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IVANPAH SOLAR ELECTRIC GENERATING SYSTEM
AVIAN & BAT MONITORING PLAN

2013-2014 ANNUAL REPORT (REVISED)
(29 OCTOBER 2013 – 20 OCTOBER 2014)

Project # 2802-07

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Executive Summary

This annual report summarizes the first four seasons of the avian and bat monitoring surveys conducted from 29 October 2013 to 20 October 2014 at the Ivanpah Solar Electric Generating System facility (referred to in this report as "Ivanpah" or "Project"). The surveys were phased in during the first winter season and conducted in accordance with the Project's Avian & Bat Monitoring and Management Plan (Plan). These surveys include: avian point counts, raptor/large bird surveys and facility monitoring for avian and bat fatalities. This report summarizes monitoring data collected during the first four seasons, analyzes Project-related and bird fatalities or injuries detected, and provides recommendations for future monitoring and adaptive management. Specification of the methods and protocols for the monitoring are found within the seasonal reports and the Plan that are available on the project's docket log at https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=07-AFC-05C.

During avian point count surveys, a total of 54 bird species were recorded. Species richness was higher in the desert bajada grids (47 species) and lower in the heliostat grids (24 species) in all seasons. Overall species richness was highest in spring and fall and lower in winter and summer; densities were similarly high in winter, spring, and fall and lowest in summer.

During the raptor/large bird monitoring, nine raptor species and six other large bird species (common raven, turkey vulture, white-faced ibis, California gull, ring-billed gull, and an unidentified duck species) were identified. Common ravens comprised 51.9% of all large bird detections. Overall abundance of raptors was highest in winter and lowest in summer.

For the avian and bat fatality monitoring, searches were conducted in the Project areas, including: 1) the "tower area", consisting of the power block and inner high-density (HD) heliostats surrounding each power block on approximately 154 acres, which was surveyed with 100% coverage; 2) the "heliostat area", consisting of the inner and outer heliostat segments outside of the inner HD heliostats on approximately 720 acres, which was surveyed with 24.1% coverage in randomly selected arc-shaped plots; 3) the "fenceline", consisting of the perimeter fences and Common Logistics Area (CLA) fence, which was 100% surveyed; 4) the "collector line", consisting of the Unit 3 collector line, which was also 100% surveyed; and 5) offsite transects. Overall, approximately 29.2% of the facility was searched (not including the offsite transects, which are outside the facility).

All bird and bat fatalities and injuries, referred to as "detections" in this report, including those found incidentally and during standardized fatality searches, were documented and categorized as singed, collision, other Project causes or unknown based on an examination using a binocular microscope and evidence collected from the location of the detection. A total of 32 bat detections, 695 avian detections (including 25 injured birds that died), and eight injured bird detections were found over the first four seasons.

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

Overall, the estimated avian mortality was 1492 or 42.6% of birds (90% confidence interval 1,046-2,371) from known causes and 2012 or 57.4% of birds (90% confidence interval 1,450-3,334) from unknown causes. Of the known causes, 457 or 30.6% of fatalities (90% confidence interval 345-659) were estimated for the 18-acre power blocks, 278 or 18.6% of fatalities (90% confidence interval 160-530) were estimated for the 136-acre inner HD heliostat areas, and 753 or 50.5% of fatalities (90% confidence interval 537-1,178) were estimated for the 2,991-acre heliostat areas. Based on the acreages of these Project components, these fatality estimates correspond to densities of 25.4 fatalities/acre in the power block, 2.0/acre in the inner HD heliostats, and 0.3/acre in the heliostat area. The sources of mortality for known causes was 47.4% singed, 51.9% with evidence of collision effects, and 0.7% from other Project causes (e.g. entrapment or occurrence in the air cooled condenser (ACC) buildings).

For the fatalities from unknown causes, the estimate was driven by a high number of feather spots (47.2% of all detections) which may lead to over-estimation of the number of unknowns. Nevertheless, of the estimated unknown fatalities, 79 or 3.9% of fatalities (90% confidence interval 47-152) were estimated for the 18-acre power blocks, 200 or 9.9% of fatalities (90% confidence interval 134-342) were estimated for the 136-acre inner HD heliostat areas, 1,665 or 82.8% of fatalities (90% confidence interval 1221-2735) were estimated for the 2,991-acre heliostat areas, and 68 or 3.3% of fatalities (90% confidence interval 48-105) were estimated for the 39-acre fencelines. Based on the acreages of these Project components, these fatality estimates correspond to densities of 4.4 fatalities/acre in the power block, 1.5/acre in the inner HD heliostats, 0.6/acre in the heliostat areas, and 1.7/acre within the fenceline area.

The Project has implemented several best management practices and deterrent measures to reduce avian and bat mortality to the extent practical. These include heliostat repositioning software upgrades, light emitting diode (LED) lighting installation, anti-perching devices, and active avian deterrent systems. Software upgrades limit the number of heliostats in standby position and decrease the area of elevated flux. Software upgrades have also minimized the number and time heliostats are in the maintenance position, lowering the collision risk. LED lighting is not attractive to insects and lighting upgrades currently scheduled include the installation of anti-perch devices. Active deterrent systems include the deployment of a chemosensory deterrent system and the upcoming installation of an avian sonic deterrent system. In addition, sonic deterrence devices for bats were tested and will be installed in all units. Continued monitoring will further inform the effectiveness of these measures and may lead to modifications of existing measures, or adoptions of new measures over time.

According to Section 5.3 of the Plan, migratory bird mortality is required to be classified as high, medium, or low to provide an appropriate biological basis for Technical Advisory Committee (TAC) review and decision

making. Results from the first four seasons of monitoring indicate that migratory bird mortality during this monitoring period would be categorized as low. Total detections (and fatality estimates) of any one species represent a small proportion of local, regional, or national populations. Avian detections at the site included 83 different bird species with 64 having fewer than 10 detections. Of the remaining 19 species, all have populations that are great enough locally (either as breeders, wintering birds, or migrants), regionally, and nationally that the magnitude of mortality detected and/or estimated at Ivanpah during the first four seasons of monitoring would have a minimal impact on populations at any of these geographic scales. Furthermore, the cause of death for 42.2% of the detections of species with 10 or more detections was unknown and thus cannot be determined with certainty to have been "facility-caused", the standard cited in Section 5.3 of the Plan.

Recommendations concerning monitoring and/or adaptive management at Ivanpah, based on the first four seasons of monitoring results, include:

- Continuation of Plan implementation as it was performed during year 1 monitoring.
- Continue with and increase the number of searcher efficiency and carcass persistence trials to enable more refined estimates by season and/or within project elements.
- Continuation of the adaptive management process to investigate means of reducing avian mortality.
- Full implementation of bat deterrence at all three solar units.

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Section 1.0 Introduction/Purpose

1.1 Project Background

The Ivanpah Solar Electric Generating System (referred to in this report as "Ivanpah" or "Project") is composed of three solar units consisting of power electrical generating facilities (Units 1, 2, and 3) with a combined net capacity of 377 megawatts. Each unit includes a central power tower with an air cooled condenser (ACC) and associated electrical generating equipment, surrounded by a heliostat array that reflects sunlight to a boiler at the top of the 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. The three solar units became operational at different times during the winter 2013-2014 season, with Unit 1 becoming operational first, followed by Unit 3, and then Unit 2 (H. T. Harvey & Associates 2014a). The Project is subject to conditions of approval from BLM and the California Energy Commission (CEC).

1.2 Purpose of This Report

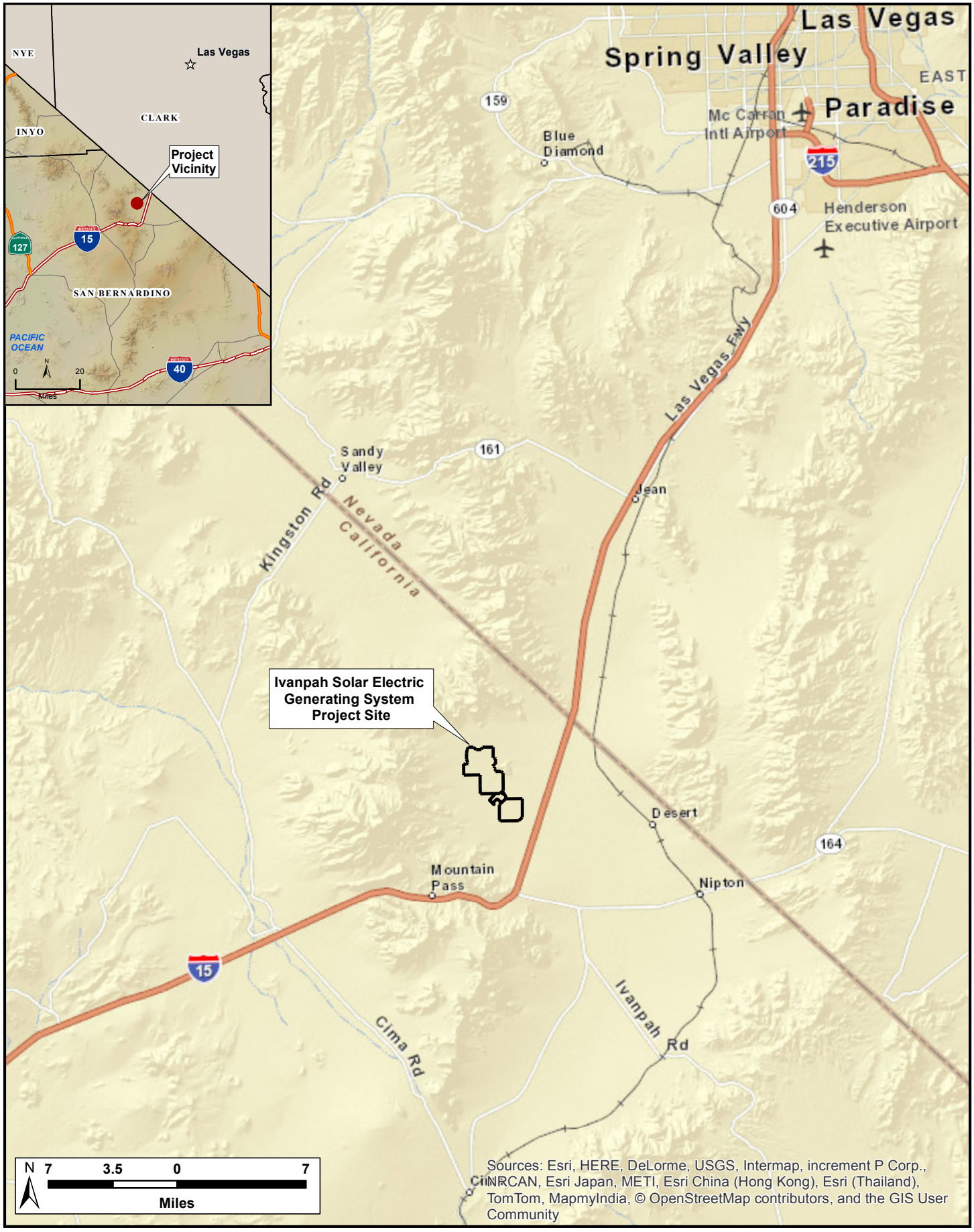
This annual report represents a summary of the first four seasons of monitoring results from avian and bat monitoring surveys conducted from 29 October 2013 to 20 October 2014 at the Project. The surveys included avian point count surveys, raptor/large bird surveys, facility monitoring for avian detections, searcher efficiency trials, and carcass removal trials. To satisfy the Project's conditions of approval, this report summarizes the first four seasons of data, analyzes bird and bat fatalities or injuries detected, and provides recommendations for future monitoring and any adaptive management actions needed.

The required avian monitoring is set forth in the Avian & Bat Monitoring and Management Plan (2013, "Plan), which is designed to comprehensively monitor and identify potential avian impacts that may be associated with the facility and was developed in collaboration with the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), CEC, and BLM. The Plan also is intended to: 1) satisfy the BLM Right-of-Way (ROW) Permit requirement that the ISEGS team develop a Migratory Bird Treaty Act (MBTA) Conservation Agreement and Avian Protection Plan and conduct surveys for avian and bat mortality at the facility (BLM mitigation measures BIO-22, BIO-23 and BIO-28); 2) satisfy the requirements of the 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 Endangered Species Act (ESA), 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. Monitoring of avian and bat injuries and fatalities began during the 2013-2014 winter season. Monitoring was performed for the 2013-2014 winter season (29 October 2013 – 22 March 2014) and the 2014 spring (23 March – 22 May), summer (23 May – 17 August), and fall (18 August – 20 October) seasons.

Regarding annual reporting, BLM condition BIO-23 is intended to document "avian and bat mortalities associated with the operation of the facility", and CEC Condition of Certification BIO-21 for the Project contains the following specific annual report requirements:

> "Following the completion of the fourth quarter of monitoring, the Designated Biologist shall prepare an Annual Report that summarizes the year's data, analyzes any Project-related bird fatalities or injuries detected, and provides recommendations for future monitoring and any adaptive management actions needed."

Thus, this report summarizes the first four seasons of monitoring (29 October 2013 – 20 October 2014), providing a summary of results, an analysis of Project-related bird and bat fatalities and injuries, and recommendations for future monitoring and adaptive management actions. Additional detail regarding monitoring methods can be found in the Plan, and additional detail regarding both methods and results can be found in the four seasonal reports prepared for the first year of monitoring (H. T. Harvey & Associates 2014a, b, c and d). Because the approach to representing monitoring results has been updated, per coordination with the Technical Advisory Committee (TAC), since the preparation of the winter 2013-2014 report, this annual report updates information provided in the 2014 winter seasonal report as appropriate. All the adaptive changes to the Plan approved by the TAC during this period have been compiled and are provided in Appendix A.



N:\Projects\2802-01\07\Report\Annual 2014 Report\Fig 1 Ivanpah Vicinity Map.mxd

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Figure 1: Ivanpah Vicinity Map
Ivanpah Four Season 2013-2014 Avian and Bat Monitoring Report (2802-07)
April 2015

Section 2.0 Summary of Four Season Data

This section provides graphical and tabular summaries of (a) the monitoring results from the seasonal reports, including summaries of (i) avian use surveys, (ii) raptor surveys, and (iii) fatality monitoring for birds and bats; and (b) the adaptive management measures and Best Management Practices (BMPs) investigated during the first year of monitoring.

2.1 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. Seventeen avian use surveys were conducted at each of 80 survey points (40 in desert bajada habitat and 40 in heliostat arrays), representing more than 350 hours of survey effort. Species composition is compared between these avian use survey results and detections during standardized monitoring surveys.

2.1.1 Avian Species Composition

A total of 54 bird species were recorded on avian use surveys during the first four seasons. Table 1 lists these species and the number of individuals observed within the heliostat and desert survey areas. As indicated by Figure 2, total species richness was highest in the desert (47 species), and much lower in the heliostat grids (24 species). In the desert, species richness was highest during the spring and fall migratory seasons. This is understandable, as greater numbers of bird species migrate through the area during these seasons and were observed while foraging and resting in the desert. In the heliostat grids, species richness was highest during the fall and winter.

Figure 2. Number of Bird Species Recorded at Desert and Heliostat Avian Survey Points.

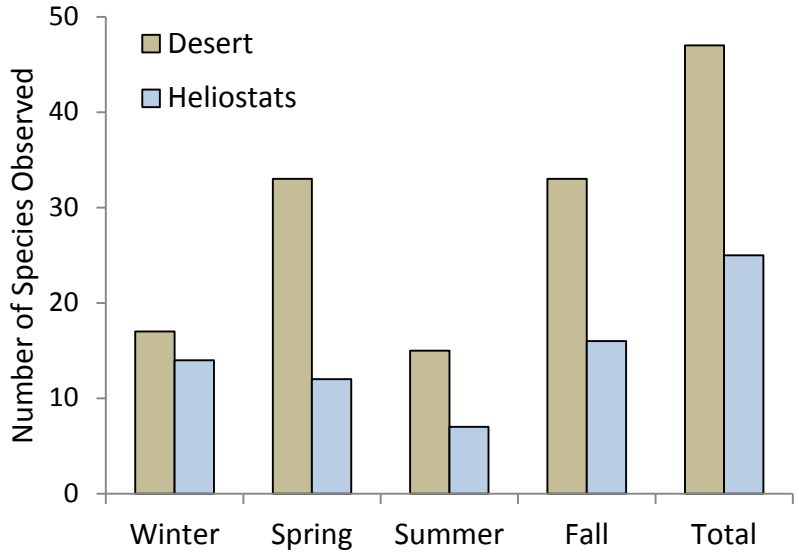


Table 1. Avian Use Survey Results - Number of Observations by Species and Habitat during Each Season.

			Desert				Heliostats				
Common Name	***Scientific Name***	**Species**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Black-throated Sparrow	*Amphispiza bilineata*	BTSP	175	134	147	266	0	7	15	2	746
Brewer's Sparrow	*Spizella breweri*	BRSP	272	66	5	23	4	0	0	5	375
Cactus Wren	*Campylorhynchus brunneicapillus*	CACW	34	42	62	57	0	2	0	0	197
Sagebrush/Bell's Sparrow	*Artemisiospiza nevadensis/belli*	SAGS	126	0	0	18	0	0	0	0	144
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	0	1	0	6	53	0	0	10	70
Bewick's Wren	*Thryomanes bewickii*	BEWR	14	6	2	46	0	0	0	0	68
Horned Lark	*Eremophila alpestris*	HOLA	0	0	0	1	9	28	7	22	67
Loggerhead Shrike	*Lanius ludovicianus*	LOSH	15	16	12	9	2	0	5	1	60
Unidentifiable Sparrow		UNSP	28	0	0	19	3	1	0	6	57
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	0	1	13	40	0	0	0	0	54
Unidentifiable Bird		UNKN	5	28	1	9	1	6	1	0	51
Gambel's Quail	*Callipepla gambelii*	GAQU	0	2	9	32	0	0	0	0	43
House Finch	*Haemorhous mexicanus*	HOFI	10	1	0	11	4	8	3	6	43
Western Meadowlark	*Sturnella neglecta*	WEME	4	0	0	3	25	3	0	4	39
American Pipit	*Anthus rubescens*	AMPI	0	0	0	0	32	2	0	0	34
Unidentifiable Passerine		UNPA	3	0	4	8	6	1	3	4	29
Ash-throated Flycatcher	*Myiarchus cinerascens*	ATFL	0	18	8	0	0	0	0	0	26
Le Conte's Thrasher	*Toxostoma lecontei*	LCTH	2	3	8	13	0	0	0	0	26
Rock Wren	*Salpinctes obsoletus*	ROWR	12	0	0	9	0	0	0	0	21

			Desert				Heliostats				
Common Name	***Scientific Name***	**Species**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	2	0	0	0	16	0	0	3	21
Common Raven	*Corvus corax*	CORA	2	1	0	1	3	5	4	2	18
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP	6	2	0	4	1	0	0	1	14
Chipping Sparrow	*Spizella passerina*	CHSP	0	1	0	10	0	0	0	0	11
Verdin	*Auriparus flaviceps*	VERD	1	1	2	7	0	0	0	0	11
American Kestrel	*Falco sparverius*	AMKE	0	0	1	1	3	1	1	3	10
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL	0	2	0	0	0	0	0	6	8
Barn Swallow	*Hirundo rustica*	BARS	0	4	0	3	0	0	0	0	7
Crissal Thrasher	*Toxostoma crissale*	CRTH	3	1	1	2	0	0	0	0	7
Unidentifiable Gnatcatcher		UNGN	0	0	1	6	0	0	0	0	7
Ladder-backed Woodpecker	*Picoides scalaris*	LBWO	0	1	3	2	0	0	0	0	6
Bullock's Oriole	*Icterus bullockii*	BUOR	0	5	0	0	0	0	0	0	5
Lesser Nighthawk	*Chordeiles acutipennis*	LENI	0	1	2	0	0	2	0	0	5
Northern Flicker	*Colaptes auratus*	NOFL	1	0	0	0	4	0	0	0	5
Red-tailed Hawk	*Buteo jamaicensis*	RTHA	0	0	0	5	0	0	0	0	5
Unidentifiable Hummingbird		UNHU	0	2	0	1	0	1	0	1	5
Orange-crowned Warbler	*Oreothlypis celata*	OCWA	0	1	0	1	0	0	0	2	4
Vaux's Swift	*Chaetura vauxi*	VASW	0	4	0	0	0	0	0	0	4
Unidentifiable Swallow		UNSW	0	1	0	0	0	0	3	0	4
Unidentifiable Wren		UNWR	1	1	0	2	0	0	0	0	4
Black-tailed Gnatcatcher	*Polioptila melanura*	BTGN	0	1	0	2	0	0	0	0	3

			Desert				Heliostats				
Common Name	***Scientific Name***	**Species**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Northern Harrier	*Circus cyaneus*	NOHA	0	0	0	1	2	0	0	0	3
Say's Phoebe	*Sayornis saya*	SAPH	0	2	0	1	0	0	0	0	3
Sage Thrasher	*Oreoscoptes montanus*	SATH	1	0	0	2	0	0	0	0	3
Wilson's Warbler	*Cardellina pusilla*	WIWA	0	3	0	0	0	0	0	0	3
Yellow Warbler	*Setophaga petechia*	YEWA	0	2	0	1	0	0	0	0	3
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	0	2	0	0	0	0	0	0	2
Lesser Goldfinch	*Spinus psaltria*	LEGO	0	0	0	0	0	1	0	1	2
Northern Mockingbird	*Mimus polyglottos*	NOMO	0	2	0	0	0	0	0	0	2
Phainopepla	*Phainopepla nitens*	PHAI	0	0	0	2	0	0	0	0	2
Tree Swallow	*Tachycineta bicolor*	TRES	0	0	0	0	0	0	2	0	2
Anna's Hummingbird	*Calypte anna*	ANHU	0	0	0	1	0	0	0	0	1
Brown-headed Cowbird	*Molothrus ater*	BHCO	0	0	0	0	0	0	0	1	1
Black Phoebe	*Sayornis nigricans*	BLPH	0	1	0	0	0	0	0	0	1
Cooper's Hawk	*Accipiter cooperii*	COHA	0	0	0	1	0	0	0	0	1
Greater Roadrunner	*Geococcyx californianus*	GRRO	0	0	1	0	0	0	0	0	1
Greater Yellowlegs	*Tringa melanoleuca*	GRYE	0	0	0	0	0	0	0	1	1
Lark Sparrow	*Chondestes grammacus*	LASP	0	0	0	0	0	1	0	0	1
Mourning Dove	*Zenaida macroura*	MODO	0	0	0	1	0	0	0	0	1
Prairie Falcon	*Falco mexicanus*	PRFA	0	0	0	0	1	0	0	0	1
Warbling Vireo	*Vireo gilvus*	WAVI	0	1	0	0	0	0	0	0	1
Western Kingbird	*Tyrannus verticalis*	WEKI	0	1	0	0	0	0	0	0	1
Unidentifiable Flycatcher		UNFL	0	1	0	0	0	0	0	0	1
		Total #	**717**	**362**	**282**	**627**	**169**	**69**	**44**	**81**	**2351**

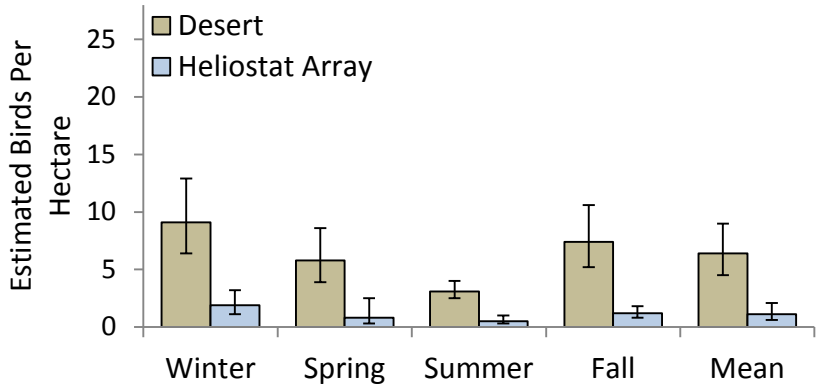
2.1.2 Avian Abundance

As with species richness, avian abundance was highest in the two desert bajada grids in all seasons (1,988 total observations) and substantially lower on the three heliostat grids (363 total observations). The extent of area surveyed was identical for the two habitats (40 points in each habitat). Thus, comparison of general avian abundance metrics such as total observations, as was done above, is appropriate for elucidating relative abundance, both overall and by species. However, because the relative abundance of various species differed among grids, and bird detectability may vary among species, we used the program Distance 6.0 (Thomas et al. 2010) to evaluate avian densities. Under the assumption that the three heliostat grids were more similar to each other (in terms of habitat and summer bird communities) than to either of the desert bajada grids, and making the same assumption with respect to the two desert bajada grids, we pooled data from the 40 heliostat points and compared bird densities to data from the 40 pooled desert bajada points. The 95% confidence intervals around density estimates for each habitat type did not overlap, thus providing statistical evidence that bird density in the desert bajada grids was significantly higher than bird density in the heliostat units in all seasons and for the four seasons combined (Table 2 and Figure 3).

