of detections showing evidence of flux effects were detected close to the towers. Twenty-three (85.2%) of the 27 flux-related detections were within the tower area. The other four flux-related detections included two in the inner heliostat segments not far outside the inner HD areas and two located along the eastern perimeter fenceline at Unit 1 (Figure 16). The fenceline detections consisted of a feather spot, which could have been deposited by a predator, and an ambulatory injured bird. These results suggest that flux-related mortality occurs in the immediate vicinity of the high-density flux fields around the towers, with relatively fewer flux-affected individuals flying longer distances from the towers. We did not analyze correlations between flux-related detections and periods when fluxing occurred during the winter season because the relatively low number of flux-related detections precluded our ability to correlate flux production with fatality frequency.

3.3.2 Collisions and Other Non-Flux Effects

Of the 96 detections, evidence of collisions was observed in the case of 14 (14.6%). The evidence that was used to classify these detections as collisions was proximity to heliostats that had smudge marks, body imprints, and/or feathers on or near the surface of the mirror. Heliostats were not always in positions where looking for such evidence on the mirrors themselves was possible (e.g., at times, the heliostats were stored in horizontal positions during the standardized searches, making it impossible to see the mirrors' surfaces), and thus in the case of some detections within the heliostat arrays, it was not possible to look for evidence of collisions with mirrors. For these reasons, and because birds are known to collide with other types of structures (e.g., buildings, wires, fenceline, etc.) that may not leave direct evidence of collisions, the percentage of detections resulting from collisions may be higher than 14.6%.

Two of these 14 collision-related detections were not associated with Project structures. A black-throated sparrow (*Amphispiza bilineata*) found dead on the road near the entrance to Unit 3 may have been struck by a vehicle, or it could possibly have struck the Unit 3 Collector Line. Although the injured common loon detected along the fenceline on the east side of Unit 3 was considered a collision-related detection, its injuries showed evidence of impacts from landing in the desert, not from collision with Project facilities.

Aside from the 14 detections where evidence of collision was noted and the 27 detections with evidence of flux effects (discussed below), the cause of injury or mortality for the remaining 55 detections (60.4%) is not known with certainty, and no obvious evidence of mortality was observed for these detections.

Thirty-eight (39.6%) of the 96 detections consisted only of feather spots; 30 of these feather spots were identifiable to species, and eight were not identifiable. While evidence of flux effects was noted on 11 of these 38 feather spots, and evidence of collision was noted in the case of five other feather spots, the cause of the feather spot for the other 22 birds is unknown. Some of these 22 feather spots may have represented fatalities (collision) that had been scavenged, in which case they would legitimately be considered Project-related detections. However, they may also have represented natural predation events associated with desert kit foxes, common ravens, or raptors; in that case, such feather spots would not represent Project-related detections. In addition, in some cases, multiple feather spots may result from one fatality, over-representing the number of fatalities. Nevertheless, all feather spots meeting minimum criteria (i.e., ≥ 10 feathers of any type, ≥ two primary feathers, or five or more tail feathers within an area 1 m^2 or smaller [Smallwood 2007], or any skin, flesh, or bone attached to feathers) were recorded as detections

As indicated in Table 6, the ratio of feather spots to carcasses was substantially lower in the power block than in other parts of the site. It is possible that this finding results from the rapidity with which carcasses around the tower are detected by people, so that there is less time for scavenging that would result in feather spots. Feather spots around the relatively open power block may also be removed by the wind more easily than in the rest of the solar field. Alternatively or in combination with these factors, it could result from the relocation of power block carcasses by scavengers. On several occasions, common ravens were observed flying away from the power block carrying carcasses; ravens may do this to avoid eating scavenged carcasses in areas of high human activity, such as the power block.

Table 6. Ratios of Feather Spots to Carcasses Relative to Site Locations.

	No. of Detections			
Location	Total	Feather Spots	Carcasses	Feather Spot : Carcass Ratio
Power Block	24	2	22	1 : 11
Inner HD Heliostats	24	14	10	1 : 0.7
Inner/Outer Heliostat Segments	39	18	21	1 : 1.2
Perimeter Fence	6	4	2	1 : 0.5

No evidence of collisions or other detections occurred along the Unit 3 Collector Line or in the offsite control areas (although as noted above, a black-throated sparrow found dead on the road near the entrance to Unit 3 could have struck the Collector Line).

None of the bat detections showed evidence of flux effects; this result is expected because bats would rarely fly during the daytime when flux is being produced. All of the bat detections were in or near the ACC units, but the cause of death for these bats remains unknown.

Section 4.0 Fatality Estimation

This section utilizes the detection data as described in Section 3 to develop an overall fatality estimate in accordance with the Plan. The estimates of carcass removal rates and searcher efficiencies are derived and subsequently utilized in the model with the detection data to provide estimates for the facility areas as required in the Plan. The areas for which estimates are provided include the tower area, heliostats, and fenceline. The total estimate for the entire facility is then presented.

4.1 Estimating Model Parameters

4.1.1 Carcass Removal Trials

We conducted 21 carcass removal trials during the 2013-2014 winter season. These trials included seven large carcasses and 14 small carcasses. Carcasses were placed in the inner HD heliostats and inner and outer heliostat segments, and along the fenceline, and a camera was placed at each carcass to record the scavenger species. Carcass removal trials were not performed around the power block. Scavenger species included desert kit fox (N=3), common ravens (*Corvus corax*; N=3), and white-tailed antelope squirrels (*Ammospermophilus leucurus*; N=4). For the remaining carcasses, the scavenger species was not captured on camera. Seven feather spots or partial carcasses remaining from carcasses that we placed for carcass removal trials persisted after scavenging occurred, and were present through a full six-week trial period; these remains, which resulted from one small carcass and six large carcasses, were collected at the end of the period. Although all large carcasses were detected and at least partially eaten by scavengers, the scavengers left enough of the carcass in six of seven large-carcass trials that the remains would have been detectable and considered a fatality if detected during the standardized searches. In contrast, small carcasses tended to be more completely removed, with only one of 14 small carcasses leaving remains that persisted for the entire six-week trial.

Carcass persistence ranged from less than one day, in the case of a single carcass, to a full six-week trial period in the case of the seven carcasses whose remains persisted throughout the trial. Figure 17 shows the persistence durations for individual small carcasses, and Figure 18 shows the persistence of large carcasses. Because seven of the carcasses persisted for the full six-week trial before being removed by the carcass removal trial team, it is unknown how long they might have persisted if not removed. Assuming conservatively a 42-day persistence for those carcasses, mean carcass persistence was 10.1 days for small carcasses and 37.2 days for large carcasses. In comparison, the assumptions used in the power analysis in the Plan were 7.4 days for small birds and 21.8 days for large birds. The longer persistence of carcasses thus increases the statistical power of our sampling approach relative to the power analysis in the Plan.

Figure 17. **Persistence Durations for 14 Small Carcasses Placed for Carcass Removal Trials.**

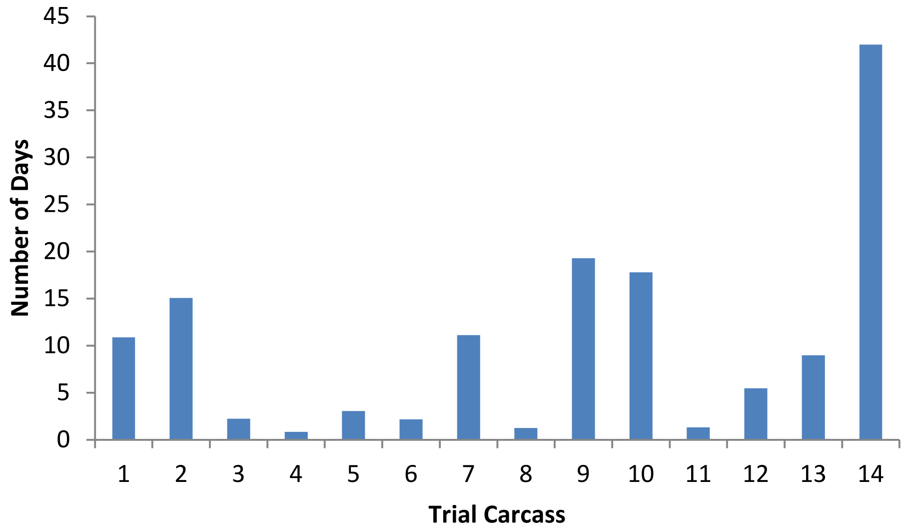
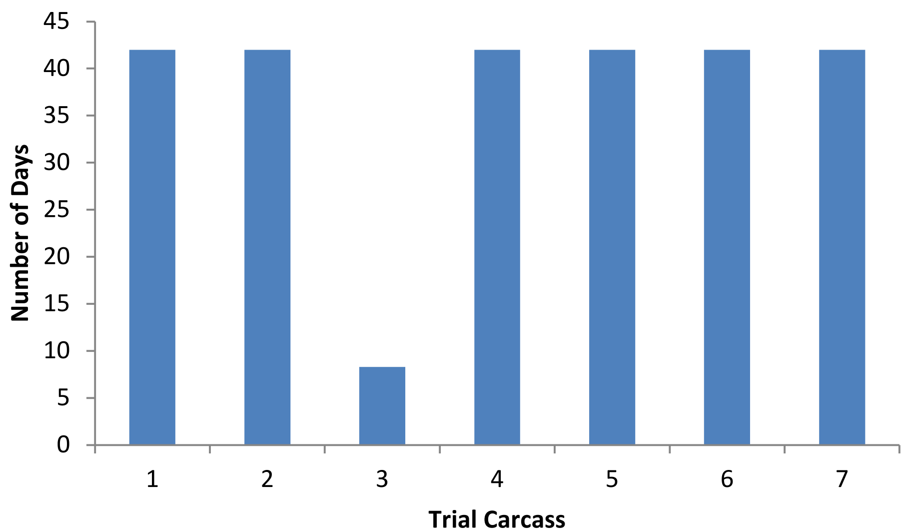


Figure 18. **Persistence Durations for Seven Large Carcasses Placed for Carcass Removal Trials.**



4.1.2 Model Selection for Carcass Removal Decay Curve

Based on the carcass removal data, four selected survival models were compared for relative quality using the Akaike information criterion (AIC) score (Table 7) as suggested in Huso (2010). As a part of the fatality estimator process, Huso (2010) recommends measuring the relative quality of the estimator model for each set of data to determine which model to use. Thus, AIC provides a means for model selection. In other words, although the absolute value of AICc may vary, the difference in AICc values among models provides information about which model is most statistically supported. This comparison demonstrated that a Weibull distribution (a continuous distribution model; Table 7) provided the best relative fit for the limited data.

Table 7. AICc Values for Each of Four Distribution Models of Carcass Persistence.

Survival Model for Carcass Persistence	AICc
Lognormal	120.62
Loglogistic	117.49
Weibull	116.46
Exponential	127.30

Although the model with the lowest AICc value is typically held to be the most supported, any model with ΔAICc values <2 from the "best model" is considered to have strong evidence supporting it (Burnham and Anderson 2004). The loglogistic and Weibull models for carcass persistence had ΔAICc values <2, and we chose to use the Weibull model (a continuous distribution model) because it had a slightly lower AICc.

4.1.3 Searcher Efficiency Trials

During the 2013-2014 winter season, 15 small carcasses and 14 large carcasses were placed in locations with various vegetation heights and with a range of contrast between the soil and vegetation to represent the various conditions under which searches occur. One of the small carcasses disappeared (e.g., it may have been scavenged) before the searcher efficiency trial, leaving a sample size of 14 small and 14 large carcasses included in the trials. In total, 35.7% of all small plants and 42.8% of all large plants were successfully discovered by searchers, for a mean searcher efficiency of 39.4%. Due to the low sample size (because this is the first seasonal report), we were not yet able to formally compare searcher efficiency rates among different levels of visual obstruction. Such analyses will be investigated in future seasons, when feather spots will also be incorporated into searcher efficiency trials.

Model Selection for Searcher Efficiency Trials. The null model, with no explanatory variables, had an AICc value of 39.67. When size was included as an explanatory variable, the AICc value was 41.67. Although the AICc value for the model with size of carcass plants included as a variable was slightly larger, we chose to include size in the final model because it had the potential to account for the most variation among samples.

4.2 Facility-Related Fatality Estimates

As per the BLM and CEC-approved and USFWS-accepted Plan, facility-wide estimates of potential avian impacts are to be estimated based on the following:

1. Observed number of detections found during standardized searches in the monitoring season for which the cause of death can be determined and is facility-related
2. Non-removal rates, expressed as the estimated average probability that a potential detection is expected to remain in the study area and be available for detection by the observers, based on removal trials
3. Searcher efficiency, expressed as the proportion of placed trial carcasses found by observers during the searcher efficiency trials.

After determining the proper model structure for both searcher efficiency and carcass persistence trials, we ran a series of fatality estimates. We only report fatality estimates as per the requirements of the Plan and only for areas and categories with more than five detections because using the fatality estimator with five or fewer detections will produce highly biased values due to the unreliability of confidence intervals.
Fatality estimates were calculated separately for specific areas over specific time periods. Because Units 1 and 3 became operational before Unit 2, and thus our standardized searches of Unit 2 did not commence until 27 January, we calculated estimates individually for Units 1 and 3 for the time period prior to 27 January. Unit 2 data are incorporated into the total fatality estimates (with all three units pooled) for the period in which all three units were searched with equal effort (27 January – 21 March). No detections prior to the start of standardized surveys in a given unit (e.g., detections during clearance surveys or incidental detections before standardized surveys began) could be included in the fatality estimator, which is designed to estimate fatalities from standardized surveys.

Estimates are initially provided for facility-related fatalities (where cause of death can be determined and is facility related). Following the estimates of facility-related fatalities, an estimate is provided of total unknown fatalities where the cause cannot be determined.

4.2.1 Fatality Estimate for Tower Area

Table 8 provides facility-related fatality estimates for the inner HD and power block areas for the portion of the 2013-2014 winter monitoring period prior to 27 January, and Table 9 provides facility-related fatality estimates for those areas for the period 27 January – 21 March.

For the power block area, most of the detections were incidental observations found between standardized surveys. We included incidental detections when they were found in areas covered during standardized surveys, during time periods in which they were being searched. Incidental detections from outside survey areas are not included in these estimates. Because of the high amount of unaccounted for searching (i.e., resulting in incidental detections) in the power block, we are providing fatality estimates separately for the inner HD area vs. power block in Tables 8 and 9 below. However, results from these two areas are pooled for total fatality estimates provided for the tower area in Section 4.2.4. No detections were found during standardized searches in Unit 3 prior to 27 January, so we were unable to make an estimate for this unit prior to the period during which searches were being conducted in all units.

