NOTE: THIS REPORT WAS NEVER FINALIZED BY THE SOLANO COUNTY TAC; ATTEMPTS WERE MADE, BUT TAC HAS NOT SINCE MET. DECISION WAS TAKEN TO SUBMIT THE REPORT, AS-IS. (4 FEB 2019).

H. T. HARVEY & ASSOCIATES

Ecological Consultants

# Montezuma II Wind Energy Center Postconstruction Monitoring Final Report

**Project #3353-01**

Prepared for:

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May 2015

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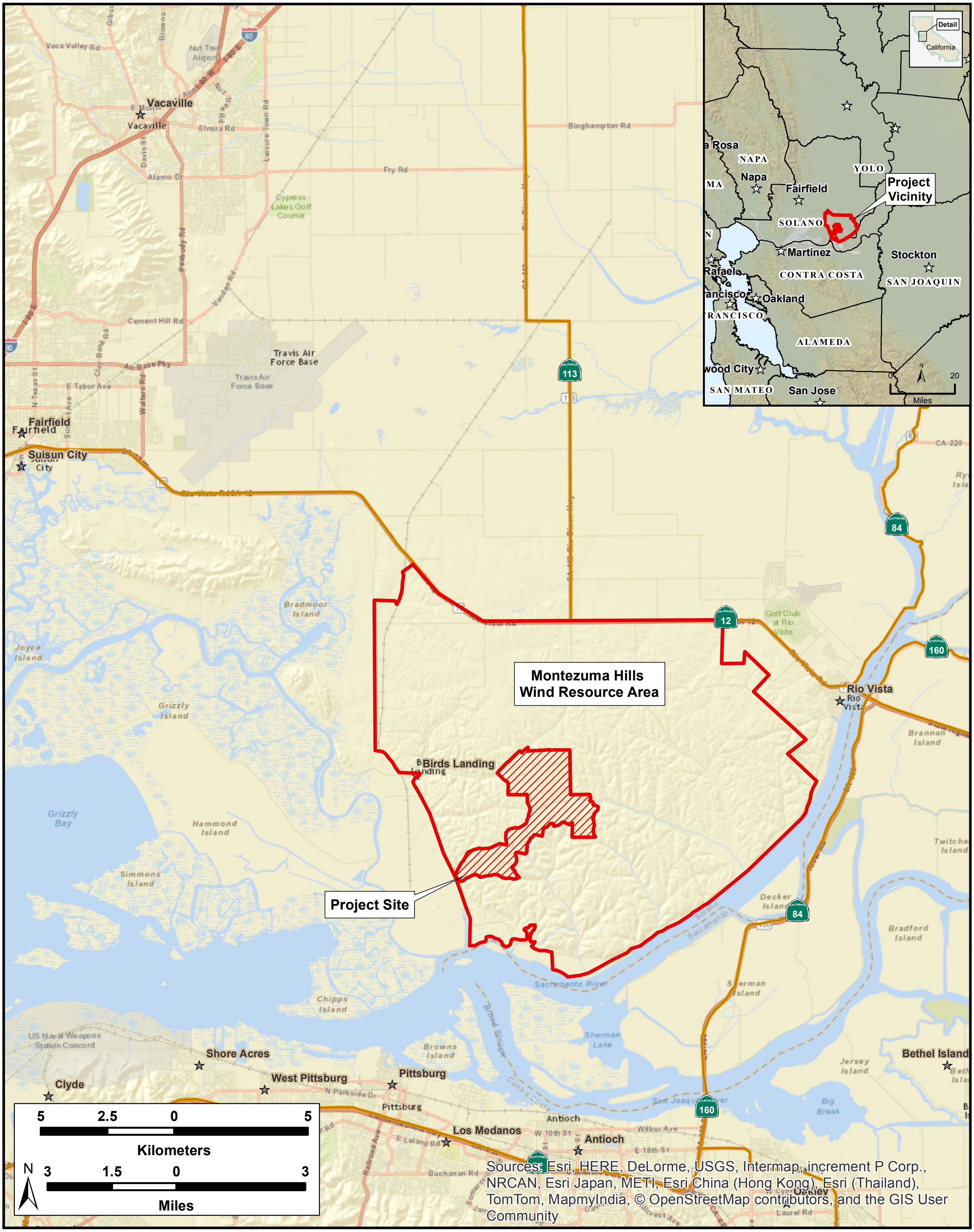
# Section 1.0 Introduction

The Montezuma Wind II, LLC Wind Energy Center (Project) is a 78.2 MW facility comprising 34 2.3-MW Siemens turbines (hub height 80 m [262 ft]; minimum blade clearance 33.5 m [110 ft] above ground level; maximum blade-tip height 126.5 m [415 ft]) distributed across approximately 1,105 hectares (2,731 acres) of mixed agricultural land in Solano County, California. This Project, which began producing power in January 2012, is one of several individual power plants that together comprise the overall Montezuma Hills Wind Resource Area (MHWRA) (Figure 1).

Wind-energy projects are known to cause direct mortality and may result in other adverse impacts for various bird and bat species. The Solano County Planning Commission (County) Land Use Permit (LUP U-10-04) that pertains to the Project stipulated development of an Avian and Bat Mitigation Plan (ABMP) (ICF Jones & Stokes 2011) to describe specific measures that would be applied to mitigate potential impacts to avian and bat species, as described in the Environmental Impact Reports prepared for the Project (Point Impact Analysis 2011a, b). Specifically, the ABMP outlined a 3-year post-construction study, which translated to the following primary objectives for the work discussed herein:

- Three years of weekly surveys for bird and bat fatalities covering at least 50% of the 34 turbines each year, and all turbines for at least 1 year.
- At least 1 year of weekly surveys for bird and bat fatalities along a short section of new overhead electrical line installed between the new Montezuma II and existing High Winds electrical substations.
- At least 1 year of monitoring avian activity in the Project area using fixed-point counts.
- Opportunistic monitoring for occurrence of potential raptor prey and carcass scavengers during all carcass surveys and while surveyors travel between survey plots within the Project area.

This report presents the results of the final year of the required 3-year post-construction monitoring effort.




N:\Projects3300\3353-01\Reports\Final Report\Fig 1 Study Area Map.mxd

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**Figure 1: Study Area Map**
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# Section 2.0 Methods

As per Condition of Approval #41 outlined in the ABMP, the U.S. Fish and Wildlife Service (USFWS) reviewed the design of this study and the qualifications of the consultants chosen to conduct the field surveys, and had no objections.

This Project site comprises three geographically distinct clusters of turbines (Figure 2), upon which we based the stratification of our survey effort:

North: turbines 107–119, $n = 13$
Central: turbines 120–131, $n = 12$
South: turbines 132–140, $n = 9$

Based on our expertise, we typically advocate allocating survey effort and partitioning data for seasonal analyses based on a quarterly break down that reflects the seasonal life history patterns of birds and bats as follows:

Spring: 15 February – 14 May
Summer: 15 May – 14 August
Fall: 15 August – 14 November
Winter: 15 November – 14 February

This breakdown helps distinguish the majority of the spring and fall migration periods for most species. Especially in California, however, and depending on the species, the nesting season may begin as early as January (e.g., for golden eagles *Aquila chrysaetos*) and continue well into September. Similarly, spring passerine migration often continues throughout May and, for some raptor species, fall migration often continues through November and into early December. Accordingly, any breakdown is somewhat arbitrary when trying to capture the seasonality of a diverse array of species. Moreover, because this Project did not begin until 5 March 2012, the LUP and ABMP require estimating searcher efficiency and carcass persistence on a quarterly basis, and the reporting objective for the Project is annual reports, for this study we adjusted the seasonal distinctions outlined above to include four 13-week quarters as follows:

Spring: 4 March – 2 June
Summer: 3 June – 1 September
Fall: 2 September – 1 December
Winter: 2 December – 2 March

This half-month adjustment did not substantially influence our analytical results and summaries.

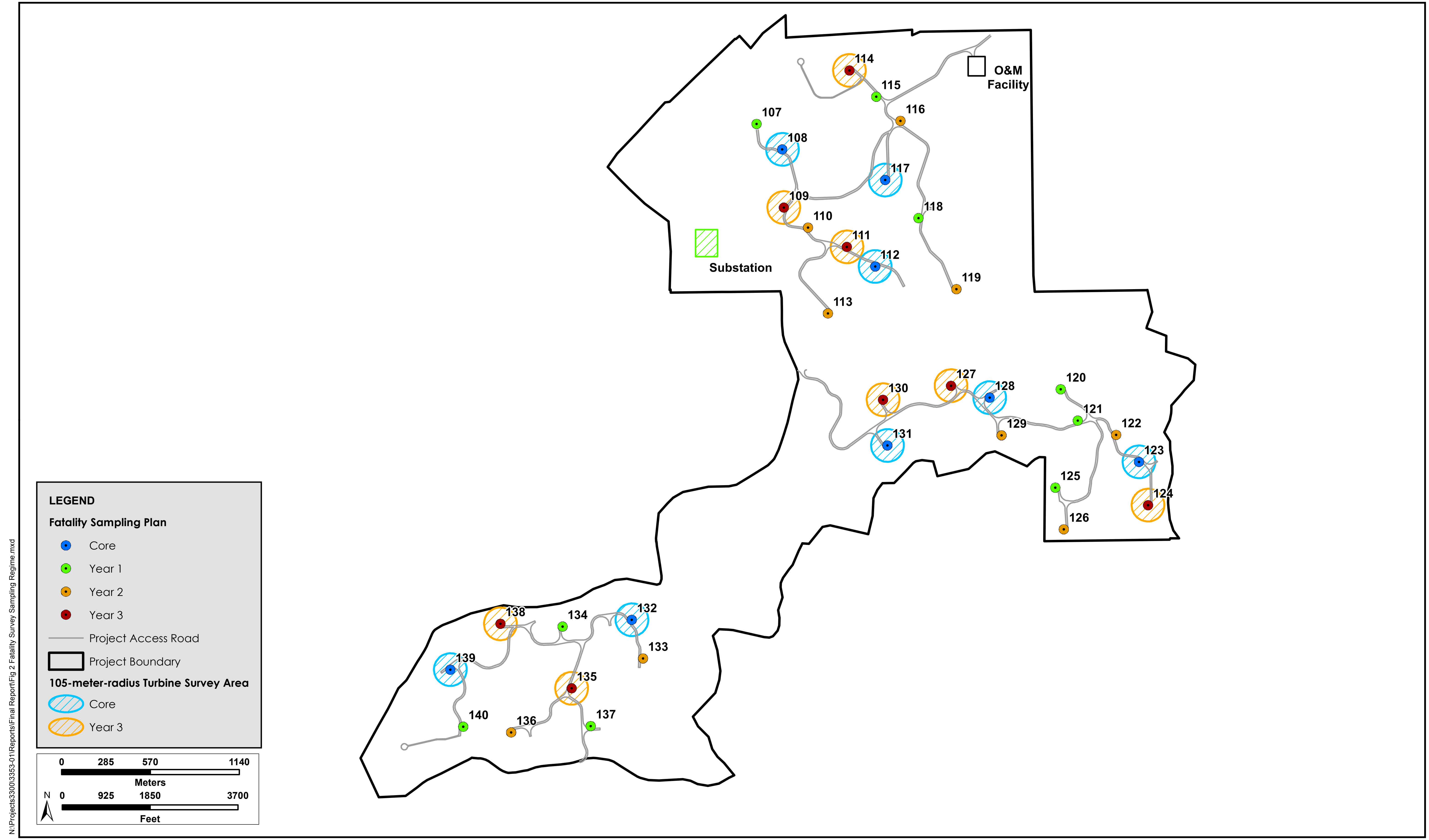


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**Figure 2: Fatality Survey Sampling Regime in Year 3**

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## 2.1 Bird and Bat Fatality Surveys

### 2.1.1 Sampling Design

To document bird and bat fatalities at turbine sites and meet the requirements as set forth in the Project LUP and ABMP, for the third year of monitoring we conducted weekly bird and bat carcass surveys at 16 (50%) of the 34 turbines (Figure 2) between 3 March 2014 and 26 February 2015. Our three-year sampling design included a "core" component of eight turbines surveyed every week throughout the three-year Project to provide a consistent index of seasonal and interannual variation in fatality rates at a representative suite of turbines. These turbines comprised a random sample stratified to equitably represent the three geographically disjunct turbine sections (i.e., three turbines each within the north and central sections and two turbines within the smaller south section) and reasonable spatial dispersion within sections (Figure 2). We surveyed the remaining 26 turbines for one year each, covering a different set of eight or nine turbines during each of the three Project years. We selected each year's "supplementary" turbines the same way we selected the "core" turbines, except for eliminating from consideration the core turbines and, in Years 2 and 3, "supplementary" turbines that were already surveyed. In Year 3, we selected the remaining eight additional turbines to survey each week along with the eight core turbines (Figure 2).

The USFWS (2012), California Energy Commission (CEC), and California Department of Fish Game (CEC and CDFG 2007) recommend that carcass searches occur at some turbines within the Project area most days each week of the monitoring effort, in part so that substantial episodic events are more likely to be detected regardless of the interval between searches at individual turbines. Accordingly, each week's carcass surveys occurred across a standard 4-day schedule (typically Monday through Thursday), with 3–5 turbine plots surveyed per day and individual turbines surveyed on the same day of the week to maintain a standard 7-day search interval for all turbines. Occasional minor variations in this standard schedule occurred to accommodate inclement weather, primary holidays, safety concerns, and surveyor illness. Within each day, surveys began at a randomly chosen start point and then proceeded in the most efficient manner to each additional turbine covered that day.

In addition to the turbine surveys, and as required by the LUP/ABMP, one day each week we also conducted a coarse-scale visual search of the new overhead powerline section installed between the new Montezuma II and existing High Winds electrical substations. These surveys focused on detecting potential raptor and waterbird collision and electrocution fatalities.

### 2.1.2 Survey Protocols

Surveys proceeded as scheduled unless inclement weather precluded a reasonable and safe search effort (e.g., because of compromised visibility, untenable surface conditions [mud], or safety concerns [lightning]), other safety issues intervened (e.g., recent crop spraying resulted in adverse conditions for the surveyor or active turbine maintenance/repair activities precluded safe passage around the turbine), or an unexpected illness intervened. One experienced individual conducted the majority of the carcass surveys. Three other individuals assisted with the Year 2 and 3 surveys for variable periods, generally conducting 20–30% of the surveys depending on the week.

Similar projects often conduct "clean-sweep" or "clearance" surveys of all plots 1–2 days before beginning fatality surveys. We believe this is an unnecessary extra effort and that doing so unnecessarily biases the first week's survey results when a weekly search interval is employed. Instead, we carefully categorized all carcasses found on the first day of surveying each individual plot to distinguish fresh from old carcasses. For any carcasses found during these initial surveys, we estimated the time since death using standard indicators of carcass freshness, and included in our analyses only those identified as <1 week old. This ensured that the estimated fatality totals for the first week of surveys were equivalent to the estimates for all subsequent weeks in representing fatalities accumulated during 1 week, as opposed to only one or at most a few days of carcass accumulation.

Transect layouts for the turbine surveys were similar to those used during the Shiloh I (Year 3), Shiloh II, and Montezuma I post-construction studies in the MHWRA (Kerlinger et al. 2009, 2013a; ICF International 2013). Each plot consisted of 13 concentric-ring transects beginning 5 meters (m) out from the base of the turbine. Spacing was 5 m for the first six transects out to 30 m, and 10 m for the remaining seven transects out to 100 m. The narrower spacing out to 30 m reflects evidence that approximately 80% of bat fatalities (generally small and hard to detect animals) typically fall within half the distance between the ground and maximum rotor-tip height (63.25 m in this case, or approximately 32 m to either side of the turbine base), whereas bird kills tend to be more uniformly distributed in relation to distance from the turbine base (Erickson et al. 2003, Johnson et al. 2003, Young et al. 2003, Kerns et al. 2005, Kerlinger et al. 2009, USFWS 2012). The surveyor walked the innermost five concentric-ring transects systematically scanning the ground to either side for bird and bat carcasses and parts of carcasses (feathers, bones, disbursed body parts, etc.) out to a maximum distance of 2.5 m to either side of the transect center line. The sixth transect centered at 30 m from the base of the turbine then involved a 2.5-m-wide search on the inside and a 5-m-wide search on the outside of the center line. Thereafter (transects 7–13), the surveyor extended the search distance out to 5 m along both sides of each transect centerline.