Table 2. Avian Density Estimates for Heliostat versus Desert Bajada Grids.

	Number of Birds per Hectare									
	Desert					Heliostats				
	Winter	Spring	Summer	Fall	Mean	Winter	Spring	Summer	Fall	Mean
Density Estimate	9.1	5.8	3.1	7.4	6.4	1.9	0.8	0.5	1.2	1.1
Low Estimate	6.4	3.9	2.5	5.2	4.5	1.1	0.3	0.3	0.8	0.6
High Estimate	12.9	8.6	4.0	10.6	9.0	3.2	2.5	1.0	1.8	2.1
Percent Coefficient of Variation	18.1	20.2	12.6	18.3	17.3	27.7	60.7	32.7	22.8	35.8

Figure 3. Avian Density Estimates (Number of Birds per Hectare) for Heliostat versus Desert Bajada Grids. Error bars indicate 95% Confidence Intervals (low and high estimates).



2.1.3 Comparison of Avian Use Survey Results to Fatality Detections

Table 3 lists the 10 identified species most frequently recorded as fatality detections and as observations on heliostat and desert bajada grid surveys, both in each season and for the seasons combined. Whereas 54 bird species were recorded during avian use surveys, 83 species were recorded as detections during fatality monitoring (described in Section 2.3).

Comparison of the most abundant bird species that were recorded on the avian use surveys to the species most frequently recorded as detections reveals greater 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 3). Of the 10 identified species most frequently recorded as detections, four species (horned lark [*Eremophila alpestris*], yellow-rumped warbler [*Setophaga coronata*], black-throated sparrow [*Amphispiza bilineata*] and house finch [*Haemorhous mexicanus*]) were among the most abundant species on the heliostat survey grids, while none were among the most abundant species on the desert bajada survey grids. Black-throated sparrows were frequently observed in both the heliostat and desert grids, and they comprised 2.8% of all detections. Horned larks were the most commonly observed species in the heliostat grids, but they were rarely observed in the desert bajada grids. Horned larks were also frequently recorded as detections and comprised 2.4% of all detections. Mourning doves, which were the most frequent fatality detection (13.9%), were not recorded during avian use surveys but were occasionally observed in heliostat areas during fatality surveys.

Table 3. Comparison of the Most Abundant Bird Species Recorded as Detections and Recorded on Heliostat and Desert Bajada Survey Grids.

a. Four Season Total

Detections[1]	Heliostat Survey Grids	Desert Bajada Survey Grids
Mourning Dove	Horned Lark	Black-throated Sparrow
Yellow-rumped Warbler	Yellow-rumped Warbler	Brewer's Sparrow
Tree Swallow	American Pipit	Cactus Wren
Black-throated Sparrow	Western Meadowlark	Sage Sparrow
Yellow Warbler	Black-throated Sparrow	Bewick's Wren
White-crowned Sparrow	House Finch	Blue-gray Gnatcatcher
Horned Lark	Savannah Sparrow	Loggerhead Shrike
Costa's Hummingbird	Common Raven	Gambel's Quail
House Finch	Brewer's Sparrow	Ash-throated Flycatcher
Anna's Hummingbird	American Kestrel	Le Conte's Thrasher

b. Winter

Detections[1]	Heliostat Survey Grids	Desert Bajada Survey Grids
Mourning Dove	Yellow-rumped Warbler	Brewer's Sparrow
Yellow-rumped Warbler	American Pipit	Black-throated Sparrow
Anna's Hummingbird	Western Meadowlark	Sagebrush Sparrow
Greater Roadrunner	Savannah Sparrow	Cactus Wren
American Kestrel	Horned Lark	Loggerhead Shrike
Brewer's Blackbird	Brewer's Sparrow	Bewick's Wren
Western Meadowlark	House Finch	Rock Wren
American Pipit	Northern Flicker	House Finch
Costa's Hummingbird	American Kestrel	White-crowned Sparrow
Great-tailed Grackle	Common Raven	Western Meadowlark

c. Spring

Detections[1]	Heliostat Survey Grids	Desert Bajada Survey Grids
Mourning Dove	Horned Lark	Black-throated Sparrow
Yellow-rumped Warbler	House Finch	Brewer's Sparrow
Costa's Hummingbird	Black-throated Sparrow	Cactus Wren
Horned Lark	Common Raven	Ash-throated Flycatcher
Rufous Hummingbird	Western Meadowlark	Loggerhead Shrike
Tree Swallow	American Pipit	Bewick's Wren
White-crowned Sparrow	Lesser Nighthawk	Bullock's Oriole
Barn Swallow	Cactus Wren	Barn Swallow
Cliff Swallow	American Kestrel	Vaux's Swift
Violet-green Swallow	Lark Sparrow	LeConte's Thrasher

d. Summer

Detections[1]	Heliostat Survey Grids[2]	Desert Bajada Survey Grids
Mourning Dove	Black-throated Sparrow	Black-throated Sparrow
Black-throated Sparrow	Horned Lark	Cactus Wren
House Finch	Loggerhead Shrike	Blue-gray Gnatcatcher
Lesser Nighthawk	Common Raven	Loggerhead Shrike
Greater Roadrunner	House Finch	Gambel's Quail
Horned Lark	Tree Swallow	Ash-throated Flycatcher
Tree Swallow	American Kestrel	LeConte's Thrasher
Anna's Hummingbird		Brewer's Sparrow
Cliff Swallow		Ladder-backed Woodpecker
Northern Rough-winged Swallow		Bewick's Wren/Verdin/ Lesser Nighthawk[3]

e. Fall

Detections[1]	Heliostat Survey Grids	Desert Bajada Survey Grids
Mourning Dove	Horned Lark	Black-throated Sparrow
Yellow-rumped Warbler	Yellow-rumped Warbler	Cactus Wren
Yellow Warbler	Brewer's Blackbird	Bewick's Wren
Brown-headed Cowbird	House Finch	Blue-gray Gnatcatcher
Vaux's Swift	Brewer's Sparrow	Gambel's Quail
White-crowned Sparrow	Western Meadowlark	Brewer's Sparrow
Tree Swallow	American Kestrel	Sagebrush Sparrow
Barn Swallow	Savannah Sparrow	Le Conte's Thrasher
Lazuli Bunting	Black-throated Sparrow	House Finch
Lesser Goldfinch	Common Raven	Chipping Sparrow
Orange-crowned warbler	Orange-crowned warbler	

[1] Bird and bat fatalities and injuries found during fatality searches are called detections.
[2] Only seven species were observed on heliostat grids in summer; all are listed here.
[3] Species are listed in descending order of abundance and in alphabetical order where equal numbers of individuals were observed.

2.2 Raptor and Large Bird Use Monitoring

An average of 18 raptor and large bird surveys were performed at each of eight points (six at the heliostat arrays and two in desert habitat west and south of the Project facilities), representing more than 550 hours of survey effort. During surveys for raptors and other large birds, nine raptor species and six other large bird species were observed and identified, either at/over the Project facilities or over habitats outside the facilities. Table 4 summarizes the number of observations of each species, and Table 5 provides the number per survey hour of each species, by season and for the seasons combined.

Table 4. Raptor/Large Bird Survey Results Summary.

		Number of Observations				
Common Name	**Scientific Name**	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Common Raven	*Corvus corax*	192	44	15	79	330
Red-tailed Hawk	*Buteo jamaicensis*	51	20	5	15	91
American Kestrel	*Falco sparverius*	14	4	6	22	46
Turkey Vulture	*Cathartes aura*	0	45	0	0	45
Golden Eagle	*Aquila chrysaetos*	24	5	1	2	32
Unidentified Raptor		12	5	2	0	19
Northern Harrier	*Circus cyaneus*	12	0	0	0	12
California Gull	*Larus californicus*	10	0	1	0	11
Unidentified Large Bird		8	0	0	0	8
Unidentified Duck		0	0	0	8	8
Cooper's Hawk	*Accipiter cooperii*	2	2	0	3	7
Unidentified Gull		5	0	2	0	7
Unidentified Falcon		1	0	2	1	4
Ring-billed Gull	*Larus delawarensis*	1	0	3	0	4
Sharp-shinned Hawk	*Accipiter striatus*	0	1	0	2	3
Prairie Falcon	*Falco mexicanus*	1	0	0	2	3
Swainson's Hawk	*Buteo swainsoni*	0	2	0	0	2
Unidentified Buteo		0	2	0	0	2
Peregrine Falcon	*Falco peregrinus*	1	0	0	0	1
White-faced Ibis	*Plegadis chihi*	0	0	0	1	1
Total		**334**	**130**	**37**	**135**	**636**

Table 5. Raptor/Large Bird Observations per Survey Results Summary.

		Number of Observations/Survey Hours				
Common Name	**Scientific Name**	**Winter[1]**	**Spring**	**Summer**	**Fall**	**Total**
Common Raven	*Corvus corax*	0.86	0.37	0.16	0.71	0.60
Red-tailed Hawk	*Buteo jamaicensis*	0.23	0.17	0.05	0.13	0.17
American Kestrel	*Falco sparverius*	0.06	0.03	0.06	0.20	0.08
Turkey Vulture	*Cathartes aura*	0.00	0.38	0.00	0.00	0.08
Golden Eagle	*Aquila chrysaetos*	0.11	0.04	0.01	0.02	0.06
Unidentified Raptor		0.05	0.04	0.02	0.00	0.03
Northern Harrier	*Circus cyaneus*	0.05	0.00	0.00	0.00	0.02
California Gull	*Larus californicus*	0.04	0.00	0.01	0.00	0.02
Unidentified Large Bird		0.04	0.00	0.00	0.00	0.01
Unidentified Duck		0.00	0.00	0.00	0.07	0.01
Cooper's Hawk	*Accipiter cooperii*	0.01	0.02	0.00	0.03	0.01
Unidentified Gull		0.02	0.00	0.02	0.00	0.01
Unidentified Falcon		<0.01	0.00	0.02	0.01	0.01
Ring-billed Gull	*Larus delawarensis*	<0.01	0.00	0.03	0.00	0.01
Sharp-shinned Hawk	*Accipiter striatus*	0.00	0.01	0.00	0.02	0.01
Prairie Falcon	*Falco mexicanus*	<0.01	0.00	0.00	0.02	0.01
Swainson's Hawk	*Buteo swainsoni*	0.00	0.02	0.00	0.00	<0.01
Unidentified Buteo		0.00	0.02	0.00	0.00	<0.01
Peregrine Falcon	*Falco peregrinus*	<0.01	0.00	0.00	0.00	<0.01
White-faced Ibis	*Plegadis chihi*	0.00	0.00	0.00	0.01	<0.01
Total		**1.49**	**1.09**	**0.39**	**1.21**	**1.15**

[1] Number of survey hours = 224 for winter, 119 for spring, 96 for summer, 112 for fall, and 551 in total.

A total of 636 raptors/large birds representing 15 species were observed across all seasons (Table 4). Of these, 226 individuals (mostly common ravens [*Corvus corax*]) were recorded at or over the Project facilities, while 410 individuals were recorded perched in or flying over habitats outside the facilities, such as the desert, or the mountains to the north and west. The frequency of occurrence of raptors/large birds across all seasons was relatively low, with approximately 1.15 birds observed per survey hour (Table 5). Common ravens, red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), turkey vultures (*Cathartes aura*), and golden eagles (*Aquila chrysaetos*) comprised 86% of all large bird observations. No golden eagles were recorded at or over the Project facility during formal raptor/large bird surveys. All 32 observations of this species during formal surveys were of birds outside the facility near the mountains or, less frequently, in the desert (three incidental observations were made of eagles generally flying over the outer heliostats or away from the facility). Common ravens made up 51.9% of all large bird observations, with 0.60 ravens observed per survey hour. The preponderance of raven observations resulted less from the abundance of ravens on the site

(typically observed only as singles or pairs) than from the persistent nature (frequently present) and widespread occurrence of the species. Overall abundance and diversity was greatest during winter, with 10 species and 334 individuals observed. Four species (common raven, red-tailed hawk, northern harrier, and golden eagle) reached their greatest abundance during the winter. Summer had the lowest abundance and diversity, with only six species and 37 individuals. Spring and fall had intermediate levels of diversity and abundance.

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. Table 6 provides the number of observations of each species that were perched or that were flying in each height category. Most species were not uniformly distributed across flight height categories. In general, more individuals were observed perched or in the higher-altitude flight categories than in the lower-altitude flight categories. Most of the raptors/large birds observed perched were common ravens and red-tailed hawks.

Table 6. Flight Heights of Raptors and Other Large Birds Over Ivanpah Facilities and Other Habitats/Areas.

	Number of Observations at Each Flight Height					
Species	**Perched**	**<10 m**	**10-100 m**	**100-200 m**	**>200 m**	**Total**
Common Raven	48	38	90	86	66	328*
Red-tailed Hawk	33	3	7	25	23	91
American Kestrel	10	12	9	13	1	45*
Turkey Vulture	0	1	2	7	35	45
Golden Eagle	7	0	3	1	21	32
Unidentified Raptor	7	0	0	5	7	19
Northern Harrier	0	4	3	3	2	12
California Gull	0	0	0	10	1	11
Unidentified Large Bird	0	0	0	0	8	8
Unidentified Duck	0	0	8	0	0	8
Cooper's Hawk	1	1	5	0	0	7
Unidentified Gull	0	0	0	5	2	7
Ring-billed Gull	0	0	1	3	0	4
Unidentified Falcon	1	0	2	0	1	4
Prairie Falcon	0	0	0	2	1	3
Sharp-shinned Hawk	0	0	2	0	1	3
Swainson's Hawk	0	0	1	0	1	2
Unidentified Buteo	0	0	0	0	2	2
Peregrine Falcon	0	0	0	1	0	1
White-faced Ibis	0	0	1	0	0	1
Total	**107**	**59**	**134**	**161**	**172**	**633**

*Flight altitude was not recorded for two common ravens and one American kestrel.

2.3 Fatality Monitoring Results

The following sections describe the results of monitoring for avian and bat injuries and fatalities (which are collectively termed "detections"). Monitoring searches were conducted in the "tower area", defined as the power block (the area consisting of the tower, the ACC unit, the associated control building, and immediately adjacent areas defined by the ring road and berm/slopes surrounding these facilities) and inner high-density (HD) heliostats surrounding each power block (100% survey coverage); the "heliostat area", defined as the inner and outer heliostat segments outside of the inner HD heliostats (24.1% survey coverage in randomly selected arc-shaped plots); the "fenceline" defined as the unit perimeter fences and CLA fence (100% survey coverage); the "collector line", defined as the Unit 3 electrical transmission line (100% survey coverage); and offsite transects. All incidental detections were immediately documented. Incidental detections were included in the modeled fatality estimates as reported in Appendix B. During the first four seasons of monitoring, a total of 8,935 person-hours of human search effort, plus 281 hours of canine search effort, were spent conducting fatality searches.

Both bird and bat detections are analyzed by location, season, and cause of injury or fatality. Cause of injury or fatality was determined to be singeing (individuals with charring, curling, or melting of feathers), collision (such as obvious physical trauma or detection adjacent to a heliostat with a bird-strike imprint, smudge mark, and/or feathers on or near the surface of the mirror), "other known causes" (i.e., entrapment or occurrence within an enclosed space), or unknown. The summary of avian data is provided first, followed by the bat monitoring results.

2.3.1 Avian Detections

During the first four seasons of monitoring, through the systematic surveys and incidental detections, eight injured birds and 695 avian fatalities were detected. The fatalities include 25 injured birds that died shortly after discovery. Of the eight injured birds, six were released alive and two are recovering in a wildlife rehabilitation facility. In total, detections found in this four season reporting period included 83 avian species. Table 7 depicts the abundance of each bird species recorded as a detection.

Table 7. Number of Individual Avian Detections by Species, Year 1 Monitoring.

			Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
Common Name	*Scientific Name*	Species Code	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Mourning Dove	*Zenaida macroura*	MODO	0	19	0	23	0	15	0	41	0	98
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	0	8	0	22	0	2	0	23	0	55
Unidentifiable Passerine			0	2	0	14	0	12	0	17	0	45
Tree Swallow	*Tachycineta bicolor*	TRES	0	0	0	7	0	5	0	9	0	21
Black-throated Sparrow	*Amphispiza bilineata*	BTSP	0	1	0	3	0	11	0	5	0	20
Yellow Warbler	*Setophaga petechia*	YEWA	0	0	0	1	0	2	0	16	0	19
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP	0	1	0	7	0	0	0	10	0	18
Horned Lark	*Eremophila alpestris*	HOLA	0	2	0	10	0	5	0	0	0	17
Costa's Hummingbird	*Calypte costae*	COHU	0	3	0	12	0	1	0	0	0	16
House Finch	*Carpodacus mexicanus*	HOFI	0	2	0	3	0	6	0	5	0	16
Anna's Hummingbird	*Calypte anna*	ANHU	0	7	0	3	0	4	0	1	0	15
Barn Swallow	*Hirundo rustica*	BARS	0	0	0	6	0	0	0	8	0	14
Greater Roadrunner	*Geococcyx californianus*	GRRO	0	6	0	0	0	5	0	3	0	14
American Kestrel	*Falco sparverius*	AMKE	0	4	1	4	0	1	1	3	2	12
Rufous Hummingbird	*Selasphorus rufus*	RUHU	0	0	0	7	0	1	0	5	0	13
Unidentifiable Bird			0	5	0	1	0	3	0	2	0	11

Common Name	*Scientific Name*	Species Code	Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
			Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Brown-headed Cowbird	*Molothrus ater*	BHCO	0	0	0	0	0	1	0	10	0	11
Lesser Nighthawk	*Chordeiles acutipennis*	LENI	0	0	0	2	0	6	0	3	0	11
Vaux's Swift	*Chaetura vauxi*	VASW	0	0	0	1	0	0	0	10	0	11
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	0	0	0	6	0	4	0	0	0	10
Lazuli Bunting	*Passerina amoena*	LAZB	0	0	0	2	0	1	0	7	0	10
Unidentifiable Hummingbird			0	0	0	5	0	2	0	3	0	10
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL	0	4	0	4	0	0	0	1	0	9
Townsend's Warbler	*Dendroica townsendi*	TOWA	0	1	0	2	0	2	0	4	0	9
Violet-green Swallow	*Tachycineta thalassina*	VGSW	0	0	0	6	0	0	0	3	0	9
Wilson's Warbler	*Cardellina pusilla*	WIWA	0	0	0	3	0	0	0	6	0	9
Lesser Goldfinch	*Spinus psaltria*	LEGO	0	0	0	1	0	0	0	7	0	8
Orange-crowned Warbler	*Vermivora celata*	OCWA	0	1	0	0	0	0	0	7	0	8
Western Meadowlark	*Sturnella neglecta*	WEME	0	3	0	4	0	0	0	1	0	8
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	0	0	0	0	0	1	0	6	0	7
Hermit Warbler	*Setophaga occidentalis*	HEWA	0	0	0	2	0	2	0	3	0	7

Common Name	*Scientific Name*	Species Code	Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
			Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Nashville Warbler	*Vermivora ruficapilla*	NAWA	0	0	0	3	0	0	0	4	0	7
Unidentifiable Swallow			0	0	0	5	0	1	0	2	0	8
Bank Swallow	*Riparia riparia*	BANS	0	0	0	3	0	1	0	1	0	5
Loggerhead Shrike	*Lanius ludocivianus*	LOSH	0	1	0	3	0	1	0	1	0	6
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	0	0	0	2	0	3	0	1	0	6
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	0	1	0	0	0	0	1	5	1	6
American Coot	*Fulica americana*	AMCO	0	2	0	1	0	0	0	2	0	5
American Pipit	*Anthus rubescens*	AMPI	0	3	0	0	0	0	0	2	0	5
Rock Pigeon	*Columba livia*	ROPI	0	2	0	1	0	1	0	1	0	5
Verdin	*Auriparus flaviceps*	VERD	0	0	0	0	0	2	0	3	0	5
Black-chinned Hummingbird	*Archilochus alexandri*	BCHU	0	0	0	0	0	0	0	4	0	4
Brewer's Sparrow	*Spizella breweri*	BRSP	0	0	1	2	0	0	0	2	1	4
Calliope Hummingbird	*Selasphorus calliope*	CAHU	0	0	0	3	0	1	0	0	0	4
Gambel's Quail	*Callipepla gambelii*	GAQU	0	0	0	0	0	0	0	4	0	4
Great-tailed Grackle	*Quiscalus mexicanus*	GTGR	0	4	0	0	0	0	0	0	0	4
Lincoln's Sparrow	*Melospiza lincolnii*	LISP	0	0	0	2	0	0	0	2	0	4

Common Name	*Scientific Name*	Species Code	Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
			Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Unidentifiable Sparrow		UNSP	0	1	0	0	0	1	0	2	0	4
Unidentifiable Warbler		UNWA	0	0	0	1	0	0	0	3	0	4
Black-throated Gray Warbler	*Dendroica nigrescens*	BTYW	0	0	0	0	0	0	0	3	0	3
Cactus Wren	*Campylorhynchus brunneicapillus*	CACW	0	1	0	0	0	1	0	1	0	3
Olive-sided Flycatcher	*Contopus cooperi*	OSFL	0	0	0	1	0	1	0	1	0	3
Pine Siskin	*Carduelis pinus*	PISI	0	0	0	0	0	1	0	2	0	3
Unidentifiable Gnatcatcher		UNGN	0	0	0	0	0	0	0	3	0	3
White-throated Swift	*Aeronautes saxatalis*	WTSW	0	1	0	2	0	0	0	0	0	3
Ash-throated Flycatcher	*Myiarchus cinerascens*	ATFL	0	0	0	1	0	0	0	1	0	2
Chipping Sparrow	*Spizella passerina*	CHSP	0	0	0	0	0	1	0	1	0	2
Common Raven	*Corvus corax*	CORA	2	0	0	0	0	0	0	0	2	0
Eurasian Collared-Dove	*Streptopelia decaocto*	EUCD	0	0	0	1	0	1	0	0	0	2
Lark Sparrow	*Chondestes grammacus*	LASP	0	0	0	0	0	0	0	2	0	2
Ladder-backed Woodpecker	*Picoides scalaris*	LBWO	0	0	0	0	0	0	0	2	0	2
Northern Flicker	*Colaptes auratus*	NOFL	0	2	0	0	0	0	0	0	0	2

Common Name	*Scientific Name*	Species Code	Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
			Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Spotted Sandpiper	*Actitis macularius*	SPSA	0	1	0	0	0	0	0	1	0	2
Unidentifiable Blackbird			0	2	0	0	0	0	0	0	0	2
Unidentifiable Passerine or Swift		UNPS	0	0	0	1	0	1	0	0	0	2
Western Tanager	*Piranga ludoviciana*	WETA	0	1	0	0	0	0	0	1	0	2
Black-and-white Warbler	*Mniotilta varia*	BAWW	0	1	0	0	0	0	0	0	0	1
Bewick's Wren	*Thryomanes bewickii*	BEWR	0	0	0	0	0	1	0	0	0	1
Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR	0	0	0	1	0	0	0	0	0	1
Broad-tailed Hummingbird	*Selasphorus platycercus*	BTAH	0	0	0	1	0	0	0	0	0	1
Common Gallinule	*Gallinula galeata*	COGA	0	0	0	0	0	1	0	0	0	1
Cooper's Hawk	*Accipiter cooperii*	COHA	0	0	0	0	0	0	0	1	0	1
Eared Grebe	*Podiceps nigricollis*	EAGR	0	0	0	1	0	0	0	0	0	1
European Starling	*Sturnus vulgaris*	EUST	0	0	0	0	0	0	0	1	0	1
Green-tailed Towhee	*Pipilo chlorurus*	GTTO	0	0	0	0	0	0	0	1	0	1
Hermit Thrush	*Catharus guttatus*	HETH	0	0	0	0	0	0	0	1	0	1
House Wren	*Troglodytes aedon*	HOWR	0	0	0	0	0	0	0	1	0	1
Lapland Longspur	*Calcarius lapponicus*	LALO	0	0	0	0	0	1	0	0	0	1

Common Name	*Scientific Name*	Species Code	Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
			Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Lucy's Warbler	*Oreothlypis luciae*	LUWA	0	0	0	0	0	0	0	1	0	1
Phainopepla	*Phainopepla nitens*	PHAI	0	0	0	0	0	1	0	0	0	1
Ruby-crowned Kinglet	*Regulus caledula*	RCKI	0	0	0	0	0	0	0	1	0	1
Say's Phoebe	*Sayornis saya*	SAPH	0	1	0	0	0	0	0	0	0	1
Scott's Oriole	*Icterus parisorum*	SCOR	0	0	0	0	0	1	0	0	0	1
Swainson's Thrush	*Catharus ustulatus*	SWTH	0	0	0	0	0	0	0	1	0	1
Unidentifiable Heron			0	0	0	1	0	0	0	0	0	1
Unidentifiable Swift			0	0	0	1	0	0	0	0	0	1
Unidentifiable Woodpecker			0	0	0	0	0	0	0	1	0	1
Virginia Rail	*Rallus limicola*	VIRA	0	0	0	0	0	0	0	1	0	1
Western Kingbird	*Tyrannus verticalis*	WEKI	0	0	0	1	0	0	0	0	0	1
White-winged Dove	*Zenaida asiatica*	WWDO	0	0	0	0	0	0	0	1	0	1
Yellow-breasted Chat	*Icteria virens*	YBCH	0	0	0	1	0	0	0	0	0	1
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	YHBL	0	0	0	0	0	1	0	0	0	1
Common Loon	*Gavia immer*	COLO	1	0	0	0	0	0	0	0	1	0
Double-Crested Cormorant	*Phalacrocorax auritus*	DCCO	1	0	0	0	0	0	0	0	1	0

Common Name	*Scientific Name*	Species Code	Number of Detections									
			Winter		Spring		Summer		Fall		Annual	
			Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities	Injuries	Fatalities
Total			**4**	**93**	**2**	**200**	**0**	**115**	**2**	**287**	**8**	**695**

Out of the total 703 detections, 529 avian fatalities and two avian injuries were detected during standardized fatality searches (Table 8). One-hundred and seventy-two avian detections were made incidentally by workers performing operational duties and reported in accordance with the reporting protocol of the Ivanpah Wildlife Incident Reporting System. Of the 172 incidental detections, 162 were found inside the solar units (Figures 4, 5, and 6). The remaining 10 were found outside of the solar units along Colosseum Road, under power lines between Commons East and Unit 2, and in other areas (Figure 7).