Table 8. Facility-Related Tower Area Fatality Estimates for Temporal Periods Preceding Site-Wide Standardized Surveys (30 Oct 2013 – 14 Jan 2014 for Unit 1 and 9 Dec 2013 – 2 Jan 2014 for Unit 3). Includes detections found during standardized surveys and incidental observations.

Project Area	Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Unit 1 Inner HD	Flux + Collision	8	35	23	74
	Flux Cause	7	30	20	63
	Collision Cause	1	NA*	NA	NA
	Large Bird	4	NA	NA	NA
	Raptor	0	NA	NA	NA
	Small Bird	4	NA	NA	NA
Unit 1 Power Block	Flux + Collision	0	NA	NA	NA
	Flux Cause	0	NA	NA	NA
	Collision Cause	0	NA	NA	NA
	Large Bird	0	NA	NA	NA
	Raptor	0	NA	NA	NA
	Small Bird	0	NA	NA	NA
Unit 3 Inner HD and Power Block**	Flux + Collision	0	NA	NA	NA
	Flux Cause	0	NA	NA	NA
	Collision Cause	0	NA	NA	NA
	Large Bird	0	NA	NA	NA
	Raptors	0	NA	NA	NA
	Small Bird	0	NA	NA	NA

* NA = not applicable because there were fewer than five detections within that group.
** The Inner HD and Power Block areas are reported together for Unit 3 because no detections occurred in either area during the period analyzed in this table.

Table 9. Facility-Related Tower Area Fatality Estimates Based on Standardized Searches, 27 January – 21 March 2014. Includes detections found during standardized surveys and incidental observations.

Project Area	Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Inner HD	Flux + Collision	3	NA*	NA	NA
	Flux Cause	3	NA	NA	NA
	Collision Cause	0	NA	NA	NA
	Large Bird	0	NA	NA	NA
	Raptor	1	NA	NA	NA
	Small Bird	2	NA	NA	NA
Power Block	Flux + Collision	8	27	15	63
	Flux Cause	8	27	15	63
	Collision Cause	0	NA	NA	NA
	Large Bird	1	NA	NA	NA
	Raptor	0	NA	NA	NA
	Small Bird	7	23	9	59

* NA = not applicable because there were fewer than five detections within that group.

4.2.2 Fatality Estimate for Heliostat Area

Table 10 provides facility-related fatality estimates for the heliostat area for the portion of the 2013-2014 winter monitoring period prior to 27 January, and Table 11 provides facility-related fatality estimates for the heliostat area for the period 27 January – 21 March. Note that four mourning dove carcasses were removed from the estimates because they were determined to be much older than the search interval.

Table 10. Facility-Related Heliostat Area Fatality Estimates for Temporal Periods Preceding Site-Wide Standardized Surveys (31 Oct 2013 – 16 Jan 2014 for Unit 1 and 10 Dec 2013 – 5 Jan 2014 for Unit 3).

Project Area	Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Unit 1	Flux + Collision	3	NA*	NA	NA
	Flux Cause	0	NA	NA	NA
	Collision Cause	3	NA	NA	NA
	Large Bird	0	NA	NA	NA
	Raptor	0	NA	NA	NA
	Small Bird	3	NA	NA	NA
Unit 3	Flux + Collision	3	NA	NA	NA
	Flux Cause	0	NA	NA	NA
	Collision Cause	3	NA	NA	NA
	Large Bird	1	NA	NA	NA
	Raptor	0	NA	NA	NA
	Small Bird	2	NA	NA	NA

* NA = not applicable because there were fewer than five detections within that group.

Table 11. Facility-Related Heliostat Area Fatality Estimates Based on Standardized Searches, 27 January – 21 March 2014. Estimate based on searches of 144 plots and extrapolated to 598 at site*.

Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Flux + Collision	2	NA**	NA	NA
Flux Cause	0	NA	NA	NA
Collision Cause	2	NA	NA	NA
Large bird	1	NA	NA	NA
Raptor	0	NA	NA	NA
Small Bird	1	NA	NA	NA

* 598 plots comprise the total area of the heliostat fields.
** NA = not applicable because there were fewer than five detections within that group.

4.2.3 Fatality Estimate for Fenceline

The Unit 1 fenceline was searched beginning on 30 October 2013, and the entire fenceline was searched from 27 November onward. All detections along the fenceline were incidental. No fatalities that could be directly attributed to the facility were recorded for the portion of the 2013-2014 winter monitoring period prior to 27

November. Table 12 provides fenceline detection data for the period 27 November – 21 March. Because there were only two facility-related detections (i.e., fewer than the five detections necessary for a fatality estimate), we do not provide a fatality estimate for the fenceline here.

Table 12. Facility-Related Fenceline Fatality Estimates for Standardized Searches of the Fenceline, 27 Nov 2013 – 21 Mar 2014. No fatality estimate is provided due to small sample size.

Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Flux + Collision	2	NA*	NA	NA
Flux Cause	2	NA	NA	NA
Collision Cause	0	NA	NA	NA
Large bird	2	NA	NA	NA
Raptor	1	NA	NA	NA
Small Bird	0	NA	NA	NA

* NA = not applicable because there were fewer than five detections within that group.

We recorded two fenceline detections with effects of flux (an American kestrel that was observed as a feather spot and an injured common raven that was observed and taken to a wildlife rehabilitation center) and no fenceline detections with evidence of collision. .

4.2.4 Total Facility-Related Fatality Estimates

To calculate total facility-related fatality estimates for the winter 2013-2014 season, we added mean estimates and 90% confidence intervals for each project component for the portion of the 2013-2014 winter monitoring period preceding 27 January 2014 and for the period 27 January – 21 March when all three units were being sampled with equal effort. There may be statistical issues with combining confidence intervals from separate estimates, but this approach seemed to be most appropriate for estimating the total number of fatalities. Although fatality estimates are not provided in Tables 8 to 12 above when the number of detections for any group (e.g., flux, collision, flux + collision, large bird, raptor, or small bird) was less than five, all flux and collision-related detections (there were no detections from "other project impacts", as noted in Section 3.1 of the Plan) were included in the overall facility-related fatality estimates below.

During the period 29 October 2013 to 21 March 2014, for the tower area, there were an estimated 81 fatalities (90% confidence interval estimates 47-180) for detections with signs of flux or collision. Estimates for the tower area include unadjusted avian detections from the ACC units which were added to the mean and confidence intervals. Note that these include estimates made from the power block which should be interpreted with caution due to unaccounted for search effort from other project personnel. For the heliostat area, there were an estimated 111 fatalities (90% confidence interval estimates 49-272) for detections with signs of flux or collision. Along the fenceline, there were an estimated eight detections (90% confidence interval estimates 4-14) with signs of flux effects.

4.3 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 flux or collision effects was noted in the case of these unknown detections, they cannot be clearly attributed to the facility. The methods for determining fatality estimates for these unknown detections are the same as those described in Section 4.2 for facility-related detections.

4.3.1 Fatality Estimate for Tower Area

During the portion of the 2013-2014 winter monitoring period prior to 27 January, only one detection of unknown cause (a rock pigeon, considered a large bird) was recorded in the tower area during standardized surveys or detected incidentally during the period in which standardized surveys were being conducted in Units 1 and 3; this bird was in the Unit 1 power block. Table 13 provides fatality estimates from unknown causes for the tower area for the period 27 January – 21 March.

Table 13. Tower Area Fatality Estimates for Unknown Causes Based on Standardized Searches, 27 January – 21 March 2014. Includes detections found during standardized surveys and incidental observations.

Project Area	Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Inner HD	Unknown Cause	5	24	10	59
	Large Bird	1	NA	NA	NA
	Raptor	1	NA	NA	NA
	Small Bird	4	NA	NA	NA
Power Block	Unknown Cause	2	NA	NA	NA
	Large Bird	1	NA	NA	NA
	Raptor	0	NA	NA	NA
	Small Bird	1	NA	NA	NA

* NA = not applicable because there were fewer than five detections within that group.

4.3.2 Fatality Estimate for Heliostat Area

Table 14 provides fatality estimates from unknown causes for the heliostat area for the portion of the 2013-2014 winter monitoring period prior to 27 January, and Table 15 provides fatality estimates from unknown causes for the heliostat area for the period 27 January – 21 March.

Table 14. Heliostat Area Fatality Estimates for Unknown Causes for Temporal Periods Preceding Site-Wide Standardized Surveys (31 Oct 2013 – 16 Jan 2014 for Unit 1 and 10 Dec 2013 – 5 Jan 2014 for Unit 3).

Project Area	Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Unit 1	Unknown Cause	4	NA	NA	NA
	Large Bird	3	NA	NA	NA
	Raptors	0	NA	NA	NA
	Small Bird	1	NA	NA	NA
Unit 3	Unknown Cause	0	NA	NA	NA
	Large Bird	0	NA	NA	NA
	Raptors	0	NA	NA	NA
	Small Bird	0	NA	NA	NA

* NA = not applicable because there were fewer than five detections within that group.

Table 15. Heliostat Area Fatality Estimates for Unknown Causes Based on Standardized Searches, 27 January – 21 March 2014. Estimate based on searches of 144 plots and extrapolated to 598 at site*.

Type of Estimate	Number of Detections Included in Model	Estimate	90% Confidence Intervals	
Unknown Cause	6	186	107	401
Large bird	4	NA**	NA	NA
Raptor	0	NA	NA	NA
Small Bird	2	NA	NA	NA

*598 plots comprise the total area of the heliostat fields.
** NA = not applicable because there were fewer than five detections within that group.

4.3.3 Fatality Estimate for Fenceline

Table 16 provides fenceline detection data from unknown causes for the portion of the 2013-2014 winter monitoring period prior to 27 January. Because of the low number of detections for this time period (i.e., fewer than the five detections necessary for a fatality estimate), we do not provide a fatality estimate. During the period 27 January – 21 March, there were no fenceline detections from unknown causes.

Table 16. Fenceline Fatality Estimates for Unknown Causes for Temporal Periods Preceding Site-Wide Standardized Surveys (30 Oct - 26 Nov 2013). No fatality estimate is provided due to small sample size.

	Type of Estimate	Number of Detections	Estimate	90% Confidence Intervals	
Unit 1 Fenceline	Unknown Cause	3	NA	NA	NA
	Large Birds	3	NA	NA	NA
	Raptors	0	NA	NA	NA
	Small Birds	0	NA	NA	NA

* NA = not applicable because there were fewer than five detections within that group.

4.3.4 Total Fatality Estimates from Unknown Causes

Total fatality estimates from unknown causes were calculated as described in Section 4.2.4 above. During the period 29 October 2013 to 21 March 2014, estimates of fatalities from unknown causes, which cannot be attributed to the facility, were 35 (90% confidence interval estimates 14-84) in the tower area; 153 fatalities (90% confidence interval estimates 57-406) in the heliostat area; and 13 (90% confidence interval estimates 7-25) in the fenceline area.

Section 5.0 Avian Use and Raptor/Large Bird Monitoring Surveys

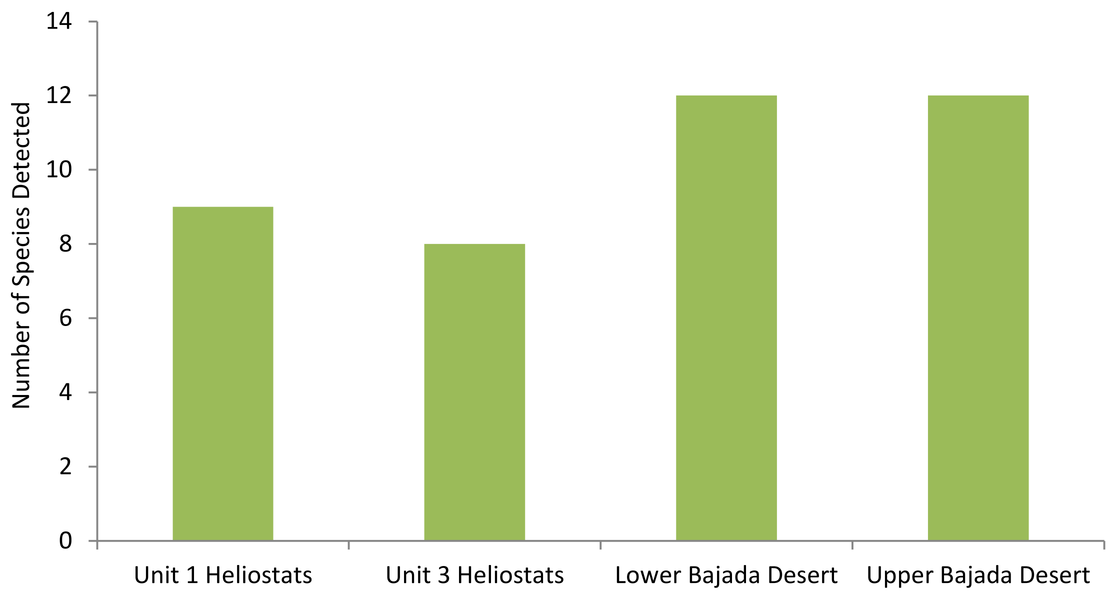
5.1 Avian Use Monitoring

This section provides the results of monitoring of avian use of the heliostat arrays and offsite desert bajada plots, including species composition and abundance. Species composition is compared between these avian use survey results and detections during standardized monitoring surveys. More than 93 hours of field observation time was spent conducting avian use surveys during the 2013-2014 winter season.

5.1.1 Species Composition

A total of 23 bird species were recorded during avian use surveys during the 2013-2014 winter season. Table 17 lists these species, their temporal occurrence status and foraging guild, and the frequency of occurrences (i.e., number of individuals detected) within the four survey grids. As indicated by Figure 19, species richness was the same on the two desert bajada grids (12 species each), being slightly lower in the heliostat grids (nine species in Unit 1 and eight in Unit 3). Statistical tests were not attempted because of the high number of 0 values in the samples.

Figure 19. Number of Bird Species Recorded at Avian Survey Points on Four Survey Areas.



Although all birds observed during surveys were recorded, only individual birds using the survey plots were included in these analyses. These included birds that were perched on a plot or aerial foragers (such as raptors) that appeared to be foraging on the plot. Birds that were only observed flying over or through the plot were not included in the analysis, both because these birds' occurrence did not signify use of a particular area and because inclusion of birds transiting over a plot would result in substantial problems associated with spatial autocorrelation of results (e.g., as birds are observed flying through multiple plots). The only species for which individuals were observed flying over survey plots more often than perched in the plots were common ravens (12 detections of birds flying over vs. 5 on plots), house finches (16 detections flying over vs. 14 on plots), and horned larks (42 detections flying over vs. one on plots). For other species, more individuals (usually many more) were observed on the plots than flying over.