This design achieved coverage out to a radius of 105 m from the turbine base, yielding a total survey-plot diameter of 210 m (ignoring the 5-m width of the turbine base). Such coverage has been typical for studies in the MHWRA and exceeds the USFWS (2012) and CEC and CDFG (2007) recommendations that the diameter of search plots equal at least the maximum ground to rotor-tip distance (126.5 m in this case). To maintain appropriate distances while proceeding along transects, the surveyor used a laser range finder to periodically check and adjust distance from the plot center. Otherwise, the surveyor attempted to walk each belt transect at an average pace of about 1 m/second, or roughly 1 step/second, with the goal of completing each turbine survey in 1–1.25 hours.

We followed the CEC and CDFG (2007) and Altamont Pass Monitoring Team (2008) guidelines for classifying avian fatalities. To qualify as a fatality, finds must have included either ≥10 feathers total or at least five tail feathers or two primaries located within ≤5 m of each other. Upon finding a fatality, the surveyor temporarily marked each location with a pin flag and then returned after searching the entire plot to record data on all finds using a standard data form. Recorded information included:

1. Unique incident number including the year, month, date, and a number corresponding to the sequential order in which multiple specimens were found that day; e.g., the third specimen found on 11 October 2011 would be #20111011-03.
2. Turbine number.
3. Distance (m) and direction (°) from base of turbine, with distance determined using a laser rangefinder and direction determined using a compass.
4. Distance (m) and direction (°) to other nearest structure if closer to fatality than turbine.
5. Description of other nearest non-turbine structure.
6. Location coordinates: UTM datum NAD83, using a handheld device such as the Garmin GPS Map60s or DeLorme Earthmate PN-60 accurate to ±3–4 m.
7. Substrate on which carcass was found, determined using a 1 m x 1m quadrat centered on the carcass with recorded data including: substrate type (i.e., crop [seeded, growing, mature], plowed [fine, medium or coarse], fallow, fallow/grazed, barren, road, or turbine pad), proportional coverages of different cover types, average vegetation height (i.e., low <25 cm, medium 25–50 cm, high >50 cm), and average vegetation density (i.e., low = ground surface largely visible from above, medium = ground surface patchily visible from above; high = ground surface mostly non-visible from above).
8. Species or closest taxonomic group possible; e.g., red-tailed hawk (*Buteo jamaicensis)*, unknown *Buteo*, or as a last resort unknown large raptor, or California myotis (*Myotis californicus*), unknown *Myotis*, or as last resort unknown small bat. If unknown, specify as "unknown small bird" (smaller than a mourning dove [*Zenaida macroura*]), "unknown medium bird" (between a mourning dove/American kestrel [*Falco sparverius*] and American crow [*Corvus brachyrhynchos*]/northern harrier [*Circus cyaneus*] size), or "unknown large bird" (common raven [*Corvus corax*]/red-tail hawk size or larger).
9. Evidence for species identification; e.g., plumage, individual feather ID, measurements, hair for bats, etc. If a recognized sensitive species, record detailed notes, measurements, and extensive photos to substantiate ID.
10. Age and sex, if known.
11. Basis of age/sex determination; e.g., for birds—plumage, molt limits, fault bars, etc., and for bats—pelage, bone structure, or gonadal evidence.

12. Carcass condition: intact/fresh, intact/decayed, scavenged/depredated—indicate specific parts found, or feather spot.

13. Cause of death: evidence of trauma, broken bones, barotrauma, indicators of ill health, etc., if discernible.

*Blade Strike/Turbine Collision*

A. Intact carcass with injuries consistent with a turbine blade strike or tower collision; i.e., blunt force trauma, severed wings, legs or torso, decapitation, etc.

B. Rarely depredated species (e.g., golden eagle, red-tailed hawk or other large buteo, large falcon, or great horned owl (*Bubo virginianus*) found within the turbine search radius.

C. Intact carcass (no evidence of vertebrate scavenging or predation) with no apparent injuries found within the turbine search radius.

*Electrocution*

A. Carcass with obvious signs of electrocution; i.e., singed feathers, burn marks on feet or wrists, clenched talons, etc.

B. Intact carcass with no apparent injuries found within 3 m of a power pole and >10 m from turbine string axis.

*Line Strike*

A. Intact carcass with injuries consistent with a line strike (i.e., blunt-force trauma, broken wings or neck, decapitation, etc.), but no evidence of electrocution, found outside of turbine search radius and beneath (within 10 m) power lines or guy wires.

B. Intact carcass with no apparent injuries or evidence of electrocution found outside of turbine search radius, beneath (within 10 m) power lines or guy wires, and >3 m from the nearest power pole.

14. Estimated time since death: fresh, <1 week, <1 month, >1 month.

*Fresh (≤1–2 days old):* rigor mortis evident; exposed flesh fresh, not appreciably gooey or dried; blood still present in tissues; eyes still round and fluid filled; minimal sign of micro-scavengers and no obvious fly maggots present.

*≤1 week:* rigor mortis no longer evident; exposed flesh starting to turn gooey; blood gone from tissues; eyes, if still present, beginning to dry and sink into socket; evidence of micro-scavengers and fly maggots present; limited color fading of bird culmen, cere, and legs; minimal or no evidence of feather, fur or bone bleaching.

*≤1 month:* exposed flesh gooey or partially dried; eyes, if still present, dried and sunken into sockets; substantial evidence of micro-scavengers; noticeable color fading of bird culmen, cere, and legs; non-scavenged bones still largely articulated; limited bleaching of feathers, fur, or bones.

*>1 month:* exposed flesh dried or gone; eyes completely dried or gone; substantial color fading of bird culmen, cere, and legs; non-scavenged bones may be disarticulated; bleached feathers, fur, or bones.

15. Types of insects observed on/in carcass, if any, with brief description of kind and size.
16. Scavenger/predator: type of predator or scavenger (bird, large mammal, small mammal, or invertebrate), if possible to determine, and the effects of scavenging/predation.
17. Condition of flesh: fresh, gooey, dried, none.
18. Condition of eyes: round and fluid-filled, sunken, dried, none.
19. Condition of enamel, for birds: waxy covering on culmen and claws present or not.
20. Color, for birds: leg scales and/or cere have begun to fade or not.
21. Additional notes about special circumstances, carcass condition, details for identification of rare species, band numbers, obvious injuries, and potential cause of death if other than those listed above.
22. Searchers: first initial and last name of all relevant individuals in case of future questions.
23. Digital photographs of carcass confirming status (e.g., intact, scavenged, scattered parts, etc.) and portraying evidence of trauma where relevant, key facets required for positive species identification (e.g., distinct plumage or pelage features, illustration of size, bone structures, etc.), and the habitat in the immediate vicinity of the carcass.

After completing a given survey and recording data for each incident, the surveyor placed all discovered carcasses or body parts in zip-locked plastic bags, clearly labeled each with the relevant incident number, and stored them in a designated freezer at the Montezuma Wind O&M facility.

We acknowledge that estimating the time since death for discovered carcasses is often fraught with uncertainty (Strickland et al. 2011). This is especially true for older carcasses and when the environmental conditions (e.g., rainfall, wind, and solar insolation levels) at a site vary substantially through time. It can also be particularly difficult to accurately assess time since death when only remnants of the specimen remain due to scavenging. In this study, the important distinction was differentiating "clearance" carcasses believed to be older than 1 week old from fresher carcasses during the first survey at a given turbine. We submit that this level of distinction is not hard to accomplish with accuracy (± a few days) sufficient for generating fatality estimates.

Other data recorded each time an area was searched included weather conditions, standardized groundcover classification data for the plot as a whole (e.g., proportions of search area in crop types [low, medium, or high vegetation, as defined in Section 2.1.2, item 7], plowed [fine, medium, or coarse], fallow or fallow/grazed [low, medium, or high vegetation], road, turbine pad, etc.), whether the turbine was functional or not, and any relevant search-area access issues.

In assigning groundcover classifications to plots, a plowed field transitioned to a fallow or crop classification once new vegetation growth began to overtake the plot. Conversely, a harvested crop transitioned to classification as a fallow field after approximately six weeks, by which time grazing, wind, and sometimes renewed vegetation growth typically had markedly altered the condition of the field compared to the initial post-harvest state.

Our team also documented any bird or bat fatalities or injuries reported to us by others or that we found in the Project area incidentally outside of the fatality surveys. We recorded each such carcass or injury as an incidental find and handled them in the same manner as the regular survey incidents, including securing and transporting any injured animals to an appropriate care facility. We excluded incidental finds from calculation of adjusted fatality estimates.

## 2.2 Bias Correction Surveys

As required by the Project LUP and ABMP, we conducted quarterly bias trials to estimate searcher efficiency and carcass persistence rates, and incorporated data from those assessments in the models we used to calculate adjusted fatality rates.

Subject to the availability of suitable carcasses, our objective was to place at least 20 birds and 20 bats per quarter for both the searcher-efficiency and carcass-persistence trials, with the bird carcasses including at least 10 small and 10 medium/large birds. The CEC and CDFG (2007) define small birds as those with a body length <25 centimeters (cm) and large birds as those with a body length >25 cm. We further refined the classification to include small, medium, and large birds, as defined in Section 2.1.2, Item 8. During each quarterly trial we allocated an approximately equal mix of medium and large birds to compose the medium/large bird sample. Personnel limitations and the need to avoid placing too many carcasses on the landscape to minimize attraction or swamping of potential scavengers (Smallwood 2007) precluded placing greater numbers of trial specimens to provide equal representation of medium and large birds.

For both types of trials, we used only species known, or with the potential, to occur in the study region, including primarily native species but also a few nonnative species that routinely occur in the study area, such as European starling (*Sturnus vulgaris*), rock pigeon (*Columba livia*), Eurasian collared-dove (*Streptopelia decaocto*), ring-necked pheasant (*Phasianus colchicus*), and house sparrow (*Passer domesticus*) (CEC and CDFG 2007, Smallwood 2007). For the carcass persistence trials, in particular, we specifically avoided using surrogate animals, because of evidence that scavenging rates for avian surrogates such as gamebirds and chickens, and bat surrogates such as mice, can be much higher than for the species they are meant to mimic (Smallwood 2007, Hale 2010). All specimens used for bias trials during this study were either found during the study, recovered elsewhere as authorized by staff salvage permits (broad coverage for birds and bats), transferred from other wind facilities, or gathered from regional nature or animal rescue/rehabilitation centers. All of the latter specimens either died naturally or were euthanized using only $CO_2$, and were frozen immediately thereafter. All trial carcasses other than those found on the Project site were obtained under appropriate

USFWS/CDFW permits and used, transferred, or released to permitted personnel. If a specimen used in a bias trial remained to be recovered at the end of the 28-day trial, we retrieved the carcass (or any detected remnants) and stored it in a designated freezer on the Project site, to be used again in a subsequent searcher-efficiency trial or later transferred to the USFWS for disposal.

Factors that influence searcher efficiency and carcass persistence include how fresh and intact the carcass is (Smallwood 2007). If multiple pieces of a depredated or scavenged carcass are scattered over a modest area, in some cases that may increase detectability of the fatality; more generally, the presence of only remnants of a carcass, carcass aging, and attendant degradation tend to decrease detectability (Smallwood 2007). Open or dismembered carcasses also may increase scavenger attraction compared to intact carcasses (Smallwood 2007). We did not attempt to address or control for such influences on searcher efficiency or carcass persistence. Instead, we used only largely intact specimens for our searcher efficiency trials and carcasses that ranged from freshly dead, frozen, and thawed to partially mummified (i.e., selected, subject to availability, to mimic the range of carcass freshness that typically accrues over 7-day periods), whereas for the carcass persistence trials we used only specimens that were largely intact (at most moderate contusions/lacerations consistent with blade-strike damage) and freshly dead (estimated to be no more than 1–2 days old and fresh frozen/newly thawed, as appropriate). For the latter, we acknowledge evidence that scavenging rates of fresh/frozen and thawed bats may be lower than for fresh/never frozen bats (Kerns et al. 2005, Strickland et al. 2011); however, without using frozen specimens, essentially no bat-specific trials would have been possible due to very low documented fatality rates and some of the discovered fatalities being too old when found to comprise a suitable trial specimen. This factor may have biased high our estimates of carcass-persistence for bats and thereby biased low our adjusted fatality estimates for bats; however, as discussed further below, we do not believe this effect had any significant impact on the conclusions drawn.

To reduce possible biases related to leaving scent traces or visual cues that may unnecessarily alert potential scavengers, we handled all carcasses used in bias trials only with latex gloves and minimized handling time. We also attempted to ensure that carcass markings used to distinguish trial specimens from new fatalities were as inconspicuous as possible to both minimize the chance of artificially attracting scavengers and unnecessarily alerting the searchers to the presence of searcher-efficiency trial specimens. To mark trial specimens prior to placement, we used bits of electrical tape (black for searcher-efficiency and green for carcass-persistence specimens) wrapped around a leg or wing (bats). To ensure a degree of "natural" placement, technicians placed all bias-trial specimens by dropping them from a height of approximately 2 m above the ground over the designated placement spots.

### 2.2.1 Searcher Efficiency

We documented searcher efficiency quarterly using blind trials. On several scattered days over the course of 4–5 weeks around the middle of each quarter, a field supervisor or other technician not involved in the fatality surveys placed trial carcasses in turbine plots and recorded the proportion of placed carcasses that surveyors detected during the course of the fatality surveys. For this purpose, we defined quarterly trial periods as the 4–5 weeks centered on a randomly chosen day selected from among the central 30 days of each quarter. For example, for the first sample quarter in the third year (2 March–31 May 2014), we randomly selected 26 April from among the central 30 days of the quarter (2 April–1 May), which translated to a 4-week trial period running from 14 April to 11 May. Sometimes we extended the trial to a 5-week period to accommodate logistic/personnel constraints. Within each quarterly trial period, we selected 5–6 days when fatality surveys were scheduled on which to place the trial carcasses. On selected days, the trial technician placed carcasses early in the morning before the surveyor arrived on site to conduct the fatality surveys, with the surveyor unaware of when and where carcasses were placed. Documentation of each location included GPS coordinates and notes about the substrate and carcass placement.

Once the surveyor completed the day's surveys, the supervisor/technician communicated with him or her to record findings and plan to recover any remaining carcasses. Accordingly, our standard protocol called for searchers to have only one opportunity to discover a given trial specimen. During Year 1 through most of the third quarter, the primary surveyor attempted to recover most of the trial specimens he had missed. This resulted in a recovery rate of only 7% ($n$ = 55 attempts), likely due to a combination of using different GPS devices and the surveyor lacking knowledge of specific placement landmarks and characteristics. Changing the protocol to having the supervisor/technician who placed the trial specimens also attempt to recover all specimens that the surveyor missed, on the same day, resulted in an 84% recovery rate ($n$ = 34 attempts) during the latter part of Year 1. We continued the latter practice through the remainder of the study.

Within quarters, we selected placement dates and allocated trial carcasses among turbines based on a stratified random approach designed to achieve reasonable distributions of bat carcasses and bird carcasses of different size classes (small, medium, and large) among turbine sections, among turbines within sections, and, to the degree possible, among different habitat types and pre-defined habitat/substrate visibility classes (Tables 1 and 2, Appendix A). In addition, during each trial we tested all individuals participating as regular surveyors to ensure that each individual's contribution to the overall searcher efficiency estimates was approximately proportional to their level of participation.

Within turbine plots, we used a random number generator to select random distances and bearings at which to place each specimen. We modified the allocations to avoid overloading specific areas with too many carcasses and thereby unnecessarily attracting carcass scavengers or biasing the surveyor's expectations for finding carcasses, by never placing more than three trial carcasses or more than one large-bird carcass on the same turbine plot on the same day (CEC and CDFG 2007, Smallwood 2007, USFWS 2012). Figure 3 displays an example of the resulting distribution of trial specimens within the north turbine section.

Three factors precluded achieving a more robust sampling design across quarterly seasons that accounted for both specimen size classes and habitat visibility classes: 1) restricted ability to allocate sufficient numbers and varieties of trial specimens because of the limited number of turbine plots and concerns about avoiding carcass overload on the landscape; 2) a lack of consistent representation of different visibility classes from

**Table 1. Examples of Visibility Classes Assigned to Different Substrate/Habitat Types for Purposes of Estimating Searcher Efficiency**

| | Visibility Class | | |
|---|---|---|---|
| Substrate[1] | High | Medium | Low |
| Barren | x | | |
| Gravel | x | | |
| Gravel/fallow | | x | |
| Fallow-sparse new growth | x | | |
| Fallow-low | | x | |
| Fallow-medium/high | | | x |
| Plowed-fine/medium | x | | |
| Plowed-coarse | | x | |
| Crop-seeded/sparse new growth | x | | |
| Crop-low | | x | |
| Crop-medium/high | | | x |
| Crop-harvested | | x | |

[1] Vegetation height classified as low = <25 cm, medium = 25–50 cm, and high = >50 cm, consistent with definitions presented in Section 2.1.2, Item 7.