Table 8. Number of Detections Found Across Standardized Searches and Incidentally, by Season.

	Number of Detections				
	Winter	Spring	Summer	Fall	Four Season Total
Incidental					
Avian fatalities	31	45	27	63	166
Avian injuries	4	0	0	2	6
Standardized Survey					
Avian fatalities	62	155	88	224	529
Avian injuries	0	2	0	0	2

In total, there were 16 days when the number of avian detections was 10 or greater. These detections were not attributed predominantly to a single cause. Rather, they were distributed among singed detections, those with evidence of collision, detections of other known causes, and unknown detections. Larger numbers of detections occurred on certain days in spring and fall as opposed to winter and summer and were likely related to migratory activity in the region. The Cornell Lab of Ornithology's "BirdCast" website[1] provides weekly analyses of migratory activity within North America during spring and fall migration seasons. Examination of these records showed that daily detection rates of 10 or more per day at Ivanpah coincided with increases in migration activity within the desert southwest in spring, but not in fall. During the fall season, surges in fatalities were not consistently preceded by, or did not coincide with, heavier migratory movements (as analyzed by the "BirdCast" website). Spring migration tends to be concentrated into pulses, as multiple species take advantage of weather systems favorable for rapid flight to reach their breeding grounds in time for ideal breeding conditions. In contrast, fall migration tends to be more protracted and steady than spring migration due to variation in the cessation of breeding activity and onset of juvenile migration among individuals, populations, and species.

[1] http://birdcast.info/forecasts

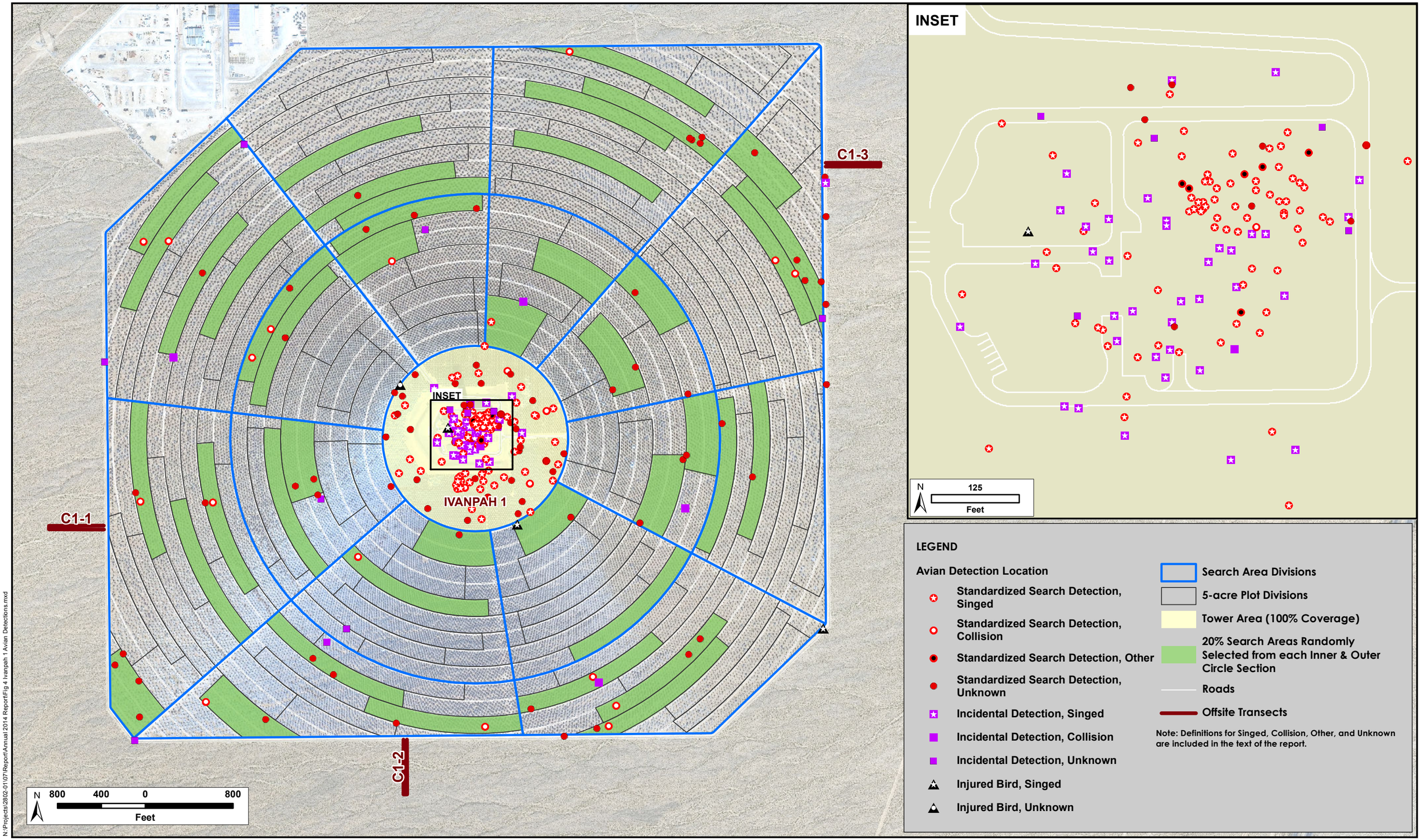


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Figure 4: Ivanpah 1 Avian Detections
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April 2015

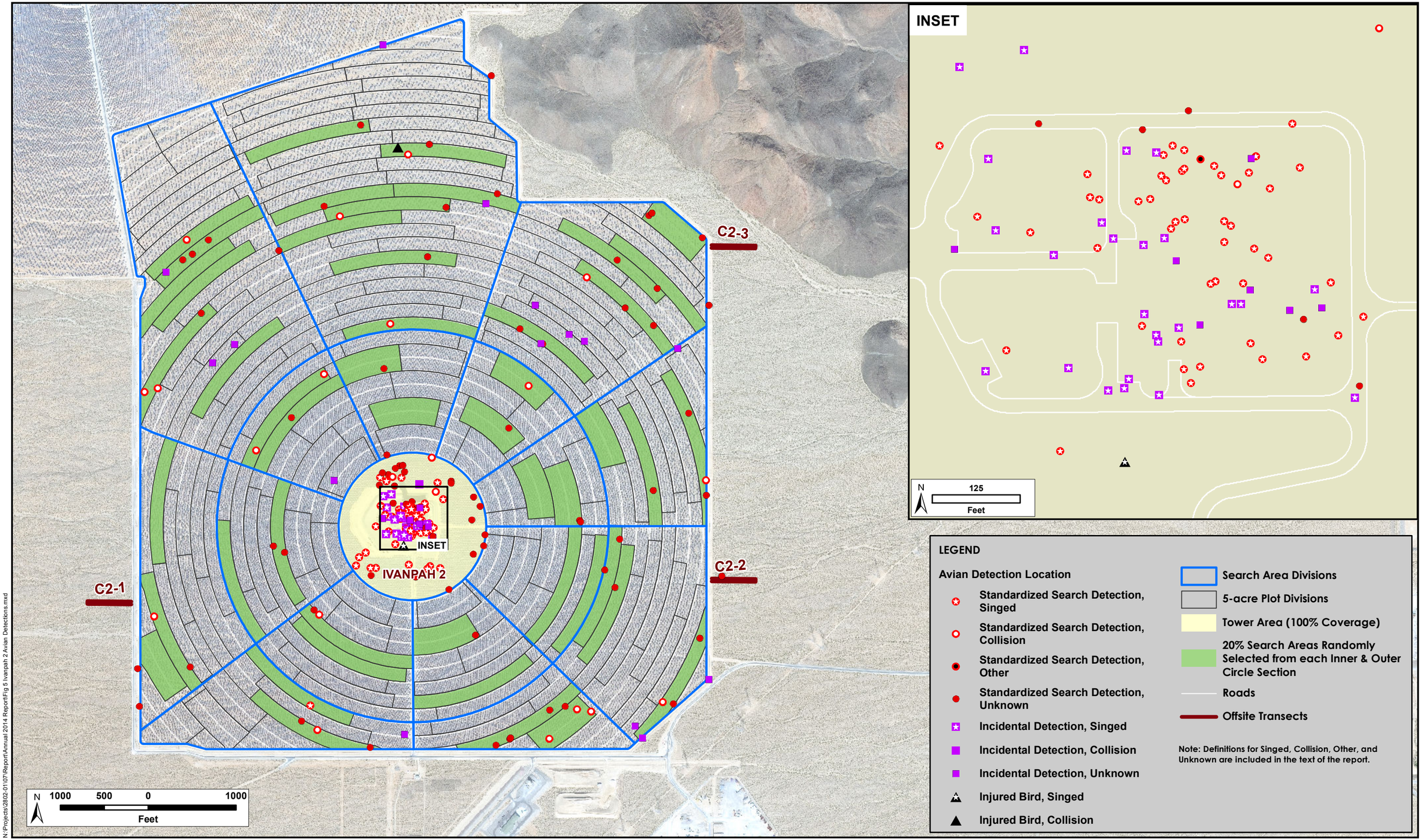

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Figure 5: Ivanpah 2 Avian Detections
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April 2015

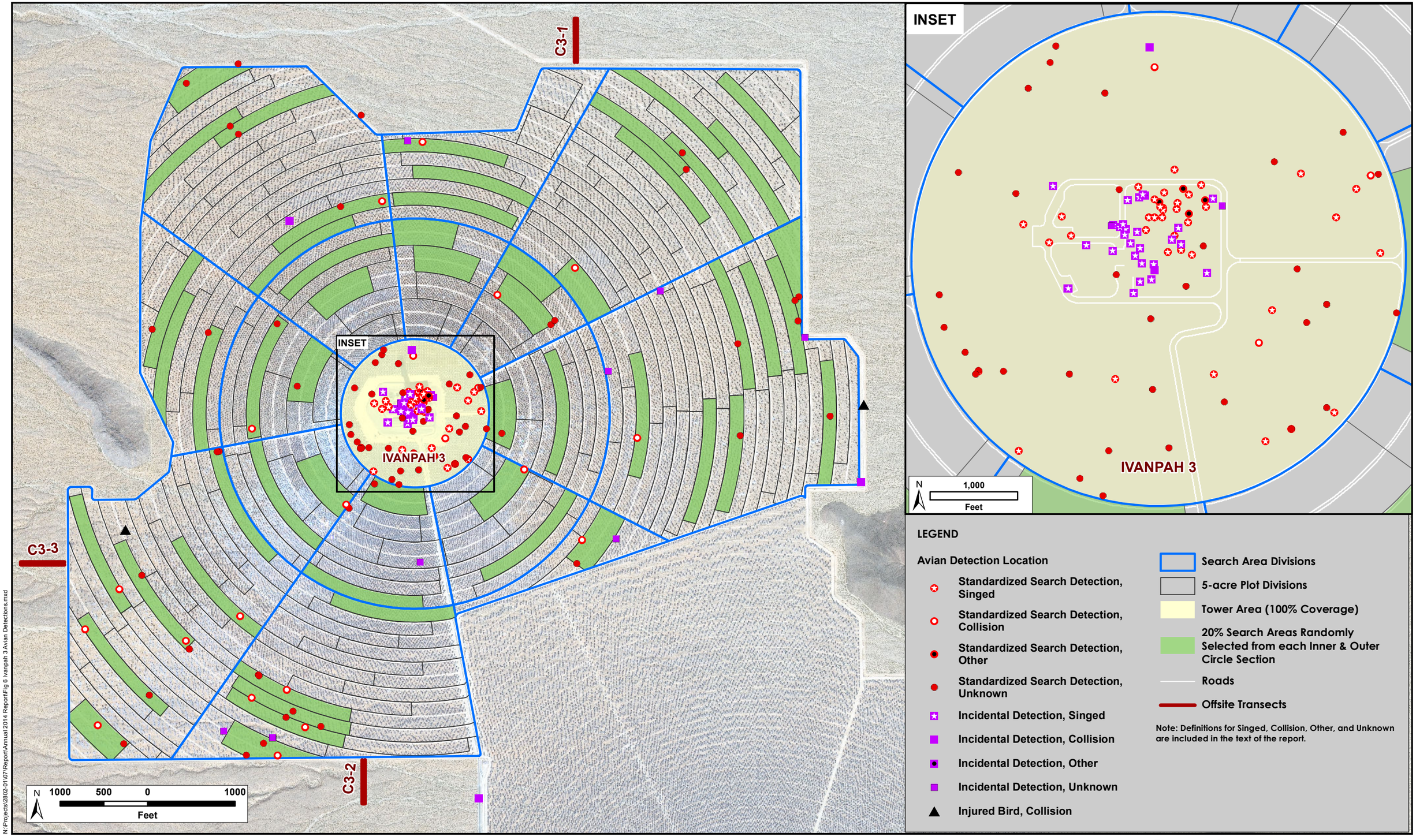

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Figure 6: Ivanpah 3 Avian Detections
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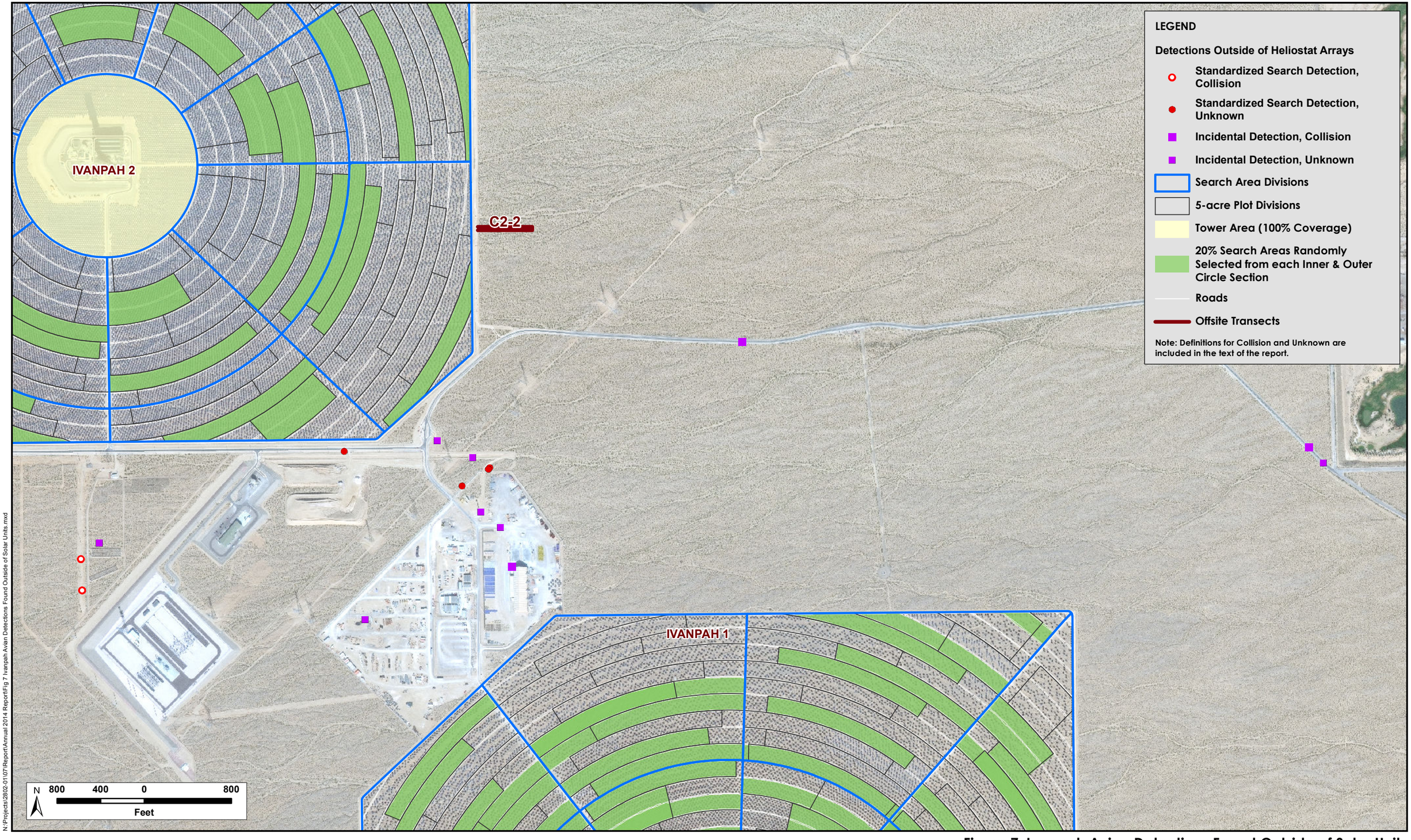
April 2015



N:\Projects\2802-01\07\Report\Annual 2014 Report\Fig 7 Ivanpah Avian Detections Found Outside of Solar Units.mxd

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Figure 7: Ivanpah Avian Detections Found Outside of Solar Units
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2.3.1.1 Locations of Avian Detections

As indicated in Table 9 (which includes both standardized survey detections and incidental detections), 448 detections were in the tower area, consisting of the area within 260 m of the tower, which was searched with 100% coverage. Search effort varied by survey location, so the unadjusted numbers presented here should be interpreted with caution. See Sections 3.2 to 3.4 for fatality estimates for each survey area. Two-hundred and eighteen detections were detected over the much larger area composed of the inner and outer heliostats. Otherwise, 23 detections were along the fencelines, two were noted along the Unit 3 collector line, one was found on the offsite transects, and 11 were on Project lands outside the standardized search areas (Table 9).

Table 9. Locations of Avian Detections (Including Standardized Survey and Incidental Detections), Year 1 Monitoring.

	Number of Detections				
Location	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Tower Area	48	141	66	193	448
Inner and Outer Heliostat Segments	41	54	40	83	218
Fences	5	3	6	9	23
Unit 3 Collector Line	0	0	0	2	2
Offsite Transects	0	1	0	0	1
Other Project Lands	3	3	3	2	11
Total	97	202	115	289	703

Of all 703 detections, those consisting only of feather spots numbered 111 in the tower areas, 79 in the inner and outer heliostat segments, 14 along fences, and two on Project lands outside of standardized search areas, for a total of 206 feather spots. No feather spots were found in offsite transects or along the Unit 3 collector line. Of the 685 avian detections within the solar units (i.e., excluding the CLA fence, Unit 3 collector line, offsite transects, and other Project lands), 291 were detected in Unit 1, 211 in Unit 2, and 183 in Unit 3.

2.3.1.2 Cause of Injury or Fatality

Table 10 indicates the number of detections with evidence of singeing or collision effects, from other Project causes, or for which cause of injury or fatality is unknown. Table 11 indicates the number of detections for each species with evidence of singeing or collision effects, from other Project causes, or for which cause of injury or fatality is unknown.

Table 10. Number of Avian Detections from Singeing, Collision, Other Project Causes, and Unknown Causes, Year 1 Monitoring.

	Number of Detections				
Cause	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Singed	27	100	42	147	316
Collision	14	15	10	45	84
Other*	5	5	2	3	15
Unknown	51	82	61	94	288
Total	**97**	**202**	**115**	**289**	**703**

* Includes detections in ACC buildings without evidence of singeing or collision effects.

Table 11. Number of Avian Detections from Singeing, Collision, Other Project Causes, and Unknown Causes by Species, Year 1 Monitoring.

Common Name	Scientific Name	Species Code	Singed	Collision	Other Project Causes	Unknown	Total Detections
Mourning Dove	*Zenaida macroura*	MODO	0	19	1	78	98
Yellow-rumped Warbler	*Setophaga coronata*	YRWA	42	4	2	7	55
Unidentifiable Passerine			15	0	1	29	45
Tree Swallow	*Tachycineta bicolor*	TRES	18	1	0	2	21
Black-throated Sparrow	*Amphispiza bilineata*	BTSP	5	8	0	7	20
Yellow Warbler	*Setophaga petechia*	YEWA	14	1	0	4	19
White-crowned Sparrow	*Zonotrichia leucophrys*	WCSP	0	8	0	10	18
Horned Lark	*Eremophila alpestris*	HOLA	1	3	0	13	17
Costa's Hummingbird	*Calypte costae*	COHU	14	1	0	1	16
House Finch	*Haemorhous mexicanus*	HOFI	10	1	0	5	16
Anna's Hummingbird	*Calypte anna*	ANHU	15	0	0	0	15
American Kestrel	*Falco sparverius*	AMKE	10	0	0	4	14
Barn Swallow	*Hirundo rustica*	BARS	13	0	0	1	14
Greater Roadrunner	*Geococcyx californianus*	GRRO	0	1	0	13	14
Rufous Hummingbird	*Selasphorus rufus*	RUHU	10	0	1	2	13
Brown-headed Cowbird	*Molothrus ater*	BHCO	2	2	0	7	11
Lesser Nighthawk	*Chordeiles acutipennis*	LENI	0	4	0	7	11
Unidentifiable Bird			0	0	1	10	11
Vaux's Swift	*Chaetura vauxi*	VASW	11	0	0	0	11
Cliff Swallow	*Petrochelidon pyrrhonota*	CLSW	10	0	0	0	10
Lazuli Bunting	*Passerina amoena*	LAZB	10	0	0	0	10
Unidentifiable Hummingbird			10	0	0	0	10
Brewer's Blackbird	*Euphagus cyanocephalus*	BRBL	0	0	0	9	9

Common Name	Scientific Name	Species Code	Singed	Collision	Other Project Causes	Unknown	Total Detections
Townsend's Warbler	*Setophaga townsendi*	TOWA	7	0	1	1	9
Violet-green Swallow	*Tachycineta thalassina*	VGSW	8	0	0	1	9
Wilson's Warbler	*Cardellina pusilla*	WIWA	7	0	0	2	9
Lesser Goldfinch	*Spinus psaltria*	LEGO	7	0	1	0	8
Orange-crowned Warbler	*Oreothlypis celata*	OCWA	6	1	1	0	8
Unidentifiable Swallow			6	0	0	2	8
Western Meadowlark	*Sturnella neglecta*	WEME	0	3	0	5	8
Blue-gray Gnatcatcher	*Polioptila caerulea*	BGGN	5	0	0	2	7
Hermit Warbler	*Setophaga occidentalis*	HEWA	3	1	0	3	7
Nashville Warbler	*Oreothlypis ruficapilla*	NAWA	7	0	0	0	7
Savannah Sparrow	*Passerculus sandwichensis*	SAVS	0	6	0	1	7
Loggerhead Shrike	*Lanius ludovicianus*	LOSH	0	1	0	5	6
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	NRWS	4	0	1	1	6
American Coot	*Fulica americana*	AMCO	1	1	0	3	5
American Pipit	*Anthus rubescens*	AMPI	1	2	0	2	5
Bank Swallow	*Riparia riparia*		5	0	0	0	5
Brewer's Sparrow	*Spizella breweri*	BRSP	0	3	0	2	5
Rock Pigeon	*Columba livia*	ROPI	1	0	0	4	5
Verdin	*Auriparus flaviceps*	VERD	2	0	2	1	5
Black-chinned Hummingbird	*Archilochus alexandri*	BCHU	2	1	0	1	4
Calliope Hummingbird	*Selasphorus calliope*	CAHU	4	0	0	0	4
Gambel's Quail	*Callipepla gambelii*	GAQU	0	0	0	4	4
Great-tailed Grackle	*Quiscalus mexicanus*	GTGR	4	0	0	0	4