5.1.2 Avian Abundance

Although species richness was the same on the two desert bajada grids, bird abundance was substantially higher on the upper bajada grid southwest of Unit 3 (502 detections) than on the lower bajada grid south of Unit 1 (193 detections), and the two heliostat units had substantially lower abundance than either of the two desert bajada grids (75 detections in Unit 1 and 51 in Unit 3; Figure 20). The results between the Desert and the Heliostat were significantly different based on the fact that the 95% Confidence Intervals do not overlap (Distance 6.0, Thomas et al. 2010).

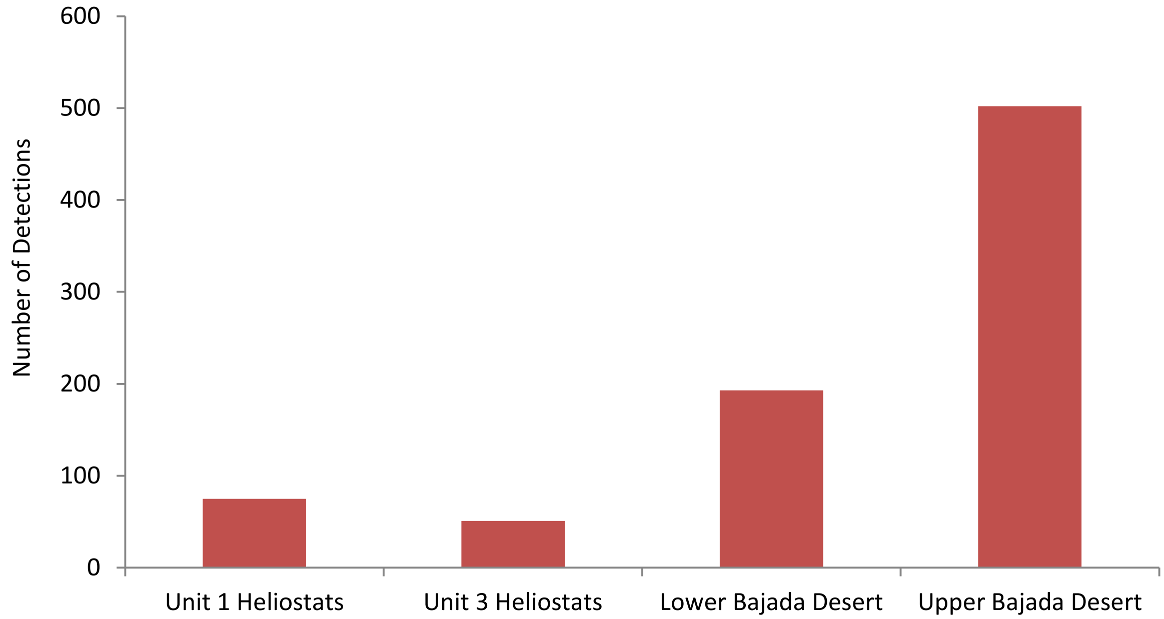
Table 17. Avian Use Survey Results - Frequency of Occurrence by Species and Survey Grid.

Common Name	Scientific Name	Temporal Occurrence Group	Foraging Guild*	Unit 1 Heliostats	Unit 3 Heliostats	Lower Desert Bajada	Upper Desert Bajada
Cooper’s Hawk	*Accipiter cooperii*	Nonbreeding-season resident	Carnivore	0	0	0	1
Northern Harrier	*Circus cyaneus*	Nonbreeding-season resident	Carnivore	3	0	0	0
American Kestrel	*Falco sparverius*	Permanent resident	Carnivore	3	0	0	0
Common Raven	*Corvus corax*	Permanent resident	Carnivore	3	0	0	2
American Pipit	*Anthus rubescens*	Nonbreeding-season resident	Granivore	7	0	0	0
Bewick's Wren	*Thryomanes bewickii*	Permanent resident	Insectivore	0	0	7	7
Black-throated Sparrow	*Amphispiza bilineata*	Permanent resident	Granivore	0	0	66	101
Brewer's Sparrow	*Spizella breweri*	Permanent resident	Granivore	0	4	28	236
Cactus Wren	*Campylorhynchus brunneicapillus*	Permanent resident	Insectivore	0	0	12	22
Crissal Thrasher	*Toxostoma crissale*	Permanent resident	Insectivore	0	0	0	3
Horned Lark	*Eremophila alpestris*	Permanent resident	Granivore	1	0	0	0
House Finch	*Haemorhous mexicanus*	Permanent resident	Granivore	1	3	6	4
Le Conte's Thrasher	*Toxostoma lecontei*	Permanent resident	Insectivore	0	0	1	0
Loggerhead Shrike	*Lanius ludovicianus*	Permanent resident	Carnivore	0	2	2	12
Northern Flicker	*Colaptes auratus*	Nonbreeding-season resident	Insectivore	0	3	0	0
Rock Wren	*Salpinctes obsoletus*	Permanent resident	Insectivore	0	0	10	1
Sagebrush Sparrow	*Artemisiospiza nevadensis*	Nonbreeding-season resident	Granivore	0	0	41	81
Sage Thrasher	*Oreoscoptes montanus*	Nonbreeding-season	Insectivore	0	0	1	0

		resident					
Savannah Sparrow	*Passerculus sandwichensis*	Nonbreeding-season resident	Granivore	1	15	0	0
Verdin	*Auriparus flaviceps*	Permanent resident	Insectivore	0	0	1	0
White-crowned Sparrow	*Zonotrichia leucophrys*	Nonbreeding-season resident	Granivore	0	1	6	0
Western Meadowlark	*Sturnella neglecta*	Permanent resident	Granivore	5	18	0	3
Yellow-rumped Warbler	*Setophaga coronata*	Nonbreeding-season resident	Insectivore	50	1	0	0
Unknown Passerine				0	0	0	1
Unknown Bird				1	4	6	18
Unknown Sparrow				0	0	6	9
Unknown Wren				0	0	0	1
TOTALS				**75**	**51**	**193**	**502**

* Indicates primary diet in winter.

Figure 20. **Number of Bird Detections Recorded at Avian Survey Points on Four Survey Areas.**



Bird abundance by temporal occurrence group is depicted in Figure 21. Permanent residents predominated on both desert bajada grids and at Unit 3. However, it is likely that many of the individuals of species such as black-throated sparrow and Brewer's sparrow (*Spizella breweri*), which are present year-round in the Ivanpah vicinity, were individuals that had bred elsewhere and thus were using the area as though they were nonbreeding-season residents. At Unit 1, the predominance by nonbreeding-season residents was a result of the relatively high abundance of yellow-rumped warblers (*Setophaga coronata*).

Figure 21. **Number of Bird Detections Recorded at Avian Survey Points on Four Survey Areas by Temporal Occurrence Group.**

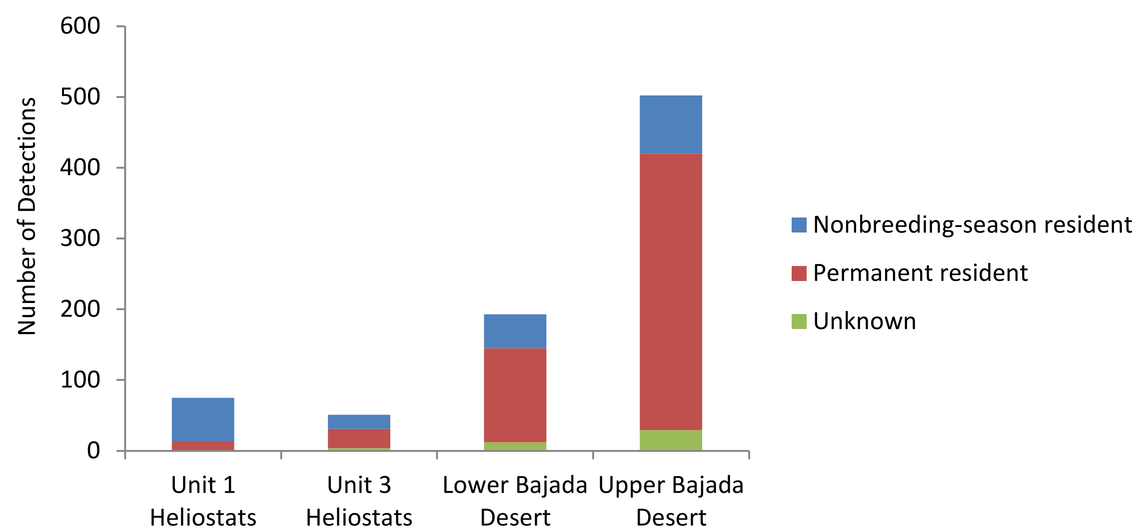
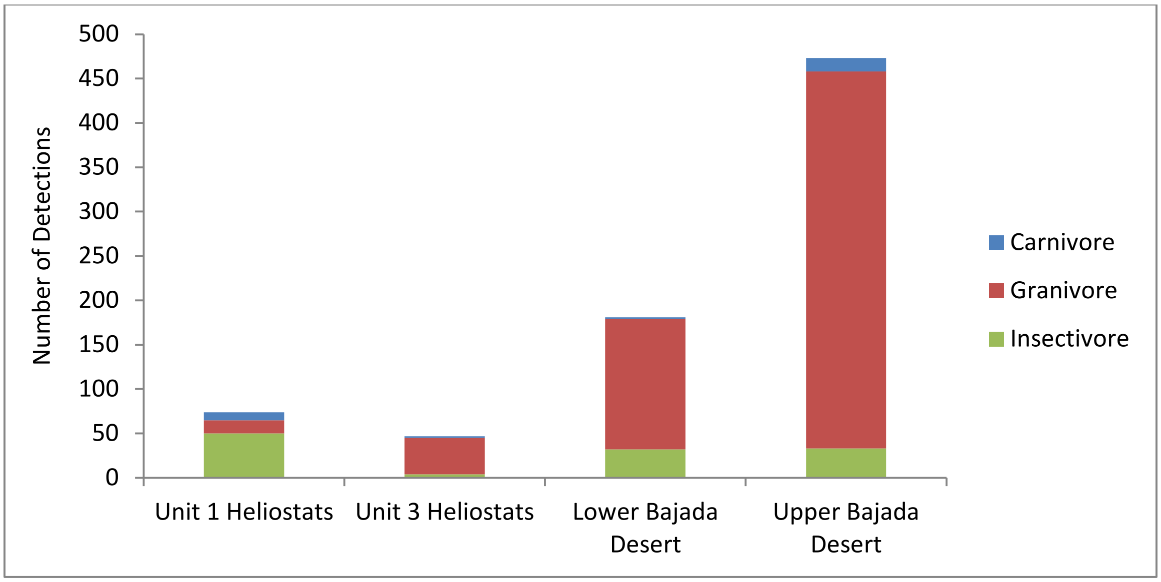


Figure 22 depicts bird abundance by foraging guild. Granivores dominated the foraging guilds on both desert bajada grids and at Unit 3; this is as expected given the relative abundance of seeds and scarcity of insects and other prey during the winter season. However, at Unit 1, the high abundance of yellow-rumped warblers drove the predominance by insectivores. Carnivores were also more abundant on the upper desert bajada grid than on other grids; this likely reflects the greater abundance of avian prey present there.

Figure 22. Number of Bird Detections Recorded at Avian Survey Points on Four Survey Areas by Foraging Guild.



Because the survey areas (e.g., 20 points in each grid) were identical for each of the four grids, comparison of general avian abundance metrics such as total detections, as was done above, is appropriate for elucidating relative abundance, both overall and by species and species group (e.g., temporal occurrence group and foraging guild). However, because the relative abundance of various species differed among grids, and bird detectability may vary among species, assessing relative abundance using raw numbers may result in inaccurate conclusions regarding relative abundance. As a result, we used the program Distance 6.0 (Thomas et al. 2010) to evaluate avian densities. As discussed in Section 2.2.1, distance sampling analysis requires a fairly large amount of data, and due to the low number of individuals of most species recorded during these surveys (owing to the naturally low abundance of winter birds in the habitats surveys), 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 control grids). However, under the assumption that the two heliostat grids were more similar to each other (in terms of habitat and winter bird communities) than to either of the desert bajada grids, and making the inverse 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 95% confidence intervals around density estimates for each habitat type did not overlap, thus providing strong statistical evidence that bird density in the Desert Bajada was higher than bird density in the Heliostat Units (Table 16).

Table 18. Avian Density Estimates for Heliostat vs. Desert Bajada Grids (Derived Using DISTANCE).

		95% Confidence Interval	
Habitat Type	**Density Estimate (Birds/Hectare)**	**Low Estimate (Birds/Hectare)**	**High Estimate (Birds/Hectare)**
Heliostat Units	2.1	0.9	4.9
Desert Bajada	10.2	7.7	13.4

5.1.3 Comparison of Avian Use Survey Results to Fatality Detections

Whereas 23 bird species were recorded during avian use surveys, 30 species were recorded as detections during standardized fatality monitoring. Comparison of the most abundant bird species that were recorded on the avian use surveys to the species most frequently recorded as detections reveals more similarity between detections and birds using the heliostat grids (as identified during avian use surveys) than between detections and birds using the desert bajada habitats (Table 17). This result is not unexpected in that the birds using the heliostat grids have much more exposure to heliostats and other Project facilities that are sources of collision mortality, and are using areas that are closer to the power towers where flux concentrations are highest. Of the 10 species most frequently recorded as detections, four species (yellow-rumped warbler, American kestrel, western meadowlark, and American pipit) were among the most abundant species on the heliostat survey grids, whereas none were among the most abundant species on the desert bajada survey grids. While the mourning dove, which was the most frequent fatality detection, was not recorded in the use surveys, it was observed incidentally as surveyors traveled among survey points.

Table 19. Comparison of the Most Abundant Bird Species Recorded as Detections and Recorded on Heliostat and Desert Bajada Survey Grids (in Descending Order of Abundance).

Detections	Heliostat Survey Grids	Desert Bajada Survey Grids
Mourning Dove	Yellow-rumped Warbler	Brewer's Sparrow
Yellow-rumped Warbler	Western Meadowlark	Black-throated Sparrow
Anna's Hummingbird	Savannah Sparrow	Sagebrush Sparrow
Greater Roadrunner	American Pipit	Bewick's Wren
American Kestrel	House Finch	Loggerhead Shrike
Brewer's Blackbird	Brewer's Sparrow	Cactus Wren
Western Meadowlark	Northern Harrier	Rock Wren
American Pipit	American Kestrel	House Finch
Costa's Hummingbird	Common Raven	White-crowned Sparrow
Great-tailed Grackle	Northern Flicker	

5.2 Raptor and Large Bird Use Monitoring

This section discusses the results of surveys for use of the site and surrounding areas by raptors and other large birds, including a summary of species composition, abundance, and habitat use, as observed from points around the edges of and outside the facility. In addition, this section provides information on the number of individuals of these species observed perched vs. those in flight, as well as the heights at which flying birds were recorded. A total of 224 hours of field observation time was spent conducting raptor/large bird surveys during the 2013-2014 winter season.