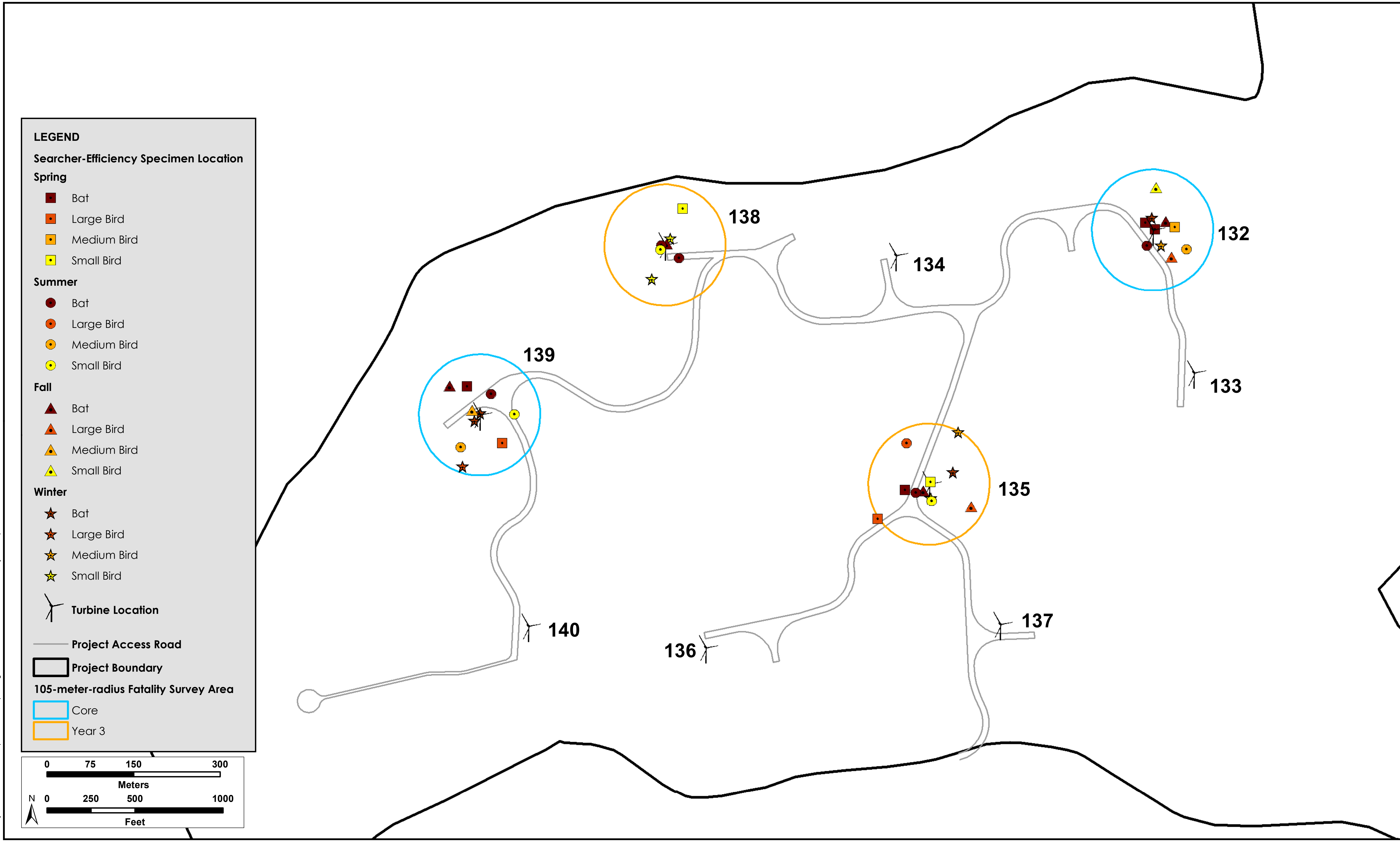
**Table 2. Allocation of Bat and Bird Searcher Efficiency Trial Specimens by Season, Substrate Type / Visibility Class, and Bird Size Class in Year 3**

| | | | Birds[2] | | | |
|---|---|---|---|---|---|---|
| **Season** | **Substrate[1] (Visibility Class)** | **Bats** | **Small** | **Medium** | **Large** | **Total** |
| **Spring** | Gravel (high) | 2 | 2 | 1 | 1 | 4 |
| | Plowed-coarse (moderate) | 5 (4)[3] | 3 | 2 | 2 | 7 |
| | Crop-medium/high (low) | 4 (3) | 3 | 3 (1) | 0 | 6 (4) |
| | Fallow-low (moderate) | 1 (0) | 1 (0) | 1 | 0 | 2 (1) |
| | Fallow-medium/high (low) | 9 (3) | 2 | 1 | 3 | 6 |
| | **Spring Total** | **21 (12)** | **11 (10)** | **8 (6)** | **6** | **25 (22)** |
| **Summer** | Gravel (high) | 3 | 1 | 0 | 0 | 1 |
| | Plowed-fine/medium (high) | 6 (5) | 4 | 3 | 2 | 9 |
| | Plowed-coarse (moderate) | 3 | 1 | 1 | 1 | 3 |
| | Crop-high (low) | 2 | 1 | 1 | 0 | 2 |
| | Crop-harvested (moderate) | 4 | 3 (2) | 0 | 1 | 4 (3) |
| | Fallow-low (moderate) | 0 | 1 | 0 | 0 | 1 |
| | Fallow-high (low) | 4 | 2 | 1 | 3 | 6 |
| | **Summer Total** | **22 (21)** | **13 (12)** | **6** | **7** | **26 (25)** |
| **Fall** | Gravel/barren (high) | 4 (3) | 0 | 0 | 0 | 0 |
| | Plowed-fine/medium (high) | 10 (9) | 10 (7) | 3 | 3 | 16 (13) |
| | Plowed-medium/Fallow-low (moderate) | 0 | 1 | 0 | 0 | 1 |
| | Plowed-coarse (moderate) | 2 (1) | 1 | 1 | 1 | 3 |
| | Crop-harvested (moderate) | 5 (4) | 3 (1) | 2 | 2 | 7 (5) |
| | Fallow-low/barren (moderate) | 0 | 1 | 0 | 0 | 1 |
| | **Fall Total** | **21 (17)** | **16 (11)** | **6** | **6** | **28 (23)** |
| **Winter** | Gravel/barren (high) | 5 (4) | 2 | 1 | 0 | 3 |
| | Plowed-fine (high) | 0 | 2 | 0 | 0 | 2 |
| | Crop-new (high) | 3 | 3 | 0 | 1 | 4 |
| | Crop-low (moderate) | 6 (4) | 5 | 1 | 2 | 8 |
| | Crop-medium (low) | 0 | 1 | 0 | 0 | 1 |
| | Fallow-low (moderate) | 4 | 5 | 4 | 3 | 12 |
| | Fallow-medium (low) | 1 | 0 | 0 | 0 | 0 |
| | **Winter Total** | **19 (16)** | **18** | **6** | **6** | **30** |
| **Total** | | **83 (66)** | **58 (51)** | **26 (24)** | **25** | **109 (100)** |

[1] Vegetation height classified as low = <25 cm, medium = 25–50 cm, and high = >50 cm, consistent with definitions presented in Section 2.1.2, Item 7.

[2] Small = smaller than a mourning dove; medium = between mourning dove/American kestrel and American crow/northern harrier size; and large = common raven/red-tail hawk size or larger, consistent with definitions presented in Section 2.1.2, Item 8.

[3] Numbers in parentheses represent totals reduced by the number of placed specimens that were not recovered and may not have been available for detection because of scavenging prior to when the searcher covered the relevant survey plot. To ensure an unbiased assessment, these trial specimens were excluded from estimation of searcher efficiency for the purpose of developing adjusted fatality estimates.




N:\Projects3300\3353-01\Reports\Final Report\Fig 3 Placement of Searcher Efficiency Trial Specimens in the South Turbine Section in Year 3.mxd

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**Figure 3: Placement of Searcher Efficiency Trial Specimens in the South Turbine Section in Year 3**
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quarter to quarter due to natural variation in habitat and crop status; and 3) the inability to routinely and effectively describe the distribution of habitat coverages across all turbine plots on a seasonal basis using current aerial imagery to support effective GIS-based habitat mapping and sample allocation. For these reasons and to meet the basic sample-size requirements for the applicable fatality estimation software (Huso 2011, Huso et al. 2012), it was necessary to restrict our classification scheme to minimum arrays of general habitat visibility classes (low, medium, and high) and carcass size classes (small and medium/large).

### 2.2.3 Carcass Persistence

To quantify carcass persistence, during each quarterly season we sought to place at least 20 bats, 10 small birds, and 10 medium/large birds among the turbine plots subject to fatality surveys (Table 3, Appendix B). We sometimes fell short of these targets due to a lack of suitable specimens, especially bats. We monitored the status of each trial carcass daily for 7 days, every 2–3 days during the second week, and twice more at weekly intervals for a maximum trial period of 28 days, or until such time as the specimen was removed or had been scavenged to the degree that it no longer qualified as a detectable fatality incident. To help avoid potential bias due to scavenger swamping (Smallwood 2007), we placed trial carcasses on three different occasions each quarter to avoid overlap of at least the first 14-days of monitoring for each trial round. Within quarters, we placed trial specimens according to a stratified random sampling design that accounted for turbine section, representative habitat/substrate variants, and specimen types and sizes (Table 3). We limited placement of relevant carcasses to no more than two fresh carcasses per plot and no more than one large carcass per plot. We also generally avoided placing carcass-persistence and searcher-efficiency trial specimens concurrently on the same plots. Otherwise, within selected turbine plots, we placed trial carcasses at random distances and bearings from the turbine base, recorded GPS coordinates for the locations, described the substrate/habitat cover at the placement locations, and took digital photographs of the placements. Figure 4 displays an example of the resulting distribution of carcasses within one turbine section during Year 3. The primary monitoring biologist placed and monitored all persistence trial specimens. At each check, he classified the carcass into one of the following categories, consistent with protocols used in the NextEra WRRS and as described in the ABMP:

**Intact**: whole and unscavenged other than by insects.

**Scavenged**: carcass incomplete, dismembered, or flesh removed by scavenger(s) other than insects.

**Feather Spot**: avian carcass scavenged and removed, but sufficient feathers remain to qualify as a fatality, as defined above.

**Removed**: not enough remains to be considered a fatality during fatality surveys, as defined above.

### 2.2.4 Adjusted Fatality Estimates

To achieve consistency among MHWRA analyses (Point Impact Analysis 2012), we calculated adjusted fatality estimates using USGS estimation software (Huso et al. 2012) and incorporating adjustments for both searcher efficiency and carcass persistence. The Huso (2011) estimator has increased flexibility compared to other estimators (e.g., Thompson 1992, Erickson et al. 2000; Johnson et al. 2000, 2003; Schoenfeld 2004;

**Table 3. Allocation of Bat and Bird Carcass Persistence Trial Specimens by Season, Substrate Type, and Bird Size Class in Year 3**

| | | | Birds | | | |
|---|---|---|---|---|---|---|
| **Season** | **Substrate** | **Bats** | **Small** | **Medium** | **Large** | **Total** |
| **Spring** | Gravel/barren | 1 | 1 | 1 | 0 | 2 |
| | Plowed-coarse | 1 | 0 | 1 | 0 | 1 |
| | Crop-high | 8 | 0 | 0 | 1 | 1 |
| | Fallow-low/medium | 4 | 3 | 1 | 1 | 5 |
| | Fallow-medium/high | 6 | 5 | 3 | 1 | 9 |
| | **Spring Total** | **20** | **9** | **6** | **3** | **18** |
| **Summer** | Gravel | 1 | 0 | 0 | 0 | 0 |
| | Plowed-coarse | 6 | 3 | 2 | 2 | 7 |
| | Plowed-fine | 1 | 0 | 1 | 0 | 1 |
| | Crop-high | 2 | 2 | 0 | 2 | 4 |
| | Plowed-medium/coarse | 1 | 0 | 0 | 1 | 1 |
| | Fallow-low | 2 | 2 | 1 | 0 | 3 |
| | Fallow-medium/high | 7 | 1 | 2 | 0 | 3 |
| | **Summer Total** | **20** | **10** | **6** | **6** | **22** |
| **Fall** | Gravel | 2 | 1 | 0 | 0 | 1 |
| | Plowed-fine | 3 | 2 | 3 | 0 | 5 |
| | Plowed-medium/coarse | 1 | 1 | 0 | 2 | 3 |
| | Crop-harvested | 0 | 1 | 2 | 0 | 3 |
| | Fallow-low | 4 | 1 | 0 | 1 | 2 |
| | Fallow-medium/high | 3 | 2 | 2 | 0 | 4 |
| | **Fall Total** | **15** | **9** | **8** | **4** | **21** |
| **Winter** | Gravel | 0 | 1 | 0 | 0 | 1 |
| | Crop-new | 8 | 3 | 2 | 0 | 5 |
| | Crop-low | 0 | 1 | 2 | 2 | 5 |
| | Fallow-low | 7 | 5 | 3 | 2 | 10 |
| | **Winter Total** | **15** | **10** | **7** | **4** | **21** |
| **Total** | | **70** | **38** | **27** | **17** | **82** |

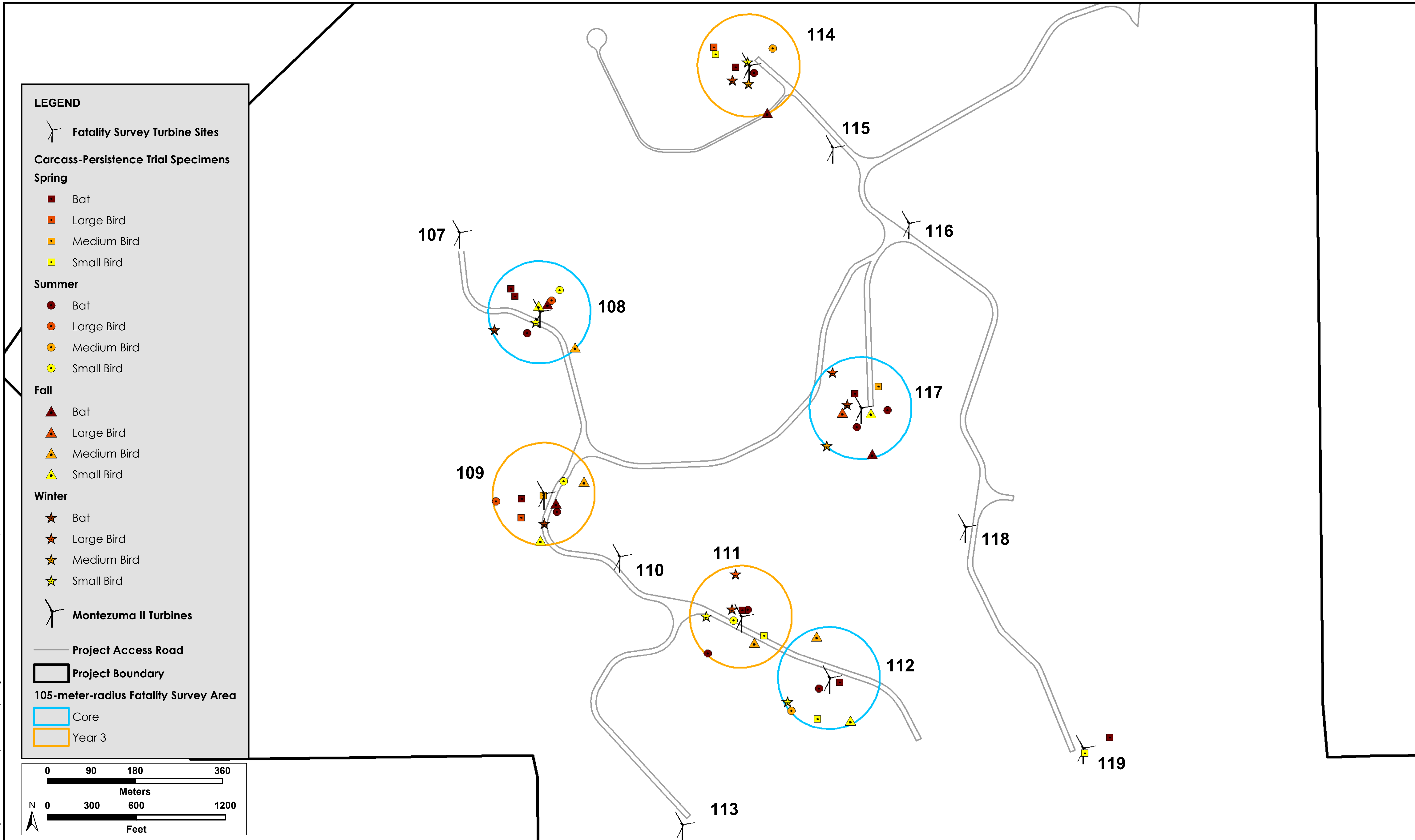


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**Figure 4: Placement of Carcass Persistence Trial Specimens in the North Turbine Section in Year 3**
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Smallwood 2007; Korner-Nievergelt 2011) by allowing for unequal probability sampling; incorporating additional parameterization to model the influence on searcher efficiency and carcass persistence of covariates such as season, carcass type/size, and habitat visibility classes; and incorporating an "effective search interval" based on the mean persistence time of a carcass. In addition, the Huso estimator typically produces less biased estimates in situations where the average carcass-persistence time is less than the average search interval (Strickland et al. 2011). As discussed below, this scenario applied in this study for all but the largest birds and then only in some seasons. The Huso method also assumes no *bleed through*, meaning that specimens found after they have been dead longer than the average search interval must be excluded to produce accurate and unbiased results (Strickland et al. 2011, Warren-Hicks et al. 2013). In using the Huso estimator, we incorporated a 2014 update to the software that improved the estimation of confidence intervals for searcher efficiency estimates, which in turn improved the accuracy and precision of the adjusted fatality estimates, especially for large, easy-to-detect birds (Huso 2014).