Common Name	Scientific Name	Species Code	Singed	Collision	Other Project Causes	Unknown	Total Detections
Lincoln's Sparrow	*Melospiza lincolnii*	LISP	0	3	0	1	4
Unidentifiable Sparrow		UNSP	1	0	1	2	4
Unidentifiable Warbler		UNWA	2	0	1	1	4
Black-throated Gray Warbler	*Setophaga nigrescens*	BTYW	3	0	0	0	3
Cactus Wren	*Campylorhynchus brunneicapillus*	CACW	0	1	0	2	3
Olive-sided Flycatcher	*Contopus cooperi*	OSFL	1	0	0	2	3
Pine Siskin	*Spinus pinus*	PISI	3	0	0	0	3
Unidentifiable Gnatcatcher		UNGN	1	0	0	2	3
White-throated Swift	*Aeronautes saxatalis*	WTSW	3	0	0	0	3
Ash-throated Flycatcher	*Myiarchus cinerascens*	ATFL	0	1	0	1	2
Chipping Sparrow	*Spizella passerina*	CHSP	1	0	0	1	2
Common Raven	*Corvus corax*	CORA	2	0	0	0	2
Eurasian Collared-Dove	*Streptopelia decaocto*	EUCD	1	0	0	1	2
Ladder-backed Woodpecker	*Picoides scalaris*	LBWO	0	0	0	2	2
Lark Sparrow	*Chondestes grammacus*	LASP	0	1	0	1	2
Northern Flicker	*Colaptes auratus*	NOFL	0	0	0	2	2
Spotted Sandpiper	*Actitis macularius*	SPSA	0	0	0	2	2
Unidentifiable Blackbird			2	0	0	0	2
Unidentifiable Passerine or Swift		UNPS	0	0	0	2	2
Western Tanager	*Piranga ludoviciana*	WETA	1	0	0	1	2
Bewick's Wren	*Thryomanes bewickii*	BEWR	0	0	0	1	1
Black-and-white Warbler	*Mniotilta varia*	BAWW	0	0	1	0	1

Common Name	Scientific Name	Species Code	Singed	Collision	Other Project Causes	Unknown	Total Detections
Black-headed Grosbeak	*Pheucticus melanocephalus*	BHGR	0	0	0	1	1
Broad-tailed Hummingbird	*Selasphorus platycercus*	BTAH	1	0	0	0	1
Common Gallinule	*Gallinula galeata*	COGA	0	0	0	1	1
Common Loon	*Gavia immer*	COLO	0	1	0	0	1
Cooper's Hawk	*Accipiter cooperii*	COHA	0	0	0	1	1
Double-crested Cormorant	*Phalacrocorax auritus*	DCCO	0	0	0	1	1
Eared Grebe	*Podiceps nigricollis*	EAGR	0	1	0	0	1
European Starling	*Sturnus vulgaris*	EUST	0	0	0	1	1
Green-tailed Towhee	*Pipilo chlorurus*	GTTO	0	0	0	1	1
Hermit Thrush	*Catharus guttatus*	HETH	0	0	0	1	1
House Wren	*Troglodytes aedon*	HOWR	0	0	0	1	1
Lapland Longspur	*Calcarius lapponicus*	LALO	0	1	0	0	1
Lucy's Warbler	*Oreothlypis luciae*	LUWA	1	0	0	0	1
Phainopepla	*Phainopepla nitens*	PHAI	0	0	0	1	1
Ruby-crowned Kinglet	*Regulus calendula*	RCKI	1	0	0	0	1
Say's Phoebe	*Sayornis saya*	SAPH	0	0	0	1	1
Scott's Oriole	*Icterus parisorum*	SCOR	0	1	0	0	1
Swainson's Thrush	*Catharus ustulatus*	SWTH	0	1	0	0	1
Unidentifiable Heron			0	0	0	1	1
Unidentifiable Swift			1	0	0	0	1
Unidentifiable Woodpecker			1	0	0	0	1
Virginia Rail	*Rallus limicola*	VIRA	0	1	0	0	1

Common Name	Scientific Name	Species Code	Singed	Collision	Other Project Causes	Unknown	Total Detections
Western Kingbird	*Tyrannus verticalis*	WEKI	0	0	0	1	1
White-winged Dove	*Zenaida asiatica*	WWDO	0	0	0	1	1
Yellow-breasted Chat	*Icteria virens*	YBCH	0	0	0	1	1
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	YHBL	0	0	0	1	1
Total			**316**	**84**	**15**	**288**	**703**

Microscopic analysis of the 288 detections of unknown cause showed no evidence of collision or singeing. In all units, the majority of unknown detections were found in the heliostat arrays, which included the inner high density, inner segment, and outer segment heliostats. We considered potential factors contributing to the fatality of these unknowns. However, we found no evidence that a large proportion of these were temporally clumped (which might have suggested that discrete events such as lightning strikes or disease events had killed multiple birds), nor any other evidence suggesting the likely cause of injury or mortality for these detections.

2.3.2 Bat Detections

During the first four seasons of monitoring, one live bat (possibly sick or temporarily unable to fly) and 31 bat fatalities of six species were detected (Table 12 and Figure 8). Although bats were detected in all seasons (Figure 9), the total numbers were low, and the majority were in and around the ACC buildings.

Table 12. Number of Individual Bat Fatalities by Species, Year 1 Monitoring.

		Number of Fatalities				
Common Name	**Scientific Name**	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
California Myotis	*Myotis californicus*	2	2	5	3	12
Canyon Bat[1]	*Parastrellus hesperus*	1	0	3	3	7
Mexican Free-tailed Bat	*Tadarida brasiliensis*	0	2	1	2	5
Unidentifiable *Myotis*		0	0	1	1	2
Unidentifiable Bat		1	0	0	1	2
Pallid Bat	*Antrozus pallidus*	1	0	0	0	1
Big Brown Bat	*Eptesicus fuscus*	0	0	0	1	1
Western Small-Footed Bat	*Myotis ciliolabrum*	0	0	1	0	1
Total		**5**	**4**	**11**	**11**	**31**

[1] In addition, one injured canyon bat was detected in summer.

Figure 8. Number of Bat Detections by Species.

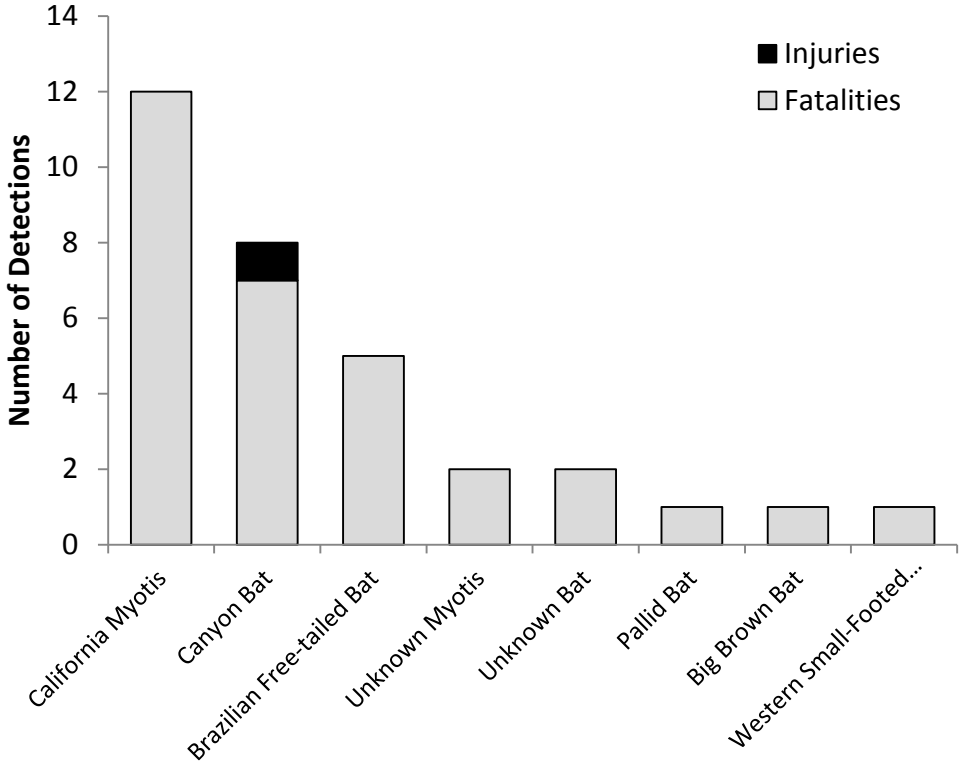
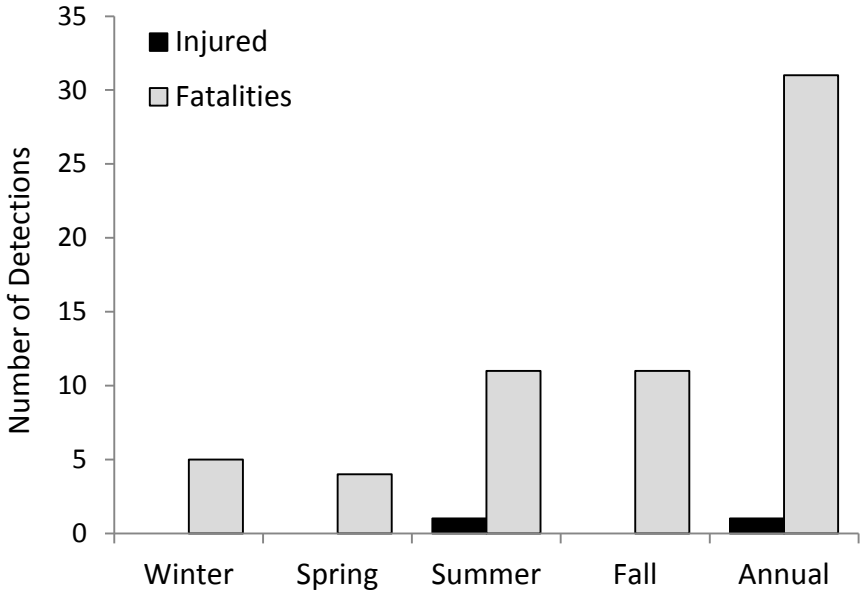


Figure 9. Number of Bat Detections by Season.



Two bat fatalities and one injured bat were found incidentally during this reporting period. The remaining twenty-nine bat detections were found during the course of standardized searches (Table 13).

Table 13. Number of Bat Detections Found Across Standardized Searches and Incidentally, by Season.

	Number of Detections				
	Winter	Spring	Summer	Fall	Total
Incidental					
Bat Fatalities	0	1	1	0	2
Bat Injuries	0	0	1	0	1
Standardized Survey					
Bat Fatalities	5	3	10	11	29
Bat Injuries	0	0	0	0	0

2.3.2.1 Locations of Bat Detections

Bats were detected in all three units (Figures 10, 11, and 12). Thirteen bats (40.6%) were in Unit 3, 11 (34.4%) were found in Unit 1, and eight (25.0%) were found in Unit 2. All 32 bats were found in the power block, and the majority were found within or immediately adjacent to the ACC buildings (Table 14).

Table 14. Locations of Bat Detections, Year 1 Monitoring.

	Number of Detections				
Location	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Tower Area	5	4	12	11	32
Inner and Outer Heliostat Segments	0	0	0	0	0
Fences	0	0	0	0	0
Unit 3 Collector Line	0	0	0	0	0
Offsite Transects	0	0	0	0	0
Other Project Lands	0	0	0	0	0
Total	**5**	**4**	**12**	**11**	**32**

2.3.2.2 Cause of Death or Injury

During the first four seasons of monitoring, 10 bats (31.3%) were detected with evidence of effects from collisions, such as physical trauma or detection adjacent to a structure with an imprint (Table 15 and Figure 13). Twelve bats (37.5%) were found in or near ACC buildings without evidence of singeing or collision injuries. Although the cause of death for these bats remains unknown, their association with the ACC building indicates that the cause of death of these bats should be attributed to "other Project causes", such as

entrapment within the ACC buildings. The remaining nine (28.1%) bat fatalities had no obvious signs of sickness or injury, and the cause of their death cannot be determined. The live bat (3.1%) had no obvious external injuries but would not fly away, so it was captured, given food and water, and kept in a cool, dark box until evening. Evaluation of the bat in the evening indicated that it had recovered, so it was released. No bats with evidence of singeing were noted.

Table 15. Number of Bat Detections from Singeing, Collision, Other Project Causes, and Unknown Causes, Year 1 Monitoring.

	Number of Detections				
Cause	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Singed	0	0	0	0	0
Collision	0	0	6	4	10
Other	3	2	4	3	12
Unknown	2	2	2	4	10
Total	**5**	**4**	**12**	**11**	**32**

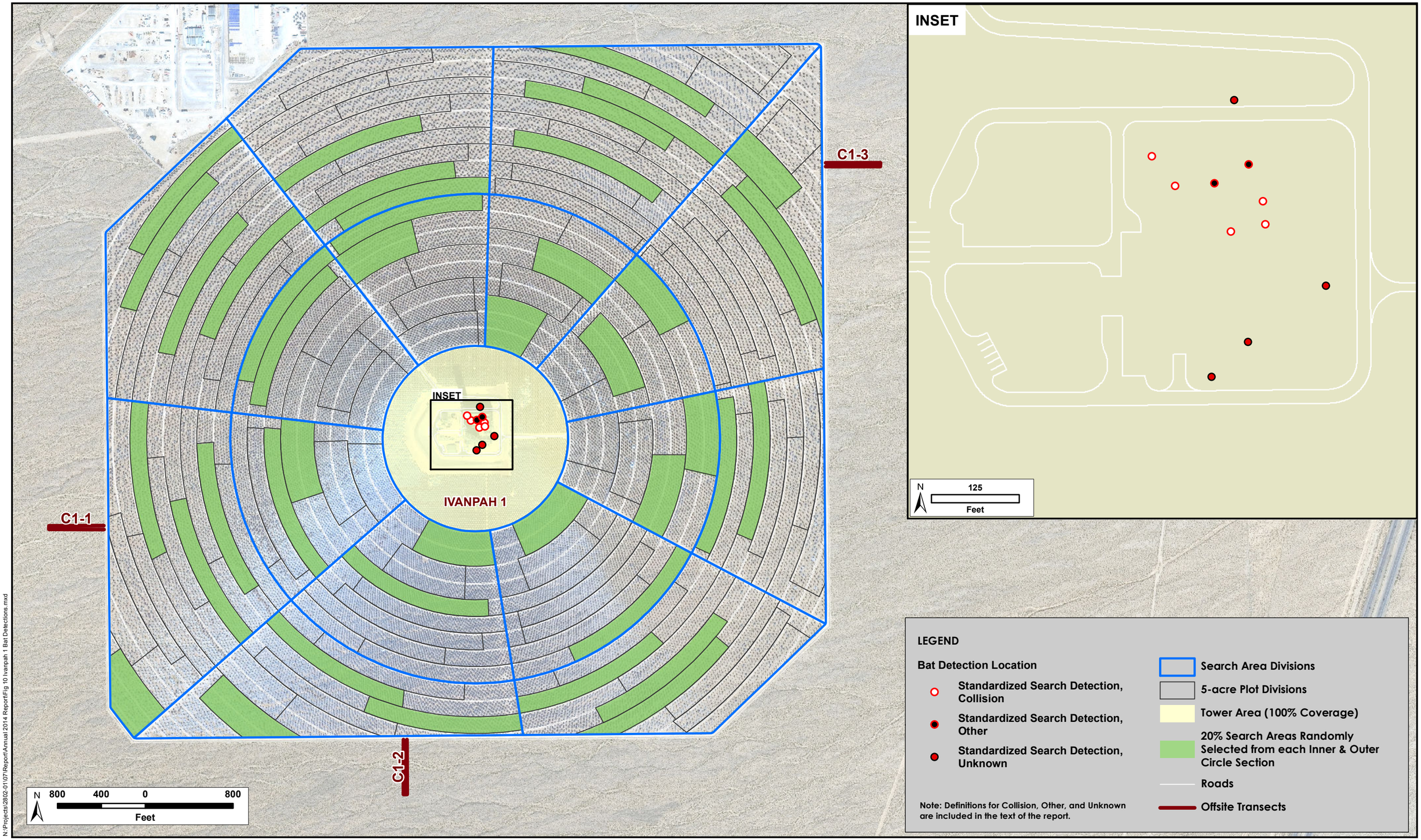


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Figure 10: Ivanpah 1 Bat Detections
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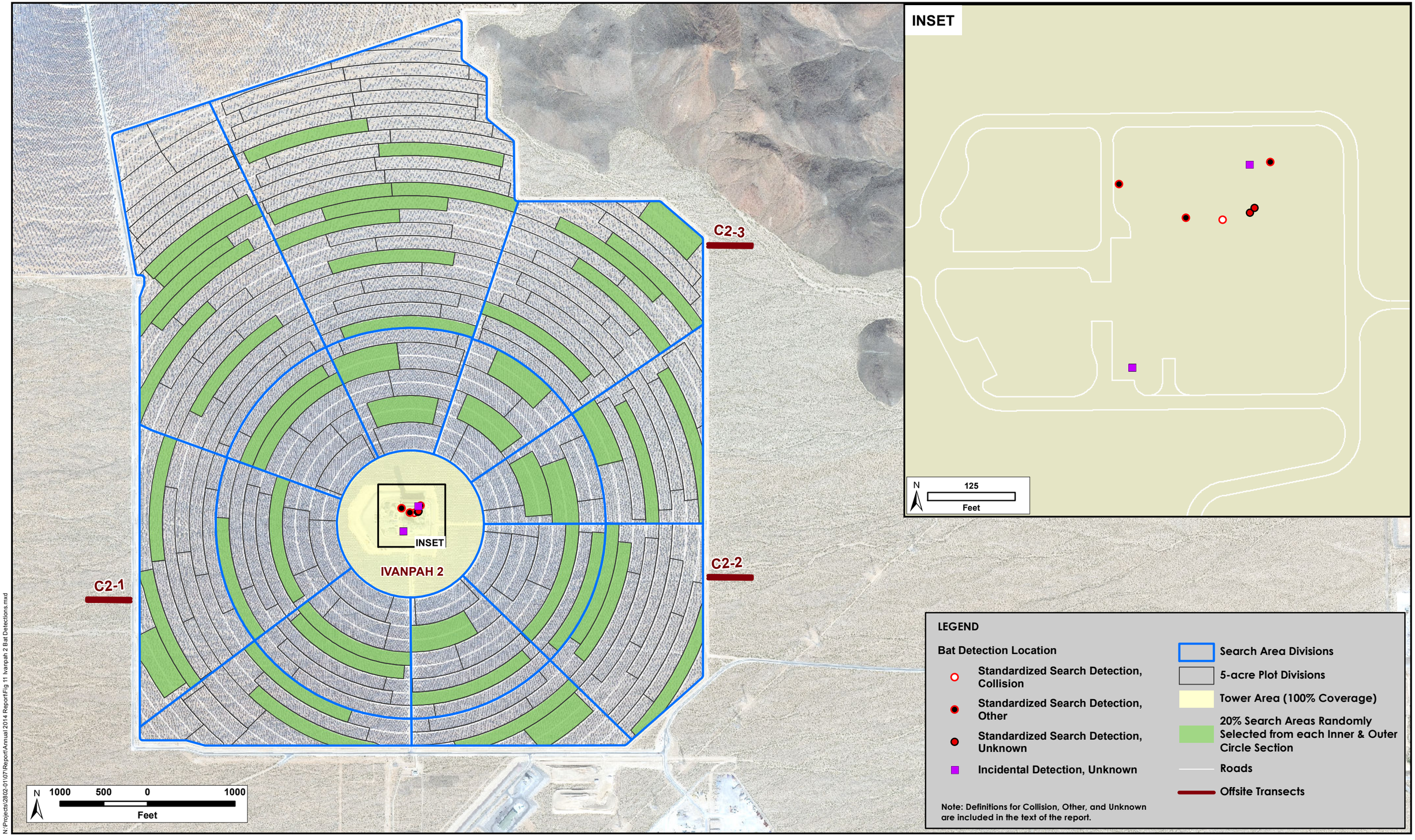

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Figure 11: Ivanpah 2 Bat Detections
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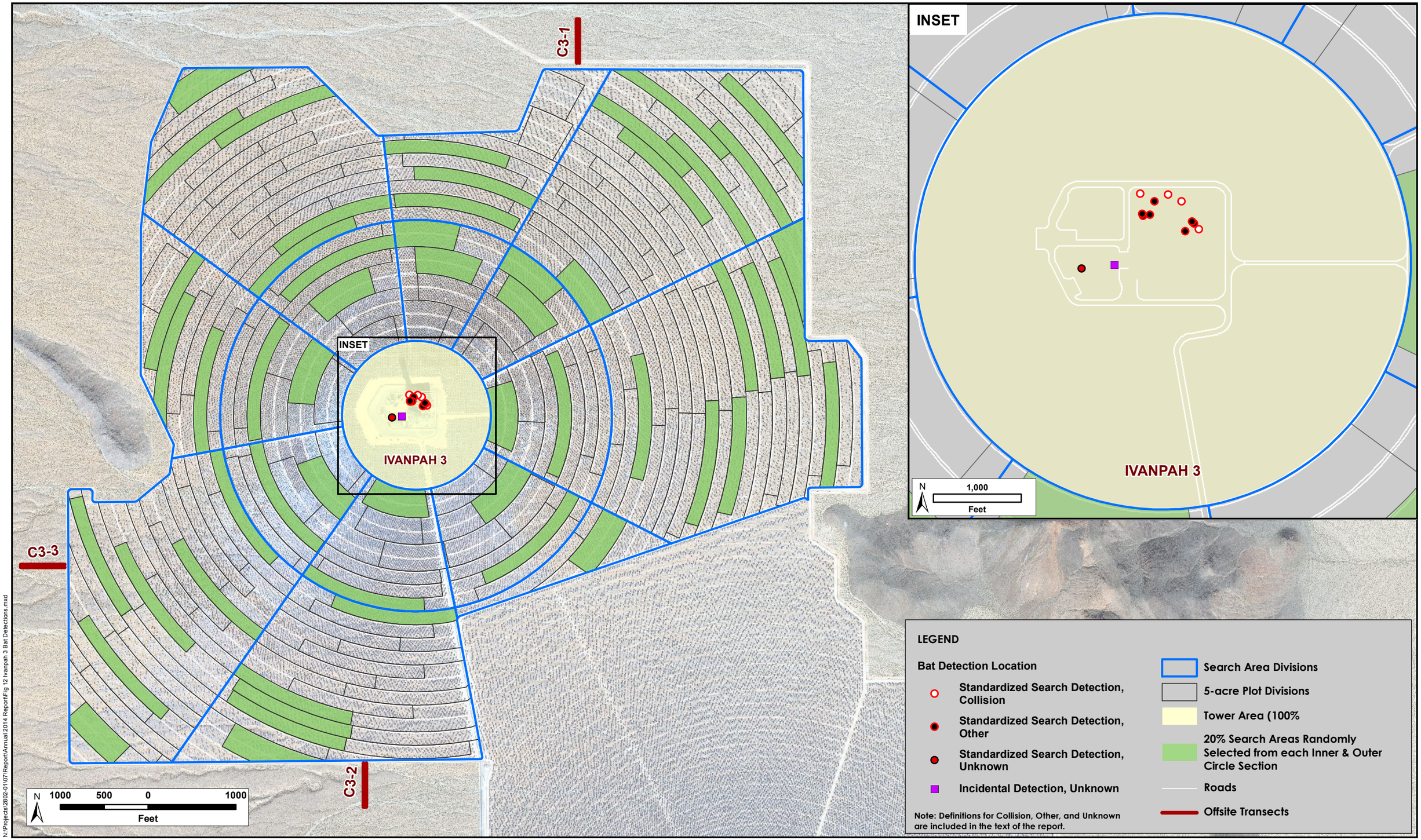

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Figure 12: Ivanpah 3 Bat Detections
Ivanpah Four Season 2013-2014 Avian and Bat Monitoring Report (2802-07)
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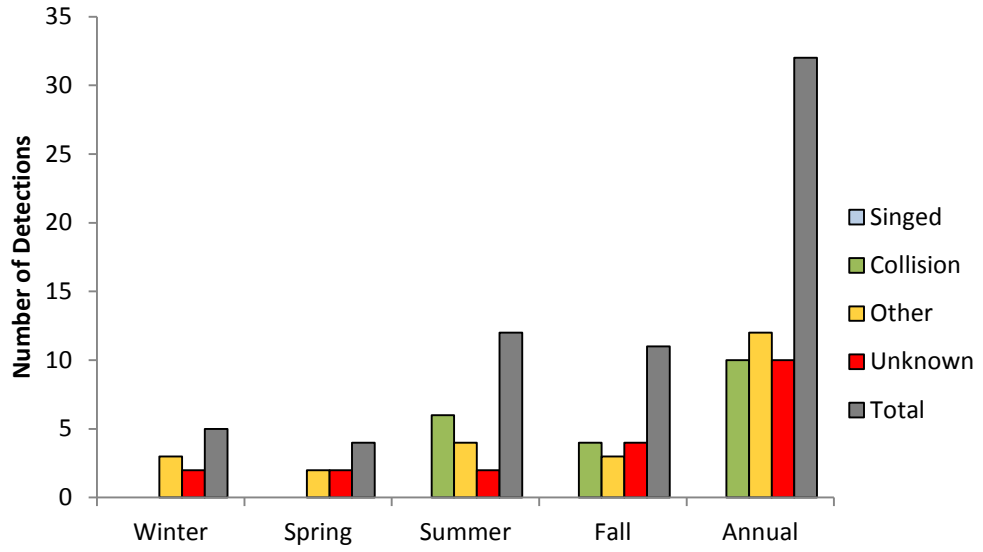
Figure 13. Number of Bat Detections by Season and Cause of Injury or Death.