5.2.1 General Species Composition, Abundance, and Habitat Use

Seven 4-hour surveys for raptors and other large birds were conducted from each of eight points as shown on Figure 5. During these surveys, six raptor species and two other large bird species (common raven and ring-billed gull [*Larus delawarensis*]) were observed and identifiable. Table 18 summarizes the total number of detections of each of these species during all surveys combined. 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 in terms of observation rather than individuals.

Table 20. Raptor/Large Bird Point Count Results Summary (Number of Detections).

		Number of Observations				
Common Name	**Scientific Name**	**Ivanpah Facilities**	**Desert**	**Mountains**	**Other***	**Total**
American Kestrel	*Falco sparverius*	9	5	0	0	14
Peregrine Falcon	*Falco peregrinus*	0	1	0	0	1
Prairie Falcon	*Falco mexicanus*	0	1	0	0	1
Golden Eagle	*Aquila chrysaetos*	0	8	15	1	24
Northern Harrier	*Circus cyaneus*	3	8	0	0	11
Red-tailed Hawk	*Buteo jamaicensis*	9	31	2	2	44
Common Raven	*Corvus corax*	66	98	3	14	181
Ring-billed Gull	*Larus delawarensis*	1	0	0	0	1
Unknown Large Bird		6	5	14	0	25
Unknown Raptor		2	4	3	2	9
Total		**96**	**161**	**37**	**19**	**294**

* Includes the Primm Valley Golf Course and birds whose habitat was not recorded.

Common ravens comprised 56.8% of all large bird detections. The preponderance of raven detections resulted less from the abundance of ravens on the site (with counts of up to five birds at a time, though more frequently singles or pairs) than from the persistent nature of the species (frequently present) and widespread occurrence. Ravens were most abundant in the desert adjacent to the Ivanpah facilities, with somewhat lower abundance at the Ivanpah facilities themselves and with few observed toward the mountains. Several other raptors, such as the American kestrel, northern harrier, and red-tailed hawk, showed this same pattern of abundance. Most golden eagle observations were of birds near the mountains; this species was recorded less frequently in the desert, and none were observed at the Ivanpah facilities themselves during formal surveys. However, a golden eagle was observed incidentally over the Ivanpah facilities by our biologists on 5 February 2014, an adult was observed soaring more than 500 m above the ground, heading eastward from an area over the heliostats of Unit 2 toward and beyond Metamorphic Hill. There were relatively few incidental observations of other raptors at or over the Ivanpah facilities during the 2013-2014 winter season. These involved occasional American kestrels, red-tailed hawks, a northern harrier, and a peregrine falcon flying over heliostat fields; a red-tailed hawk perched on the weather station at the southwest corner of Unit 1; and two perched American kestrels, one on a power pole along the western fence line of Unit 2 and the other on a weather station near Unit 1.

Because the same survey effort was expended at all points during formal raptor/large bird surveys, the relative abundance of these species is the same whether reported in terms of raw observations as in Table 18 or converted to number/survey hour. Nevertheless, in accordance with the Plan, Table 19 reports these data in terms of observations/survey hour.

Table 21. Raptor/Large Bird Point Count Results Summary (Number of Observations/Survey Hour).

	Number of Observations/Survey Hour				
Common Name	**Ivanpah Facilities**	**Desert**	**Mountains**	**Other***	**Total**
American Kestrel	0.040	0.022	0	0	0.062
Peregrine Falcon	0	0.004	0	0	0.004
Prairie Falcon	0	0.004	0	0	0.004
Golden Eagle	0	0.036	0.067	0.004	0.107
Northern Harrier	0.013	0.036	0	0	0.049
Red-tailed Hawk	0.040	0.138	0.009	0.009	0.196
Common Raven	0.295	0.438	0.013	0.063	0.809
Ring-billed Gull	0.004	0	0	0	0.004
Unknown Large Bird	0.027	0.022	0.063	0	0.112
Unknown Raptor	0.009	0.018	0.013	0.009	0.049
Total	**0.428**	**0.718**	**0.165**	**0.085**	**1.396**

* Includes the Primm Valley Golf Course and birds whose habitat was not recorded.

As shown by Table 18, the frequency of occurrence of large birds, in terms of the number/survey hour, was relatively low. An average of approximately 1.4 birds/hour were recorded during the 224 hours of raptor/large bird surveys.

Common ravens and red-tailed hawks were observed perched (e.g., on vegetation in the desert, along the edge of I-15, or perched on offsite electrical transmission towers) moderately frequently. Ravens were observed perched within Ivanpah facilities on 13 occasions during these raptor surveys, including 10 occasions within heliostat arrays or on fencelines, and three occasions in which ravens were observed perched on power towers. Of the 20 observations of red-tailed hawks perched, all were in the desert or on offsite electrical transmission towers. American kestrels were observed perched on Ivanpah fencelines and electrical poles on three occasions. Golden eagles were observed perched in the desert or mountain areas on six occasions, but no eagles were seen perched in or within a kilometer of Ivanpah facilities. At no time during the 2013-2014 winter season were raptors observed perched on or near Ivanpah power towers.

The majority of observations of raptors and other large birds involved individuals seen in flight. 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 (primary boiler area at 120–140 m agl)
- 3 = > 200 m agl (above the elevated solar flux risk zone)

Table 20 provides the number of observations of each species that were perched or that were flying in each height category; this information is provided separately for birds seen over Ivanpah facilities and over other habitats such as desert, mountains, or the Primm Valley Golf Course.

Within the Ivanpah facility, the majority of birds (most of which were ravens) were observed in the three lower height categories (i.e., below 200 m agl). In surrounding areas, the highest numbers were observed flying in the highest category, possibly as they approached the adjacent mountains.

Table 22. Flight Heights of Raptors and Other Large Birds Over Ivanpah Facilities and Other Habitats/Areas (Data are the Number of Observations at Each Flight Height).

		Flight Height Category Above Ivanpah Facilities				Flight Height Category Above Other Habitats/Areas			
Species	**Perched**	**0**	**1**	**2**	**3**	**0**	**1**	**2**	**3**
American Kestrel	4	3	1	1	0	0	1	2	1
Peregrine Falcon	0	0	0	0	0	0	0	1	0
Prairie Falcon	0	0	0	0	0	0	0	0	1
Golden Eagle	6	0	0	0	0	0	1	0	15
Northern Harrier	0	2	1	0	0	2	3	2	2
Red-tailed Hawk	20	0	0	0	0	0	0	0	0
Common Raven	46	6	18	12	6	11	30	14	25
Ring-billed Gull	0	0	1	0	0	0	0	0	0
Unknown Large Bird	0	0	0	5	1	0	0	0	19
Unknown Raptor	4	0	1	1	0	0	0	0	4
Total	80	11	22	19	7	13	35	19	67

5.2.2 Raptor and Large Bird Distribution

Table 21 provides the number of observations of each raptor and large bird species from each of the eight survey points (Figures 23-30).

Table 23. Raptor/Large Bird Point Count Results By Survey Point.

	Survey Point							
Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
American Kestrel	0	3	1	2	1	0	0	7
Peregrine Falcon	0	1	0	0	0	0	0	0
Prairie Falcon	0	1	0	0	0	0	0	0
Golden Eagle	7	5	2	1	1	0	5	3
Northern Harrier	1	2	2	1	2	2	1	0
Red-tailed Hawk	3	5	1	1	16	16	2	0
Common Raven	24	13	12	22	43	38	8	21
Ring-billed Gull	0	0	0	0	0	1	0	0
Unknown Large Bird	12	0	5	0	0	5	0	3
Unknown Raptor	2	1	1	1	3	2	0	1
Total	49	31	24	28	69	64	16	35

Points 1 and 2, 5 and 3, and 6 and 8 represent paired points on the eastern and western sides of Units 3, 2, and 1, respectively. At all three units, overall abundance was higher on the eastern points than on the western. This difference appears to have resulted primarily from higher common raven abundance on the eastern points. Higher raven abundance on the eastern side of the site was expected because ravens move between the Ivanpah site and areas in Primm with anthropogenic food sources and the relatively low abundance of ravens in areas toward the mountains west of the Project site. Red-tailed hawks showed a similar pattern at Units 1 and 2, with much higher numbers of observations on the eastern side than the western side. Other raptors were slightly more abundant on the west side than the east side of the three power units.

Figures 23 through 30 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 activity of raptors and other large birds.

5.3 Regional Awareness Monitoring

According to the Plan, a communication protocol is to be 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.

The veterinarians closest to the Ivanpah facility are in Henderson and Las Vegas, Nevada, 35 miles or more northeast of Ivanpah, and in Bullhead City, Arizona, 53 miles southeast of Ivanpah. The closest wildlife rehabilitation facility is the Wild Wing Project, located in North Las Vegas, 47 miles northeast of Ivanpah. Owing to the distance between the Project site and these facilities, we do not expect a noticeable increase in avian injuries or fatalities brought in to these facilities that can be attributable to Ivanpah. However, local district game wardens for the Bureau of Land Management and California Department of Fish and Wildlife will be contacted on a quarterly basis. Further, designated biologists for tortoise radio tracking and monitoring are also being interviewed for information regarding new incidences of avian injury or fatality for the facility vicinity and region. Once the protocol process has been established, interviews and queries are to take place within one week of the end of the time period covering a given report. Because of turnover in personnel and potential issues with these contacts' availability for interviews, a total of at least four interviews (two from the three agencies and two from the three biologists working in the Ivanpah Valley) will be conducted to complete the quarterly requirement. The following is a summary of contacts available to be interviewed for this process, and their preferred means of contact:

Bureau of Land Management……………Ryan Regnell (office: 760-326-7025, cell: 760-221-2746)
Calif. Department of Fish and Wildlife….Magdalena Rodriquez (Magdalena.Rodriguez@wildlife.ca.gov)
Mohave Desert National Reserve………..Ranger on duty (760-252-6104 or 760-928-2572)
Designated Biologists working in the Ivanpah Valley
Craig Himmelwright, DVM(craig.himmelwright@gmail.com)

Danna Hinderle (dhinderle@ironwoodbio.com)
Chris Bladford (chris@ironwood-inc.com)