Using the USGS software, we modeled searcher efficiency and carcass persistence with taxon/size class, visibility class, and season as covariates. We fit models that integrated data for birds and bats, with the taxon/size class covariate categorized as bats, small birds, and medium/large birds. We included visibility class as a second covariate in the searcher-efficiency models, and evaluated the utility of including a taxon/size class x visibility class interaction term. Visibility classifications reflected the viewing conditions within a few square meters of where the trial specimen was placed, classified as described above (Table 1). We based estimation of searcher efficiency on data combined from across the 3-year study to ensure more robust sample sizes for all relevant covariate classes. We excluded data from the first three quarters of Year 1, however, because the rate of post-trial specimen recovery was atypically low during this period. The low recovery rate resulted from our initially having the searcher seek to recover trial specimens he missed, rather than having the person that placed the specimens also recover them. Because of the low recovery rate, we could not confidently identify which specimens might have been removed by scavengers prior to the trial survey. After this initial period, we excluded from analysis all trial carcasses that were not recovered post-trial. In Years 2 and 3, this amounted to 17% of the bats, 13% of the small birds, and 9% of the medium-sized birds that we placed as trial specimens (Table 2).

For carcass persistence, we included season as a second covariate and evaluated the utility of including a taxon/size class x season interaction term. We limited the carcass-persistence estimation to year-specific datasets, because of indications that carcass persistence varied noticeably among years of the study, for medium/large birds in particular. During the spring and fall quarters of Year 3, our trial sample sizes for birds fell just short of the 10 per covariate group required by the Huso software (Table 3). For this reason, to estimate carcass persistence in Year 3, we aggregated data into two seasons: spring/summer and fall/winter. Before rendering a final model based on the two-season approach, we first investigated whether there appeared to be support for modeling quarterly seasons by creating three dummy records (using average values for persistence time) to boost the quarterly sample sizes to a minimum of 10 samples per covariate group. This manipulation allowed the estimation software to proceed with the quarterly analysis, and allowed us to examine the comparative performance of the four-season and two-season models. The results revealed preferential support for the two-season model. The supporting evidence included comparable Weibull-distribution model shapes and a ΔAIC of 3.95 favoring the two-season model.

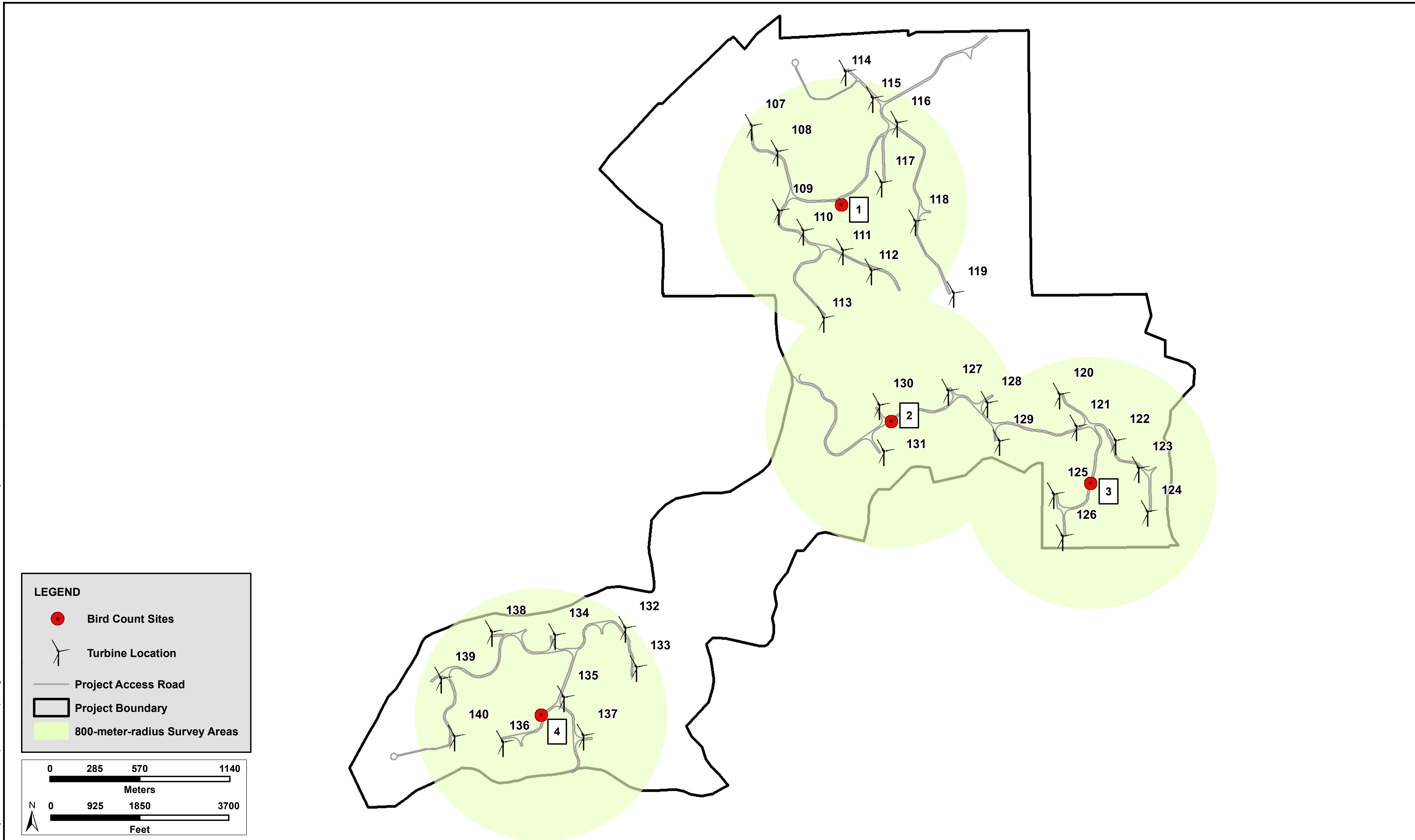
We calculated adjusted fatality estimates for Year 3 based on applying the estimator to all incident data, excluding bleed-through carcasses aged >1 week and incidental finds. To determine the best model to use in estimating adjusted fatality rates, we used AIC scores to compare the full models with no interaction terms to all simpler models.

To provide comparative data, we recalculated adjusted fatality estimates for Years 1 and 2, using the same combined-year model parameters for searcher efficiency and new year-specific, two-season model parameters for carcass persistence.

## 2.3 Bird Use Counts

We conducted point counts to document bird occurrences and estimate detection rates within the Project area concurrent with conducting fatality surveys. We selected four sites at which to conduct fixed-point counts modeled after the *long-duration, large-plot* bird surveys or *bird use counts* (BUCs) typically recommended for assessments of avian activity at wind-energy facilities in California (CEC and CDFG 2007) and elsewhere (Strickland et al. 2011, USFWS 2012). These BUCs are modified point counts, during which the observer records bird detections from a single vantage point over an 800-m-radius area for 20–30 minutes. Such counts are designed to provide information on bird species composition, relative abundance, and behavior relative to different habitat elements and Project infrastructure. The primary value of counts conducted in this fashion is documenting the distribution, relative abundance, and activity patterns of larger birds such as raptors and waterbirds (Strickland et al. 2011). The counts also provide useful insight about the general distribution, relative abundance, and habitat associations of smaller birds.

We strategically located the four count sites to provide largely unobstructed, nonoverlapping views of the surrounding terrain out to 800 m, and broad coverage of turbine locations (Figure 5). We located all count sites at least 100 m away from actual turbine locations to 1) minimize noise effects from operating turbines that could hamper an observer's ability to hear bird calls, and 2) maximize the chances of observing "natural" bird and carcass-scavenger behavior around operating turbines. We positioned one count site each to represent the relatively compact north and south turbine sections, and two sites to represent the more geographically extensive central section. Each week, we surveyed all four sites twice for 30 minutes, once during morning hours (0800–1200 H Pacific Standard Time [PST]) and once during afternoon hours (1300–1700 H PST). To avoid time-of-day biases, each weekly round of surveys began at a randomly chosen site and then proceeded in the most efficient manner through the rest of the count sites, with the start points for morning and afternoon surveys independently randomized. Typically, the same observer conducted all counts on the same one or two days each week (most often afternoon counts on Thursday and morning counts on Friday), except that inclement weather and other unforeseen factors occasionally forced slight schedule modifications. Observations proceeded as scheduled unless excessively inclement or windy weather precluded




N:\Projects3300\3353-01\Reports\Final Report\Fig 5 Locations of Bird Use Count Sites and Associated Survey Areas.mxd

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**Figure 5: Locations of Bird Use Count Sites and Associated Survey Areas**
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effective visibility and bird detection; i.e., they occurred only during periods with no or at most scattered precipitation, lateral visibility ≥1.6 km in all directions, vertical visibility ≥150 m (i.e., approximately equivalent to the average rotor-swept height of turbines), and average wind speeds ≤40 kph (preferably much less for detecting smaller birds, but stronger winds often create ideal foraging conditions for larger raptors).

Data recording included documentation of all birds seen or heard within 800 m of the count site. The surveyor sometimes recorded birds seen beyond that distance (e.g., large raptors) separately for informational purposes, but we did not include those data in formal quantitative analyses. The surveyor recorded the species and numbers of all birds detected, classified all detections according to the approximate distance and direction from the count center, estimated the flight height of the bird or group of birds when relevant, and recorded behavior information and habitat associations for all observations. During the counts, the surveyor repeatedly covered the 360° viewshed by slowly rotating his or her perspective, while using high quality 8–10x binoculars for detection and species identification.

The surveyor classified bird behaviors as follows:

(V)oice only: (c)alling, (s)inging

(P)erched: (r)esting, (p)reening, (f)eeding, (c)ourting/mating

(G)round: (r)esting, (p)reening, (f)oraging/feeding, (c)ourting/mating

(F)lying: (m)igrating, (t)ransit, (s)oaring, (f)oraging, (c)ourtship/territorial, (d)efensive/escape.

(N)esting: (b)uilding, (i)ncubating, (t)ending young, (f)eeding.

Where relevant, the surveyor also recorded additional notes concerning specific interactions with Project infrastructure and operations (e.g., use of power poles/lines as hunting perches, responses to close encounters with operational turbines, responses to facility personnel and vehicles, etc.) and specifics of any predator-prey interactions observed (e.g., species involved, setting, and outcome). In addition, to better gauge use of plots by larger species such as raptors and ravens, whose foraging home ranges routinely extend well beyond the bounds of any one 800-m-radius count plot, the surveyor tracked and recorded the amount of time individual large birds spent on the plot during a given count period.

The surveyor classified the flight heights of birds as follows:

LOW = <30 m — below the rotor swept zone

MED = 30–150 m — within the approximate rotor swept zone (upper limit purposefully not an exact match to actual maximum blade height [126.5 m], but consistent with reasonable approximation of elevated flight heights)

HIGH = >150 m — above the rotor-swept zone

A misunderstanding in Year 1 resulted in an improper classification scenario for flight heights that year. For this reason, we consider only Year 2 and Year 3 data in evaluating potential relationships between flight height and risk of turbine collision.

The surveyor classified flight directions as N, NW, E, SE, S, SW, W, or NW for birds that exhibited distinct directional flight; e.g., when transiting or otherwise moving purposefully across or through the survey area.

Habitat categories used to classify bird occurrences included turbine pad/roadway, other roadway, substation, plowed field, crop, grassland, fallow field, fallow/grazed field, eucalyptus grove, and marsh/wetland.

The surveyor recorded the weather conditions at the beginning of each survey with the help of a handled Kestrel 4500 Pocket Weather Tracker (Nielsen-Kellerman Company, Boothwyn, PA, U.S.A.). Recorded data included cloud cover estimates and types, presence/absence and type of precipitation, estimates of horizontal and vertical visibility when restricted, barometric pressure, ambient temperature, wind speed, and wind direction.

### 2.3.1 Data Analysis

To describe patterns of variation in bird activity levels across years, seasons, sites, species and species groups, and to render data comparable to those presented in several previous reports from the MHWRA (e.g., Kerlinger et al. 2009, Curry and Kerlinger 2011), we translated the raw survey counts into estimates of detection rates (detections per hour). For summary purposes, we classified species into seven groups: raptors (hawks, eagles, falcons, owls, and vultures), corvids (Corvidae: ravens, crows, and magpies), columbids (Columbidae: doves and pigeons), waterbirds (waterfowl, gulls, shorebirds, cormorants, herons, egrets, pelicans, coots, and grebes), pheasants (nonnative ring-necked pheasants the sole representative), blackbirds and starlings, and other small birds (passerines, swallows, swifts, and woodpeckers).

We evaluated variation in detection rates for each species group (except uncommon pheasants) as a function of year, season, and site. For each species group, we averaged detection rates within sites across the surveys conducted in each quarterly season. Averaging detections in this way is a recommended and commonly used way of summarizing point count data (Nur et al. 1999) and helps avoid invalid inference that may result from temporally pseudoreplicated data. After summarizing the data in this way, we fit a generalized linear model (GLM) to the data for each species group, with average detection rates as the dependent variable and year, season, and site as predictors. We evaluated normality of residuals by visually inspecting q-q plots and applying Shapiro-Wilk tests. Because the data for blackbirds, columbids, and waterbirds were not normally distributed, for these groups we used the nonparametric Kruskal-Wallis rank sum test and pairwise Mann-Whitney U-tests to separately evaluate the effects of the three predictor variables on detection rates. We did not evaluate interactions between the three predictor variables quantitatively because of limited degrees of freedom following data summarization; however, we evaluated possible interactions qualitatively based on plots of predicted means. We evaluated significance of the three predictor variables at $\alpha = 0.05$, but also considered marginally significant results at $\alpha = 0.10$.

## 2.4 Documenting Raptor Prey and Carcass Scavengers

While conducting fatality and BUC surveys, placing bias-trial specimens, and traveling within the wind facility between survey locations, field staff recorded observations of potential raptor prey species and carcass scavengers they saw on or near the turbine plots. These observations were inherently haphazard in nature, depending on the daily schedule of carcass surveys, point counts, and other field activities. The focus was documenting occurrences of mammalian scavengers, nonavian prey species, and avian scavenger and prey species not seen regularly during the fatality and BUC surveys.

# Section 3.0 Results

## 3.1 Habitat Conditions

In Year 3 in the north section, two of the six surveyed turbine plots (108 and 109) supported grain crops that were harvested in June, and then the plots were grazed by sheep and remained in a post-harvest fallow state through the remainder of the survey (Appendix C). Both of these survey plots spanned dual ownerships and 10–15% of each plot remained fallow throughout the survey year. The other four plots surveyed in the north section remained fallow through October, variably grazed by sheep; were plowed in November and December; and then remained fallow through the end of the survey. All six of these north-section plots supported patches of tall (~2 m) mustard during the summer and generally until the plots were plowed in mid-November, which made carcass surveys a challenge. Although this issue applied in all three years of the study, mustard growth was more prevalent and affected a higher proportion of the surveys in Year 3 than in previous years, especially Year 2. In the central section, two of the six survey plots supported grain crops through June, and then were grazed by sheep and remained in a post-harvest fallow state through the remainder of the survey. The other four turbine plots surveyed in the central section were initially fallow and grazed by sheep; were plowed in April and remained in that state through fall; and then were seeded in November with a new grain crop that grew to medium stature by the end of the survey. In the south section, all three surveyed plots were initially fallow and grazed, by a mix of cattle and sheep. The plots were then plowed in May, remained in that state through fall, and then were seeded in December with a new grain crop that grew to medium-high stature by the end of the survey.