2.3.3 Summary of Adaptive Management Measures and BMPs Implemented

The Project is applying the process of adaptive management to inform BMPs and deterrence measures designed to reduce avian and bat mortality to the extent practical. Adaptive management is a structured, iterative process of robust decision making in the face of uncertainty that aims to reduce the uncertainty over time (Holling, 1978; Walters, 1986; Rist et al., 2013). With any new technology, uncertainty exists for the environmental effects that may occur; however, monitoring may be implemented to reduce this uncertainty and to inform BMPs. As measures are implemented, monitoring further informs the effectiveness of the measures deployed and may lead to modifications of existing measures, or adoption of new measures over time through the iterative process of adaptive management.

The BMPs and deterrent measures are designed in response to the quantitative evidence of the causes of and locations of avian and bat fatalities at the facility. For avian species, elevated levels of avian mortality were detected in the tower area and heliostat field relative to the much lower levels of mortality associated with the electricity transmission line, fences, and other Project lands, and the known causes were principally associated with singeing and collision. Bats were exclusively discovered in the tower areas, specifically near or in the ACC units (Section 2.3.2.1).

2.3.3.1 Best Management and Deterrence Measures for Avian Species

The Project has implemented a number of BMPs in response to the results of seasonal monitoring. One of the principal management practices that has been implemented is the use of advanced heliostat positioning for flux management. This measure was implemented through a software upgrade installed in summer 2014 for all three Units. The advanced positioning algorithm decreases the number of heliostats in standby zones

and minimizes the amount of time mirrors are in the wash position. Decreasing the number of heliostats in standby decreases flux concentrations surrounding the towers. The algorithm also utilizes a "wave pattern" of heliostat deployment during startup to decrease flux concentrations during the morning hours. Ivanpah is continuing to work on development and deployment of advanced dynamic heliostat positioning techniques that will continue to decrease flux concentrations surrounding the boiler. Decreased flux levels are hypothesized to correlate with decreased singeing of avian species and to result in decrease fatalities in the tower area. Minimizing the amount of time mirrors are in the wash position addresses incidental observations by avian biologists who hypothesized that placing mirrors in the wash/maintenance position (mirrors are perpendicular to the ground) resulted in increased collisions. Although mirrors must be placed in this position to allow for access into the solar field for maintenance, the Project is investigating the potential to wash mirrors while they are in the active mode. .

The Project has deployed a chemosensory deterrent measure, BirdBuffer, at the Unit 1 tower in the fall of 2014. The Unit 1 tower was selected as a result of the elevated avian mortality at this tower relative to Units 2 and 3. The chemosensory deterrent, which effectiveness has been documented in scientific literature, uses a grape-extract aerosol that is dispersed from the tower (Avery and Decker 1994; Avery et al. 1995; Cummings et al. 1995; Marples and Roper 1997; Mason et al. 1989). This measure was approved by the TAC on 12 September 2014 and is hypothesized to deter resident species, which adapt to the presence of the deterrent by avoiding the tower area. The BirdBuffer system commenced operation on 12 October 2014, roughly a week prior to the cessation of surveys for this annual report. Because implementation of this measure occurred over a very limited time during the reporting period the deterrent is not thought to have significantly reduced detections during the reporting period.

The Project has also implemented a BMP for lighting based on the hypothesis that lighting at the facility may attract insects to the tower area and increase attractiveness of the tower area to avian insectivores, which in turn may increase avian mortality. To address this potential, the Project uses lighting in the power towers only as necessary for nighttime maintenance and safety. Lights are completely extinguished at night except for required FAA lighting. In addition to the reduction of lighting in the tower, ground-based lighting will be replaced with light emitting diode (LED) lighting that is not attractive to insects. This lighting installation will start at Unit 1 in 2015.

Another measure currently in development is to install perching deterrence for Project features near the tower. Assessment of raven management studies has shown that perching by ravens occurs in areas near the power block and may increase scavenging. In addition, affording perching opportunities may increase use of the area by other avian species. Perching deterrence is therefore hypothesized to decrease scavenger rates and produce more robust monitoring results, while also discouraging avian species from the power block, thus decreasing levels of mortality in the tower area. The perch deterrents have been ordered and will be installed together with the phased LED lighting installation.

Finally, in addition to the measures already deployed, the Project has evaluated avian sonic deterrence and is proposing to deploy this measure in conjunction with the chemosensory deterrence being tested in Unit 1. Studies show that sonic deterrence may be effective; however, attenuation due to habituation may occur (Ronconi and St. Clair, 2005; Ribot, et al, 2011; Tupper, et al 2011). As a result of the potential for attenuation, the sonic deterrence is hypothesized to deter migrants and transients that are not habituated to the avian distress and predator calls. The project is proposing chemosensory deterrence and sonic deterrence to be tested concurrently at Unit 1 to determine the effectiveness of these combined measures. The Project anticipates the deployment of this measure in 2015 after consideration by the TAC.

In summary, avian BMPs and deterrent measures include:

- Use of an advanced heliostat positioning algorithm to decrease the number of heliostats in standby zones and minimize the amount of time mirrors are in the wash position.
- Deployment of a chemosensory deterrent measure, BirdBuffer, at the Unit 1 tower.
- Use of lighting in the power towers only as necessary for nighttime maintenance and safety; completely extinguish tower lights at night except for required FAA lighting
- Replacement of ground-based lighting with LED lighting that is not attractive to insects is planned for early 2015.
- Installation of perching deterrence devices on Project features near the tower will occur with the LED lighting.
- Deployment of an avian sonic deterrent device in conjunction with the chemosensory deterrence being tested in Unit 1 is planned for early 2015.

2.3.3.2 Best Management and Deterrence Measures for Bats

During this four season reporting period, two measures to address bat mortality were explored. The first measure implemented by the Project was to test the feasibility of installing screening devices over the ACC intakes to deter bats from entering the ACC. This measure was implemented at the Unit 3 ACC at one intake fan. The single fan was chosen to allow for airflow testing, thus establishing the potential effects to facility equipment. Further investigation determined that commercial considerations, such as warranty of equipment, may be affected by deployment of this method of bat deterrence.

As a result, a second alternative method of bat deterrence was explored. The second method to deter bats was the use of an ultrasonic bat deterrent, BD100 (Binary Acoustic Technology, Tucson, AZ). This device emits ultrasonic frequencies to deter bats from entering areas where the sounds exist. This measure was deployed at the Unit 3 ACC on 10 September 2014. The Unit 3 ACC area was selected for the test unit as a result of the elevated bat mortality discovered there relative to Units 1 and 2. The deterrence appears to generally effective, as no bat mortalities were detected at this location for the remainder of the period of this report. The Project anticipates deploying additional devices to Units 1 and 2 in spring of 2015.

Section 3.0 Analysis of Four Season Detection Data

This section includes an analysis of the detection data summarized in Section 2.3 to develop annual fatality estimates in accordance with the Plan. Searcher efficiency rates and carcass persistence durations, derived from searcher efficiency and carcass removal trials, respectively, are incorporated into the fatality estimator (Huso 2010). Whereas the fatality estimates for the individual seasonal reports generally used searcher efficiency and carcass persistence data from each season, or pooled among a subset of seasons, the four season fatality estimate uses such data pooled across all four seasons. In addition, because vegetation and habitat complexity, and therefore searcher efficiency, differ between the tower area and other surveyed areas (i.e., the inner and outer heliostat segments, fenceline, Unit 3 collector line, and offsite transects), this four season estimate uses different searcher efficiency rates for these two subsets of the surveyed areas. Using the methods described in Appendix B, we found carcass persistence rates to vary by season, and thus we incorporated a seasonal component of carcass persistence to more accurately estimate fatalities at the facility.

Fatality estimates could not be produced for bats because of a combination of the areas in which bat detections were found and low sample sizes. As discussed in Section 2.3.2, during the period covered by this four season report, 22 of the 32 bat detections found during fatality surveys and incidentally were of known causes. Twenty of these were recovered in the ACC buildings, for which fatality estimates are not modeled because these buildings are closed systems with minimal scavenging. Eight of these 20 displayed physical evidence of collision, and the other 12 showed no signs of trauma or were too desiccated to determine cause but were all considered entrapped. Of the 12 bat detections outside of the ACC buildings, two showed evidence of collision, and the remainder showed no evidence of cause of death. Five of the 10 detections with unknown cause of death were determined to be much older than the search interval and would be excluded from the estimate. Due to small sample sizes, no fatality estimates are provided for the two collision-related fatalities or bat detections for which cause of death could not be identified.

3.1 Carcass Removal and Searcher Efficiency Trials

3.1.1 Carcass Removal Trials

Eighty-eight carcass removal trials (31 large and 57 small carcass trials) were used to model carcass persistence for fatality estimation. Eighty-nine carcass removal trials were initiated during the first year of monitoring, but one large carcass trial was removed from the analysis because the carcass was removed prematurely by operational staff after a scavenger relocated the carcass to a road. Carcasses were placed on the power block, in the inner HD heliostats and inner and outer heliostat segments, along the unit fencelines and CLA fence, under the Unit 3 collector line, and on offsite transects. A camera was placed at each carcass to record the time of scavenging and the scavenging species. Scavenger species included common ravens (N=25), desert kit fox (*Vulpes macrotis*; N=15), white-tailed antelope squirrels (*Ammospermophilus leucurus*; N=11), greater roadrunner (*Geococcyx californianus*; N=1), turkey vulture (N=1), and an unidentified canid (N=1). For the

remaining 27 scavenged carcasses (seven carcasses were not scavenged), the scavenger species was not captured on camera. With respect to scavenger species occurrence among various Project components, the most prominent patterns were (1) common ravens were recorded as scavengers in the power block, and (2) antelope squirrels were recorded as scavengers only outside the tower area.

Carcass persistence ranged from less than one day, in the case of 15 carcasses (one large and 14 small), to a full six-week trial period in the case of the 31 carcasses (24 large and seven small) whose remains persisted throughout the trial. Because 31 of the carcasses persisted for the full six-week trial, it is unknown how long they might have persisted if not removed. We therefore conservatively assumed that carcasses would not have persisted beyond the time the trial ended and carcasses were retrieved (about 6 weeks). Because the data were not normally distributed, we report the median carcass persistence times. Mean persistence times are also provided to reflect comparison with the Plan, which discusses the mean. Median carcass persistence over the entire year was 4.8 days (mean 10.9 days) for small carcasses and 42.0 days (mean 37.1 days) for large carcasses (Table 16).

Table 16. Median and Mean Persistence Durations for Carcasses by Size and Season, Year 1 Monitoring.

	Median Duration (Days)				
	Winter	Spring	Summer	Fall	Combined
Small	7.6	9.3	0.6	2.9	4.8
Large	44.7	42.0	41.3	41.9	42.0
	Mean Duration (Days)				
	Winter	Spring	Summer	Fall	Combined
Small	12.3	18.9	4.9	7.1	10.9
Large	39.3	41.6	32.9	38.8	37.1

3.1.2 Searcher Efficiency Trials

Human Searcher Efficiency Trials. During the period covered by this four season report, a total of 53 small carcasses, 44 large carcasses, and 57 feather spots 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. Carcasses were placed in all areas where standardized searches occurred (i.e., the power block, inner HD area, inner and outer heliostats, Unit perimeter and CLA fences, the Unit 3 collector line, and offsite transects). Five of the small carcasses and five of the large carcasses disappeared (e.g., they may have been scavenged) before the searcher efficiency trial, leaving a sample size of 48 small carcasses, 39 large carcasses, and 57 feather spots included in the trials. Table 17 depicts the results of human searcher efficiency trials by season.

In the seasonal report for fall 2014, all human searcher efficiency data for the entire first four seasons of monitoring were analyzed to determine the best approach to pooling or partitioning data. That analysis determined that the best model for use of human searcher efficiency data included survey area and carcass size rather than season. In other words, pooling data by season was determined to be appropriate, but

searcher efficiency results should be separated between the tower area and the remaining survey areas (likely due to differences in vegetation and topography, and thus carcass detectability), and they should be separated by small carcasses, large carcasses, and feather spots. As a result, Table 18 presents human searcher efficiency data for the four season survey period separately for the tower area and other survey areas, and by type (small carcass, large carcass, and feather spot) rather than by season.

Table 17. Results of Human Searcher Efficiency Trials by Type and Season.*

	Number of Carcasses Detected/Planted				
SET Type	Winter	Spring	Summer	Fall	Combined
Large carcass	6/14	5/7	11/11	6/7	28/39
	42.8%	71.4%	100%	85.7%	71.8%
Small carcass	5/14	4/7	11/17	4/10	24/48
	35.7%	57.1%	64.7%	40.0%	50.0%
Feather spot	0/0	5/14	10/25	8/18	23/57
	NA	35.7%	40.0%	44.4%	40.4%
Total	11/28	14/28	32/53	18/35	75/144
	39.3%	50.0%	60.4%	51.4%	52.1%

*Note: No feather spots were planted in the winter season.

Table 18. Four Season Results of Human Searcher Efficiency Trials by Type and Area.*

	Tower Area (Number Detected/ Placed)	Tower Area (% Detected)	Other Areas (Number Detected/ Placed)	Other Areas (% Detected)	Total (Number Detected/ Placed)	Total (% Detected)
Large carcasses	9/11	81.8	19/28	67.9	28/39	71.8
Small carcasses	10/14	71.4	14/34	41.2	24/48	50.0
Feather spots	8/15	53.3	15/42	35.7	23/57	40.4
Total	27/40	67.5	48/104	46.2	75/144	52.1

*Searcher efficiency plants that disappeared before the trial concluded are not included in this table. Results are presented as the number placed/number detected and % detected by area and carcass type.

Overall human searcher efficiency for the first four seasons of monitoring was 71.8% for large carcasses, 50.0% for small carcasses, and 40.4% for feather spots. Target rates assumed in the Plan were 69% for large birds and 55% for small birds (the Plan did not contain a target for feather spots).

Canine Searcher Efficiency Trials. During the 2014 summer and fall seasons, 21 carcasses and 247 feather spots were placed in locations in the heliostat field with various vegetation heights and with a range of contrast between the soil and vegetation to represent the various conditions under which searches occur to measure searcher efficiency of detection dogs. Twelve of the feather spots disappeared before the searcher efficiency trial, leaving a sample size of 21 carcasses and 235 feather spots included in the trials. Because detection dogs only searched outer heliostat segments during those seasons, canine searcher efficiency rates were not partitioned by Project area, but rather they were separated between carcasses and feather spots and pooled over the summer and fall seasons; they were not separated by carcass size due to the low sample size (N=3) of large carcasses used in these trials. Table 19 presents canine searcher efficiency data for the entire year separately for carcasses and feather spots. Detection dog searcher efficiency was 76.2% for carcasses and 59.6% for feather spots.

Table 19. Results of Detection Dog Searcher Efficiency Trials by Season for Summer and Fall 2014.

	Summer (Number Detected/ Placed)	Summer (% Detected)	Fall (Number Detected/ Placed)	Fall (% Detected)	Total (Number Detected/ Placed)	Total (% Detected)
Carcasses	15/20	75.0	1/1	100	16/21	76.2
Feather spots	83/130	63.8	57/105	54.3	140/235	59.6
Total	98/150	65.3	58/106	54.7	156/256	60.9

3.2 Fatality Estimates for Year 1 Monitoring

Fatality estimates for known and unknown causes were calculated in accordance with the Plan; specifically estimates were derived by project elements and fatality source for the first four seasons of monitoring. Table 20 summarizes fatality estimates for the first four season period of monitoring. Seasonal fatality estimates for known and unknown causes are detailed below in Sections 3.3 and 3.4.

Table 20. Four Season Avian Fatality Estimates by Project Element (with Lower and Upper 90% Confidence Intervals) Based on Detections, Year 1 Monitoring.

Project Element	Number of Estimated Fatalities[1]	
	Known Cause	Unknown Cause
Power Block	457 (345 - 659)	79 (47 - 152)
Inner HD	278 (160 - 530)	200 (134 - 342)
Heliostat Segments	753 (537 – 1,178)	1,665 (1,221 – 2,735)
Fenceline	n<5	68 (48 - 105)
Unit 3 Collector Line	n<5	n<5
Total	1,492 (1,046 – 2,371)	2,012 (1,450 - 3,334)

[1] n<5 = No estimate provided because there were fewer than five detections for the given group. The four season total does not reflect the sum of fatality estimates from the power blocks, inner HD areas, and heliostat segments because it also includes fatalities from the fenceline and Unit 3 collector line, and because of the inherent properties of the bootstrap process using the fatality estimator.

3.3 Fatality Estimates for Known Causes

Four season fatality estimates from known causes (singeing, collision, and entrapment) were calculated for the power blocks, inner HD areas, and inner and outer heliostat segments, both for each season and for the first four seasons combined. Due to low numbers of detections (<5) with known cause along the Unit 3 collector line and the fencelines, no estimates are provided for these elements. Tables 21 through 23 and Figure 14 summarize the fatality estimates for known causes, and Appendix B provides supporting information used to develop the summaries in Table 21. A total of 1,492 fatalities (90% confidence interval 1,046-2,371) based on detections of known causes are estimated over this period. During the first four seasons of monitoring under the Plan, 47.4 % of estimated total fatalities from known causes were singed, 51.9% showed evidence of collision effects, and 0.7% were from other Project causes (e.g. entrapment or occurrence in the ACC buildings) (Table 21).

Table 21. Estimated Avian Fatalities from Singeing, Collision, and Other Project Causes, Year 1 Monitoring.

	Estimated Fatalities				
Cause	**Winter**	**Spring**	**Summer**	**Fall**	**Total**
Singed	40 (28-61)	172 (131-453)	136 (79-274)	335 (176-605)	683 (414-1393)
Collision	8 (NA)	159 (80-291)	6 (NA)	463 (291-788)	636 (385-1093)
Other*	1 (NA)	5 (NA)	2 (NA)	3 (NA)	11 (NA)
Total	**49 (37-70)**	**336 (216-749)**	**144 (87-282)**	**801 (470-1396)**	**1330[1] (810-2497)**

* Includes detections in ACC buildings without evidence of singeing or collision effects.

[1] Note that estimate is lower than total known-causes estimate, due to some subgroups based on season and cause having fewer than 5 detections, in which case no estimate is provided. When no estimate is provided the count is added to the total unadjusted.

Table 22. Estimated Avian Fatalities from Singeing, Collision, and Other Project Causes by Project Element, Year 1 Monitoring.

	Estimated Fatalities					
Cause	Heliostats	InnerHD	PowerBlock	Fence	Powerlines	Total
Singed	3 (NA)	246 (108-518)	439 (302-684)	2 (NA)	(NA)	690 (415-1207)
Collision	718 (391-1353)	32 (16-80)	4 (NA)	(NA)	2 (NA)	756 (413-1439)
Other*	(NA)	(NA)	11 (NA)	(NA)	(NA)	11 (NA)
Total	**612 (394-1356)**	**278 (124-598)**	**454 (317-699)**	**2 (NA)**	**2 (NA)**	**1457[1] (839-2657)**

* Includes detections in ACC buildings without evidence of singeing or collision effects.

[1] Note that estimate is lower than total known-causes estimate, due to some subgroups based on element and cause having fewer than 5 detections, in which case no estimate is provided. When no estimate is provided the count is added to the total unadjusted.

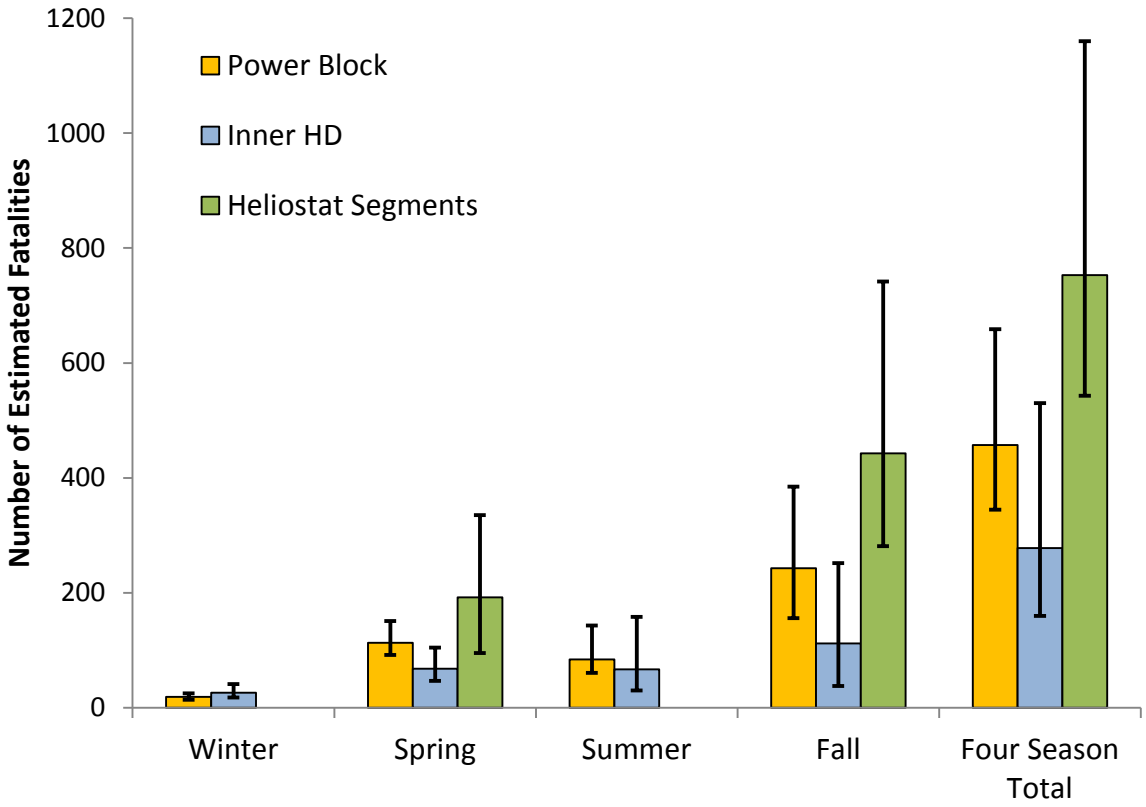
Table 23. Seasonal and Four Season Avian Fatality Estimates by Project Element (with Lower and Upper 90% Confidence Intervals) Based on Detections of Known Causes, Year 1 Monitoring.

Project Element[2]	Season (Number of Estimated Fatalities)[1]				Four Season Total (Number of Estimated Fatalities)[2]
	Winter	Spring	Summer	Fall	
Power Blocks	19 (14 - 25)	113 (92 - 151)	84 (61 - 143)	243 (156 - 385)	457 (345 - 659)
Inner HDs	26 (18 - 41)	68 (47 - 105)	67 (30 - 158)	112 (38 - 252)	278 (160 - 530)
Heliostat Segments	n<5	192 (101 - 347)	n<5	443 (281 - 754)	753 (537 – 1,178)
Fencelines	n<5	n<5	n<5	n<5	n<5
Unit 3 Collector Line	n<5	n<5	n<5	n<5	n<5
Total	54 (41 - 75)	373 (240 - 603)	154 (94 - 304)	800 (477 – 1,393)	1492 (1,046 – 2,371)

[1] n<5 = No estimate provided because there were fewer than five detections for the given group. Seasonal totals may not reflect the sum of estimates from each component, and four season totals may not reflect the sum of seasonal totals, due to the inherent properties of the bootstrap process using the fatality estimator. Also, the four season total does not reflect the sum of fatality estimates from the power blocks, inner HD areas, and heliostat segments because it also includes fatalities from the fencelines and Unit 3 collector line, and because of the inherent properties of the bootstrap process using the fatality estimator.

[2] Sample size by project element is reported in Table 9.

Figure 14. Seasonal and Four Season Fatality Estimates (with Lower and Upper 90% Confidence Intervals) Based on Detections of Known Causes, Year 1 Monitoring.