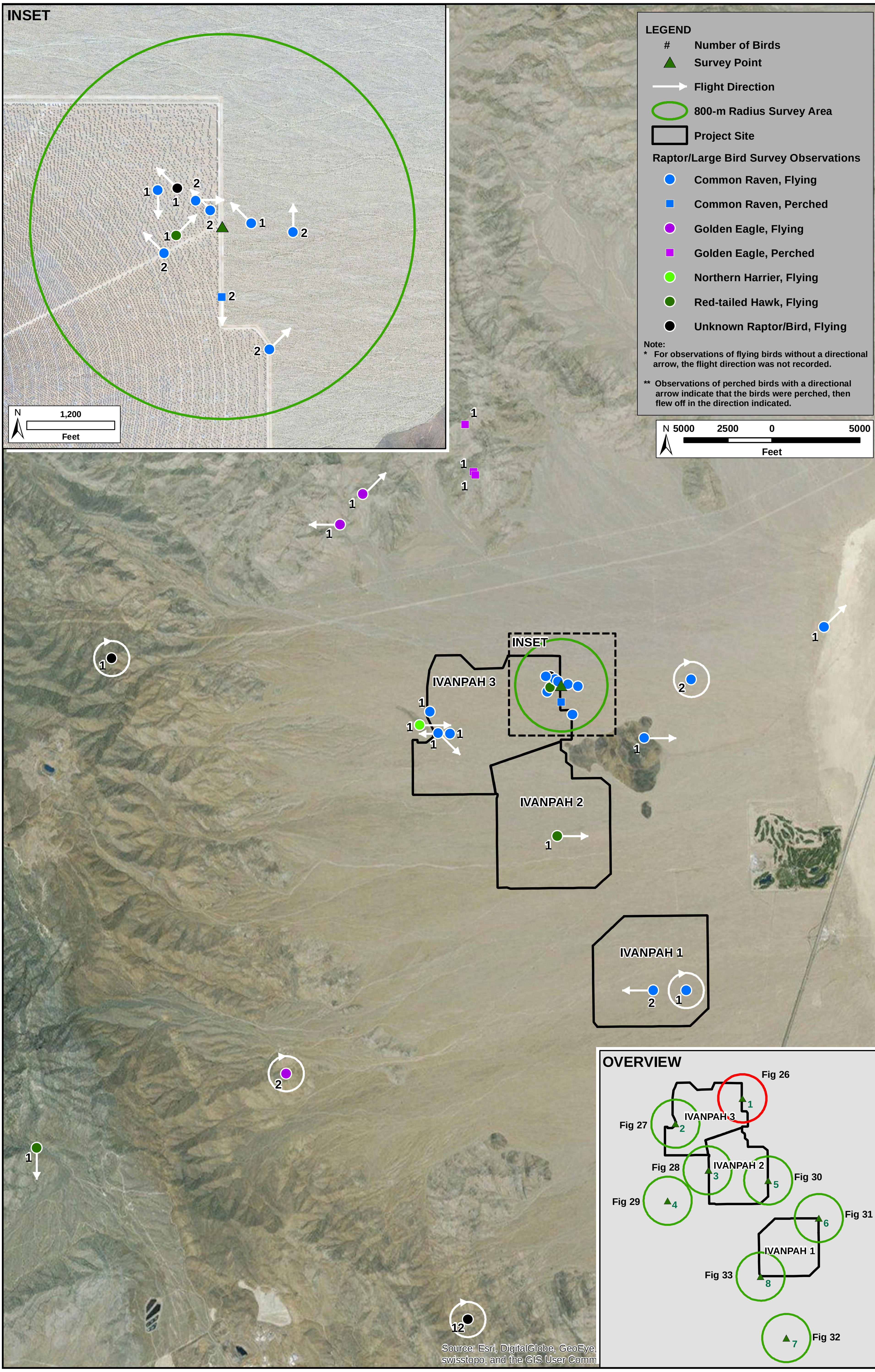


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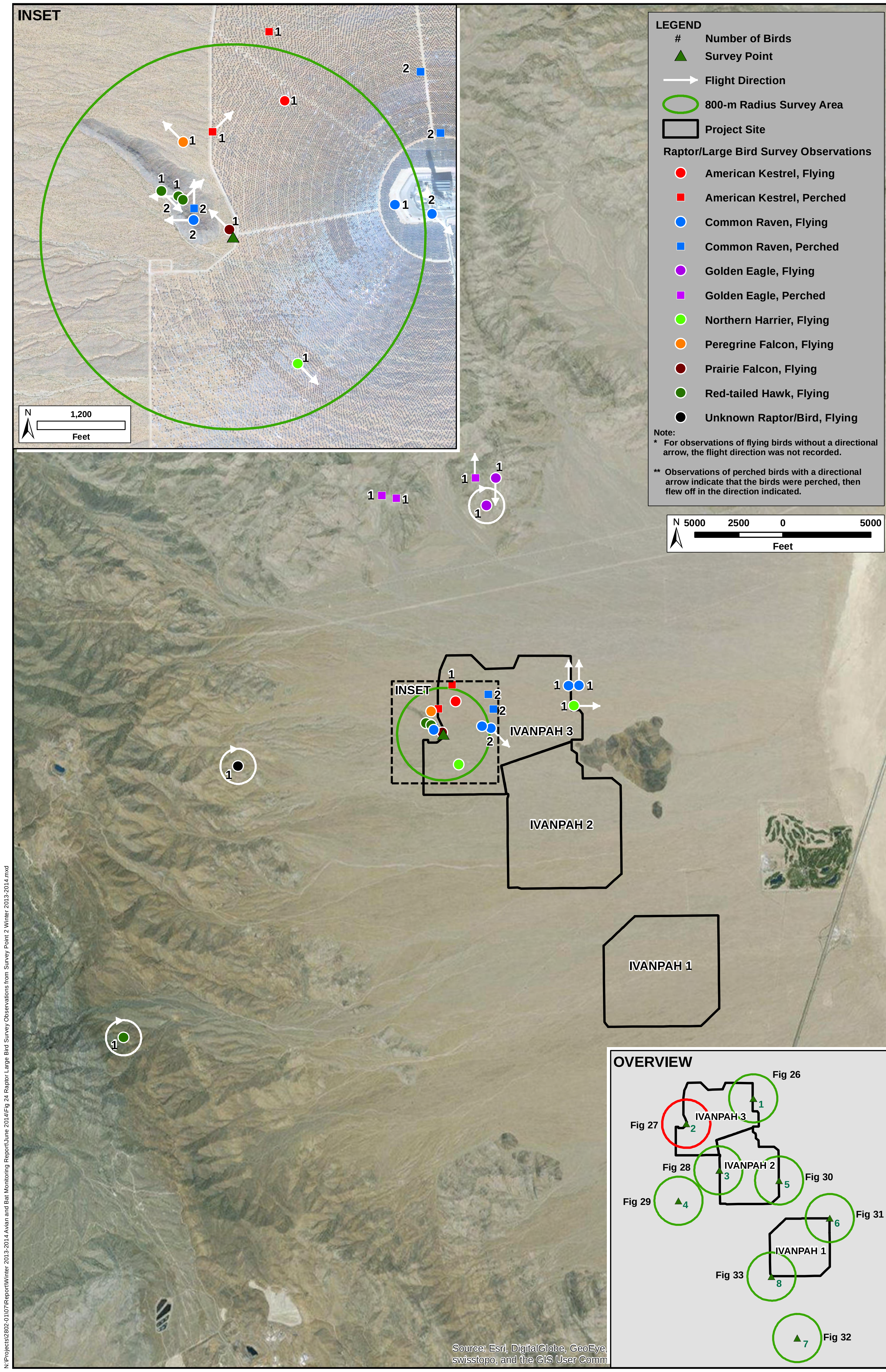
Figure 23: Raptor/Large Bird Survey Observations from Survey Point 1, Winter 2013-2014
Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)
June 2014



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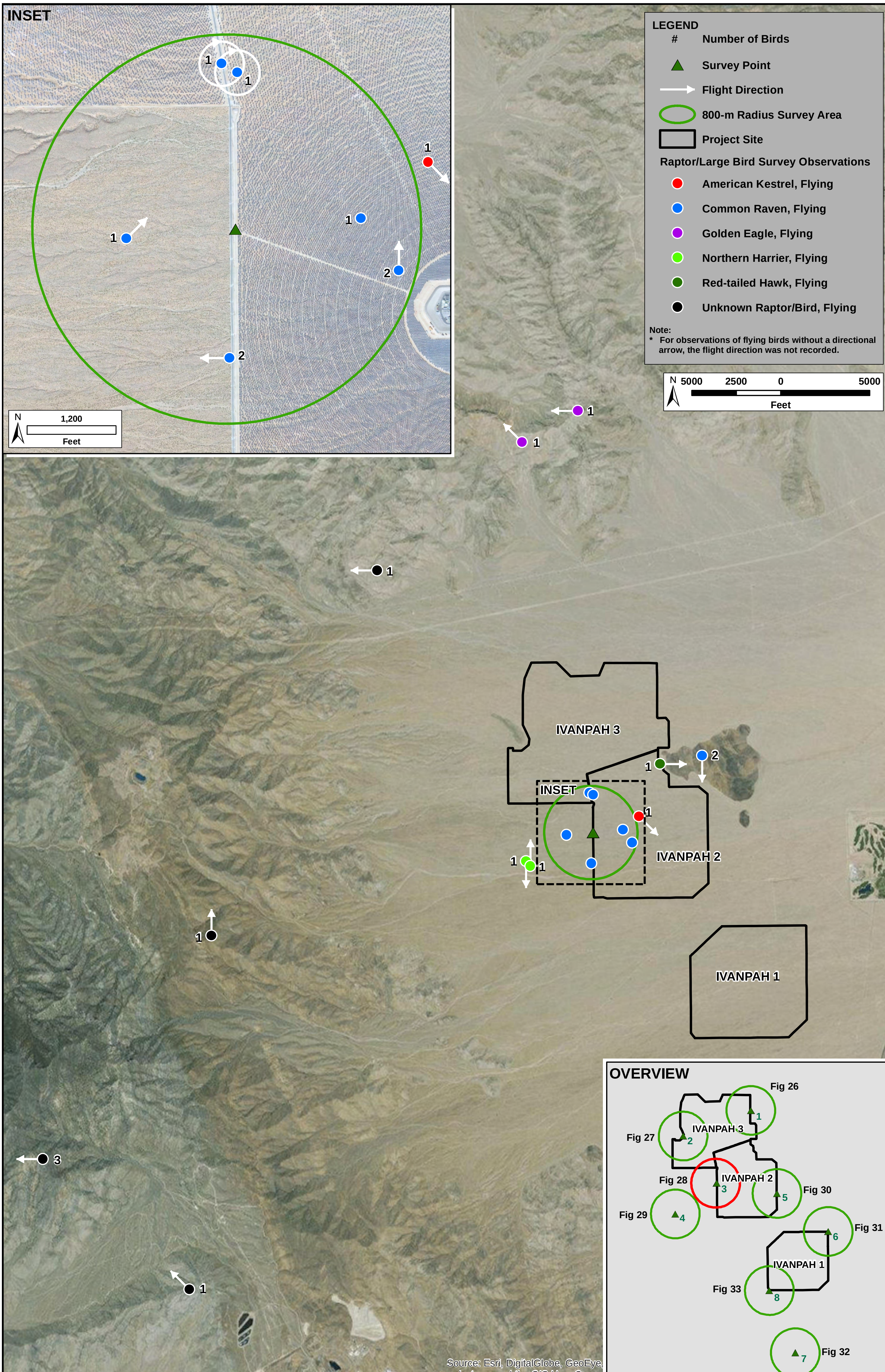
Ecological Consultants

Figure 24: Raptor/Large Bird Survey Observations from Survey Point 2, Winter 2013-2014

Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)
June 2014



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 25 Raptor Large Bird Survey Observations from Survey Point 3, Winter 2013-2014.mxd

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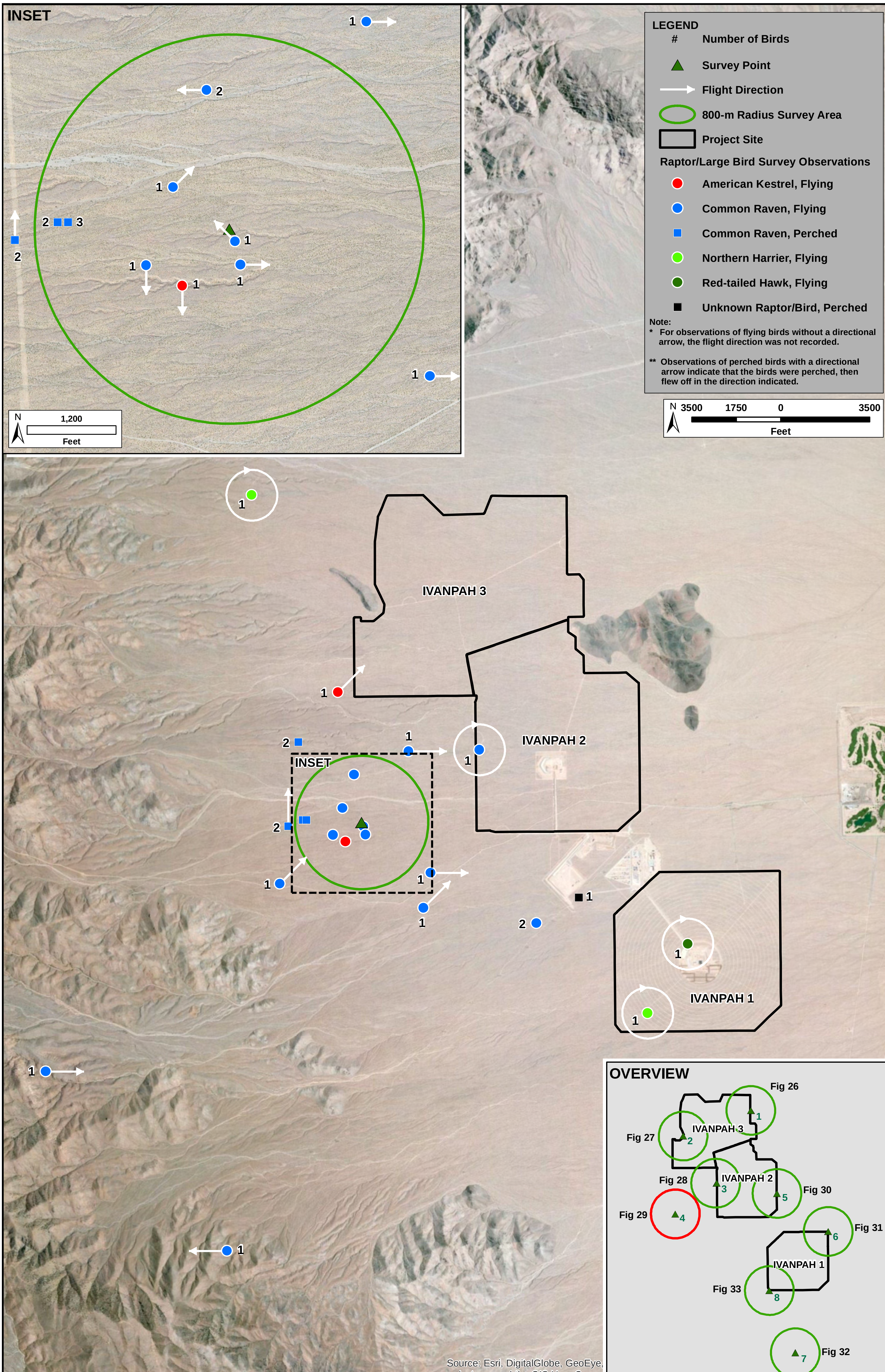
Figure 25: Raptor/Large Bird Survey Observations from Survey Point 3, Winter 2013-2014

Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)

June 2014



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 26 Raptor Large Bird Survey Observations from Survey Point 4, Winter 2013-2014.mxd

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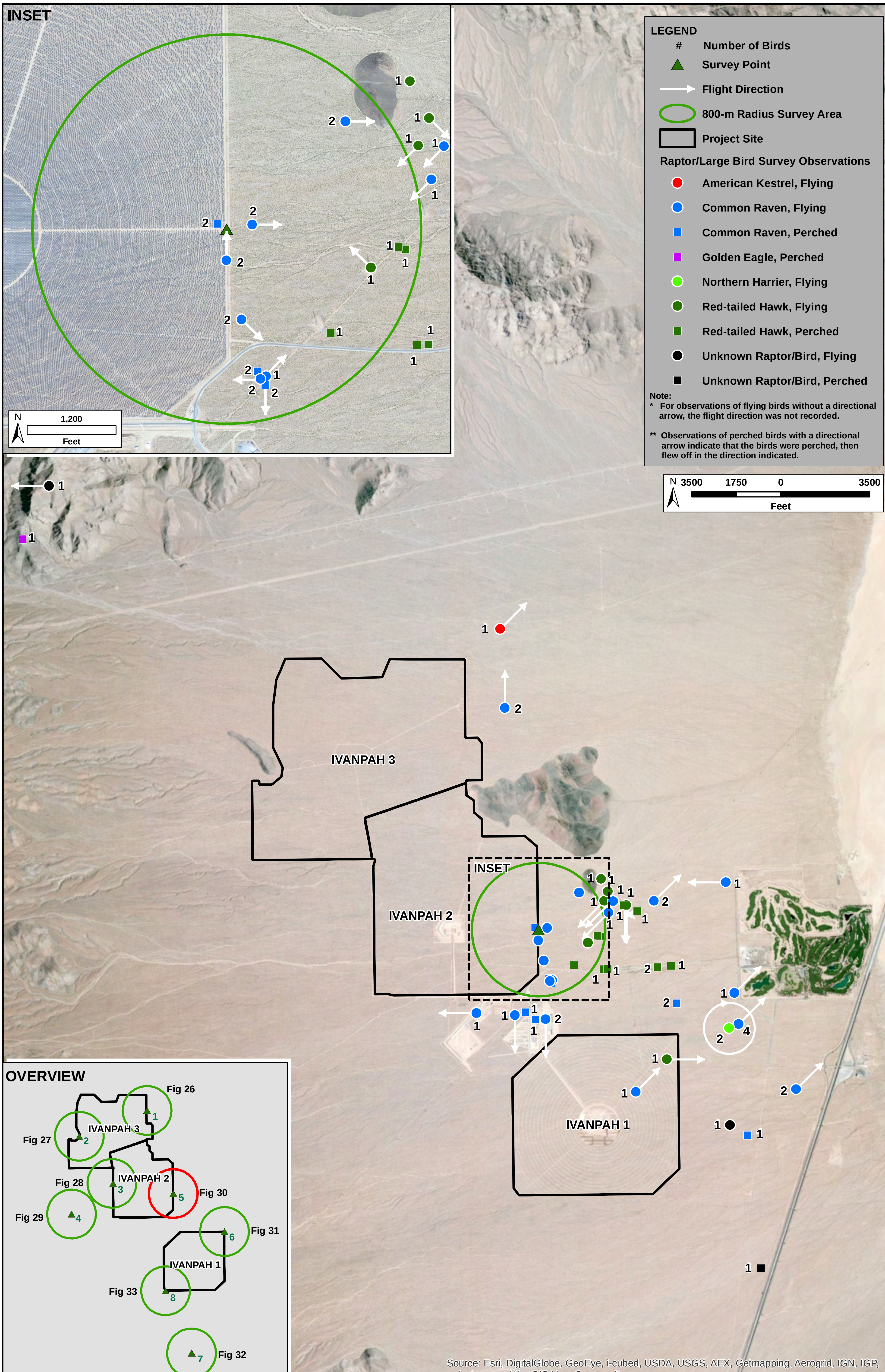
Figure 26: Raptor/Large Bird Survey Observations from Survey Point 4, Winter 2013-2014