Besides the "mustard plots" in the north section, only two other survey plots, both in the south section (138 and 139), supported fallow vegetation that exceeded the 50-cm threshold for being classified as "high" vegetation in Year 3. Plots that supported spring grain crops also rose to high vegetation status before they were harvested in midsummer, and crops planted in winter rose to medium height by the end of the survey in February. Otherwise, because of dry conditions and grazing pressure, no survey plots supported more than medium-height vegetation outside of these season- and plot-specific situations. In many cases, plots supported parched earth and dry standing, harvested wheat stalks or standing and flattened old fallow vegetation throughout much of the survey year, until limited winter rainfall brought some relief to the area and allowed new growth of planted crops and fallow vegetation.

In Year 1, a relatively high proportion of the surveys were conducted on plots that supported grain crops or were plowed (Figure 6). In Year 2, most survey plots featured fallow and post-harvest fallow conditions for most of the year, reflecting the influence of drought diminishing the capacity for dryland crop cultivation. In Year 3, the six north-section survey plots were fallow most of the year, whereas a relatively high proportion of the central and southern plots were plowed until planted in winter.

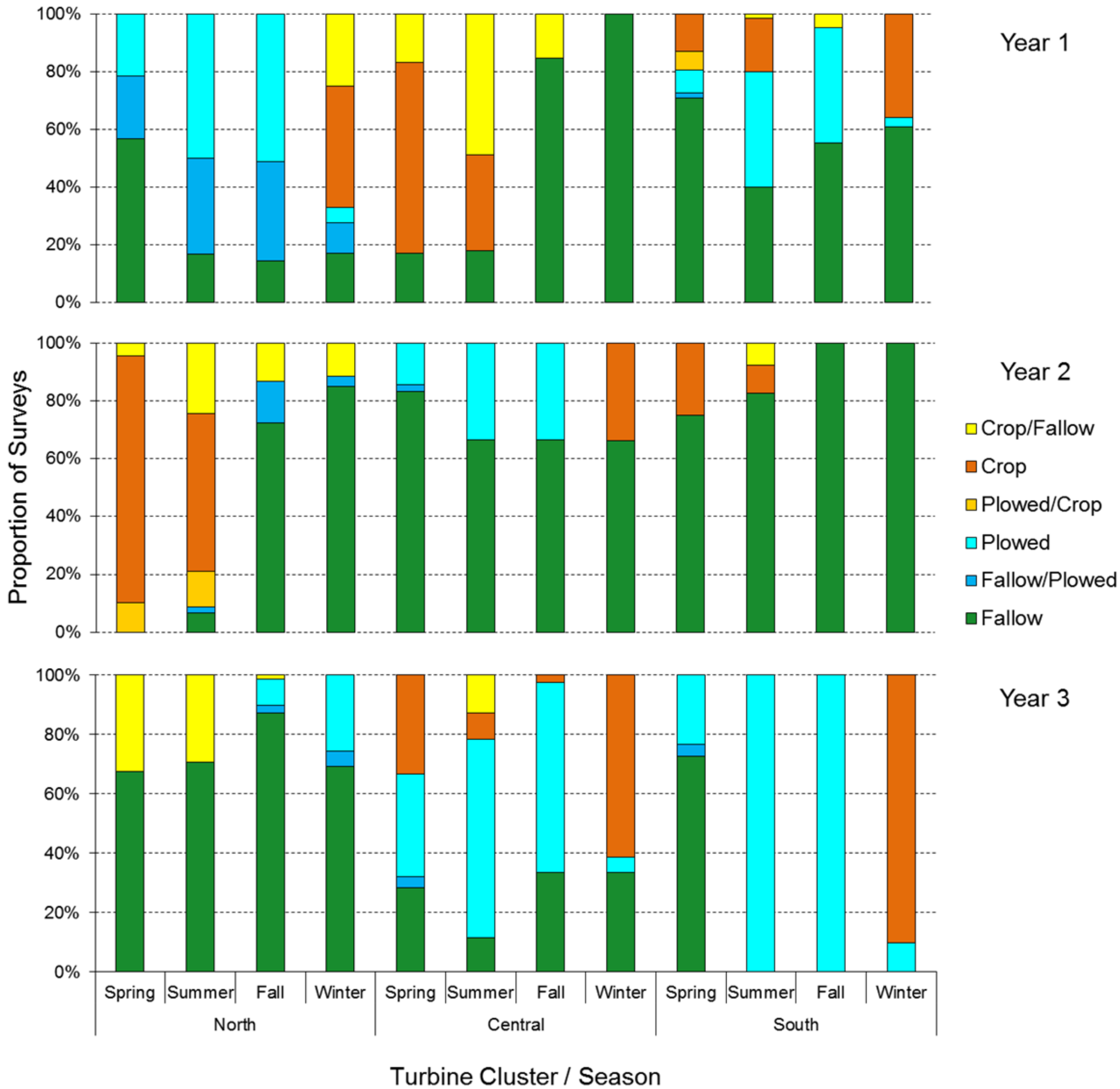



**Figure 6. Proportion of Turbine Surveys Conducted in Plots with Different Landcover Types by Survey Year, Turbine Section, and Season (Without Regard to Distinguishing Variation in Vegetation Height)**

## 3.2 Fatality Surveys

### 3.2.1 Survey Effort

Of 884 fatality surveys scheduled to occur in Year 3, 879 (828 turbine and 51 substation powerline) surveys occurred as planned on or within 1–2 days of the scheduled date, with minor variations to accommodate unexpected surveyor illness and primary holidays (Appendix C). Four scheduled turbine surveys did not occur because of active plowing, an equipment malfunction, and personnel constraints, and one substation powerline survey did not occur because of surveyor illness. In addition, one other turbine survey was curtailed prematurely because of fertilizer spraying.

The time it took to complete an individual turbine survey in Year 3 averaged 74 ± 5 (SD) minutes, ranging from 55–99 minutes. The time it took to complete an individual substation powerline survey averaged 16 ± 3 minutes, ranging from 11–23 minutes.

### 3.2.2 Composition of Fatality Incidents

During the course of the Year 3 surveys, we discovered 20 fatalities during the fatality surveys, no incidents during the substation powerline surveys, and one incidental large-bird fatality on a nonsurvey turbine plot (Table 4, Appendix E). The 20 incidents discovered during the turbine surveys included six bats, six small birds, three medium-sized birds, and five large birds. The bats were species commonly found as fatalities in the MHWRA: two hoary bats (*Lasiurus cinereus*) and four Mexican free-tailed bats (*Tadarida brasiliensis*). Two of the free-tailed bats showed definitive signs of blade-strike trauma (Appendix E). The small birds included three western meadowlarks (*Sturnella neglecta*), one white-crowned sparrow (*Zonotrichia leucophrys*), one warbling vireo (*Vireo gilvus*), and one sora (*Porzana carolina*). It appeared that one of the meadowlarks died of a broken neck. A second meadowlark was originally noticed intact on a turbine pad by a wind technician just before the end of Year 2, but the carcass was scavenged and by the time the surveyor discovered it during the first survey of Year 3. The third meadowlark also was only a feather spot at the time of discovery. The other small birds all showed definitive signs of blade-strike trauma. The medium-sized birds included 1 northern harrier, 1 barn owl (*Tyto alba*), and 1 mourning dove. The barn owl showed definitive signs of blade-strike trauma, whereas the harrier and mourning dove were mostly feather spots upon discovery. The large birds included one red-tailed hawk, one Swainson's hawk (*Buteo swainsoni*), one turkey vulture (*Cathartes aura*), one Ross's goose (*Chen rossii*), and one American white pelican (*Pelecanus erythrorhynchos*). The pelican, goose, and Swainson's hawk all showed definitive signs of blade-strike trauma, whereas no conclusive determination was possible for the vulture (shredded by a plow) and red-tailed hawk (discovered in a highly decayed state within a dense plot of tall mustard).

The single Year 3 incidental find was either a Ross's goose or snow goose (*Chen caerulescens*), and was found as a scattered feather spot near T121 on the same day we confirmed a Ross's goose blade-strike fatality at T123.

The Year 3 fatalities included three special-status species: a northern harrier (California species of special concern [CSSC]), a Swainson's hawk (California threatened), and an American white pelican (CSSC).

**Table 4. Fatality Incidents Discovered during Turbine Surveys and Incidentally by Year**

| | Year 1 | | Year 2 | | Year 3 | | |
|---|---|---|---|---|---|---|---|
| **Species**[1] | **Turbine Survey**[2] | **Incidental**[3] | **Turbine Survey** | **Incidental** | **Turbine Survey** | **Incidental** | **Total** |
| Hoary bat | 1 | 1 | 2 | | 1 (1) | | 6 |
| Mexican free-tailed bat | 1 | 1 | 4 | | 3 (1) | | 10 |
| American coot | (1) | | | | | | 1 |
| American kestrel | 1 (1) | 3 | 2 | | | | 7 |
| American white pelican* | | | | | 1 | | 1 |
| Barn owl | 1 | 2 | | | 1 | | 4 |
| Glaucous-winged gull | 1 | | | | | | 1 |
| House finch | | | 1 | | | | 1 |
| Horned lark | 1 | | | | | | 1 |
| Mourning dove | 1 | | 1 | | 1 | | 3 |
| Northern harrier* | 1 | 1 | | | 1 | | 3 |
| Ross's goose | | | | | 1 | | 1 |
| Ross's/snow goose | | | | | | 1 | 1 |
| Rock pigeon | 1 (1) | | 1 | | | | 3 |
| Red-tailed hawk | 2 (1) | | 3 (1) | 3 | (1) | | 11 |
| Red-winged blackbird | 1 | | 4 | | | | 5 |
| Sora | | | | | 1 | | 1 |
| Swainson's hawk* | | | | | 1 | | 1 |
| Tree swallow | | | 2 (1) | | | | 3 |
| Turkey vulture | 3 (1) | 4 | 2 | 1 | 1 | | 12 |
| Warbling vireo | | | | | 1 | | 1 |
| White-crowned sparrow | | | | | 1 | | 1 |
| Western grebe | 1 | | | | | | 1 |
| Western meadowlark | | | 1 | | 2 (1) | | 4 |
| White-throated swift | 1 | | | | | | 1 |
| Unidentified blackbird | 2 | | 1 (1) | | | | 4 |
| Unidentified small bird | | | | 1 | | | 1 |
| **Total** | **19 (5)** | **12** | **24 (3)** | **5** | **16 (4)** | **1** | **89** |

[1] Species marked with an asterisk are special-status species in California.

[2] Incidents discovered during turbine surveys were Included in adjusted fatality estimates, except that numbers in parentheses indicate carcasses that were excluded because they were classified as dead for more than one week.

[3] Incidental finds were excluded from analyses of adjusted fatality estimates.

The number of incidents found during the fatality surveys in Year 3 was similar but slightly lower than the numbers found in Years 1 and 2, whereas the number of documented incidental fatalities declined each year of the study (Table 4).

Of the 71 incidents discovered during the fatality surveys over the course of the 3-year study, we excluded 12 from analyses of adjusted fatality rates (5 in Year 1, 3 in Year 2, and 4 in Year 3), because they were estimated to have been dead for >7 days at the time of discovery. Of these incidents, one old red-tailed hawk carcass was found during the first survey of a Year 1 turbine (a "clearance" carcass), whereas the rest represented bleed through, which the Huso estimator does not accommodate. The excluded incidents comprised two bats, three small birds, three medium-sized birds, and four large birds (Table 4). Most of these cases involved discoveries of old carcasses in low-visibility high crop or fallow vegetation, or in areas that had been recently cleared of such vegetation. In one case during Year 2, a turkey vulture appeared to have been buried under a pile of cut straw and was discovered only once the stench of rot was easily detected. In a few cases, the determination of time since death was highly uncertain because we found only dried carcass scraps, but we chose to err on the side of caution and exclude such incidents from the adjusted fatality estimates. The four incidents excluded from the Year 3 calculations included the meadowlark originally found by a wind technician that had been scavenged and was not found until 10 days later by a surveyor (also effectively as "clearance" carcass for Year 3); a red-tailed hawk that had been hidden in a fallow field with tall mustard; a dried and torn hoary bat found in a patch of tall mustard; and a Mexican free-tailed bat found in a recently harvested grain field. The exclusions reduced the numbers of incidents available for calculation of adjusted fatality estimates to 17 birds and 2 bats in Year 1, 18 birds and 6 bats in Year 2, and 12 birds and 4 bats in Year 3 (Table 5).

### 3.2.3 Fatality Incidents and Habitat Visibility

The only Year 3 fatality-survey incidents found in low-visibility habitat patches (i.e., characterizing a few square meters in the immediate vicinity of the incident) were two hoary bats and a red-tailed hawk found in fallow fields with tall mustard. Of the remaining Year 3 incidents, approximately 50% were found in high visibility areas (i.e., on gravel pads or roads, a turbine-tower stair step, or finely plowed field) and 50% in medium visibility areas (i.e., fallow fields with low vegetation, coarsely plowed fields, or harvested crops with sparse standing stems). Across the 3-year study, 35% of the incidents discovered during fatality surveys were found in high visibility habitat situations, 56% in medium-visibility situations, and 9% in low visibility situations.

### 3.2.4 Temporal Distribution of Fatality Incidents

In Year 3, we documented bird and/or bat fatalities in all months except July and December (Appendix E). We detected most bat fatalities in fall (3 Mexican free-tailed bats and 1 hoary bat), with additional incidents in spring (1 hoary bat) and winter (1 Mexican free-tailed bat) (Figure 7). We detected small (2) and large (1) bird fatalities in spring, all three size classes of bird fatalities in summer (1 small, 2 medium, and 1 large) and fall (2 small, 1 medium, and 1 large), and only large bird fatalities in winter (2) (Figure 7). For bats, there was no consistent seasonal pattern of fatalities across the three study years; however, the total number of documented bat fatalities was highest in fall (8) and spring (5) and lower in summer (2) and winter (1) (Figure 7). For birds, the pattern of fatality accumulation across the seasons was similar in Years 1 and 2, with consistently lower numbers in summer and higher numbers in winter, whereas in Year 3 the number of documented fatalities was slightly higher in spring and lowest in winter (Figure 7). In general, though, the overall very low numbers of documented fatalities preclude discerning meaningful patterns.

**Table 5. Bird and Bat Fatalities Included in Calculations of Adjusted Fatality Estimates for Year 3 by Specimen Size Class, Season, and the Substrate Visibility Class of the Location Where the Specimen was Found**

| | | Season / Visibility Class[1] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Spring | | | Summer | | | Fall | | | Winter | | | |
| **Taxon** | **Size** | **High** | **Med** | **Low** | **High** | **Med** | **Low** | **High** | **Med** | **Low** | **High** | **Med** | **Low** | **Total** |
| **Year 1** | | | | | | | | | | | | | | |
| Bat | Small | | | | | | | 1 | 1 | | | | | 2 |
| Bird | Small | | | | 1 | | | | | | 3 | 1 | | 5 |
| | Medium | | 2 | | | | | | 2 | | 1 | 1 | | 6 |
| | Large | | 2 | | | 1 | | 1 | 2 | | | | | 6 |
| | **Total Year 1** | **0** | **4** | **0** | **1** | **1** | **0** | **2** | **5** | **0** | **4** | **2** | **0** | **19** |
| **Year 2** | | | | | | | | | | | | | | |
| Bat | Small | 2 | 1 | | | 2 | | 1 | | | | | | 6 |
| Bird | Small | 3 | 1 | | | | | | | | 1 | 4 | | 9 |
| | Medium | | | 1 | 1 | | | 1 | | | | 1 | | 4 |
| | Large | | 1 | | | | | 1 | 1 | | | 2 | | 5 |
| | **Total Year 2** | **5** | **3** | **1** | **1** | **2** | **0** | **3** | **1** | **0** | **1** | **7** | **0** | **24** |
| **Year 3** | | | | | | | | | | | | | | |
| Bat | Small | | | | | | | | 2 | 1 | | 1 | | 4 |
| Bird | Small | 1 | 1 | | 1 | | | 1 | 1 | | | | | 5 |
| | Medium | | | | | 2 | | 1 | | | | | | 3 |
| | Large | 1 | 1 | | | | | 1 | | | 1 | | | 4 |
| | **Total Year 3** | **2** | **2** | **0** | **1** | **2** | **0** | **3** | **3** | **1** | **1** | **1** | **0** | **16** |
| **Grand Total** | | **7** | **9** | **1** | **3** | **5** | **0** | **8** | **9** | **1** | **5** | **10** | **0** | **59** |

[1] See Table 1 for examples of habitats classified in different visibility classes.