Based on the acreages of individual Project components listed in Table 23, the fatality estimates from known causes correspond to densities of 25.4 fatalities/acre in the power blocks, 2.0/acre in the inner HD heliostats, and 0.3/acre in the inner and outer heliostat segments.

3.4 Fatality Estimates from Unknown Causes

Four season bird fatality estimates from unknown causes were calculated for the power blocks, inner HD areas, inner and outer heliostat segments, and fenceline, both for each season and for the first four seasons combined. Due to low numbers of detections (<5) with known cause along the Unit 3 collector line, no estimates are provided for this Project component. Table 24 and Figure 15 summarize the fatality estimates from unknown causes, and Appendix B provides supporting information used to develop the summaries in Table 24. A total of 2,012 fatalities (90% confidence intervals 1,450-3,334) based on detections of unknown causes are estimated to have occurred during this time period.

Of the detections of unknown cause, approximately half (47.2%) were from feather spots. The proportions of these feather spots representing fatalities (e.g., collision) that had been scavenged or representing natural predation events associated with kit foxes, common ravens, or raptors are not known. Furthermore, in some

cases, multiple feather spots may result from one fatality. As a result, the fatality estimates from unknown causes indicated in Table 24 and Figure 15 may over-represent the actual number of fatalities.

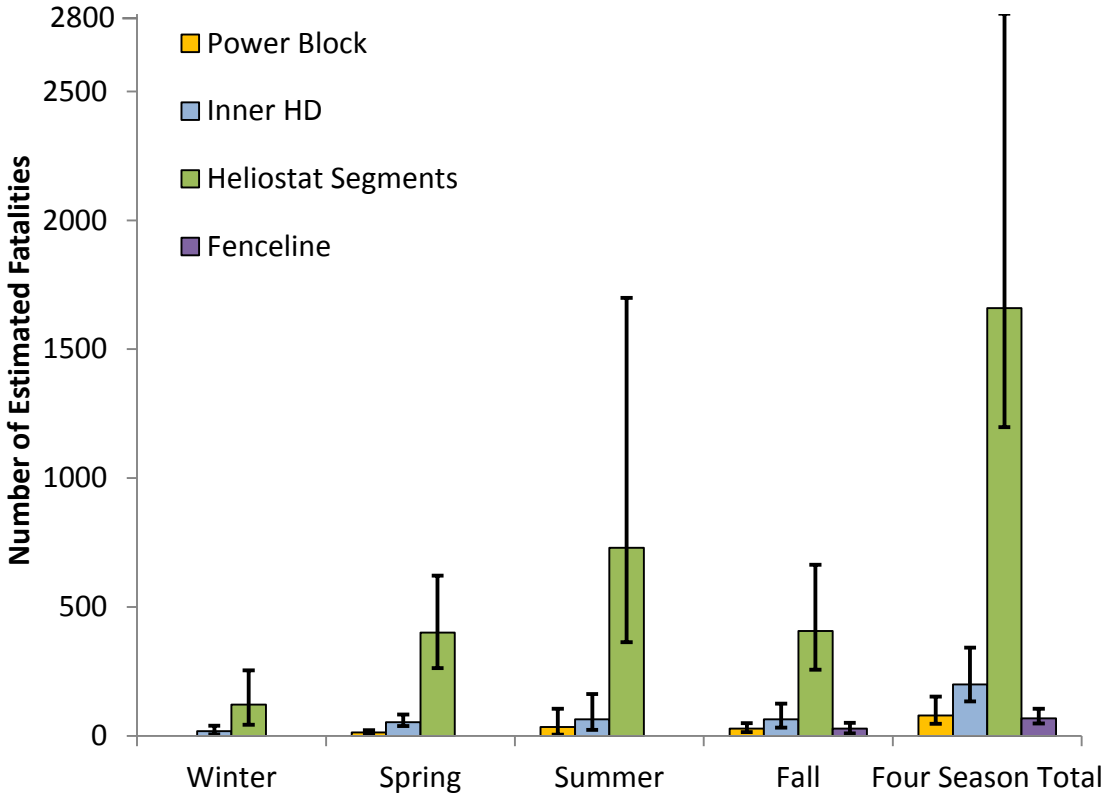
Based on the acreages of individual Project components listed in Table 24, the fatality estimates from unknown causes correspond to densities of 4.4 fatalities/acre in the power blocks, 1.5/acre in the inner HD heliostats, 0.6/acre in the inner and outer heliostat segments, and 1.7/acre within the fenceline area surveyed.

Table 24. Seasonal and four season Avian Fatality Estimates by Project Element (with Lower and Upper 90% Confidence Intervals) Based on Detections of Unknown Causes, Year 1 Monitoring.

Project Element	Season (Number of Estimated Fatalities)[1]				Four Season Total (Number of Estimated Fatalities)[2]
	Winter	Spring	Summer	Fall	
Power Block	n<5	14 (7 - 22)	34 (5 - 105)	28 (15 - 49)	79 (47 - 152)
Inner HD	19 (6 - 39)	53 (38 - 83)	64 (24 - 163)	65 (32 - 125)	200 (134 - 342)
Heliostat Segments	122 (49 - 248)	401 (263 - 646)	730 (370 - 1591)	413 (269 - 670)	1,665 (1,221 – 2,735)
Fenceline	n<5	n<5	n<5	29 (10 - 51)	68 (48 - 105)
Unit 3 Collector Line	n<5	n<5	n<5	n<5	n<5
Total	146 (60 - 292)	471 (311 - 754)	832 (403 - 1863)	535 (326 - 895)	2,012 (1,450 - 3,334)

[1] n<5 = No estimate provided because there were fewer than five detections for the given group. Seasonal totals may not reflect the sum of estimates from each component, and four season totals may not reflect the sum of seasonal totals, due to the inherent properties of the bootstrap process using the fatality estimator.

Figure 15. Seasonal and Four Season Fatality Estimates (with Lower and Upper 90% Confidence Intervals) Based on Detections of Unknown Causes, Year 1 Monitoring.



3.5 Assessment by Survey Area

To inform the recommendations on continued monitoring and adaptive management measures, this section includes a discussion of avian and bat injury or mortality at, or associated with, specific Project features.

3.5.1 Birds

The sections below discuss avian fatality monitoring results and fatality monitoring by individual Project features and locations.

3.5.1.1 Tower Area

The tower area consists of the power block (which includes the ACC buildings) and inner HD heliostats. These areas are surveyed with 100% coverage. Fatalities estimated from the tower areas represented 49.2% of the fatalities based on detections from known causes (Table 23) and 13.8% of fatalities based on detections from unknown causes (Table 24). Singeing was the most common cause of injury/death in the tower areas, with 311 singed detections. This result is understandable because flux density is highest close to the towers.

Collision with Project structures accounted for 16 detections. Fourteen detections resulted from entrapment of birds in ACC buildings. For the remaining 106 detections in the tower area, the cause of injury/death was unknown. The tower areas accounted for 98% of all singed detections from this survey period.

Continued monitoring of the tower areas in year 2 is warranted. Because of the risk of flux injury/mortality for birds close to the towers, the tower areas are appropriately the focus of BMPs and adaptive management measures as discussed in Section 2.3.3.

3.5.1.2 Heliostat Area

The heliostat area includes the inner and outer heliostat segments, which are collectively surveyed with 24.1% coverage in randomly selected arc-shaped plots. Fatality estimation was performed for the inner and outer heliostats collectively. Fatalities estimated from the inner and outer heliostat segments represented 50.5% of the total estimated fatalities based on detections from known causes (Table 23) and 82.8% of the total estimated fatalities based on detections from unknown causes (Table 24). There were a total of 218 avian detections within the inner and outer segment heliostat arrays of all three units reported during the first four seasons of monitoring. Only three detections with evidence of singeing were found in the heliostat segments. Given the very low percentage of detections in the heliostat segments that were singed, singeing is not a substantial cause of injury or mortality for birds within the inner and outer heliostat segments.

Cause of death for 61 of these detections was attributed to collision with heliostat mirrors. Four additional detections showed strong evidence of predation, and the remaining 150 detections, many feather spots, were of unknown causes. These detections of unknown cause may have resulted from collisions or predation events that did not leave adequate evidence of cause, much like unknowns found in the inner HD areas. Because of the difficulty in determining the cause, which is confounded by the high number represented by feather spots, assessing the level of collision risk in this area is challenging.

Continued monitoring of the heliostat areas in year 2 is warranted.

3.5.1.3 Fencelines

Fencelines include the perimeter fences around solar units and around the CLA fence. Fatalities estimated from the fenceline represented 3.4% of total estimated fatalities based on detections from unknown causes (Table 24). There were a total of 19 avian detections found along the three unit fencelines and four detections found along the CLA fence during the reporting period. With such relatively small numbers of detections, the fatality risk associated with the fencelines appears to be low. An injured common loon was found along the fenceline of unit 3 and categorized as a collision due to mild abrasions to both feet and cholla cactus spines stuck in its breast and foot; however, there was no evidence that the bird collided with the fence itself. There were two singed detections found along the unit fences, an injured common raven and a singed American kestrel feather spot. For the remaining 20 detections, including all four along the CLA fence, cause of death was unknown. Seven of these 20 detections were greater roadrunners; most roadrunner detections along fencelines have been of feather spots, suggesting predation as the cause of death.

Fatalities along fencelines are sufficiently low that continued monitoring is unlikely to reveal substantially new information regarding the effects of the Ivanpah facility on birds. Nevertheless, continued monitoring of fencelines in year 2 is recommended to comply with the Plan's requirements to monitor Project areas such as fencelines for two years.

3.5.1.4 Unit 3 Collector Line

Two detections were found under the Unit 3 collector line. Both showed evidence of collision with the line. The number of detections associated with the Unit 3 collector line was too low to allow for fatality modeling. Although these detections indicate that birds do occasionally collide with the Unit 3 collector line, the very low number of detections suggests that this feature poses a low level of fatality risk. As a result, continued monitoring of this feature is unlikely to reveal substantially new information regarding the effects of the Ivanpah facility on birds and further inform management decisions. Nevertheless, continued monitoring of the Unit 3 collector line in year 2 is recommended to comply with the Plan's requirements to monitor Project areas for two years.

3.5.1.5 Offsite Transects

There was only one detection, of an unknown cause of death, during surveys of all nine offsite transects. Continued surveys of these transects are unlikely to reveal substantially new information regarding the effects of the Ivanpah facility on birds and further inform management decisions. The area surveyed does not facilitate the collection of adequate samples, and avian species composition is not representative of what is observed within the heliostat fields. Nevertheless, continued monitoring of the offsite transects in year 2 is recommended to comply with the Plan's requirements to monitor these offsite transects for two years.

3.5.1.6 Other Areas

The remaining 11 avian detections were found incidentally on other Project lands, such as the CLA fence and along Colosseum Road. Of these 11, four showed evidence of collision with vehicles or Project buildings, and the remaining seven were of unknown cause. Although these detections indicate that birds do collide with vehicles and other Project structures on occasion, the low number of detections (too low to support fatality estimates) suggests that these features collectively pose a low level of fatality risk. As a result, continued monitoring of these features is unlikely to reveal substantially new information regarding the effects of the Ivanpah facility on birds and further inform management decisions. Nevertheless, incidental detections found in these areas will continue to be tallied and reported in year 2.

3.5.2 Bats

All 32 bats recorded as detections were found in the power blocks, most of them within or immediately adjacent to the ACC buildings. Ten bats (31.3%) were detected with evidence of effects from collisions, most likely with the ACC fan blades. Twelve bats (37.5%) were found in or near ACC buildings without evidence of singeing or collision injuries. Although the cause of death for these bats remains unknown, their

association with the ACC building indicates that the cause of death of these bats should be attributed to "other Project causes". The remaining nine (28.1%) bat fatalities and one injury had no obvious signs of sickness or injury, and the cause of their death cannot be determined.

Thirteen bats (40.6%) were in Unit 3, 11 (34.4%) were found in Unit 1, and eight (25.0%) were found in Unit 2. The mountains and hills directly north of Unit 3 provide potential roost habitat and are likely the source of many bats found on the Project site. As a result, on 10 September 2014, an ultrasonic bat deterrent, BD100 (Binary Acoustic Technology, Tucson, AZ), was installed in the ACC building of Unit 3. The bat deterrent emits high-frequency sounds that interfere with bats' echolocation and thus make the area less desirable as a foraging or roosting site. After the BD100 was installed, no bat fatalities were found for the duration of this reporting period in Unit 3. It should be noted that only two bat detections occurred at Units 1 and 2 between 10 September 2014 and the end of the reporting period, suggesting the possibility of a seasonal decrease in bat occurrence or activity during this time. Nevertheless, this sonic deterrence is expected to be effective at reducing bat activity, and we recommend the addition of such deterrence devices at Units 1 and 2.

3.6 Overall Assessment

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

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

Based on the first four seasons of monitoring, these standards were applied to both bats and birds as described below.

3.6.1 Birds

The effects of the avian mortality observed at Ivanpah during the first four seasons on local, regional, or national populations is described below, considering all bird species first, followed by an assessment focusing on special-status species.

3.6.1.1 Overall Birds

There were 703 avian detections represented by 83 different species during the first four seasons of monitoring. Based on the monitoring results, overall fatality estimates for this period were 1,492 (90% confidence intervals 1,046-2,371) from known causes (i.e., singeing, collisions, or entrapment within Project facilities) and 2,012 (90% confidence intervals 1,450-3,334) from unknown causes.

Of the 83 species recorded as detections, 64 were represented by fewer than 10 detections. All species represented by fewer than 10 detections have populations that are great enough locally (either as breeders, wintering birds, or migrants), regionally, and nationally that the loss of individuals indicated by the detected fatalities would have no substantive impact on populations at any of these geographic scales. Therefore, with the exception of special-status species (which are addressed in Section 3.6.1.2 below), these 64 species are not assessed further.

Table 25 below lists the 19 identified species with 10 or more detections. Fatality estimates were prepared by Project element (e.g., tower areas, inner and outer heliostat segments, Unit 3 collector line, and fenceline, and offsite transects) and were prepared separately for known and unknown causes. Fatality estimates could only be calculated when at least five detections of known or unknown cause, and that met other criteria such as the age of the detection relative to the survey interval and whether or not the detection occurred in a standardized survey area (as discussed in Appendix B), occurred within a given element. As a result, fatality estimates for individual species are provided in Table 25 only when at least five detections of a species, of known or unknown cause, occurred within one or more Project elements and could these detections be included in the fatality estimator. Numbers of detections included in the model are listed parenthetically next to total numbers of detections for clarity.

Of the 19 species with 10 or more detections, two are special-status species (yellow warbler and Vaux's swift, both state species of special concern) and thus are discussed in Section 3.6.1.2 below. None of the 17 other species represented by 10 or more detections is particularly rare locally, regionally, or nationally. Fifteen of these species, including the mourning dove (*Zenaida macroura*), yellow-rumped warbler, tree swallow (*Tachycineta bicolor*), black-throated sparrow, white-crowned sparrow (*Zonotrichia leucophrys*), horned lark, Costa's hummingbird (*Calypte costae*), house finch, Anna's hummingbird (*Calypte anna*), barn swallow (*Hirundo rustica*), American kestrel, rufous hummingbird (*Selasphorus rufus*), brown-headed cowbird (*Molothrus ater*), cliff swallow (*Petrochelidon pyrrhonota*), and lazuli bunting (*Passerina amoena*) are common to abundant species, and are fairly to extremely widespread species. Two others, the lesser nighthawk and greater roadrunner, have more limited

Table 25. Bird Species with 10 or More Detections, Year 1 Monitoring.

Common Name	Total Number of Detections	Number of Detections from Known Causes[1]	Number of Detections from Unknown Causes	Fatality Estimate from Known Causes (with Lower and Upper C.I.)[2]	Fatality Estimate from Unknown Causes (with Lower and Upper C.I.)[2]
Mourning Dove	98	19 (12)	79 (46)	118 (63 – 194)[3]	294 (184 – 458)[4]
Yellow-rumped Warbler	55	46 (27)	9	67 (31 – 125)[5]	n<5
Tree Swallow	21	19 (10)	2	24 (17 – 37)[6]	n<5
Black-throated Sparrow	20	12	8	n<5	n<5
Yellow Warbler	19	15 (11)	4	22 (11 – 38)[6]	n<5
White-crowned Sparrow	18	8	10	n<5	n<5
Horned Lark	17	4	13	n<5	n<5
Costa's Hummingbird	16	15 (8)	1	13 (9 – 19)[6]	n<5
House Finch	16	11 (5)	5	10 (5 – 23)[6]	n<5
Anna's Hummingbird	15	15 (9)	0	28 (13 – 65)[6]	n<5
Barn Swallow	14	13 (11)	1	30 (11 – 61)[5]	n<5
Greater Roadrunner	14	1	13 (5)	n<5	15 (7 – 28)[7]
American Kestrel	14	6 (5)	8	10 (5 – 20)[8]	n<5
Rufous Hummingbird	13	10	3	n<5	n<5
Brown-headed Cowbird	11	4	7	n<5	n<5
Lesser Nighthawk	11	4	7	n<5	n<5
Vaux's Swift	11	11 (5)	0	18 (5 – 46)[8]	n<5
Cliff Swallow	10	10	0	n<5	n<5
Lazuli Bunting	10	10 (5)	0	9 (5 – 18)[6]	n<5

[1] Known causes include singeing, collision, or entrapment within Project structures Numbers in parentheses represent the number of detections meeting the criteria for inclusion in the fatality estimator (see H. T. Harvey & Associates 2014b for details on inclusion criteria).

[2] n<5 indicates that the sample size for known or unknown causes within any individual Project component was insufficient (i.e., less than five detections) to produce a fatality estimate. Estimates are only provided for those Project components with at least five detections meeting the criteria for inclusion in the fatality estimator.

[3] Estimate for the inner and outer heliostat segments only.

[4] Estimate for the inner and outer heliostat segments and inner HD area only.

[5] Estimate for the power blocks and inner HD area only.
[6] Estimate for the power blocks only.
[7] Estimate for the fenceline area only.
[8] Estimate for the inner HD area only.

breeding distributions but are still numerous within their breeding ranges and occur in large numbers in southeastern California.

Even considering the site-wide fatality estimates for individual species listed in Table 25, the number of individuals of any given species that were recorded as detections, or that were estimated to have died, during the first four seasons of monitoring represents a minimal proportion of local, regional, or national populations. For example, the fatality estimates for the species recorded most frequently as a detection, the mourning dove, produced estimates of 118 (90% confidence intervals 63 – 194) from known causes in the heliostat segments (the only Project component with sufficient detections of known cause to produce an estimate) and 294 (90% confidence intervals 184 – 458) from unknown causes in the heliostat segments and inner HD areas (the only Project component with sufficient detections of unknown cause to produce an estimate). Given the species' North American population of approximately 349 million and annual take by hunters of nearly 14.5 million (Seamans et al. 2013), the loss of mourning doves at Ivanpah represents a very small proportion of the population. Considering the much lower fatality estimates for the other species in Table 25, the magnitude of the fatality of these species at Ivanpah for the first four seasons of monitoring does not rise above the "low" category. Furthermore, the cause of death for 42.2% of the detections of species listed in Table 25 was unknown and thus cannot be determined with certainty to have been "facility-caused", which is the standard cited in Section 5.3 of the Plan.

3.6.1.2 Special-Status Species

Of the 703 avian detections reported, 47 of the detections were of special-status species (Table 26). Five were bank swallows, which are State-listed as threatened. The remainder consisted of California species of special concern, which included 19 yellow warblers, 11 Vaux's swifts, six loggerhead shrikes, three olive-sided flycatchers, and single Lucy's warbler, yellow-breasted chat, and yellow-headed blackbird. Loggerhead shrikes breed in the vicinity of the site, but all the other special-status species recorded as detections are transients that breed elsewhere.

Table 26. Special-Status Bird Detections, Year 1 Monitoring.

Common Name	Total Number of Detections	Number of Detections from Known Causes[1]	Number of Detections from Unknown Causes
Yellow Warbler	19	15	4
Vaux's Swift	11	11	0
Loggerhead Shrike	6	1	5
Bank Swallow	5	5	0
Olive-sided Flycatcher	3	1	2
Lucy's Warbler	1	1	0
Yellow-breasted Chat	1	0	1
Yellow-headed Blackbird	1	0	1

[1] Known causes include singeing, collision, or entrapment within Project structures.

Singeing was evident on all five bank swallows, all 11 Vaux's swifts, 14 of the yellow warblers, one of the olive-sided flycatcher, and the single Lucy's warbler. One loggerhead shrike and one yellow warbler showed evidence of collision with a heliostat. The cause of death of the remaining special-status birds (five loggerhead shrikes, four yellow warblers, two olive-sided flycatchers, one yellow-breasted chat, and one yellow-headed blackbird) was unknown.

The only species in Table 26 for which sample size within a given Project component was adequate to produce a fatality estimate were Vaux's swift and yellow warbler; fatality estimates within the applicable Project components for these species are provided in Table 25.

Yellow warblers are one of the most abundant warblers in North America and occur as both migrants and summer residents in California (Shuford and Gardali 2008). Yellow warblers occur in the Mojave Desert as common migrants, but they typically do not breed there. An estimated 600,000 yellow warblers occur within California and an estimated 34,000,000 occur in the United States (Partners in Flight Science Committee 2013). The 19 yellow warblers detected, with a fatality estimate in the power block (the only Project component with sufficient detections to produce an estimate) of 22 (90% confidence intervals 11 – 38), represented a very small proportion of these populations; thus, the yellow warbler fatalities at Ivanpah do not rise above the "low" category, as loss of this magnitude would have a minimal effect on populations at all geographic scales (local, regional, national or global).

Population size for the Vaux's swift in California is estimated at 30,000 birds and an estimated 340,000 occur in North America (Partners in Flight Science Committee 2013). The 11 Vaux's swift detections at Ivanpah, with a fatality estimate in the inner HD area (the only Project component with sufficient detections to produce an estimate) of 18 (90% confidence intervals 3 – 46), would have a minimal effect on populations at local regional (i.e. migrants moving through the Ivanpah Valley and surrounding region) to national or global levels. Thus, these fatalities do not rise above the "low" category.

The loggerhead shrike is common in desert habitats of California, despite its declines in other regions. The southeastern deserts represent one of the areas of highest abundance in the state (Humple 2008), and Breeding Bird Survey data indicate no significant population trends, or perhaps even a slight increase, in the Mojave Desert since the mid-1960s (Sauer et al. 2014). The North American population of this species is estimated at 2,900,000 birds (http://birds.audubon.org/species/logshr). The six detections recorded on the site, of which five were of unknown cause, indicates a low number of impacted individuals that would not substantially affect local, regional, or national populations of the species; thus the 2013-2014 fatalities do not rise above the "low" category.

Bank swallows are widespread breeders throughout the middle and northern latitudes of North America (Garrison 1999). The five bank swallow detections represented a very small proportion of the bank swallows expected to migrate through the Ivanpah area, heading to and from breeding sites as far north as Alaska and Canada. The North American population of this species is estimated at 13,800,000 birds

(http://birds.audubon.org/species/banswa), and the species is found throughout most of Europe and Asia as well, with a global population estimate of 46,000,000 individuals (http://birds.audubon.org/species/banswa). Thus, at scales from local/regional (i.e., migrants moving through the Ivanpah area and the surrounding region) to national to global, the bank swallow fatalities at Ivanpah do not rise above the "low" category, as loss of this magnitude would have a minimal effect on populations at any of these geographic scales.

Olive-sided flycatcher, Lucy's warbler, yellow-breasted chat, and yellow-headed blackbird are sufficiently abundant at all geographic scales that the loss indicated by the few detections noted during the first year's monitoring would have a minimal impact on local, regional, and national populations. Further, the cause of mortality of two olive-sided flycatchers, the yellow-breasted chat, and the yellow-headed blackbird was unknown. For both of these reasons, the few fatalities of these three California species of special concern that occurred at Ivanpah during the first four seasons of monitoring do not rise above the "low" category.

3.6.2 Bats

Monitoring results from the first four seasons of monitoring indicate that the potential bat mortality during this period would be categorized as low. In total, 32 bats representing six species were recorded as detections during the first four seasons of monitoring. The species representing the greatest percentage of bat detections (37.5%) was the California myotis, which is a widespread and common species. Only two other identified bat species, the canyon bat and Mexican free-tailed bat, had more than one detection, and both of these species are similarly common and widespread. Of the three bat species with only one detection, the only special-status species is the pallid bat, which is a California species of special concern due to declines in known roosts throughout California and its susceptibility to noise disturbance and human development. However, the pallid bat is sufficiently abundant and widespread that the one detection at Ivanpah of this California species of special concern would have a minimal effect on local, regional and statewide populations, and thus the Project's effects on this and the other detected bat species do not rise above the "low" category.

Section 4.0 Summary of Recommendations

Following is a summary of recommendations concerning monitoring and/or adaptive management at Ivanpah, based on the first four seasons of monitoring.