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 27 Raptor Large Bird Survey Observations from Survey Point 5, Winter 2013-2014.mxd

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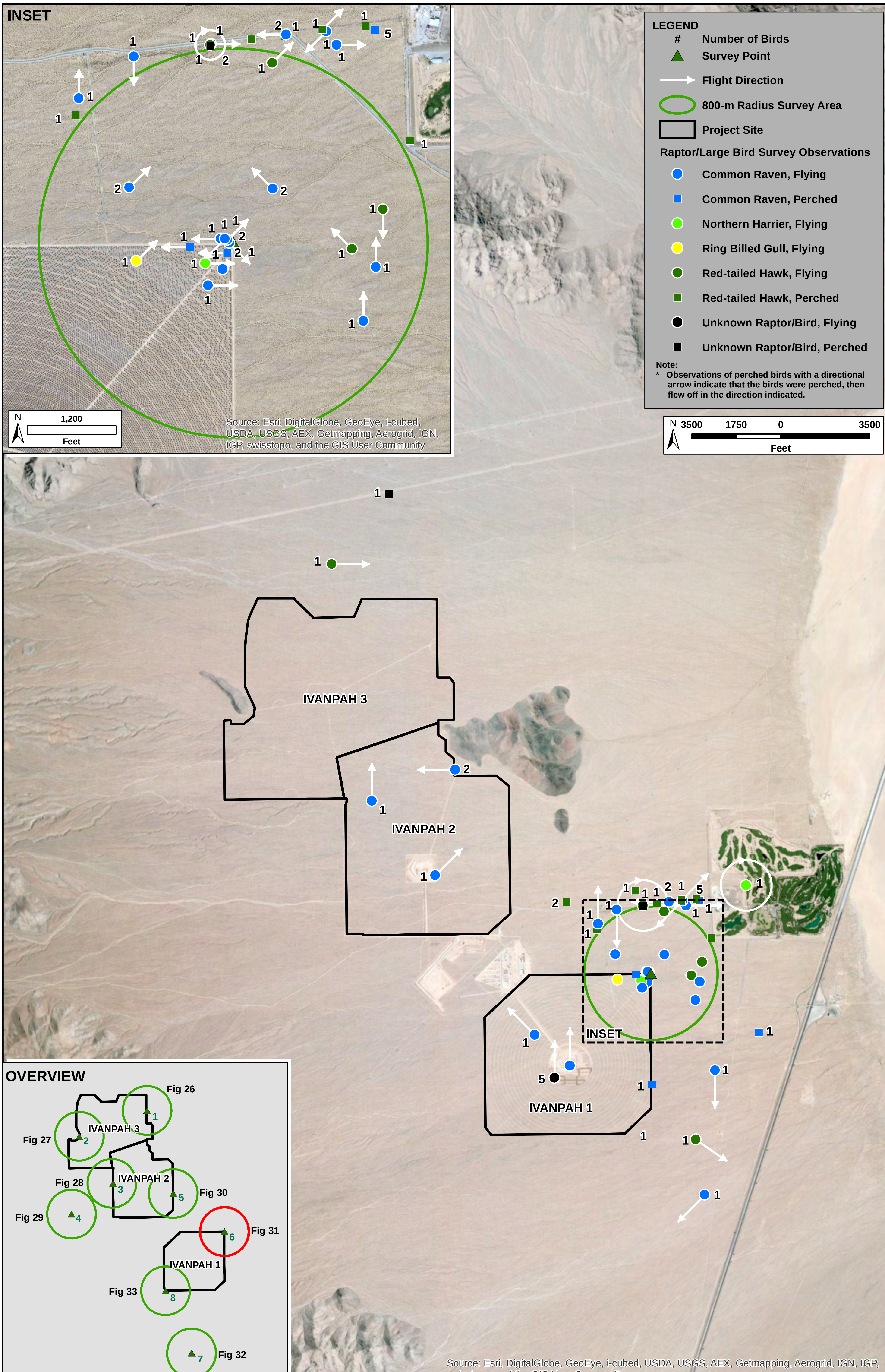
Figure 27: Raptor/Large Bird Survey Observations from Survey Point 5, Winter 2013-2014

Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)

June 2014



N:\Projects\2802-01\07\Report\Winter 2013-2014 Avian and Bat Monitoring Report\June 2014\Fig 28 Raptor Large Bird Survey Observations from Survey Point 6, Winter 2013-2014.mxd

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Figure 28: Raptor/Large Bird Survey Observations from Survey Point 6, Winter 2013-2014
Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)
June 2014

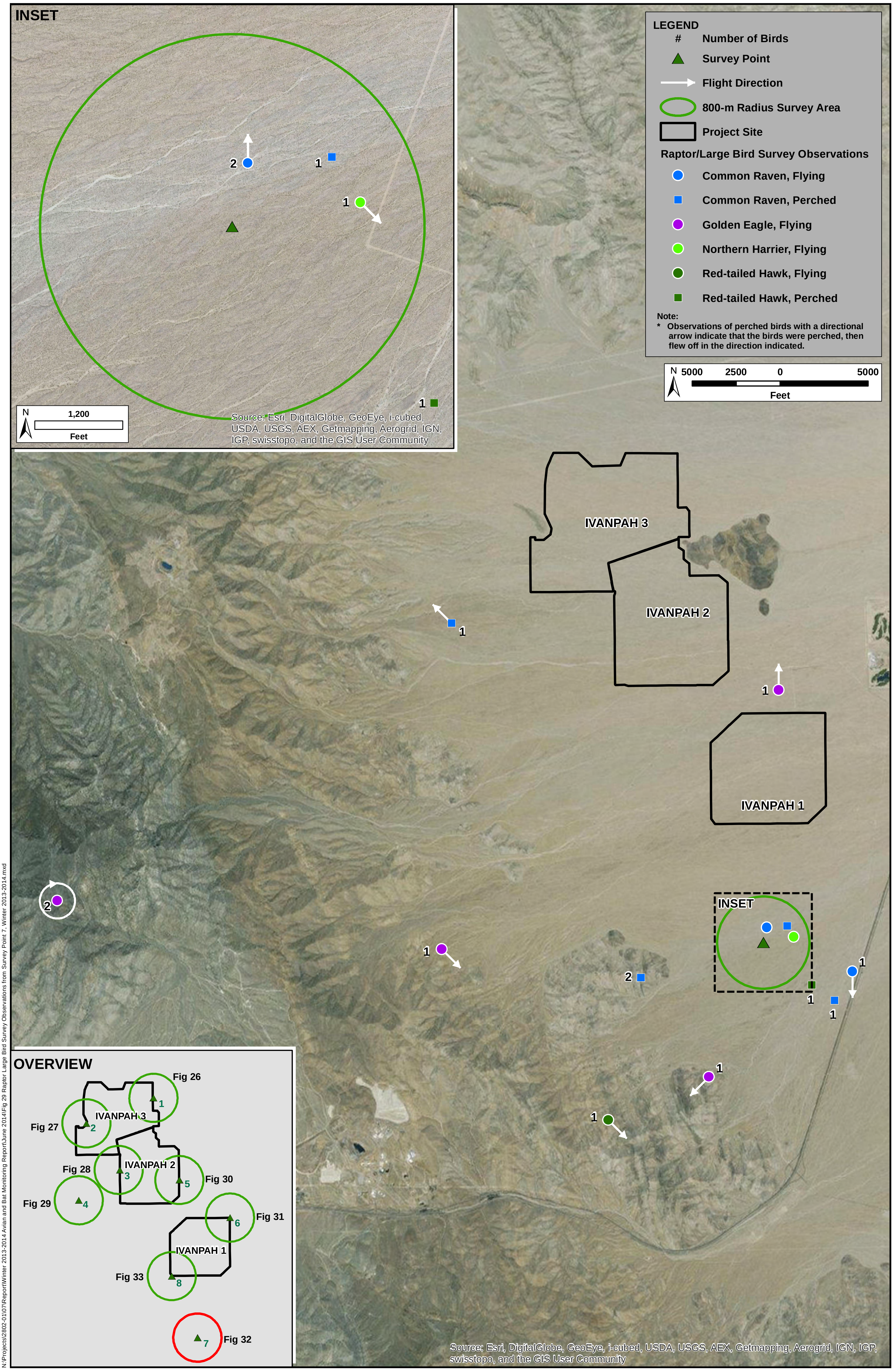

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Figure 29: Raptor/Large Bird Survey Observations from Survey Point 7, Winter 2013-2014

Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)

June 2014

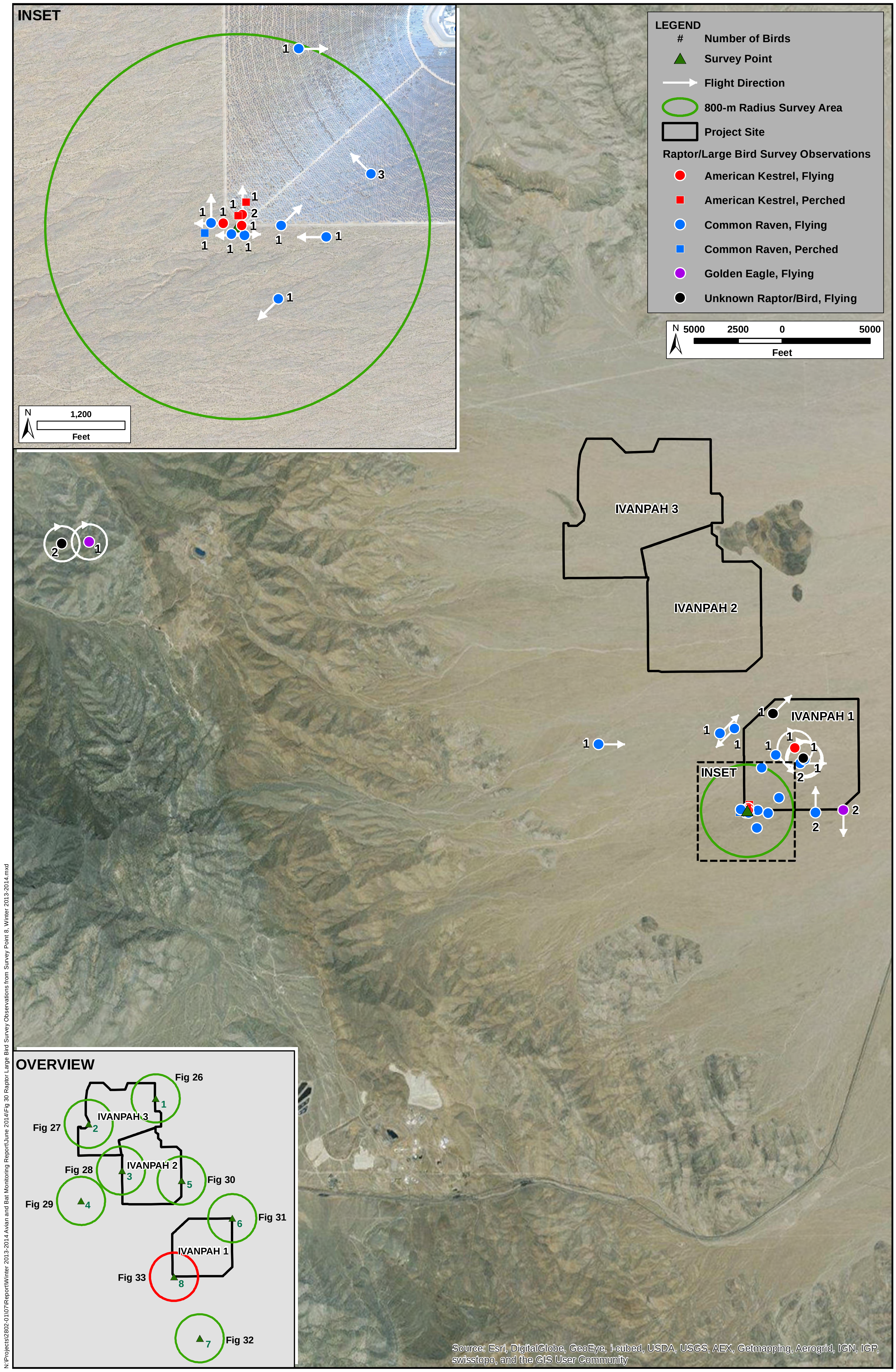

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Figure 30: Raptor/Large Bird Survey Observations from Survey Point 8, Winter 2013-2014

Ivanpah Winter 2013-2014 Avian and Bat Monitoring Report (2802-07)

June 2014

Section 6.0 Discussion

The 2013-2014 winter season represented the commencement of standardized monitoring of avian and bat detections and avian use of the Ivanpah site per the Avian & Bat Monitoring and Management Plan. Facility monitoring was phased in accordance with commencement of operations at the three units, while avian use monitoring was performed throughout the winter season. Necessary agency approvals related to the use of carcasses for searcher efficiency trials and carcass removal trials were obtained in January, at which point facility monitoring was being performed at equal effort in all three units, and searcher efficiency trials and carcass removal trials were being conducted concurrently.

Caution is necessary when drawing conclusions from the 2013-2014 winter season monitoring results because of the unequal sampling effort across units for part of the season and the relatively small number of the detections relative to the several Project elements of interest (e.g., heliostat fields, tower, fenceline, and powerlines). More extensive and robust conclusions will be possible at the end of the first full year of sampling; nevertheless, some noteworthy items related to the fatality monitoring were identified that informed recommendations regarding future monitoring.

6.1 Fatality Estimates

There was no obvious temporal clumping of detections during the winter season, and the species composition of the detections was generally similar to that observed using the heliostat grids, as identified during avian use surveys, preliminarily suggesting that there is not a bias towards a particular avian guild. Fatality estimates for the 2013-2014 winter season are limited by the low number of detections within various categories, such as guild, location, or cause of mortality. After four quarters of combined data, we anticipate that sample sizes will increase to exceed five detections per guild or location, and when this sample size is achieved, statistically robust fatality estimates for species by size, guild, area, and cause of death will be possible.