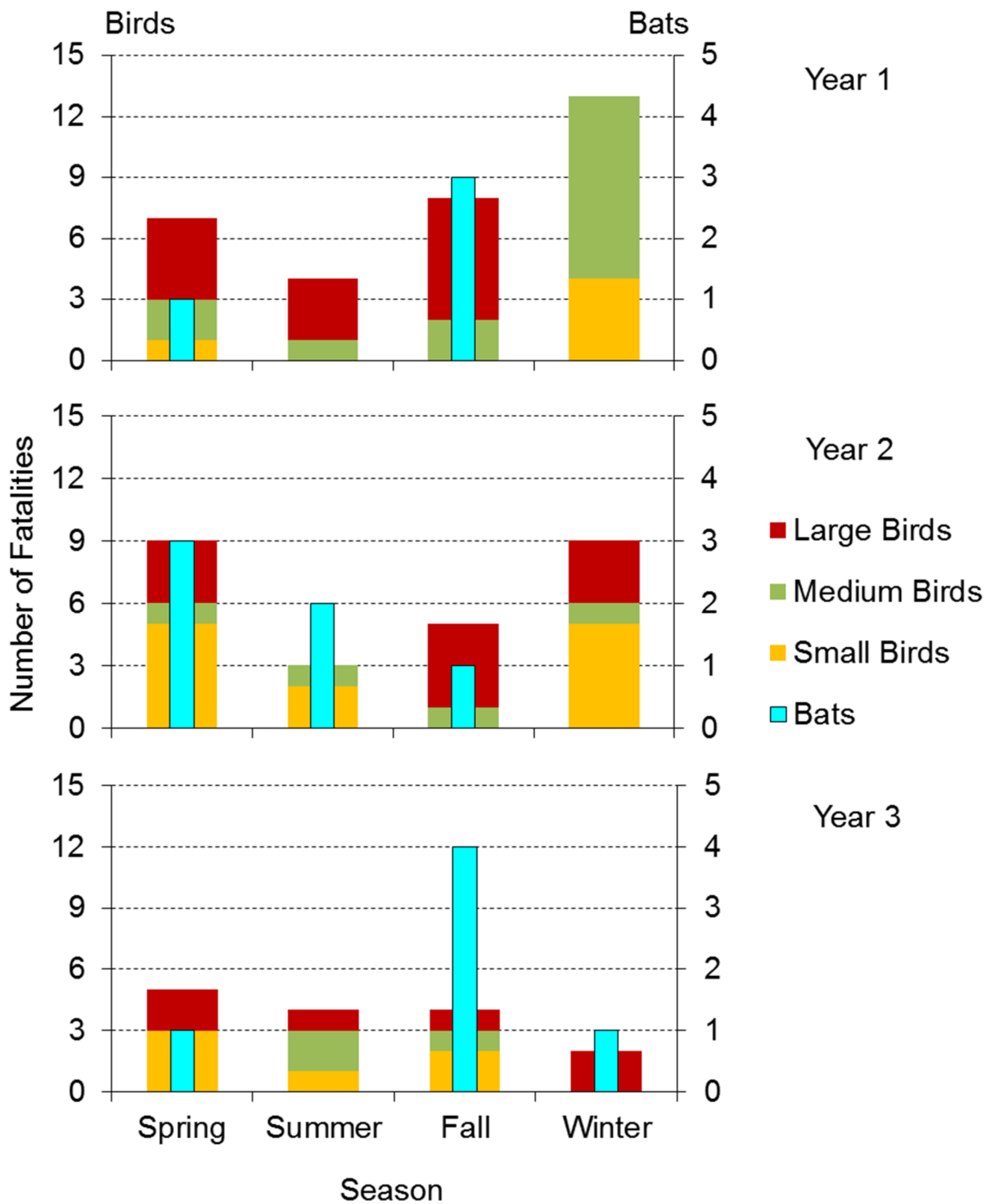



**Figure 7. Unadjusted Number of Bird and Bat Fatality Incidents (Including Incidental Finds) by Year and Season**

### 3.2.5 Spatial Distribution of Fatality Incidents

In Year 3, we documented no fatality or injury incidents during fatality surveys at 4 of the 16 surveyed turbines (3 north section, 1 south section), one fatality at seven turbines, two fatalities at three turbines (2 central section, 1 south section), three fatalities at one turbine (south section), and four fatalities at one turbine (central section) (Table 6, Figure 8). The Year 3 incidental finds included one goose fatality in the central section (Appendix D).

Each year of the study, 50% of the documented bat fatalities (fatality-survey and incidental finds combined) occurred in the central turbine section, 25–33% in the north turbine section, and 17–25% in the south turbine section (Figure 9). For all birds combined, the proportion of documented fatalities was again always highest in the central section (50–57%). There were also proportionately more bird fatalities in the north section than in the south section in Years 1 and 2, but the opposite was true in Year 3 (Figure 9). In addition, there was variability in pattern depending on the size class of birds involved, with fatalities of small birds least common in the central section in Year 1.

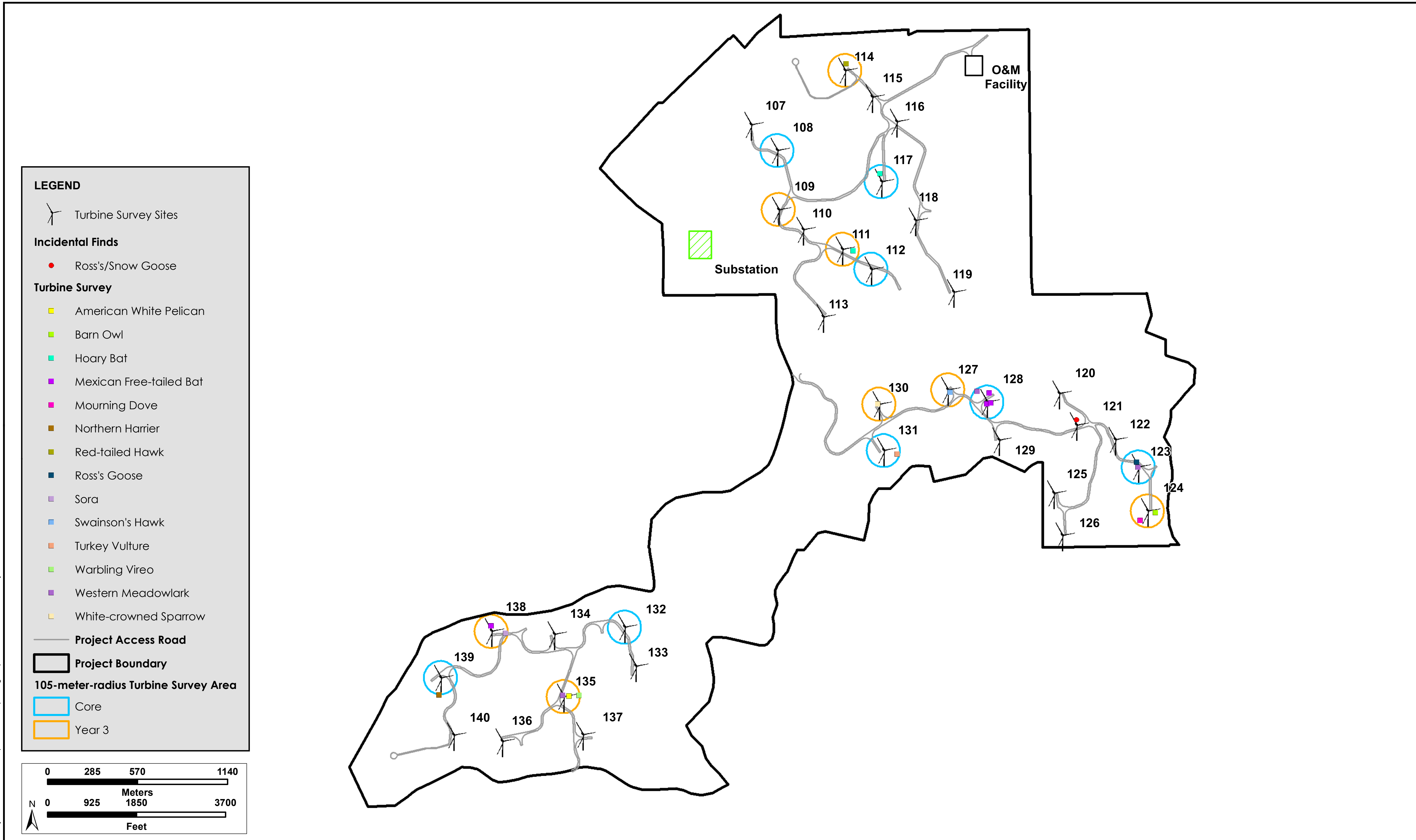
The multi-year surveys conducted at the eight core turbines mostly emphasized interannual variability rather than consistency in the pattern of fatality occurrences. Six of the eight core surveys yielded at least one bird or bat fatality each year, but none yielded bat fatalities in all 3 years and only two of the three core surveys in the central section yielded bird fatalities in all 3 years (Table 8). That said, the core surveys did show a relatively high tally of bird fatalities in both Years 1 and 2 at T117 in the north section and, conversely, highlighted that the highest single-year, single-turbine tally of fatalities (7 birds at T128 in Year 1) was not repeated in other years.

With data for birds and bats combined and including both fatality-survey and incidental finds, in Year 3 we found the highest proportions of fatalities in barren/gravel areas (33%), followed by fallow fields (29%), plowed/planted areas (24%), and crop fields (14%). For birds alone, the pattern was similar: 47% barren/gravel, 27% plowed/planted, 20% fallow, and 7% crop. For bats alone, however, the distribution relative to landscape cover was different: 50% fallow, 33% crop, and 17% plowed/planted. The proportional representation of fatalities within different landcover classes varied among the three turbine sections, with all north-section fatalities found in fallow fields, whereas we discovered fatalities in multiple landcover classes in both the central and south sections (Figure 10). Again with data for birds and bats combined, the proportional representation of fatalities in different landcover classes emphasized fallow fields more in Years 1 and 2, crop fields slightly more in Year 2, and plowed/planted areas and especially barren/gravel areas more in Year 3 (Figure 10). This pattern was consistent with the relatively high prevalence of fallow fields among the surveyed turbines in Years 1 and 2, and relatively high prevalence of plowed areas in Year 3 (Figure 6).

**Table 6. Unadjusted Numbers of Bird and Bat Fatalities Discovered During Fatality Surveys by Turbine and Year**

| | | Year 1 | | Year 2 | | Year 3 | | |
|---|---|---|---|---|---|---|---|---|
| **Section** | **Turbine[1]** | **Bat** | **Bird** | **Bat** | **Bird** | **Bat** | **Bird** | **Total** |
| North | 107 | 0 | 2 | | | | | 2 |
| | 108* | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | 109 | | | | | 0 | 0 | 0 |
| | 110 | | | 0 | 0 | | | 0 |
| | 111 | | | | | 1 | 0 | 1 |
| | 112 | | | | | 0 | 0 | 0 |
| | 113 | | | 0 | 1 | | | 1 |
| | 114 | | | | | 0 | 1 | 1 |
| | 115 | 0 | 1 | | | | | 1 |
| | 116 | | | 0 | 0 | | | 0 |
| | 117* | 0 | 2 | 1 | 3 | 1 | 0 | 7 |
| | 118 | 1 | 0 | | | | | 1 |
| | 119 | | | 1 | 0 | | | 1 |
| **North Total** | | **1** | **5** | **2** | **5** | **2** | **1** | **16** |
| Central | 121 | 0 | 1 | | | | | 1 |
| | 122 | | | 1 | 3 | | | 4 |
| | 123* | 0 | 1 | 1 | 1 | 0 | 2 | 5 |
| | 124 | | | | | 0 | 2 | 2 |
| | 125 | 0 | 1 | | | | | 1 |
| | 126 | | | 0 | 4 | | | 4 |
| | 127 | | | | | 0 | 1 | 1 |
| | 128* | 1 | 7 | 0 | 1 | 3 | 1 | 13 |
| | 129 | | | 1 | 2 | | | 3 |
| | 130 | | | | | 0 | 1 | 1 |
| | 131* | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| **Central Total** | | **1** | **11** | **3** | **11** | **3** | **8** | **37** |
| South | 132* | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| | 133 | | | 0 | 3 | | | 3 |
| | 134 | 0 | 1 | | | | | 1 |
| | 135 | | | | | 0 | 3 | 3 |
| | 136 | | | 0 | 2 | | | 2 |
| | 137 | 0 | 0 | | | | | 0 |
| | 138 | | | | | 1 | 1 | 2 |
| | 139* | 0 | 1 | 1 | 0 | 0 | 1 | 3 |
| | 140 | 0 | 1 | | | | | 1 |
| **South Total** | | **0** | **5** | **1** | **5** | **1** | **5** | **17** |
| **Total** | | **2** | **21** | **6** | **21** | **6** | **14** | **70** |

[1] Asterisks indicate "core" turbines that were surveyed during all 3 years; all other turbines were surveyed during only one year each, with the inclusion of specific fatality values indicative of the year surveyed.




N:\Projects3300\3353-01\Reports\Final Report\Fig 8 Spatial Distribution of Fatality Incidents in Year 3.mxd

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**Figure 8: Spatial Distribution of Fatality Incidents in Year 3**
**Montezuma II Wind Energy Project - Postconstruction Monitoring Final Report (3353-01)**
**May 2015**

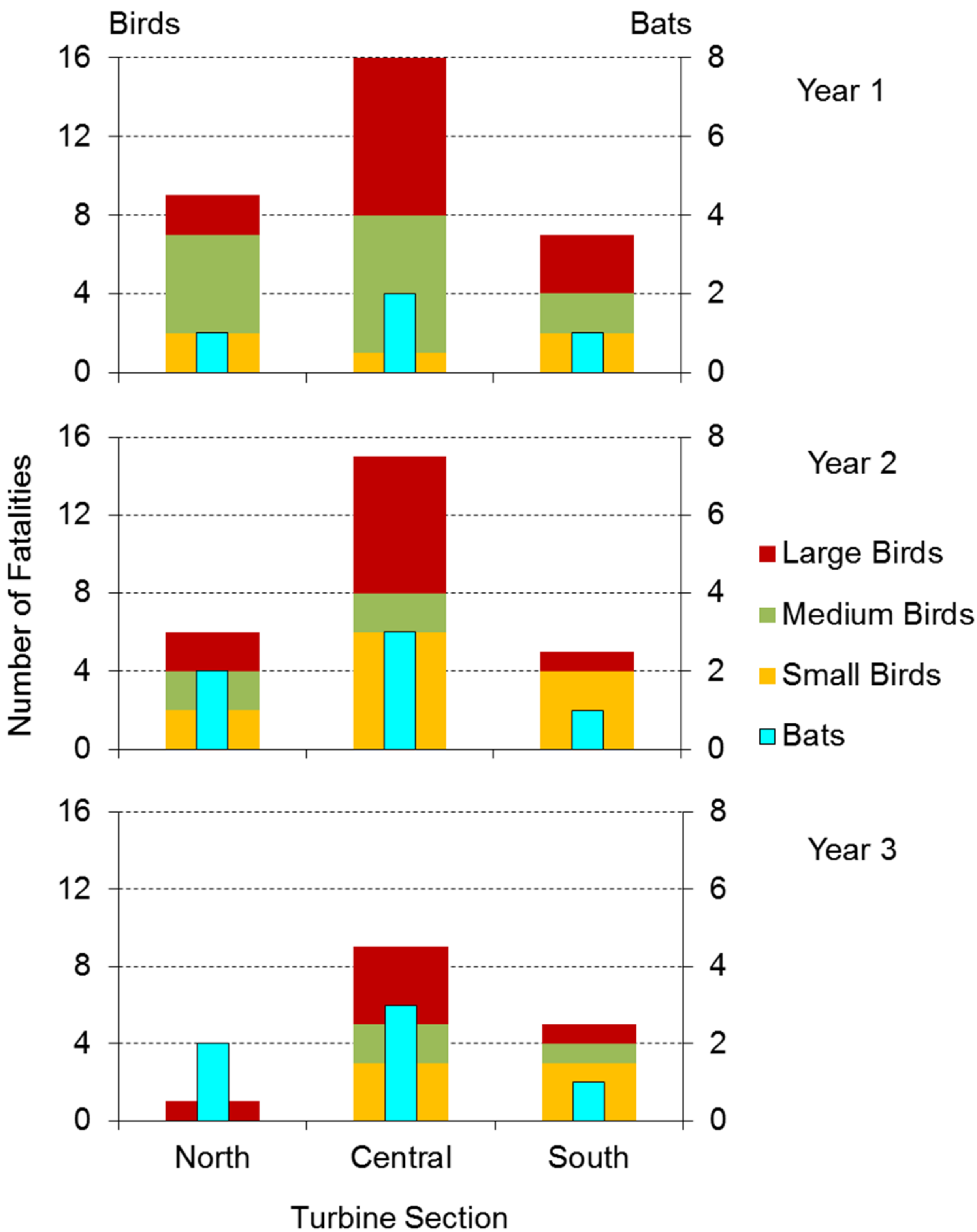



**Figure 9. Unadjusted Number of Bird and Bat Fatality Incidents (Including Incidental Finds) by Year and Turbine Section**

### 3.2.6 Adjusted Fatality Estimates

#### 3.2.6.1 Searcher efficiency

Based only on trial specimens that were confirmed present and available for detection at the time of the survey, the raw searcher-efficiency estimates for Year 3 were 80% for large birds (18 raptors of four species, 2 ring-necked pheasants, and 5 western gulls [*Larus occidentalis*]), 83% for medium birds (17 smaller raptors of three species and 7 individuals of three other species), 33% for small birds (51 individuals of 17 species), and 15% for bats (66 individuals of seven species) (Appendix A). Four of the five large birds that the surveyors failed to detect were placed in low visibility situations in high density, medium-height (great horned owl) or tall (great-horned owl, turkey vulture [in 2-m tall mustard], and ring-necked pheasant), fallow vegetation. The fifth (ring-necked pheasant) was placed in a coarsely plowed field.