(1) Continuation of Plan implementation. Only four detections occurred along the CLA fenceline, 19 were along the unit fencelines, two were found along the Unit 3 collector line, and one was found along offsite transects. Given the very low numbers of detections associated with these areas, continued monitoring of these areas is unlikely to reveal substantially new information regarding the effects of the Ivanpah facility on birds.

Section 2.1.8 of the Plan indicates that fatality searches will be conducted at the power towers, heliostats, perimeter fences, Unit 3 collector line, and off-site transects for a minimum of two years. In accordance with the Plan, continued monitoring of these areas through year 2 is recommended. We also recommend that searcher efficiency and carcass persistence trials continue and the number of trials be increased in the second year to enable more refined estimates by season and/ or within project elements.

(2) Continuation of adaptive management. To investigate the means of reducing avian mortality, it is recommended that adaptive management continue in year 2. Monitoring data will be reviewed to determine the effectiveness of the BMPs currently being implemented, such as the BirdBuffer system at Unit 1, as well as those BMPs that are proposed to be implemented, such as the use of LED lighting, anti-perch devices on towers and sonic avian deterrent devices. Continued monitoring will further inform the effectiveness of these measures and may lead to modifications of existing measures, or adoptions of new measures over time through the adaptive management process.

(3) Full implementation of bat deterrence. As discussed in Section 2.3.3, ultrasonic bat deterrent devices installed in the ACC building of Unit 3 appears to have reduced bat fatalities, as no bat fatalities were found between its installation and the end of the first year's reporting period in Unit 3. As a result, we recommend the addition of such deterrence devices at Units 1 and 2 and the continued monitoring of the effectiveness of these units at reducing bat fatalities.

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Appendix A. Summary of Plan Modifications

The following few changes were made to the original methodology outlined in the Plan with the approval or at the request of the TAC. These modifications, which were implemented to improve effectiveness or efficiency of monitoring, are summarized in Table A-1.

Table A-1. TAC-Approved Modifications to the Monitoring Methodology Described in the Plan.

Approved Change	TAC Approval Date*
Revised search pattern for arc plots to enhance searcher efficiency	6 February 2014
Integration of canine searcher teams	20 May 2014
Relocation of three raptor and large bird survey points from the eastern fenceline to the east side of the tower berms for Units 1, 2, and 3	24 July 2014
Permission to take injured birds to Nevada	12 September 2014
Protocol for estimating searcher efficiency and accounting for detections in the power block area	12 September 2014

* Indicates the TAC meeting at which each change was approved.

Appendix B. Supporting Analysis for the First Four Season Fatality Estimate Summary

This appendix provides supporting detail for the four season fatality estimates provided in the body of the four season monitoring report. Specifically, this appendix provides details on model selection for carcass persistence rates; the detections that were included in fatality estimates by season and for the four seasons combined; and the fatality estimates. Although fatality estimates for individual seasons during the first four seasons of monitoring at Ivanpah were provided in the quarterly reports, these estimates have been recalculated for the four season report using four season carcass persistence rates and four season searcher efficiency rates by Project element (i.e., the power block versus the remaining Project elements where fatality monitoring was conducted. See H. T. Harvey & Associates 2014b for details of the searcher efficiency analysis, as the values used in this report are identical to the fall estimates. Following a discussion of model selection for carcass persistence rates, the fatality estimate sections are provided, first based on detections of known cause (i.e., singeing, collision, or entrapment within Project buildings) and then based on detections of unknown cause (without any evidence of singeing, collision, or entrapment). For a comprehensive discussion regarding the treatment of incidental detections see H. T. Harvey & Associates 2014b.

Model Selection for Carcass Persistence Rates

Carcass persistence trials were conducted throughout each of the first four seasons of monitoring (i.e., from winter 2013-2014 through fall 2014). Trials for both small and large carcasses were conducted in all seasons (Table B-1).

Table B-1. Number of Carcass Persistence Trials by Season and Carcass Size Used to Model Carcass Persistence for Fatality Estimation, Year 1 Monitoring.

	Number of Trials (with Median Carcass Persistence Time, in Days)		
Season	**Large Carcasses**	**Small Carcasses**	**Total**
Winter	7 (44.7)	14 (7.6)	21 (11.4)
Spring	3 (42.0)	15 (9.3)	18 (20.9)
Summer	11 (41.3)	15 (0.6)	26 (7.7)
Fall	10 (41.9)	13 (2.9)	23 (11.4)
Total	31 (42.0)	57 (4.8)	88 (20.1)

The fatality estimator requires a minimum of 10 carcass persistence trials for each category for which fatalities are estimated. Consequently, we were unable to separate carcass size and season simultaneously with the existing data, as sample size for large carcasses was too low during some seasons. However, surveyors have noted that scavenging was fairly consistent in winter and spring, increased mid-summer, then began to decline in mid-fall. We used these observations to define a set of candidate models that may reflect expected seasonal differences in carcass persistence. We evaluated seasonality in carcass persistence in the following ways:

1. Winter and spring combined, summer and fall separated (three seasons).
2. Winter and spring combined, summer and fall combined (two seasons).

3. All seasons combined. This acts as a null model and represents the lack of any seasonal effect.

Because we have noted a marked difference in carcass persistence between small and large carcasses, carcass size was included in all models, *a priori*. Additive and interaction carcass persistence models were constructed for these three seasonal definitions using Weibull, log-logistic, and log-normal curves, for a total of fifteen models (exponential performed poorly for all seasons, and was therefore not considered). AICc was used to evaluate the relative merit of the various combinations of seasonal definitions and carcass persistence curves, and to select the carcass persistence model that was used in the fatality estimator.

AIC results are presented in Table B-2. The model with the lowest AICc value is considered to be the best fit to the data among the candidate set of models, and models within approximately two AICc points from the top model ($\Delta AICc \leq 2$) are considered to have reasonable support. The most supported model was an additive log-logistic model with three seasonal categories (winter and spring combined, summer and fall separated), and this model was used for all fatality estimates presented in this report. The proportion of carcasses expected to persist through the mean search interval for each season is presented in Table B-3.

Table B-2. Results of Model Selection for Carcass Persistence Trials.

Distribution	Factors	Shape	AICc	ΔAICc
Weibull	Size	1.85	391.6	8.64
	Size + 2Seasons[1]	1.74	385.78	2.82
	Size + 3Seasons[2]	1.73	386.25	3.29
	Size x 2Seasons	1.73	387.3	4.34
	Size x 3Seasons	1.72	389.77	6.81
Log-logistic	Size	1.31	388.47	5.51
	Size + 2Seasons	1.23	383.7	0.74
	Size + 3Seasons	1.2	382.96	0
	Size x 2Seasons	1.21	384.93	1.97
	Size x 3Seasons	1.18	386.32	3.36
Log-normal	Size	2.28	388.56	5.6
	Size + 2Seasons	2.14	383.59	0.63
	Size + 3Seasons	2.1	383.24	0.28
	Size x 2Seasons	2.13	385.44	2.48
	Size x 3Seasons	2.09	387.41	4.45

[1] Winter is combined with spring to define one season, and summer is combined with fall to define the second season.

[2] Winter is combined with spring to define one season, and summer and fall remain separate to define the second and third seasons.

Table B-3. The Proportion of Small and Large Carcasses Expected to Persist through the Search Interval, from a Log-logistic Model with Three Seasons.*

	Proportion			
Size	**Winter**	**Spring**	**Summer**	**Fall**
Small	0.47	0.67	0.17	0.52
Large	0.97	0.99	0.87	0.98

*Winter and summer are based on 21-day search intervals, and spring and fall are based on 7-day search intervals.

Fatality Estimates Based on Detections of Known Causes

The following section describes the number of detections included in models estimating fatalities from known causes, which include singeing, collision, and entrapment within Project facilities. This section also includes summaries of the fatality estimates from known causes within each Project element by season.

Number of Detections of Known Causes Included in Models

Table B-4 summarizes the number of detections of known causes (i.e., singeing, collision, and entrapment within Project facilities) that were included in fatality estimate models. Detections found outside of areas covered by standardized surveys (except for detections found on the tower itself) and detections older than the search interval for the season in which they were found are excluded from the fatality estimator. Incidental detections found within surveyed areas, but outside of the power block, were included in the fatality estimator, and their survey interval was adjusted to equal the number of days between the date found and the previous standardized survey. Incidental detections found in the power block were assigned a one-day survey interval to reflect the high probability that Project personnel would see and report any highly visible fatality in these areas. Detections found within the ACC buildings, which are relatively closed systems, were excluded from the models, though they were added unadjusted to the fatality estimator output.

The fatality estimator requires that surveys begin with a "clean slate" by assuming that there are zero fatalities present within a surveyed area at the beginning of a survey interval. If detections found before or during clearance surveys are included in the estimate, this assumption would be violated. Therefore, detections found during clearance surveys and incidentals found before clearance surveys were not included in the fatality estimator, or added unadjusted; both of these circumstances occurred only in winter. The seasonal reports include more detail on issues regarding which detections are included or excluded from the models.

The three solar units became operational at different times during the winter 2013-2014 season, with Unit 1 becoming operational first, followed by Unit 3, and then Unit 2 (see H. T. Harvey & Associates 2014a for additional details). As a result, three subsets of modeling were performed for winter – one for Unit 1 prior to all three units becoming operational, one for Unit 3 prior to all three units becoming operational, and one for the entire site during the period in which all three units were operating.

Detections from individual Project elements in which there were fewer than five detections for an individual season were not included in the seasonal fatality modeling, but instead were added unadjusted to the fatality estimator output to yield seasonal totals. However, these detections were included in the four season estimates when the total (four season) number of detections for those Project elements was five or greater. As a result, the number of detections indicated as being included in or excluded from the four season model in Table B-4 (and in Table B-24 below for detections of unknown causes) differ in a few cases from analogous, but season-specific, information in the seasonal reports.

Table B-4. Number of Detections of Known Causes in Each Project Element and Season, and Number Included in Four season Fatality Estimates, Year 1 Monitoring.

		Number of Detections		
Season/Project Unit	**Element**	**Number Included**	**Number Excluded**	**Total Found**
Winter/Unit 1 prior to all three units becoming fully operational	Power Block	0	2[1]	2
	Inner HD	7	0	7
	Heliostats	0	3[2]	3
	Fenceline	0	0	0
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	0	0
	Offsite Transects	0	0	0
	Total	**7**	**5**	**12**
Winter/Unit 3 prior to all three units becoming fully operational	Power Block	0	2[3]	2
	Inner HD	0	0	0
	Heliostats	0	3[4]	3
	Fenceline	0	0	0
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	0	0
	Offsite Transects	0	0	0
	Total	**0**	**5**	**5**
Winter/all units after all three units fully operational	Power Block	8	3[5]	11
	Inner HD	3[6]	0	3
	Heliostats	2[6]	0	2

Season/Project Unit	Element	Number of Detections		
		Number Included	Number Excluded	Total Found
	Fenceline	0	2[1]	2
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	1[7]	1
	Offsite Transects	0	0	0
	Total	**13**	**6**	**19**
Spring/all units	Power Block	49	26[8]	75
	Inner HD	26	4[9]	30
	Heliostats	13	2[9]	15
	Fenceline	0	0	0
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	0	0
	Offsite Transects	0	0	0
	Total	**88**	**32**	**120**
Summer/all units	Power Block	13[10]	26[10,11]	39
	Inner HD	8	0	8
	Heliostats	3[6]	2[12]	5
	Fenceline	0	0	0
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	2[13]	2
	Offsite Transects	0	0	0
	Total	**24**	**30**	**54**
Fall/all units	Power Block	87	37[14]	124
	Inner HD	33	0	33
	Heliostats	27	8[15]	35
	Fenceline	0	0	0

Season/Project Unit	Element	Number of Detections		
		Number Included	Number Excluded	Total Found
	Unit 3 Collector Line	0	2[2]	2
	Other Project Areas	0	1[16]	1
	Offsite Transects	0	0	0
	Total	**147**	**48**	**195**

[1] One detection found in the ACC was added to the fatality estimator output unadjusted, and one detection found in the power block was determined to be older than the search interval.
[2] Estimates are not provided when there are fewer than five detections for a given category. These detections were added unadjusted to the estimator output for the four season totals.
[3] These two detections were found in the ACC building and added unadjusted to the fatality estimator output for the power block.
[4] One detection was determined to be older than the search interval, and for the two remaining observations, estimates are not provided when there are fewer than five detections for a given category.
[5] These three detections were found in the ACC buildings and added unadjusted to the fatality estimator output for the power block.
[6] Estimates are not provided when there are fewer than five detections for a given category; however, detections found after the full site became operational are included in the four season estimate.
[7] This detection was found in an unsurveyed area of the heliostats.
[8] 23 were found in the ACC and added unadjusted to the fatality estimator output for the power block, and three were determined to be older than the search interval.
[9] These detections were determined to be older than the search interval.
[10] The summer seasonal report stated that 14 detections of known cause were included and 25 were excluded; this has been corrected for this four season report because one of the detections previously included as a power block detection (2014-317-ISEGS) was actually found in the ACC building.
[11] 25 were found in the ACC building and added unadjusted to the fatality estimator output for the power block, and one was determined to be older than the search interval.
[12] These two detections were outside of surveyed areas.
[13] One was found on Colosseum Road and one was found in the Heliostats Assembly Building area.
[14] 33 were found in the ACC building and added unadjusted to the fatality estimator output for the power block, and four were determined to be older than the search interval.
[15] Four were determined to be older than the search interval, and four were outside of surveyed areas.
[16] This detection was found on Colosseum Road.

Fatality Estimates from Known Causes

Detections from individual Project elements in which there were fewer than five detections for an individual season were not included in the seasonal fatality modeling, but instead were added unadjusted to the fatality estimator output to yield seasonal totals. After all three solar units were fully operational, those detections were included in the estimator for four season totals if there were more than five detections for the whole year within that Project element. In the following sections, detections that were not included in seasonal fatality estimate modeling, but that were included in the four season fatality estimate modeling, are presented in italics, and are not included in totals for the "number of detections included in model" column for the seasonal summaries.

Winter 2013-2014 Fatality Estimates from Known Causes

Tables B-6 through B-10 provide fatality estimates based on detections of known causes for the winter season. Table B-6 summarizes site-wide fatality estimates for known causes for the winter season, while

Tables B-7, B-8, B-9, and B-10 provide fatality estimates for the power block, inner HD area, inner and outer heliostat segments, and fenceline, respectively.

Table B-6. Site-Wide Fatality Estimates Based on Total Detections from Known Causes, 29 October 2013 – 22 March 2014.

Unit/Operational Status	Project Element	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Tower Area	7[1]	24 (16 – 39)[1,2]
	Heliostat Area	0[3]	NA[4]
	Fenceline	0	NA
Unit 3 prior to all three units being fully operational	Tower Area	0[5]	NA
	Heliostat Area	0[6]	NA[4]
	Fenceline	0	NA
All Units after all three units fully operational	Tower Area	8[7]	19 (14 – 25)[7]
	Heliostat Area	*2*[8]	NA[4]
	Fenceline	0[9]	NA[4]
	Total	**15**	**54** (41 – 75)[10]

[1] One detection in the ACC building was not included in the number of detections included in the model but was added unadjusted to the fatality estimator output for power block winter and four season estimates.
[2] The tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort.
[3] There were three detections of known cause of death in the heliostats, but because there were fewer than five there is no estimate provided. These detections were added unadjusted to the fatality estimator output for both winter and four season estimates.
[4] NA = not applicable because there were fewer than five detections within that group.
[5] Two detections from the ACC building were not included in the number of detections included in the model, but they were added unadjusted to the fatality estimator output for power block winter and four season estimates.
[6] There were two detections of known cause of death in the heliostats, but because there were fewer than five, no estimate is provided. These detections were added unadjusted to the fatality estimator output for both winter and four season estimates.
[7] Three detections from the inner high-density heliostats were added unadjusted to the fatality estimator output for winter, but included in the fatality estimator for the four season total. Three detections found in ACC buildings were not included in the model, but were added unadjusted to the fatality estimator output for power block winter and four season estimates.
[8] Added unadjusted to the fatality estimator output for winter, but included in the fatality estimator for the four season total.
[9] There were two detections from the fenceline with known cause of death, but because there were fewer than five, there is no estimate provided. These detections were added unadjusted to the fatality estimator output for both winter and four season estimates.
[10] Includes all the detections indicated by previous footnotes as being added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-7. Estimates by Cause (a.) and Size Class (b.) of Total Detections from Known Causes Based on Fatality Searches in Power Blocks, 29 October 2013 – 22 March 2014.

B-7a. Estimates by Cause

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Singeing	0	NA
	Collision	0	NA
	Other[1]	0[2]	NA[3]
Unit 3 prior to all three units being fully operational	Singeing	0[2]	NA[3]
	Collision	0	NA
	Other[1]	0[2]	NA[3]
All Units after all three units fully operational	Singeing	8[4]	16 (11 – 22)[4]
	Collision	0	NA
	Other[1]	0	NA
	Total	**8**[5]	**19** (14 – 25)[6]

[1] Detections found in the ACC buildings without evidence of singeing or collision effects are considered detections from "other Project causes".
[2] For each case in which this footnote is applied, a single detection from the ACC building was not included in the number of detections included in the model, but it was added unadjusted to the estimator output for power block winter and four season estimates.
[3] NA = not applicable because there were fewer than five detections within that group.
[4] Three detections from the ACC buildings were not included in the number of detections included in the model, but they were added unadjusted to the fatality estimator output for power block winter and four season estimates.
[5] Six detections from the ACC buildings are not included in the number of detections included in the model, but they were added unadjusted to the fatality estimator output for the power block winter and four season estimates.
[7] Includes all the detections indicated by previous footnotes as being added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

B-7b. Estimates by Size Class

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0[1]	NA[2]
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0[3]	NA
All Units after all three units fully operational	Large Bird	1	NA[2]
	Raptor	0	NA
	Small Bird	7[4]	16 (12 – 24)[4]
	Total	**8**[1,3,4]	**19** (14 – 25)[5]

[1] One detection in the ACC building was not included in the number of detections included in the model, but it was added unadjusted to the fatality estimator output for power block winter and four season estimates.
[2] NA = not applicable because there were fewer than five detections within that group.
[3] Two detections in the ACC building were not included in the number of detections included in the model, but they were added unadjusted to the fatality estimator output for power block winter and four season estimates.
[4] The three detections of small birds in the ACC buildings are not included in the number of detections included in the model, but they were added unadjusted to the fatality estimator output for power block winter and four season estimates.
[5] Includes all the detections indicated by previous footnotes as being added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-8. Estimates by Cause (a.) and Size Class (b.) of Total Detections from Known Causes Based on Fatality Searches in Inner HD Heliostats, 29 October 2013 – 22 March 2014.

B-8a. Estimates by Cause

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Singeing	6	19 (12 – 34)
	Collision	1	NA[1]
Unit 3 prior to all three units being fully operational	Singeing	0	NA
	Collision	0	NA
All Units after all three units fully operational	Singeing	*3*[2]	NA[1]
	Collision	0	NA
	Total	**7**	**26** (18 – 41)[3]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Added unadjusted to the fatality estimator output for winter, but included in the fatality estimator for the four season total.
[3] Includes three detections added unadjusted per footnote 2. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

B-8b. Estimates by Size Class

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	3	NA[1]
	Raptor	0	NA
	Small Bird	4	NA[1]
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	0	NA
	Raptor[2]	*1*[3]	NA[1]
	Small Bird	*2*[3]	NA[1]
	Total	**7**	**26** (18 – 41)[4]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table; therefore, the "large bird" and "raptor" detections should be summed to determine the total number of "large bird" detections.
[3] Added unadjusted to the fatality estimator output for winter, but included in the fatality estimator for the four season total.
[4] Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-9. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes Based on Fatality Searches in the Heliostat Area, 29 October 2013 – 22 March 2014.

B-9a. Estimates by Cause

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Singeing	0	NA
	Collision	0	NA[1,2]
Unit 3 prior to all three units being fully operational	Singeing	0	NA
	Collision	0	NA[1,3]
All Units after all three units fully operational	Singeing	0	NA
	Collision	*2*[4]	NA[1,4]
	Total	**0**	**NA**[1]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Three detections from this category were added unadjusted to the fatality estimator output for the four season total.
[3] Two detections from this category were added unadjusted to the fatality estimator output for the four season total.
[4] These two detections were included in the fatality estimator for the four season total.

B-9b. Estimates by Size Class

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0	NA[1,2]
	Raptor	0	NA
	Small Bird	0	NA[1,3]
Unit 3 prior to all three units being fully operational	Large Bird	0	NA[1,4]
	Raptor	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	*1*[5]	NA[1]
	Raptor	0	NA
	Small Bird	*1*[6]	NA[1]
	Total	**0**	**NA**[1]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] One detection from this category was added unadjusted to the total estimate.
[3] Two detections from this category were added unadjusted to the four season total estimate.
[4] Two detections from this category were added unadjusted to the four season total estimate.
[5] This detection was included in the fatality estimator for the four season total.
[6] This detection was included in the fatality estimator for the four season total.

Table B-10. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes Based on Fatality Searches Along Fencelines, 29 October 2013 – 22 March 2014.

B-10a. Estimates by Cause

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Singeing	0	NA
	Collision	0	NA
Unit 3 prior to all three units being fully operational	Singeing	0	NA
	Collision	0	NA
All Units after all three units fully operational	Singeing	0[1]	NA[2]
	Collision	0	NA
	Total	0[1]	**NA**[2]

[1] Two detections found on the Unit 1 fenceline were added unadjusted to the fatality estimator output for the winter and four season totals for the entire facility.
[2] NA = not applicable because there were fewer than five detections within that group.

B-10b. Estimates by Size Class

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	0[1]	NA[2]
	Raptor	0	NA
	Small Bird	0	NA
	Total	0[1]	**NA**[2]

[1] Two detections found on the Unit 1 fenceline were added unadjusted to the fatality estimator output for the winter and four season totals for the entire facility.
[2] NA = not applicable because there were fewer than five detections within that group.

Spring 2014 Fatality Estimates from Known Causes

Tables B-11 through B-14 provide fatality estimates based on detections of known causes for the spring season. Table B-11 summarizes site-wide fatality estimates for known causes for the spring season, while Tables B-12, B-13, and B-14 provide fatality estimates for the power block, inner HD area, and inner and outer heliostat segments, respectively.

Table B-11. Site-Wide Fatality Estimates Based on Total Detections from Known Causes, 23 March – 22 May 2014.

Project Element	Number of Detections Included in Model	Estimate of Site-Wide Detections (with Lower and Upper C.I.)
Tower Area	75[1]	181 (139 – 256)[2]
Heliostat Area	13	192 (101 – 347)
Fenceline	0	NA
Total	**88**[1]	**373** (240 – 603)[2]

[1] The 23 detections in the ACC buildings are not included in the number of detections for the model for the tower area (or the overall model) because they were added to the fatality estimator output unadjusted.
[2] Note that the tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort. The fatality estimates, both overall and for the tower area, include the 23 detections in the ACC units, which were added unadjusted to the fatality estimator results.

Table B-12. Estimates by Cause (a.) and Size Class (b.) of Total Detections from Known Causes Based on Fatality Searches in Power Blocks, 23 March – 22 May 2014.

B-12a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	48[1]	106 (86 – 145)[1]
Collision	1	NA[2]
Other[3]	0	5 (5 – 5)[4]
Total	**49**[5]	**113** (92 – 151)[6]

[1] The 18 singed detections in the ACC buildings are not included in the number of detections included in the model but were added unadjusted to the singed fatality estimates.
[2] NA = not applicable because there were fewer than five detections within that group.
[3] Five detections found in the ACC buildings without evidence of singeing or collision effects are considered detections from "other Project causes".
[4] The five detections from "other Project causes" in the ACC buildings are included unadjusted in the fatality estimates for "unknowns".
[5] The 23 detections in the ACC buildings are not included in the number of detections included in the model.
[6] Includes all the detections indicated by previous footnotes as being added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

B-12b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1[1]	NA[2]
Raptor[3]	1	NA[2]
Small Bird	47[4]	109 (87 – 148)[4]
Total	**49**[5]	**113** (92 – 151)[6]

[1] The large bird detection in the ACC buildings is not included in the number of detections included in the model.
[2] NA = not applicable because there were fewer than five detections within that group.
[3] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table; therefore, the "large bird" and "raptor" detections should be summed to determine the total number of "large bird" detections.
[4] The 22 detections of small birds in the ACC buildings are not reported in the number of detections included in the model but were added unadjusted to the small bird fatality estimates.
[5] The 23 detections in the ACC buildings are not included in the number of detections included in the model.
[6] The fatality estimate includes the 23 detections in the ACC units, which were added unadjusted to the fatality estimator results. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-13. Estimates by Cause (a.) and Size Class (b.) of Total Detections from Known Causes Based on Fatality Searches in Inner HD Heliostats, 23 March – 22 May 2014.