During the period 29 October 2013 to 21 March 2014, total estimated numbers of fatalities attributable to the project, including those with evidence of flux or collision effects, were 81 (90% confidence interval estimates 47-180) in the tower area; 111 (90% confidence interval estimates 49-272) in the heliostat area; and eight (90% confidence interval estimates 4-14) in the fenceline area.

As noted above, these estimates (and particularly the magnitude of the estimates) should be considered with caution given the limited dataset for the 2013-2014 winter season, and these estimates do not encompass the entire quarter due to the staggered start of standardized searches. Additionally, the large amount of uncontrolled search effort in the power block complicates fatality estimation in this area. Nevertheless, the relative magnitude of the fatality estimates among the three search areas (tower area, heliostat area, and fenceline) matches the pattern of detections observed. In proportion to unit area, fatality estimates suggest the highest densities of detections in the tower area, where the majority of flux detections also occur.

6.2 Carcass Removal and Searcher Efficiency Trials

After conducting the standardized searches in the units during the winter quarter, we believe that future sampling may confirm that the underlying scavenging rates and discovery rates of carcasses and feather spots occurring in the tower area are likely substantially different from those within the inner and outer arc plot segments. Although common ravens are relatively uncommon on the site as a whole, they are most often observed in the power block areas, where they scavenge some proportion of carcasses. Increased personnel activity leads to faster detection of incidental detections in the power block, and thus faster removal rates of carcasses and feather spots. Because the majority of detections are within these areas, it is important to properly understand how persistence rates here differ from surrounding areas to accurately estimate fatality rates for these sites. In addition, searcher efficiency likely differs between the tower area, where there is little vegetation, and the vegetated heliostat area. As a result, separate searcher efficiency trials and carcass removal trials for the tower area should be implemented moving forward (see Section 6.7, *Recommendations* below).

For the winter season, searcher efficiency rates, which averaged 35.7% for small birds and 42.8% for large birds, were somewhat lower than the target rates assumed in the Plan; however, these rates were within industry standards known for wind energy projects. The rates, which reflect human searchers only, showed improvement over the course of the season as we adapted our search pattern to the site-specific conditions and the dedicated search personnel gained more experience with this site. In addition, on 18-28 March 2014, we conducted a detection efficiency trial using detection dogs (H. T. Harvey & Associates 2014). Three detection dog teams (handler and dog) surveyed 23 selected arc plots within all three tower units. The plots selected were distinct from those being surveyed by humans under the Plan to avoid any conflict with regular (human) fatality monitoring. The searcher trials were conducted as a blind study, where avian carcasses and feather spots were planted (i.e., placed) in locations unknown to the detection dog team. At each arc plot, between zero and six avian fatalities, consisting of full carcasses (n=53) and feather spots (n=32) of non-native birds, were placed by a field assistant. The dog handler then guided the trained detection dogs through a survey of the arc plots containing the planted fatalities. The dogs demonstrated a learning curve as the trial progressed. The overall detection efficiency was 69% (i.e., 69% of planted fatalities were detected by the dogs). Overall dog team searcher efficiency was 68% for small birds (n=44) and 71% for large birds (n=41). The detection dog teams also detected seven novel (pre-existing) fatalities that were not placed by the field assistant.

The monitoring approach in the Plan assumed searcher efficiency rates of 55% for small birds and 69% for large birds. The results of the detection dog trial demonstrate that detection dog teams achieved mean searcher efficiencies 8% greater for small birds and 2% greater for large birds than those described in the underlying assumptions of the Plan. Therefore, incorporation of detection dog teams into the monitoring regime would increase the overall efficiency of fatality detection, improving the precision of fatality estimates (see Section 6.7, *Recommendations* below).

6.3 Cause and Distribution of Fatalities

The cause of death for the majority of the 96 avian detections during the 2013-2014 winter season could not be confirmed (i.e., the carcass or feather spot displayed no signs of flux effects and no direct collision effects) mainly because they were limited feather spots (See further discussion of feather spots below). Because singed feathers are readily observable, detections for which the cause of death is unconfirmed are likely to have resulted from predation, collision, or illness.

Half of the detections, and 23 of 27 detections (85%) showing evidence of flux effects, were detected in the relatively limited tower area. This 260-m radius area consisted of the area that was searched with 100% coverage due to proximity to the towers and is coincidental with the areas with the highest concentrations of solar flux. In addition, these towers were the focus of considerable activity by Ivanpah personnel, who found and reported detections, resulting in high numbers of incidental fatality reports. Given the intensive coverage of the power blocks, we are confident that we were able to detect a large proportion of the flux-related detections.

6.4 Feather Spots

Thirty-eight (39.6%) of the 96 detections consisted only of feather spots. While evidence of flux effects was noted on 11 of these 38 feather spots, the cause of "mortality" for the other 27 birds is unknown. These feather spots may have represented detections (e.g., collision) that had been scavenged, in which case they would legitimately be considered Project-related detections. However, they may also have represented natural predation events, which would not represent Project-related detections. The large proportion of feather spots among the detections for the site as a whole may inflate the fatality estimate as a result of the potential for multiple feather spots resulting from one fatality, feather spots resulting from predation not associated with the facility, or other causes. The ratio of feather spots to carcasses was relatively low throughout most of the site but was substantially higher in the power block. This result could indicate that predation events are less frequent around the power block than in other locations. However, it is also possible that this finding results from the rapidity with which carcasses around the tower are detected by people, so that there is less time for scavenging that would result in feather spots; the relocation of power block carcasses by scavengers; or the removal of feather spots around the power block by the wind, which may affect the relatively open power block area disproportionately compared to the rest of the solar field. Investigating the cause of feather spots, and whether they actually result from Project-related detections or natural predation, would help to elucidate whether fatality estimates are being inflated by feather spots from predation (see Section 6.7, *Recommendations* below).

6.5 Incidental Detections

A total of 30 incidental avian detections and one incidental bat detection were found during this quarter. Thus, incidental detections represented a large percentage (31.3% for birds and 20% for bats) of the detections. This demonstrates that the Ivanpah Wildlife Incident Reporting System, described in Section 3.4 of the Plan, is functioning well. However, a number of these incidental detections were retrieved from the power block, and the retrieval of incidental detections from the power block can confound accurate fatality estimates for this area because the "search effort" involved in the detection of incidental detections is not quantifiable and is subject to considerable spatial and temporal variability. Because incidental detections are retrieved at random intervals, we cannot properly assess the search interval of detected carcasses, or searcher efficiency of personnel finding detections in these areas, which are both critical model parameters when estimating fatalities. Nevertheless, incidental detections from the tower area were included in the fatality estimates because such a large proportion of detections in this area were incidental.

Because a high proportion of detections on the site are found in and around the power block areas, it is important to strive for accurate and precise fatality estimations within this area. We acknowledge the importance of obtaining data on any detections as soon as possible, but a change in the policy of removing these carcasses when they are detected incidentally would improve fatality estimates (see Section 6.7, *Recommendations* below).

6.6 Avian Use Surveys

Avian use surveys found much lower bird abundance in the heliostat arrays than on the control grids in the desert. While the vegetation in the arrays does provide habitat for some birds, it is evidently not as suitable or preferable to birds. As a result, the presence of vegetation within the heliostat arrays is not expected to result in substantial increases in the risk of facility-related detections.

6.7 Recommendations

Based on our findings, we have the following recommendations for changes in the approach to future monitoring:

(1) Searcher efficiency trials and carcass removal trials should be conducted separately for the tower area, as compared to the heliostat area, for use in fatality estimates. We will begin conducting such separate trials in summer 2014.

(2) To increase overall searcher efficiency, detection dog teams at Ivanpah should be used to complement searches by avian ecologists at the facility. Section 2.1.1 of the Plan allows for the use of trained search dogs for monitoring if determined to be appropriate by the TAC and approved by the USFWS.[2]

[2] Note: the use of detection dog teams was approved by the TAC at its May meeting.

(3) We recommend changing the policy regarding the removal of incidental detections in the power block area. Data on such detections should be taken when the birds or bats are found, but if carcasses are allowed to remain in place until the following search (with the understanding that some carcasses may be removed by scavengers before that search occurs), fatality estimation for the power block will be more accurate.

(4) Investigation of the causes of feather spots, and whether they represent Project-related mortality or natural predation, would help to refine the estimates of Project-related detections.

Section 7.0 Framework for Management and Risk Response

According to the Plan, quarterly reports are expected to categorize potential migratory bird mortality issues at Ivanpah as high, medium, or low to provide an appropriate biological basis for TAC review and decision making, based on the following definitions in Section 5.3 of the Plan:

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.

As noted in Section 4.1, only limited conclusions can be drawn from the 2013-2014 winter 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 would be categorized as low. There was no obvious temporal clumping of detections during the winter season and the species composition of the detections were generally similar to those observed using the heliostat grids, as identified during avian use surveys, preliminarily suggesting that there is not a bias towards a particular avian guild. Permanent residents in the Ivanpah Valley accounted for the majority (66.7%) of the total detections on the site during the winter. Only 16 species had more than one detection (injury or fatality) detected, and only seven species had more than three detections (see Table 1). Of the latter group of seven species, the mourning dove, yellow-rumped warbler, Anna's hummingbird, Brewer's blackbird, and western meadowlark are abundant locally, regionally, and nationally. Populations of a sixth species, American kestrel (of which there were four recorded detections), are somewhat more limited, consistent with the larger territory sizes of raptors (as compared to the previously mentioned five species). However, this is a common and widespread species on local, regional, and national scales, and the magnitude of kestrel detections at Ivanpah during the 2013-2014 winter season does not rise above the "low" category.

Section 8.0 Literature Cited

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Appendix A. Individual Avian and Bat Detections

Table A-1. Incidental Avian Fatalities Found in Standardized Search Areas (N=27) and Non-Search Areas (N=3), 29 October 2013 – 21 March 2014.

Date	Unit	Element	USFWS #	Alpha Code[1]	Age	Sex	Condition	Cause of Death[2]	Estimated Time Since Death	UTM Coordinates[3]
10/29/2013	3	Outer Segment	2013_70_Ivanpah	UNKN	U	U	Partial carcass	Unknown	<1 month	11S 638551 3937520
10/29/2013	3	Power Block (ACC Unit)	2013_69_Ivanpah	BAWW	U	U	Carcass	Unknown	<1 week	11S 637493 3937974
10/30/2013	CLA	Near kit fox shelter site*	2013_71_Ivanpah	AMCO	U	U	Partial carcass	Unknown	Unknown	11S 639365 3934573
10/31/2013	2	Power Block (ACC Unit)	2013_79_Ivanpah	TOWA	A	F	Carcass	Unknown	<1 week	11S 638678 3935914
11/12/2013	1	Power Block (grounds)	2013_82_Ivanpah	ROPI	U	U	Partial carcass	Unknown	<1 week	11S 640425 3933566
11/18/2013	3	Heliostat Array	2013_83_Ivanpah	UNKN	U	U	Feather spot	Unknown	Unknown	11S 637459 3938861
11/20/2013	1	Perimeter Fence	2013_84_Ivanpah	GRRO	U	U	Feather spot	Unknown	<1 week	11S 641339 3933815
11/25/2013	1	Perimeter Fence	2013_89_Ivanpah	GRRO	U	U	Feather spot	Unknown	<1 month	11S 639346 3933713
11/25/2013	1	Perimeter Fence	2013_88_Ivanpah	GRRO	U	U	Feather spot	Unknown	<1 month	11S 639419 3932662
11/27/2013	2	Inner HD	2013_90_Ivanpah	SAVS	A	U	Carcass	Collision	<1 week	11S 638677 3935995
11/29/2013	1	Power Block (ACC Unit)	2013_92_Ivanpah	UNKN	U	U	Feather spot	Unknown	Unknown	11S 640352 3933562
12/5/2013	3	Inner HD	2013_93_Ivanpah	AMPI	A	U	Carcass	Collision	<1 week	11S 637466 3938133
12/21/2013	1	Inner Segment	2013_101_Ivanpah	SAPH	A	U	Partial carcass	Unknown	<1 month	11S 640239 3934072
12/23/2013	2	Power Block (grounds)	2013_105_Ivanpah	BRBL	U	U	Carcass	Unknown	<1 week	11S 638708 3935849
1/24/2014	NA	Desert Tortoise Pen*	2014_20_Ivanpah	GRRO	A	U	Carcass	Unknown	<1 week	
1/27/2014	3	Entrance Road to Unit 3*	2014_18_Ivanpah	BTSP	A	M	Carcass	Collision	<24 hrs	11S 637685 3936569
2/13/2014	2	Power Block (underneath ACC unit)	2014_33_Ivanpah	ANHU	J	F	Carcass	Flux Effects - Grade 1	<24	11S 638724 3935902
2/14/2014	2	Power Block	2014_34_Ivanpah	BRBL	A	F	Carcass	Unknown	<1 week	11S 638645 3935870
2/17/2014	1	Fenceline (east side)	2014_35_Ivanpah	AMKE	A	F	Feather spot	Flux Effects	<1 week	11S 641352 3934192
2/20/2014	2	Power Block	2014_36_Ivanpah	WTSW	A	U	Carcass	Flux Effects	<24 hrs	11S 638613 3935887
2/22/2014	3	Power Block	2014_37_Ivanpah	COHU	A	M	Carcass	Flux Effects	<24 hrs	11S 637459 3937979
3/5/2014	1	Power Block	2014_43_Ivanpah	ANHU	J	M	Carcass	Flux Effects - Grade 1	<1 week	11S 640312 3933446

3/14/2014	3	Power Block	2014_50_Ivanpah	ANHU	A	F	Carcass	Flux Effects - Grade 1	<24 hrs	11S 637499 3937927
3/16/2014	3	Power Block	2014_51_Ivanpah	COHU	J	M	Carcass	Flux Effects - Grade 1	<24 hrs	11S 637526 3937897
3/19/2014	2	Outer Segment	2014_53_Ivanpah	UNKN	U	U	Carcass	Unknown	>1 month	11S 639250 3936491
3/19/2014	2	Outer Segment	2014_54_Ivanpah	UNKN	U	U	Carcass	Unknown	>1 month	11S 639078 3936616
3/21/2014	3	Outer Segment	2014_56_Ivanpah	MODO	U	U	Carcass	Unknown	>1 month	11S 638335 3938329
3/21/2014	3	Outer Segment	2014_57_Ivanpah	MODO	U	U	Feather spot	Unknown	>1 month	11S 638150 3938052
3/21/2014	3	Outer Segment	2014_59_Ivanpah	HOLA	U	U	Partial carcass	Unknown	>1 month	11S 637489 3937393
3/21/2014	1	Power Block (grounds)	2014_58_Ivanpah	COHU	A	M	Carcass	Flux effects - Grade 3	<24 hrs	11S 640338 3933433

* Denotes incidental detections outside of regularly searched areas.