The best multi-year model for searcher efficiency included carcass taxon/size class and visibility class as predictors, but no interaction term (Table 7). Modeled searcher-efficiency estimates ranged from 0.60–0.90 for medium/large birds, 0.13–0.48 for small birds, and 0.07–0.32 for bats, depending on the visibility class (Table 6). Searcher efficiency was consistently lowest in low-visibility circumstances, moderate in medium-visibility circumstances, and highest in high-visibility circumstances, with the difference between medium and high visibility classes relatively small, especially for medium/large birds.

**Table 7. Searcher Efficiency Estimates Generated by the USGS Fatality Estimator Software Using Data from Years 1–3 Combined and the Model: SE ≈ Taxon.Size + Visibility Class**

| Taxon / Size | Visibility Class | Number Placed[1] | Number Found | Searcher Efficiency | 95% CI |
|---|---|---|---|---|---|
| Bats | High | 44 | 16 | 0.32 | 0.21–0.44 |
| | Medium | 80 | 14 | 0.23 | 0.15–0.30 |
| | Low | 27 | 4 | 0.07 | 0.02–0.14 |
| Small birds | High | 22 | 8 | 0.48 | 0.33–0.62 |
| | Medium | 59 | 23 | 0.36 | 0.25–0.47 |
| | Low | 18 | 3 | 0.13 | 0.05-0.24 |
| Medium / large birds | High | 15 | 14 | 0.90 | 0.83–0.96 |
| | Medium | 60 | 53 | 0.85 | 0.77–0.92 |
| | Low | 23 | 11 | 0.60 | 0.41–0.76 |

[1] Totals include all trial specimens placed from winter quarter 2012/2013 through the end of the study that were recovered again after a given trial was completed.

#### 3.2.6.2 Carcass persistence

Based on nonmodeled data and a 28-day trial period, the average persistence time for large-bird carcasses in Year 3 was 12.9 ± 11.0 (SD) days (range 1 day up to the maximum trial period of 28 days), for medium birds

4.9 ± 4.8 days (range 1–18 days), for small birds 4.2 ± 2.0 days (range 1–8 days), and for bats 4.6 ± 2.3 days (range 1–13 days). Put another way, 93% of the bats, 89% of the small birds, 81% of the medium birds, and 41% of the large birds disappeared within a shorter period than the weekly search interval.

Using the estimator software, the best model for carcass persistence, based on Year 3 data alone, was the full model with taxon/size class, season, and taxon/size class x season as predictors, and was based on a Weibull failure time distribution (Model AIC 732.2; Table 8). Modeled carcass persistence averaged longer for medium/large birds, but was similar for small birds and bats. Inclusion of the interaction term in the model reflected that the estimated, average carcass persistence time for small birds did not vary seasonally, whereas persistence times averaged shorter in fall/winter than in spring/summer for bats and especially medium/large birds (Table 8). The modeled carcass-persistence estimates translated to 70–74% of medium/large birds, 46–47% of small birds, and 51–58% of bats persisting for longer than the typical 7-day search interval, depending on the season (Table 8).

**Table 8. Carcass Persistence Estimates by Taxon/Size Class and Season Generated by the USGS Fatality Estimator Software Using Year 3 Data and the Model: CP ≈ Taxon.Size + Season + Taxon.Size x Season**

| Taxon / Size | Season | Number Placed | Carcass Persistence Time (days) | 95% CI | Carcass Persistence Proportion | 95% CI |
|---|---|---|---|---|---|---|
| Bats[1] | Spring/Summer | 40 | 5.2 | 4.5–6.1 | 0.58 | 0.53–0.65 |
| | Fall/Winter | 30 | 4.1 | 3.5–4.8 | 0.51 | 0.43–0.57 |
| Small birds | Spring/Summer | 19 | 4.4 | 3.6–5.4 | 0.46 | 0.45–0.61 |
| | Fall/Winter | 19 | 4.4 | 3.6–5.2 | 0.47 | 0.44–0.60 |
| Medium/ large birds | Spring/Summer | 21 | 13.8 | 8.5–21.4 | 0.71 | 0.75–0.94 |
| | Fall/Winter | 23 | 7.1 | 3.9–11.2 | 0.74 | 0.48–0.83 |

Comparing modeled carcass persistence estimates for the three study years confirmed significant interannual variation in estimates of carcass persistence time for both birds and bats (Table 9). Bats persisted longer in Year 1 and for the shortest time in Year 2 during both spring/summer and fall/winter. A similar pattern applied to small birds in spring/summer; however, the persistence time for small birds during fall/winter declined each year. In contrast, for medium/large birds, average persistence time declined markedly each year in spring/summer, but was relatively high in Year 2 and much lower in both Year 1 and Year 3 during fall/winter. With regard to influencing the adjusted fatality estimates, however, the estimated carcass persistence proportions are the key values of interest. In this regard, the patterns indicated for bats and small birds, for which the estimated persistence times always averaged shorter than the 7-day search interval, were similar based on persistence times and proportions, except that there was comparatively little difference between Years 1 and 3 for bats based on persistence proportions (Table 9). In contrast, for medium/large birds, for which the estimated average persistence times were always ≥7 days, the interannual differences based on persistence proportions were less pronounced, especially in spring/summer.

**Table 9. Comparison of Modeled Carcass Persistence Estimates by Year**

| | | Year 1[1] | | | Year 2 | | | Year 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Taxon/Size** | **Season** | ***n*** | **CP** | **r** | ***n*** | **CP** | **r** | ***n*** | **CP** | **r** |
| Bats | Spring/Summer | 40 | 5.91 | 0.59 | 20 | 2.49 | 0.33 | 40 | 5.23 | 0.59 |
| | Fall/Winter | 42 | 4.22 | 0.49 | 35 | 3.44 | 0.43 | 30 | 4.12 | 0.50 |
| Birds–Small | Spring/Summer | 19 | 5.65 | 0.58 | 22 | 3.15 | 0.40 | 19 | 4.43 | 0.53 |
| | Fall/Winter | 21 | 6.71 | 0.63 | 19 | 4.90 | 0.54 | 19 | 4.42 | 0.53 |
| Birds–Medium/Large | Spring/Summer | 18 | 34.09 | 0.91 | 25 | 18.01 | 0.84 | 21 | 13.78 | 0.86 |
| | Fall/Winter | 18 | 7.51 | 0.66 | 21 | 14.08 | 0.80 | 23 | 7.08 | 0.70 |

[1] *n* = number of trial carcasses. CP = estimated carcass persistence in days. r = estimated proportion of carcasses persisting for ≥7 days.

### 3.2.6.3 Fatality estimates

For bats in Year 3, with fatality-survey incidents documented only in fall and winter, the adjusted annual fatality estimates were 3.40 bats per turbine and 116 bats for the whole facility (Table 10). The adjusted estimates for fall were approximately five times higher than the estimates for winter. The estimates for Mexican free-tailed bats and hoary bats were similar (Table 11). For raptors in Year 3, with fatality-survey incidents documented in all seasons except winter, the adjusted annual fatality estimates were 0.37 raptors per turbine and 13 raptors for the whole facility (Table 10). The seasonal estimates for spring and summer were similar, whereas the estimates for fall were approximately twice as high. Note, however, that inclusion of an excluded bleed-through red-tailed hawk found in early June—therefore likely a spring fatality—would render the spring and fall estimates more similar. For other birds in Year 3, with fatality-survey incidents documented in all seasons, the adjusted annual fatality estimates were 1.70 birds per turbine and 58 birds for the whole facility (Table 10). The other-bird fatality estimates were highest in spring, about 50% lower in summer and fall, and lowest in winter. For all birds combined in Year 3, the adjusted fatality estimates were 2.07 birds per turbine and 71 birds for the whole facility (Table 11).

The Year 3 adjusted annual fatality estimates for species documented during fatality surveys ranged from 0.08–1.74 fatalities per turbine and from 4–60 total fatalities (Table 11). The facility-wide species-specific estimates ranged from 3–4 fatalities each for seven species of raptors and other medium/large bird species, 9–21 fatalities each for four species of small birds, and 57–60 fatalities each for two bat species. Within these groups, the only noteworthy variation in the adjusted fatality estimates pertained to slight differences within the group of small birds (Table 11). With only one carcass of each species found, the fatality estimates for all large and medium-sized bird species were similar. The adjusted estimates for the two bat species also were similar, despite our having found three times more Mexican free-tailed bats that qualified for analysis. This

**Table 10. Adjusted Fatality Estimates for Bats, Raptors, and Other Birds by Season in Year 3**

| Group | Season | Number Found | Per Turbine Estimate | 95% CI | Per MW[1] Estimate | 95% CI | Facility[1] Estimate | 95% CI |
|---|---|---|---|---|---|---|---|---|
| Bats | Spring | 0 | 0 | – | | | 0 | – |
| | Summer | 0 | 0 | – | | | 0 | – |
| | Fall | 3 | 2.85 | 0.51–7.72 | 1.33 | 0.23–3.61 | 97 | 17–263 |
| | Winter | 1 | 0.56 | 0.42–2.08 | 0.27 | 0.19–0.98 | 20 | 14–71 |
| | Combined | 4 | 3.40 | 0.57–8.43 | 1.48 | 0.24–3.67 | 116 | 19–287 |
| Raptors | Spring | 1 | 0.08 | 0.07–0.28 | 0.04 | 0.03–0.14 | 3 | 2–10 |
| | Summer | 1 | 0.09 | 0.08–0.28 | 0.05 | 0.03–0.14 | 4 | 2–10 |
| | Fall | 2 | 0.20 | 0.09–0.53 | 0.10 | 0.04–0.26 | 7 | 3–19 |
| | Winter | 0 | 0 | – | – | – | 0 | – |
| | Combined | 4 | 0.37 | 0.10–0.70 | 0.17 | 0.04–0.31 | 13 | 3–24 |
| Other Birds | Spring | 3 | 0.66 | 0.21–1.70 | 0.32 | 0.10–0.81 | 23 | 7–58 |
| | Summer | 2 | 0.33 | 0.08–0.97 | 0.16 | 0.03–0.47 | 12 | 2–33 |
| | Fall | 2 | 0.61 | 0.23–1.63 | 0.10 | 0.04–0.26 | 21 | 7–56 |
| | Winter | 1 | 0.10 | 0.08–0.36 | 0.05 | 0.03–0.18 | 4 | 2–13 |
| | Combined | 8 | 1.70 | 0.58–3.38 | 0.74 | 0.24–1.47 | 58 | 19–115 |

[1] The facility is composed of 34 turbines, with a total nameplate generation capacity of 72.8 MW.

**Table 11. Adjusted Fatality Estimates for Individual Bat and Bird Species in Year 3**

| Species | Number Found | Per Turbine Estimate | 95% CI | Per MW[1] Estimate | 95% CI | Facility[1] Estimate | 95% CI |
|---|---|---|---|---|---|---|---|
| Hoary bat | 1 | 1.74 | 0.95–7.11 | 0.77 | 0.41–3.09 | 60 | 32–242 |
| Mexican free-tailed bat | 3 | 1.67 | 0.47–4.62 | 0.73 | 0.19–2.02 | 57 | 15–158 |
| **All Bats** | **4** | **0.34** | **0.57–8.43** | **1.48** | **0.24–3.67** | **116** | **19–287** |
| Barn owl | 1 | 0.10 | 0.08–0.37 | 0.05 | 0.03–0.17 | 4 | 2–13 |
| Northern harrier | 1 | 0.09 | 0.08–0.28 | 0.05 | 0.03–0.13 | 4 | 2–10 |
| Swainson's hawk | 1 | 0.08 | 0.07–0.28 | 0.04 | 0.03–0.13 | 3 | 2–10 |
| Turkey vulture | 1 | 0.10 | 0.08–0.36 | 0.05 | 0.03–0.17 | 4 | 2–13 |
| **All Raptors** | **4** | **3.40** | **0.57–8.43** | **0.17** | **0.04–0.31** | **13** | **3–24** |
| American white pelican | 1 | 0.09 | 0.08–0.27 | 0.05 | 0.03–0.13 | 4 | 2–10 |
| Mourning dove | 1 | 0.09 | 0.08–0.28 | 0.05 | 0.03–0.13 | 4 | 2–10 |
| Ross's goose | 1 | 0.10 | 0.08–0.36 | 0.05 | 0.03–0.17 | 4 | 2–13 |
| Sora | 1 | 0.25 | 0.19–0.91 | 0.12 | 0.08–0.40 | 9 | 6–31 |
| Warbling vireo | 1 | 0.33 | 0.25–1.18 | 0.15 | 0.10–0.52 | 12 | 8–41 |
| White-crowned sparrow | 1 | 0.25 | 0.19–0.93 | 0.12 | 0.08–0.41 | 9 | 6–32 |
| Western meadowlark | 2 | 0.61 | 0.23–1.53 | 0.27 | 0.09–0.68 | 21 | 7–53 |
| **All Other Birds** | **8** | **1.70** | **0.58–3.38** | **0.74** | **0.24–1.47** | **58** | **19–115** |
| **All Birds** | **12** | **2.07** | **1.05–3.54** | **0.91** | **0.45–1.55** | **71** | **35–121** |

[1] The facility is composed of 34 turbines, with a total nameplate generation capacity of 72.8 MW.

outcome reflects the combination of very low overall samples sizes and the marked influence of having found the single hoary bat in a low-visibility circumstance (second hoary bat found in a similar circumstance but excluded as bleed through) and the three free-tailed bats in medium-visibility circumstances (fourth excluded as bleed-through also found in a medium-visibility circumstance). Within the small birds group, the adjusted fatality estimates were similar for three species for which we found only one carcass (sora, warbling vireo, and white-crowned sparrow) and higher for western meadowlark, for which we found two carcasses that qualified for analysis (third carcass excluded as bleed-through) (Table 11).

Comparing adjusted fatality estimates for the three survey years revealed only subtle variants compared to the patterns illustrated by the non-modeled data in Figures 7 and 8. The modeled data reiterated that the bat and small-bird fatality rates followed similar interannual patterns, with the lowest rates in Year 1 and highest rates in Year 2, whereas the medium/large-bird fatality rate declined each year of the study (Table 12). The modeled data also reiterated that the bat fatality rate was highest during fall in Years 1 and 3, but highest during spring in Year 2. In contrast, in aggregate across the 3-year study, small-bird fatalities tended to be most prevalent during winter and spring, but the patterns of seasonal representation were not consistent from year to year, except that the winter fatality rate was highest in both Year 1 and Year 2. Medium/large bird fatalities were more widely distributed; at least one fatality qualified for analysis in every quarterly season of the study, but the relative prevalence of fatalities in different seasons varied among years (Table 12).