B-13a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	24	63 (42 – 101)
Collision	2	NA[1]
Total	**26**	**68** (47 – 105)[2]

[1]NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

B-13b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	0	NA[1]
Raptor[2]	2	NA[1]
Small Bird	24	64 (40 – 105)
Total	**26**	**68** (47 – 105)[3]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table; therefore, the "large bird" and "raptor" detections should be summed to determine the total number of "large bird" detections.
[3] Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-14. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes Within the Heliostat Area, 23 March – 22 May 2014.

B-14a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	3	NA[1]
Collision	10	156 (77 – 288)
Total	**13**	**192** (101 – 347)[2]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

B-14b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1	NA[1]
Raptor[2]	1	NA
Small Bird	11	174 (76 – 347)
Total	**13**	**192** (101 – 347)[3]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table; therefore, the "large bird" and "raptor" detections should be summed to determine the total number of "large bird" detections.
[3] Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Summer 2014 Fatality Estimates from Known Causes

Tables B-15 through B-18 provide fatality estimates based on detections of known causes for the summer season. Table B-15 summarizes site-wide fatality estimates for known causes for the summer season, while Tables B-16, B-17, and B-18 provide fatality estimates for the power blocks, inner HD areas, and inner and outer heliostat segments, respectively.

Table B-15. Site-Wide Fatality Estimates Based on Total Detections from Known Causes, 23 May – 17 August 2014.

Project Element	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Tower Area	21[1]	151 (91 – 301)[1,2]
Heliostat Area	3[3]	NA[4]
Fenceline	0	NA
Total	**21**[1]	**154** (94 – 304)[5]

[1] The 25 detections in the ACC buildings are not included in the number of detections included in the model for the tower area (or the overall model) because they were added to the fatality estimator output unadjusted.
[2] Note that the tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort.
[3] Added unadjusted to the fatality estimator output for summer, but included in the fatality estimator for the four season total.
[4] NA = not applicable because there were fewer than five detections within that group.
[5] Includes 25 detections from the ACC buildings and three detections from the heliostat area, which were added unadjusted.

Table B-16. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes Based on Fatality Searches in Power Blocks, 23 May – 17 August 2014.

B-16a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	12[1]	78 (53 – 136)[1]
Collision	1[2]	NA[3]
Other	0[4]	NA[3]
Total	**13[5]**	**84** (61 – 143)[6]

[1] The 22 detections in the ACC buildings with evidence of singeing are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[2] One collision-related detection in an ACC building was not included in the number of detections included in the model but was added unadjusted to the fatality estimator results.
[3] NA = not applicable because there were fewer than five detections within that group.
[4] Two detections found in the ACC buildings without evidence of singeing or collision effects are considered detections from "other Project causes"; they were not included in the model because there were fewer than five detections, but they were added unadjusted to the fatality estimator results.
[5] The 25 detections in the ACC buildings are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[6] Totals do not reflect the sum of individual estimates because of "NA" values less than five. The fatality estimate includes the 25 facility-related detections in the ACC buildings, which were added unadjusted to the fatality estimator results.

B-16b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	0	NA
Raptor	0	NA
Small Bird	13[1]	84 (61 – 143)[2]
Total	**13[1]**	**84** (61 – 143)[2]

[1] The 25 detections in the ACC buildings (all small birds) are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[2] Includes 25 detections in the ACC buildings, which were added unadjusted.

Table B-17. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes Based on Fatality Searches in Inner HD Heliostats, 23 May – 17 August 2014.

B-17a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	7	58 (26 – 138)
Collision	1	NA[1]
Total	**8**	**67** (30 – 158)[2]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

B-17b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1	NA[1]
Raptor	0	NA
Small Bird	7	66 (31 – 170)
Total	**8**	**67** (30 – 158)[3]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

Table B-18. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes for the Heliostat Area, 23 May – 17 August 2014.

B-18a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	0	NA
Collision	*3*[1]	NA[2]
Total	**0**	**NA**[2]

[1] Added unadjusted to the fatality estimator output for summer, but included in the fatality estimator for the four season total.
[2] NA = not applicable because there were fewer than five detections within that group. However these detections were included in the four season estimate.

B-18b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	*1*[1]	NA[2]
Raptor	0	NA
Small Bird	*2*[1]	NA[2]
Total	**0**	**NA**[12]

[1] Added unadjusted to the fatality estimator output for summer, but included in the fatality estimator for the four season total.
[2] NA = not applicable because there were fewer than five detections within that group. However these detections were included in the four season estimate.

Fall 2014 Fatality Estimates from Known Causes

Tables B-19 through B-23 provide fatality estimates based on detections of known causes for the fall season. Table B-19 summarizes site-wide fatality estimates for known causes for the fall season, while Tables B-20, B-21, B-22, and B-23 provide fatality estimates for the power blocks, inner HD areas, inner and outer heliostat segments, and Unit 3 collector line, respectively.

Table B-19. Site-Wide Fatality Estimates Based on Total Detections from Known Causes, 18 August – 20 October 2014.

Project Element	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Tower Area	120[1]	355 (194 – 637)[1,2]
Heliostat Area	27	443 (281 – 754)
Fenceline	0	NA
Unit 3 Collector Line	0[3]	NA[4]
Total	**147**[1]	**800** (477 – 1393)[5]

[1] The 33 detections in the ACC buildings are not included in the number of detections included in the model for the tower area (or the overall model) because they were added to the fatality estimator output unadjusted.
[2] The tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort.
[3] The two detections along the Unit 3 collector line are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[4] NA = not applicable because there were fewer than five detections within that group.
[5] The overall fatality estimates include the 33 detections in the ACC buildings and two found along the Unit 3 collector line, which were added unadjusted to the fatality estimator results. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-20. Estimates by Cause (a.) and Size Class (b.) of Total Detections from Known Causes Based on Fatality Searches in Power Blocks, 18 August – 20 October 2014.

B-20a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	87[1]	239 (152 – 381)[1]
Collision	0[2]	NA[3]
Other	0[4]	NA[3]
Total	**87**[5]	**243** (156 – 385)[6]

[1] The 29 singed detections in the ACC buildings are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[2] One collision-related detection in an ACC building was not included in the number of detections included in the model, but it was added to the fatality estimator output unadjusted.
[3] NA = not applicable because there were fewer than five detections within that group.
[4] Three detections found in the ACC buildings without evidence of singeing or collision effects are considered detections from "other Project causes"; they were not included in the model, but they were added unadjusted to the fatality estimator results.
[5] The 33 detections in the ACC buildings are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[6] The fatality estimate includes the 33 detections in the ACC buildings, which were added unadjusted to the fatality estimator results. Totals do not reflect the sum of individual estimates because of "NA" values less than five.

B-20b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1[1]	NA[2]
Raptor[3]	2	NA[2]
Small Bird	84[4]	238 (155 – 377)[4]
Total	**87**[5]	**243** (156 – 385)[6]

[1] One large bird detection in the ACC buildings was not included in the number of detections included in the model, but it was added to the fatality estimator output unadjusted.
[2] NA = not applicable because there were fewer than five detections within that group.
[3] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table.
[4] The 32 small bird detections in the ACC buildings are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[5] The 33 detections in the ACC buildings are not included in the number of detections included in the model, but they were added to the fatality estimator output unadjusted.
[6] The fatality estimate includes the 33 detections in the ACC buildings, which were added unadjusted to the fatality estimator results.
Totals do not reflect the sum of individual estimates because of "NA" values less than five.

Table B-21. Estimates by Cause (a.) and Size Class (b.) of Total Detections from Known Causes Based on Fatality Searches in Inner HD Heliostats, 18 August – 20 October 2014.

B-21a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	27	96 (27 – 224)
Collision	6	17 (7 – 31)
Total	**33**	**112** (38 – 252)

B-21b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	2	NA[1]
Raptor[2]	2	NA[1]
Small Bird	29	106 (30 – 243)
Total	**33**	**112** (38 – 252)[3]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table.
[3] Totals do not reflect the sum of individual estimates because of "NA" values less than five.

Table B-22. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes within the Heliostat Area, 18 August – 20 October 2014.

B-22a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	0	NA
Collision	27	443 (281 – 754)
Total	**27**	**443** (281 – 754)

B-22b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	9	78 (41 – 138)
Raptor	0	NA
Small Bird	18	365 (197 – 676)
Total	**27**	**443** (281 – 754)[1]

[1] Totals do not reflect the sum of individual estimates because of inherent properties of the bootstrap process.

Table B-23. Estimates by Cause (a.) and Size Class (b.) of Detections from Known Causes Based on Fatality Searches on the Unit 3 Collector Line, 18 August – 20 October 2014.

B-23a. Estimates by Cause

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Singeing	0	NA
Collision	0[1]	NA[2]
Total	0[1]	NA[2]

[1] Two detections found along the Unit 3 Collector Line were added to the fatality estimator output for the fall and four season totals for the entire facility.
[2] NA = not applicable because there were fewer than five detections within that group.

B-23b. Estimates by Size Class

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	0	NA
Raptor	0	NA
Small Bird	0[1]	NA[2]
Total	0[1]	NA[2]

[1] Two detections found along the Unit 3 Collector Line were added to the fatality estimator output for the fall and four season totals for the entire facility.
[2] NA = not applicable because there were fewer than five detections within that group.

Fatality Estimates Based on Detections of Unknown Causes

The following section describes the number of detections included in models estimating fatalities from unknown causes (i.e., for which there was no evidence of include singeing, collision, or entrapment within Project facilities). This section also includes summaries of the fatality estimates based on detections of unknown causes within each Project element by season.

Number of Detections of Unknown Causes Included in Models

Table B-24 summarizes the number of detections of unknown causes that were included in these models.

Table B-24. Number of Detections of Unknown Causes in Each Project Element and Season, and Number Included in Four Season Fatality Estimates, Year 1 Monitoring.

		Number of Detections		
Season/Project Unit	**Element**	**Number Included**	**Number Excluded**	**Total Found**
Winter/Unit 1 prior to all three units being fully operational	Power Block	0	1[1]	1
	Inner HD	0	0	0
	Heliostats	0	2[1]	2
	Fenceline	0	2[1]	2
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	0	0
	Offsite Transects	0	0	0
	Total	**0**	**5**	**5**
Winter/Unit 3 prior to all three units being fully operational	Power block	0	0	0
	Inner HD	0	0	0
	Heliostats	0	0	0
	Fenceline	0	0	0
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	0	0
	Offsite Transects	0	0	0
	Total	**0**	**0**	**0**
Winter/all units after all three units fully operational	Power Block	2[1]	0	2
	Inner HD	5	0	5
	Heliostats	8	6[2]	14
	Fenceline	0	0	0
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	1[3]	1
	Offsite Transects	0	0	0
	Total	**15**	**7**	**22**
Spring all units	Power Block	7	2[2]	9
	Inner HD	20	7[2]	27
	Heliostats	27	12[2]	39
	Fenceline	3[1]	0	3
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	3	3
	Offsite Transects	0	1[1]	1

Season/Project Unit	Element	Number of Detections		
		Number Included	Number Excluded	Total Found
	Total	**57**	**25**	**82**
Summer all units	Power Block	5	0	5
	Inner HD	11	3[4]	14
	Heliostats	19	16[5]	35
	Fenceline	4[1]	2[2]	6
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	1[6]	1
	Offsite Transects	0	0	0
	Total	**39**	**22**	**61**
Fall all units	Power Block	10	2[7]	12
	Inner HD	24	0	24
	Heliostats	28	20[8]	48
	Fenceline	9	0	9
	Unit 3 Collector Line	0	0	0
	Other Project Areas	0	1	1
	Offsite Transects	0	0	0
	Total	**71**	**23**	**94**

[1] Estimates are not provided when there are fewer than five detections for a given group; however, detections found after the full site became operational are included in the four season estimate.
[2] Determined to be older than the search interval.
[3] Found in tortoise holding pens.
[4] One was a feather spot of unknown species and unknown size that was added unadjusted to the fatality estimator output, and two were determined to be older than the search interval.
[5] Eight were determined to be older than the search interval, and eight were outside the search areas.
[6] Found on Colosseum Road.
[7] One was determined to be older than the search interval, and one of unknown size was added unadjusted to the fatality estimator output.
[8] Twelve determined to be older than the search interval, and nine were found outside of survey plots.

Fatality Estimates from Unknown Causes

Detections from individual Project elements in which there were fewer than five detections for an individual season were not included in the seasonal fatality modeling, but instead were added unadjusted to the fatality estimator output to yield seasonal totals. After the facility was fully operational (all three units were operational), those detections were included in the estimator for four season totals if there were more than five detections for the whole year within that Project element. In the following sections, detections that were not included in seasonal fatality estimate modeling, but that were included in the four season fatality estimate modeling, are presented in italics, and are not included in the "number of detections included in model" column for the seasonal summaries.

Winter 2013-2014 Fatality Estimates from Unknown Causes

Tables B-25 through B-29 provide fatality estimates based on detections of unknown causes for the winter season. Table B-25 summarizes site-wide fatality estimates for unknown causes for the winter season, while Tables B-26, B-27, B-28, and B-29 provide fatality estimates for the power block, inner HD area, inner and outer heliostat segments, and fenceline, respectively.

Table B-25. Site-Wide Fatality Estimates Based on Detections from Unknown Causes, 29 October 2013 – 22 March 2014.

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Tower Area	0[1]	NA[2]
	Heliostat Area	0[3]	NA[2]
	Fencelines	0[4]	NA[2]
Unit 3 prior to all three units being fully operational	Tower Area	0	NA
	Heliostat Area	0	NA
	Fencelines	0	NA
All Units after all three units fully operational	Tower Area	7[5]	21 (8 – 41)
	Heliostat Area	8	120 (47 – 246)
	Fencelines	0	NA
	Total	**13**	**146** (60 – 292)[6]

[1] One detection of unknown cause of death from the power block was not included in the estimator due to low sample size, but was added unadjusted to the fatality estimator output.
[2] Estimates are not provided when there are fewer than five detections for a given group.
[3] Two detections of unknown cause of death from the heliostats were not included in the estimator due to low sample size but were added unadjusted to the fatality estimator output.
[4] Two detections of unknown cause of death from the fenceline were not included in the estimator due to low sample size, but were added unadjusted to the fatality estimator output.
[5] Two of these seven detections in the tower area were not included in the winter model, but rather were added unadjusted to the fatality estimator output for winter; however, they were included in the fatality estimator for the four season total.
[6] Includes all the detections indicated by previous footnotes as being added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-26. Power Block Fatality Estimates Based on Detections from Unknown Causes, 29 October 2013 – 22 March 2014.

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0[1]	NA[1,2]
	Raptor	0	NA
	Small Bird	0	NA
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	*1*[3]	NA[2]
	Raptor	0	NA
	Small Bird	*1*[3]	NA[2]
	Total	**0**	**NA**

[1] One large bird detection was added to the fatality estimator output unadjusted.
[2] Estimates are not provided when there are fewer than five detections for a given group.
[3] This detection was included in the fatality estimator for the four season total.

Table B-27. Inner HD Heliostats Fatality Estimates Based on Detections from Unknown Causes, 29 October 2013 – 22 March 2014.

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0	NA
	Raptor[1]	0	NA
	Small Bird	0	NA
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor[1]	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	1	NA[2]
	Raptor[1]	0	NA
	Small Bird	4	NA[2]
	Total	**5**	**19** (6 – 39)[3]

[1] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table; therefore, the "large bird" and "raptor" detections should be summed to determine the total number of "large bird" detections.
[2] Estimates are not provided when there are fewer than five detections for a given group.
[3] Totals do not reflect the sum of individual estimates because of "NA" values less than five

Table B-28. Heliostat Area Fatality Estimates Based on Detections from Unknown Causes, 29 October 2013 – 22 March 2014.

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0[1]	NA[2]
	Raptor	0	NA
	Small Bird	0[3]	NA[2]
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	6	72 (23 – 150)
	Raptor	0	NA
	Small Bird	2	NA[2]
	Total	**8**	**122** (49 – 248)[4]

[1] One large bird detection was added to the fatality estimator output unadjusted.
[2] Estimates are not provided when there are fewer than five detections for a given group.
[3] One small bird detection was added to the fatality estimator output unadjusted.
[4] Includes all the detections indicated by previous footnotes as being added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-29. Fenceline Fatality Estimates Based on Detections from Unknown Causes, 29 October 2013 – 22 March 2014.

Unit/Operational Status	Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Unit 1 prior to all three units being fully operational	Large Bird	0[1]	NA[2]
	Raptor	0	NA
	Small Bird	0	NA
Unit 3 prior to all three units being fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
All Units after all three units fully operational	Large Bird	0	NA
	Raptor	0	NA
	Small Bird	0	NA
	Total	**0**[1]	**NA**[2]

[1] Two large bird detections found on the Unit 1 fenceline were added unadjusted to the fatality estimator output for the winter and four season totals for the entire facility.
[2] NA = not applicable because there were fewer than five detections within that group.

Spring 2014 Fatality Estimates from Unknown Causes

Tables B-30 through B-4 provide fatality estimates based on detections of unknown causes for the spring season. Table B-30 summarizes site-wide fatality estimates for unknown causes for the spring season, while Tables B-31, B-32, B-33, and B-34 provide fatality estimates for the power block, inner HD area, inner and outer heliostat segments, and fenceline, respectively.

Table B-30. Site-Wide Fatality Estimates Based on Detections from Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Tower Area	27	67 (45 – 105)[1]
Heliostat Area	27	401 (263 – 646)
Fenceline	*3*[2]	NA[3]
Total	**54**	**471** (311 – 754)[4]

[1] Note that the tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort.
[2] Added unadjusted to the fatality estimator output for spring, but included in the fatality estimator for the four season total.
[3] NA = not applicable because there were fewer than five detections within that group.
[4] Includes three fenceline detections added unadjusted to the fatality estimator output for spring, but included in the fatality estimator for the four season total. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-31. Power Block Fatality Estimates Based on Detections from Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1	NA[1]
Raptor	0	NA
Small Bird	6	13 (7 – 20)
Total	**7**	**14** (7 – 22)[2]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-32. Inner HD Heliostats Fatality Estimates Based on Detections from Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	5	9 (5 –17)
Raptor	0	NA
Small Bird	15	44 (30 – 71)
Total	**20**	**53** (38 – 83)[1]

[1] Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-33. Heliostat Area Fatality Estimates Based on Detections from Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	11	108 (53 – 192)
Raptor	0	NA
Small Bird	16	294 (160 –557)
Total	**27**	**401** (263 – 646)[1]

[1] Totals do not reflect the sum of individual estimates because of inherent properties of the bootstrap process.

Table B-34. Fenceline Fatality Estimates Based on Detections from Unknown Causes, 23 March – 22 May 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	0	NA
Raptor	0	NA
Small Bird	*3*[1]	NA[2]
Total	**0**	**NA**

[1] These detections were included in the four season estimate.
[2] NA = not applicable because there were fewer than five detection within that group.

Summer 2014 Fatality Estimates from Unknown Causes

Tables B-35 through B-39 provide fatality estimates based on detections of unknown causes for the summer season. Table B-35 summarizes site-wide fatality estimates for unknown causes for the summer season, while Tables B-36, B-37, B-38, and B-39 provide fatality estimates for the power block, inner HD area, inner and outer heliostat segments, and fenceline, respectively.

Table B-35. Site-Wide Fatality Estimates Based on Detections from Unknown Causes, 23 May – 17 August 2014.

Type of Estimate	Number of Detections Included	Fatality Estimate (with Lower and Upper C.I.)
Tower Area	16[1]	98 (29 – 268)[2]
Heliostat Area	19	730 (370 – 1591)
Fenceline	*4*[3]	NA[4]
Total	**35**[1]	**832** (403 – 1863)[5]

[1] The number of detections does not include a feather spot of unknown size that was discovered in the inner HD heliostats; this detection was added unadjusted to the output of the fatality estimator.
[2] Note that the tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort. Includes one feather spot of unknown size that was added unadjusted to the fatality estimator output for the inner HD heliostats.
[3] Added unadjusted to the fatality estimator output for summer, but included in the fatality estimator for the four season total.
[4] NA = not applicable because there were fewer than five detections within that group.
[5] This estimate includes a feather spot of unknown size that was discovered in the inner HD heliostats and four fence line detections, all of which were added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-36. Power Block Fatality Estimates Based on Detections from Unknown Causes, 23 May – 17 August 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1	NA[1]
Raptor	0	NA
Small Bird	4	NA[1]
Total	**5**	**34** (5 – 105)

[1] NA = not applicable because there were fewer than five detections within that group.

Table B-37. Inner HD Heliostats Fatality Estimates Based on Detections from Unknown Causes, 23 May – 17 August 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	4	NA[1]
Raptor[2]	1	NA[1]
Small Bird	6	54 (20 – 145)
Total	**11**[3]	**64** (24 – 163)[4]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table; therefore, the "large bird" and "raptor" detections should be summed to determine the total number of "large bird" detections.
[3] The number of detections does not include a feather spot of unknown size.
[4] Estimate includes one detection that could not be assigned a size class, which was added unadjusted. Totals do not reflect the sum of individual estimates because of "NA" values less than five and inherent properties of the bootstrap process.

Table B-38. Heliostat Area Fatality Estimates Based on Detections from Unknown Causes, 23 May – 17 August 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	5	54 (17 – 114)
Raptor	0	NA
Small Bird	14	676 (316 – 1525)
Total	**19**	**730** (370 – 1591)

Table B-39. Fenceline Fatality Estimates Based on Detections from Unknown Causes, 23 May – 17 August 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	*3*[1]	NA[2]
Raptor	0	NA
Small Bird	*1*[3]	NA[2]
Total	[1]	NA[2]

[1] Two detections found along the Unit 3 fenceline and one found along the Unit 2 fenceline were added unadjusted to the fatality estimator output for the summer total for the entire facility and included in the fatality estimator for the four season total for both the fenceline and grand total.
[2] NA = not applicable because there were fewer than five detections within that group.
[3] One detection found along the fenceline was added unadjusted to the fatality estimator output for the summer total for the entire facility and included in the fatality estimator for the four season total for both the fenceline and grand total.

Fall 2014 Fatality Estimates from Unknown Causes

Tables B-40 through B-44 provide fatality estimates based on detections of unknown causes for the fall season. Table B-40 summarizes site-wide fatality estimates for unknown causes for the fall season, while Tables B-41, B-42, B-43, and B-44 provide fatality estimates for the power block, inner HD area, inner and outer heliostat segments, and fenceline, respectively.

Table B-40. Site-Wide Fatality Estimates Based on Detections from Unknown Causes, 18 August – 20 October 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Tower Area	34[1]	93 (47 – 174)[1,2]
Heliostat Area	28	413 (269 – 670)
Fenceline	9	29 (10 – 51)
Total	**71**[1]	**535** (326 – 895)[1]

[1] The number of detections does not include a feather spot of unknown size that was discovered in the power block, but it was added unadjusted to the fatality estimator results.
[2] Note that the tower area estimate includes estimates for the power block, which should be interpreted with caution as they may be inaccurate due to the large amount of unaccounted for search effort.

Table B-41. Power Block Fatality Estimates Based on Detections from Unknown Causes, 18 August – 20 October 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	1	NA[1]
Raptor[2]	1	NA[1]
Small Bird	8	24 (11 – 45)
Total	**10**[3]	**28** (15 – 49)[4]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] All raptors are also considered large birds, but they were considered separately to avoid having redundant data in this table.
[3] The number of detections does not include a feather spot of unknown size.
[4] Estimate includes one detection that could not be assigned to a size class, which was added unadjusted to the fatality estimator output. Totals do not reflect the sum of individual estimates because of "NA" values less than five.

Table B-42. Inner HD Heliostats Fatality Estimates Based on Detections from Unknown Causes, 18 August – 20 October 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	12	22 (12 – 36)
Raptor	0	NA
Small Bird	12	44 (19 – 92)
Total	**24**	**65** (32 – 125)[1]

[1] Totals do not reflect the sum of individual estimates because of inherent properties of the bootstrap process.

Table B-43. Heliostat Area Fatality Estimates Based on Detections from Unknown Causes, 18 August – 20 October 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	12	102 (46 – 198)
Raptor	0	NA
Small Bird	16	311 (179 – 557)
Total	**28**	**413** (269 – 670)[1]

[1] Totals do not reflect the sum of individual estimates because of inherent properties of the bootstrap process.

Table B-44. Fenceline Area Fatality Estimates Based on Detections from Unknown Causes, 18 August – 20 October 2014.

Type of Estimate	Number of Detections Included in Model	Fatality Estimate (with Lower and Upper C.I.)
Large Bird	6	16 (6 – 39)
Raptor	0	NA
Small Bird	3	NA[1]
Total	**9**	**29** (10 – 51)[2]

[1] NA = not applicable because there were fewer than five detections within that group.
[2] Totals do not reflect the sum of individual estimates because of "NA" values less than five.