[1] Alpha codes are defined in Table 1.

[2] "Unknown" cause of death = no evidence of singeing and no clear evidence that the fatality was caused by a collision with project facilities; "Flux Effects" = singeing observed; "Collision" = evidence of collision was observed, such as a bird-strike imprint and/or feathers on a heliostat above the detection.

Beginning in early March 2014, and where sufficient information was available for earlier detections, flux-related carcass detections were 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

Grades were not applied in the case of feather spots or partial carcasses.

[3] UTM = Universal Transverse Mercator coordinate system

Table A-2. Bird Fatalities Found During Standardized Searches, 29 October 2013 – 21 March 2014 (N=61).

Date	Unit	Element	HTH Incident Number	USFWS Incident Number	Alpha Code[1]	Age	Sex	Condition	Cause of Death[2]	Estimated Time Since Death	UTM Coordinates[3]
10/30/2013	1	Power Block (ACC unit)	20131030-103	2013-72-Ivanpah	YRWA	J	U	Carcass	Flux Effects- Grade 2	<1 week	11S 640412.64 3933522.2
10/30/2013	1	Power Block (ACC unit)	20131030-32	2013-77-Ivanpah	YRWA	A	M	Carcass	Unknown	<1 month	11S 640367 3933540
10/30/2013	1	Power Block (grounds)	20131030-47	2013-78-Ivanpah	MODO	U	U	Partial carcass	Unknown	<1 month	11S 640360 3933585
10/30/2013	1	Inner HD	20131030-46	2013-75-Ivanpah	YRWA	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 640482 3933537
10/30/2013	1	Inner HD	20131030-91	2013-76-Ivanpah	SPSA	U	U	Partial carcass	Unknown	<1 week	11S 640150 3933621
10/30/2013	1	Inner HD	20131030-92	2013-73-Ivanpah	YRWA	J	U	Carcass	Unknown	<1 week	11S 640157 3933561
10/30/2013	1	Inner Segment	20131030-93	2013-74-Ivanpah	GTGR	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 640318 3933863
10/31/2013	1	Inner Segment	20131031-91	2013-80-Ivanpah	WCSP	J	U	Carcass	Unknown	<1 week	11S 640755 3933623
10/31/2013	1	Inner Segment	20131031-92	2013-81-Ivanpah	unknown	U	U	Feather spot	Unknown	<1 week	11S 640958 3933439
11/25/2013	1	Inner HD	20131125-26	2013-85-Ivanpah	blackbird sp.	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 640332 3933374
11/25/2013	1	Inner HD	20131125-27	2013-86-Ivanpah	YRWA	U	U	Carcass	Collision	<24 hrs	11S 640343 3933355
11/25/2013	1	Inner HD	20131125-28	2013-87-Ivanpah	YRWA	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 week	11S 640324 3933382
11/27/2013	1	Outer Segment	20131127-61	2013-91-Ivanpah	AMPI	U	U	Carcass	Collision	<1 week	11S 640392 3932691
12/11/2013	3	Outer Segment	20131211_61	2013_94_Ivanpah	AMKE	A	F	Carcass	Unknown	>1 Month	11S 636870 39388890
12/11/2013	3	Outer Segment	20131211_31	2013_95_Ivanpah	NOFL	A	U	Partial carcass	Unknown	<1 Month	11S 638428 3938752
12/11/2013	3	Outer Segment	20131211_71	2013_96_Ivanpah	MODO	A	U	Carcass	Unknown	>1 Month	11S 636682 3937097
12/20/2013	1	Inner HD	20131220_27	2013_97_Ivanpah	AMCO	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 640353 3933496
12/20/2013	1	Inner HD	20131220_26	2013_98_Ivanpah	AMPI	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 640390 3933393
12/20/2013	1	Inner HD	20131220_61	2013_99_Ivanpah	GTGR	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 6403232 3933373
12/20/2013	1	Inner HD	20131220_62	2013_100_Ivanpah	GTGR	U	U	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 640481 3933454
12/21/2013	1	Inner Segment	20131221_46	2013_102_Ivanpah	WEME	U	U	Feather spot	Unknown	<1 week	11S 640820 3933892
12/21/2013	1	Inner Segment	20131221_71	2013_103_Ivanpah	WEME	U	U	Feather spot	Collision	<1 week	11S 639527 3934048
12/22/2013	1	Outer Segment	20131222_26	2013_104_Ivanpah	MODO	U	U	Feather spot	Collision	<1 week	11S 640645 3934563

1/2/2014	3	Power Block (ACC unit)	20140102_72	2014_01_Ivanpah	unknown	U	U	Feather spot	Unknown	<1 week	11S 637524 3937973
1/2/2014	3	Power Block (ACC unit)	20140102_73	2014_02_Ivanpah	YRWA	A	M	Carcass	Flux Effects - Grade 3	<1 week	11S 637747 393766
1/4/2014	3	Outer Segment	20140104_31	2014_03_Ivanpah	GRRO	A	U	Feather spot	Collision	<1 month	11S 637020 3936953
1/4/2014	3	Outer Segment	20140104_32	2014_04_Ivanpah	COYE	U	U	Carcass	Collision	>1 month	11S 636860 3937211
1/5/2014	3	Outer Segment	20140105_71	2014_05_Ivanpah	MODO	A	U	Carcass	Collision	<1 week	11S 638053 3937465
1/8/2014	2	Inner HD	20140108_71	2014_06_Ivanpah	BRBL	U	F	Partial carcass	Unknown	<1 month	11S 638608 3936060
1/8/2014	2	Inner HD	20140108_72	2014_07_Ivanpah	MODO	A	U	Feather spot	Unknown	<1 week	11S 638888 3935919
1/8/2014	2	Inner HD	20140108_61	2014_08_Ivanpah	AMKE	A	M	Partial carcass	Unknown	<1 week	11S 638905 3935820
1/9/2014	2	Inner Segment	20140108_46	2014_09_Ivanpah	MODO	A	U	Feather spot	Collision	<1 month	11S 638330 3935543
1/10/2014	2	Outer Segment	20140110_31	2014_10_Ivanpah	MODO	A	U	Feather spot	Unknown	<1 month	11S 638347 3936960
1/10/2014	2	Outer Segment	20140110_32	2014_11_Ivanpah	YRWA	A	U	Feather spot	Unknown	<1 month	11S 638473 3937242
1/16/2014	1	Outer Segment	20140116_46	2014_12_Ivanpah	MODO	A	U	Feather spot	Unknown	<1 week	11S 641337 3933917
1/16/2014	1	Outer Segment	20140116_47	2014_13_Ivanpah	MODO	A	U	Feather spot	Unknown	<1 week	11S 641270 3933978
1/27/2014	3	Power Block (ACC unit)	20140127_32	2014_15_Ivanpah	ANHU	A	F	Carcass	Flux Effects - Grade 1	<1 week	11S 637454 3937987
1/27/2014	3	Inner HD	20140127_71	2014_16_Ivanpah	AMKE	A	F	Feather spot	Flux Effects – evidence of singeing on feather spot	<1 month	11S 637707 3937918
1/27/2014	3	Inner HD	20140127_72	2014_17_Ivanpah	ROPI	A	U	Feather spot	Unknown	<1 week	11S 637630 3937845
1/28/2014	3	Inner Segment	20140128_31	2014_19_Ivanpah	MODO	A	U	Feather spot	Unknown	<1 week	11S 637777 3937839
1/30/2014	3	Outer Segment	20140130_31	2014_21_Ivanpah	CACW	A	U	Feather spot	Unknown	<1 week	11S 638816 3938305
1/30/2014	3	Outer Segment	20140130_32	2014_22_Ivanpah	MODO	A	U	Feather spot	Unknown	<1 month	11S 638802 3938292
1/30/2014	3	Outer Segment	20140130_71	2014_23_Ivanpah	NOFL	A	U	Feather spot	Unknown	<1 month	11S 638415 3938810
2/3/2014	2	Inner HD	20140203_61	2014_24_Ivanpah	WEME	A	U	Broken up	Unknown	<1 month	11S 638594 3936051
2/3/2014	2	Inner HD	20140203_62	2014_25_Ivanpah	BRBL	A	F	Feather spot	Unknown	<1 month	11S 638620 3936061
2/3/2014	2	Inner HD	20140203_63	2014_26_Ivanpah	HOFI	A	M	Carcass	Unknown	<1 week	11S 638564 3936097
2/4/2014	2	Inner Segment	20140204_71	2014_27_Ivanpah	LOSH	A	U	Partial carcass	Unknown	<1 week	11S 639236 3935865
2/4/2014	2	Inner Segment	20140204_61	2014_28_Ivanpah	HOFI	A	M	Carcass	Collision	<1 week	11S 638111 3936113
2/5/2014	2	Outer Segment	20140205_61	2014_29_Ivanpah	MODO	A	U	Carcass	Unknown	>1 month	11S 639658 3936851
2/11/2014	1	Inner Segment	20140211_31	2014_31_Ivanpah	GRRO	A	U	Feather spot	Unknown	<1 month	11S 640964 3933609
2/12/2014	1	Outer Segment	20140212_46	2014_32_Ivanpah	WETA	A	M	Carcass	Unknown	>1 month	11S 639433 3932727
2/25/2014	3	Inner HD	20140225_36	2014_38_Ivanpah	ANHU	A	F	Carcass	Flux Effects - Grade 3	<1 week	11S 637329 3937711
2/26/2014	3	Inner Segment	20140226_61	2014_39_Ivanpah	MODO	A	U	Feather spot	Collision	<1 week	11S 637233 3937596
3/3/2014	2	Power Block (ACC unit)	20140303_46	2014_40_Ivanpah	ANHU	A	M	Carcass	Flux Effects - Grade 3	<1 month	11S 638666 3936887
3/5/2014	2	Outer Segment	20140305_71	2014_41_Ivanpah	MODO	A	U	Carcass	Unknown	>1 month	11S 638706 3936785
3/5/2014	2	Outer Segment	20140303_72	2014_42_Ivanpah	MODO	A	U	Carcass	Unknown	>1 month	11S 638770 3936956
3/10/2014	1	Power Block (ACC unit)	20140310_81	2014_45_Ivanpah	ANHU	A	F	Carcass	Flux Effects - Grade 3	<1 month	11S 640374 3933532
3/10/2014	1	Inner HD	20140310_71	2014_46_Ivanpah	Unk. small passerine	U	U	Feather spot	Unknown	<1 week	11S 640377 3933695
3/10/2014	1	Inner HD	20140310_72	2014_47_Ivanpah	Blackbird sp.	U	U	Feather spot	Flux Effects –	<1 month	11S 640331 3933354

									evidence of singeing on feather spot		
3/12/2014	3	Outer Segment	20140312_71	2014_48_Ivanpah	MODO	A	U	Carcass	Unknown	>1 month	11S 636681 3937099
3/12/2014	3	Outer Segment	20140312_81	2014_49_Ivanpah	MODO	A	U	Partial carcass	Unknown	>1 month	11S 636785 3937784

[1] Alpha codes are defined in Table 1.

[2] "Unknown" cause of death = no evidence of singeing and no clear evidence that the fatality was caused by a collision with project facilities; "Flux Effects" = singeing observed; "Collision" = evidence of collision was observed, such as a bird-strike imprint and/or feathers on a heliostat above the detection.

Beginning in early March 2014, and where sufficient information was available for earlier detections, flux-related carcass detections were 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

Grades were not applied in the case of feather spots or partial carcasses.

[3] UTM = Universal Transverse Mercator coordinate system

Table A-3. Injured Birds Found in Standardized Search Areas, 29 October 2013 – 21 March 2014 (N=5)

Date	Unit	Element	USFWS #	Alpha Code[1]	Age	Sex	Injury	Cause of Injury[2]	Outcome	Zone	Easting	Northing
10/29/2013	3	Fence	NA	COLO	Juvenile	Unknown	Mild foot abrasions; cholla spines in feet and one in breast.	Collision	Released at Primm Valley golf course pond	?	?	?
10/30/2013	1	Power Block (near ACC)	NA	GTGR	Adult	Female	Flight feathers singed.	Flux Effects – Grade 1	Bird transferred to wildlife rehabilitator 10/31/2013	?	?	?
3/7/2014	2	Power Block (berm area)	2014_44_Ivanpah	CORA	Adult	Unknown	Flight and body feathers singed.	Flux Effects – Grade 2 and 3	Bird transferred to wildlife rehabilitator same day.	11S 638622 3935783	638622	3935783
3/17/2014	1	Fence	2014_52_Ivanpah	CORA	Adult	Unknown	Flight and body feathers singed.	Flux Effects – Grade 2 and 3	Bird transferred to wildlife rehabilitator same day.	11S 641333 3932954	641333	3932954
3/19/2014	1	Power Block (berm area)	2014_55_Ivanpah	DCCO	Juvenile	Unknown	No external trauma noted; could fly short distance.	Unknown	Bird released at west pond of golf course; later that day found on Yates Well Rd. Picked up and released at larger pond on golf course	11S 640165 3933642	640165	3933642

[1] Alpha codes are defined in Table 1.

[2] "Unknown" cause of death = no evidence of singeing and no clear evidence that the fatality was caused by a collision with project facilities; "Flux Effects" = singeing observed; "Collision" = evidence of collision was observed, such as a bird-strike imprint and/or feathers on a heliostat above the detection.

Beginning in early March 2014, and where sufficient information was available for earlier detections, flux-related carcass detections were 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

Grades were not applied in the case of feather spots or partial carcasses.

Table A-4. Bat Fatalities Found During Standardized Searches, 29 October 2013 – 21 March 2014 (N=4).

Date	Unit	Element	HTH Incident Number	USFWS Incident Number	Alpha Code	Adult	Sex	Condition	Cause of Death	Estimated Time Since Death	UTM Coordinates
1/2/2014	3	Power Block (ACC unit)	20140102_71	2014_B01 _Ivanpah	Myotis sp.	U	U	Carcass	Unknown	<1 month	11S 637508 3937951
1/27/2014	3	Power Block (ACC unit)	20140127_31	2014_B02 _Ivanpah	Unk.	U	U	Partial carcass	Unknown	<1 month	11S 637506 3937953
2/3/2014	2	Power Block (ACC unit)	20140203_71	2014_B03 _Ivanpah	MYCI	U	U	Carcass	Unknown	<1 month	11S 638652 3935888
3/3/2014	2	Power Block (ACC unit)	20140303_61	2014_B04 _Ivanpah	MYCA	U	U	Carcass	Unknown	<1 month	11S 638682 3935892

[1] UTM = Universal Transverse Mercator coordinate system