**Table 12. Adjusted Per-Turbine Fatality Rates for Bats and Birds by Year and Season**

| | | Year 1 | | Year 2 | | Year 3 | |
|---|---|---|---|---|---|---|---|
| **Taxon/Size** | **Season** | **Number Found** | **Per Turbine Fatality Estimate** | **Number Found** | **Per Turbine Fatality Estimate** | **Number Found** | **Per Turbine Fatality Estimate** |
| Bats | Spring | 0 | 0 | 3 | 2.73 | 0 | 0 |
| | Summer | 0 | 0 | 2 | 1.67 | 0 | 0 |
| | Fall | 2 | 0.91 | 1 | 0.43 | 3 | 2.85 |
| | Winter | 0 | 0 | 0 | 0 | 1 | 0.56 |
| **All Bats** | | **2** | **0.91** | **6** | **4.83** | **4** | **3.40** |
| Birds | Spring | 0 | 0 | 4 | 1.33 | 2 | 0.58 |
| Small | Summer | 1 | 0.20 | 0 | 0 | 1 | 0.25 |
| | Fall | 0 | 0 | 0 | 0 | 2 | 0.61 |
| | Winter | 4 | 0.85 | 5 | 1.42 | 0 | 0 |
| **All Small Birds** | | **5** | **1.05** | **9** | **2.76** | **5** | **1.43** |
| Birds | Spring | 4 | 0.30 | 2 | 0.20 | 2 | 0.17 |
| Medium/Large | Summer | 1 | 0.08 | 1 | 0.08 | 2 | 0.17 |
| | Fall | 5 | 0.48 | 3 | 0.25 | 2 | 0.20 |
| | Winter | 2 | 0.21 | 3 | 0.26 | 1 | 0.10 |
| **All Medium/Large Birds** | | **12** | **1.06** | **9** | **0.79** | **7** | **0.64** |
| **All Birds** | | **17** | **2.12** | **18** | **3.55** | **12** | **2.07** |

## 3.3 Bird Use Counts

### 3.3.1 Survey Effort

Of 408 individual counts scheduled to occur in Year 3 between 6 March 2014 and 26 February 2015, all occurred as scheduled or within 1–2 days of the original scheduled date, except during one week in October and one week in December when surveyor illness intervened (Appendix F).

### 3.3.2 Species Composition

During Year 3, we recorded 26,421 individual bird detections involving 52 identified species (Table 13). These included 9 species of raptors, 13 species of waterbirds, 4 species of blackbirds and starlings, 3 species of pigeons and doves, 3 species of corvids, 1 species of pheasant, and 19 species of passerines and other small birds. The surveyors were unable to identify to species 1% of the total individual detections. Special-status species recorded during the counts included Swainson's hawk (California threatened), golden eagle (California fully protected), peregrine falcon (*Falco peregrinus*; California fully protected), northern harrier (CSSC breeding), American white pelican (CSSC breeding), tricolored blackbird (*Agelaius tricolor*; California endangered—emergency 180-day listing on 3 December 2014), and loggerhead shrike (*Lanius ludovicianus*; CSSC breeding).

Based on the number of individual surveys during which at least one individual of a species was seen, the 10 species most frequently encountered during the Year 3 BUCs were, in descending order of prevalence, horned lark (*Eremophila alpestris*), red-tailed hawk, turkey vulture, common raven, western meadowlark, rock pigeon, American kestrel, mourning dove, loggerhead shrike, and American pipit (*Anthus rubescens*) (Table 13). Based on total counts and average detection rates, however, the top-10 list looked different, with tricolored blackbird topping the list, followed in descending order of abundance by Brewer's blackbird (*Euphagus cyanocephalus*), rock pigeon, red-winged blackbird (*Agelaius phoeniceus*), horned lark, American pipit, turkey vulture, European starling, western meadowlark, and house finch (*Haemorhous mexicanus*) (Table 13).

Across the 3 years of study, we tallied a remarkably consistent 52 species each year; however, the species represented each year differed. We recorded a combined total of 72 species during the 3-year study, but only 32 species were present every year. Species that each year ranked among the top 10 species in terms of frequency of occurrence were horned lark, red-tailed hawk, turkey vulture, common raven, western meadowlark, and American kestrel. Species that each year ranked among the top 10 species in terms of average detections per hour were horned lark, tricolored blackbird, Brewer's blackbird, red-winged blackbird, western meadowlark, and rock pigeon. Across the study, the species tally included 16 species of raptors, 20 species of waterbirds, 3 species of pigeons and doves, 1 species of pheasant, 3 species of corvids, 5 species of blackbirds and starlings, 6 species of swallows and swifts, 1 species of woodpecker, and 17 species of other passerines.

## Table 13. Frequency of Occurrence, Total Counts, and Detection Rates for Birds by Species and Count Site: Year 3

| | Frequency of Occurrence[1] | | | | | Total Count | | | | | Detections Per Hour | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** **Site** | **1** | **2** | **3** | **4** | **Combined** | **1** | **2** | **3** | **4** | **Combined** | **1** | **2** | **3** | **4** | **Combined** |
| **Raptors** | | | | | | | | | | | | | | | |
| American kestrel | 31 | 18 | 31 | 15 | 95 | 33 | 23 | 34 | 16 | 106 | 0.66 | 0.46 | 0.68 | 0.32 | 0.53 |
| Golden eagle | 1 | 10 | 4 | 2 | 17 | 1 | 12 | 4 | 2 | 19 | 0.02 | 0.24 | 0.08 | 0.04 | 0.10 |
| Merlin | 1 | 1 | 0 | 2 | 4 | 1 | 1 | 0 | 2 | 4 | 0.02 | 0.02 | 0.00 | 0.04 | 0.02 |
| Northern harrier | 2 | 12 | 22 | 9 | 45 | 2 | 15 | 27 | 10 | 54 | 0.04 | 0.30 | 0.54 | 0.20 | 0.27 |
| Peregrine falcon | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0.00 | 0.00 | 0.02 | 0.00 | 0.01 |
| Prairie falcon | 3 | 3 | 1 | 0 | 7 | 3 | 4 | 1 | 0 | 8 | 0.06 | 0.08 | 0.02 | 0.00 | 0.04 |
| Red-tailed hawk | 39 | 58 | 60 | 55 | 212 | 42 | 76 | 84 | 69 | 271 | 0.84 | 1.52 | 1.68 | 1.38 | 1.36 |
| Swainson's hawk | 0 | 6 | 2 | 1 | 9 | 0 | 18 | 4 | 1 | 23 | 0.00 | 0.36 | 0.08 | 0.02 | 0.12 |
| Turkey vulture | 33 | 48 | 51 | 64 | 196 | 127 | 199 | 205 | 411 | 942 | 2.54 | 3.98 | 4.10 | 8.22 | 4.71 |
| Unidentified raptor | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0.00 | 0.00 | 0.02 | 0.00 | 0.01 |
| **All Raptors** | **77** | **88** | **86** | **86** | **337** | **209** | **348** | **361** | **511** | **1,429** | **4.18** | **6.96** | **7.22** | **10.22** | **7.15** |
| **Waterbirds** | | | | | | | | | | | | | | | |
| American coot | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 91 | 91 | 0.00 | 0.00 | 0.00 | 1.82 | 0.46 |
| American white pelican | 1 | 0 | 0 | 1 | 2 | 4 | 0 | 0 | 5 | 9 | 0.08 | 0.00 | 0.00 | 0.10 | 0.05 |
| Canada goose | 2 | 1 | 1 | 3 | 7 | 6 | 2 | 7 | 34 | 49 | 0.12 | 0.04 | 0.14 | 0.68 | 0.25 |
| Cinnamon teal | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 |
| Double-crested cormorant | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 12 | 12 | 0.00 | 0.00 | 0.00 | 0.24 | 0.06 |
| Domestic goose | 1 | 0 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 7 | 0.14 | 0.00 | 0.00 | 0.00 | 0.04 |
| Great blue heron | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 |
| Greater white-fronted goose | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 3 | 4 | 0.00 | 0.02 | 0.00 | 0.06 | 0.02 |
| Killdeer | 15 | 11 | 9 | 13 | 48 | 159 | 27 | 109 | 49 | 344 | 3.18 | 0.54 | 2.18 | 0.98 | 1.72 |
| Mallard | 1 | 2 | 0 | 4 | 7 | 2 | 10 | 0 | 11 | 23 | 0.04 | 0.20 | 0.00 | 0.22 | 0.12 |
| Northern pintail | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 |

| Species | Site | Frequency of Occurrence[1] 1 | 2 | 3 | 4 | Combined | Total Count 1 | 2 | 3 | 4 | Combined | Detections Per Hour 1 | 2 | 3 | 4 | Combined |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern shoveler | | 0 | 1 | 0 | 1 | 2 | 0 | 1 | 0 | 1 | 2 | 0.00 | 0.02 | 0.00 | 0.02 | 0.01 |
| Snow goose | | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 7 | 7 | 0.00 | 0.00 | 0.00 | 0.14 | 0.04 |
| Unidentified gull | | 0 | 0 | 1 | 5 | 6 | 0 | 0 | 2 | 16 | 18 | 0.00 | 0.00 | 0.04 | 0.32 | 0.09 |
| **All Waterbirds** | | **19** | **15** | **11** | **32** | **77** | **178** | **41** | **118** | **234** | **571** | **3.56** | **0.82** | **2.36** | **4.68** | **2.86** |
| **Crows, Ravens & Allies** | | | | | | | | | | | | | | | | |
| American crow | | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 3 | 0.18 | 0.00 | 0.00 | 0.00 | 0.05 |
| Common raven | | 24 | 30 | 24 | 43 | 121 | 190 | 23 | 3 | 6 | 222 | 1.16 | 1.80 | 1.64 | 3.30 | 1.98 |
| Yellow-billed magpie | | 2 | 0 | 0 | 0 | 2 | 1,245 | 848 | 474 | 57 | 2,624 | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 |
| **All Crows & Ravens** | | **26** | **30** | **24** | **43** | **123** | **1,435** | **871** | **479** | **64** | **2,849** | **1.38** | **1.80** | **1.64** | **3.30** | **2.03** |
| **Pigeons & Doves** | | | | | | | | | | | | | | | | |
| Eurasian collared-dove | | 0 | 0 | 1 | 1 | 2 | 9 | 0 | 0 | 0 | 9 | 0.00 | 0.00 | 0.04 | 0.02 | 0.02 |
| Mourning dove | | 53 | 8 | 3 | 4 | 68 | 58 | 90 | 82 | 165 | 395 | 3.80 | 0.46 | 0.06 | 0.12 | 1.11 |
| Rock pigeon | | 44 | 35 | 25 | 4 | 108 | 2 | 0 | 0 | 0 | 2 | 24.90 | 16.96 | 9.48 | 1.14 | 13.12 |
| **All Pigeons & Doves** | | **73** | **39** | **28** | **8** | **148** | **69** | **90** | **82** | **165** | **406** | **28.70** | **17.42** | **9.58** | **1.28** | **14.25** |
| **Quail & Pheasants** | | | | | | | | | | | | | | | | |
| Ring-necked pheasant | | **0** | **0** | **0** | **3** | **3** | **0** | **0** | **0** | **3** | **3** | **0.00** | **0.00** | **0.00** | **0.06** | **0.02** |
| **Blackbirds & Starlings** | | | | | | | | | | | | | | | | |
| Brewer's blackbird | | 13 | 10 | 6 | 13 | 42 | 2,079 | 2,083 | 100 | 360 | 4,622 | 41.58 | 41.66 | 2.00 | 7.20 | 23.11 |
| European starling | | 20 | 5 | 16 | 3 | 44 | 520 | 58 | 246 | 43 | 867 | 10.40 | 1.16 | 4.92 | 0.86 | 4.34 |
| Red-winged blackbird | | 13 | 11 | 9 | 8 | 41 | 353 | 1,258 | 501 | 344 | 2,456 | 7.06 | 25.16 | 10.02 | 6.88 | 12.28 |
| Tricolored blackbird | | 4 | 3 | 6 | 5 | 18 | 3,666 | 210 | 1,024 | 1,092 | 5,992 | 73.32 | 4.20 | 20.48 | 21.84 | 29.96 |
| Unidentified blackbird | | 0 | 1 | 0 | 0 | 1 | 0 | 2,509 | 0 | 0 | 2,509 | 0.00 | 50.18 | 0.00 | 0.00 | 12.55 |
| **All Blackbirds & Starlings** | | **41** | **22** | **29** | **21** | **113** | **6,618** | **6,118** | **1,871** | **1839** | **16,446** | **132.360** | **122.360** | **37.420** | **36.780** | **82.230** |
| **Other Small Birds** | | | | | | | | | | | | | | | | |
| American goldfinch | | 2 | 7 | 5 | 0 | 14 | 44 | 178 | 57 | 0 | 279 | 0.88 | 3.56 | 1.14 | 0.00 | 1.40 |

| Species Site | Frequency of Occurrence[1] | | | | | Total Count | | | | | Detections Per Hour | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | Combined | 1 | 2 | 3 | 4 | Combined | 1 | 2 | 3 | 4 | Combined |
| American pipit | 7 | 15 | 15 | 14 | 51 | 102 | 363 | 307 | 195 | 967 | 2.04 | 7.26 | 6.14 | 3.90 | 4.84 |
| American robin | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 3 | 3 | 0.00 | 0.00 | 0.00 | 0.06 | 0.02 |
| Barn swallow | 1 | 1 | 2 | 1 | 5 | 16 | 12 | 9 | 7 | 44 | 0.32 | 0.24 | 0.18 | 0.14 | 0.22 |
| Cliff swallow | 2 | 0 | 3 | 12 | 17 | 23 | 0 | 23 | 82 | 128 | 0.46 | 0.00 | 0.46 | 1.64 | 0.64 |
| House finch | 28 | 8 | 5 | 5 | 46 | 429 | 75 | 64 | 42 | 610 | 8.58 | 1.50 | 1.28 | 0.84 | 3.05 |
| Horned lark | 50 | 62 | 44 | 59 | 215 | 308 | 463 | 268 | 390 | 1429 | 6.16 | 9.26 | 5.36 | 7.80 | 7.15 |
| House sparrow | 0 | 1 | 0 | 1 | 2 | 0 | 4 | 0 | 5 | 9 | 0.00 | 0.08 | 0.00 | 0.10 | 0.05 |
| Lesser goldfinch | 1 | 1 | 0 | 0 | 2 | 6 | 8 | 0 | 0 | 14 | 0.12 | 0.16 | 0.00 | 0.00 | 0.07 |
| Loggerhead shrike | 35 | 11 | 5 | 9 | 60 | 38 | 11 | 6 | 9 | 64 | 0.76 | 0.22 | 0.12 | 0.18 | 0.32 |
| Northern flicker | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 |
| Northern mockingbird | 6 | 1 | 0 | 0 | 7 | 6 | 1 | 0 | 0 | 7 | 0.12 | 0.02 | 0.00 | 0.00 | 0.04 |
| Northern rough-winged swallow | 1 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 5 | 0.10 | 0.00 | 0.00 | 0.00 | 0.03 |
| Say's phoebe | 12 | 0 | 3 | 1 | 16 | 12 | 0 | 3 | 1 | 16 | 0.24 | 0.00 | 0.06 | 0.02 | 0.08 |
| Savannah sparrow | 3 | 3 | 1 | 2 | 9 | 50 | 19 | 17 | 34 | 120 | 1.00 | 0.38 | 0.34 | 0.68 | 0.60 |
| Tree swallow | 0 | 0 | 2 | 3 | 5 | 0 | 0 | 14 | 38 | 52 | 0.00 | 0.00 | 0.28 | 0.76 | 0.26 |
| Western kingbird | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 2 | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 |
| Western meadowlark | 20 | 37 | 28 | 29 | 114 | 226 | 195 | 188 | 152 | 761 | 4.52 | 3.90 | 3.76 | 3.04 | 3.81 |
| White-throated swift | 0 | 1 | 1 | 21 | 23 | 0 | 7 | 2 | 197 | 206 | 0.00 | 0.14 | 0.04 | 3.94 | 1.03 |
| **All Other Small Birds** | **90** | **82** | **68** | **89** | **329** | **1268** | **1336** | **958** | **1155** | **4717** | **25.36** | **26.72** | **19.16** | **23.10** | **23.59** |
| **All Species** | **100** | **99** | **95** | **98** | **392** | **9,777** | **8,804** | **3,869** | **3,971** | **26,421** | **195.54** | **176.08** | **77.38** | **79.42** | **132.11** |

[1] Number of individual surveys during which ≥1 individual of the species or group was seen.

### 3.3.3 Temporal and Spatial Distribution of Activity

With data combined across all species, seasons, and sites, the average detection rate declined each year, but most substantially between Years 1 and 2: 308 detections per hour in Year 1, 145 detections per hour in Year 2, and 132 detections per hour in Year 3. The Year 2 average detection rates were ≥50% lower than in Year 1 for 26 species and ≥25% lower for eight other species, including 11 species that were seen in Year 1 but not in Year 2 (see Table 23 presented in the Discussion section). In Year 3, the detection rates declined further for eight of these species, and fell to ≥50% below the Year 1 rates for another six species, including an additional eight species that were detected in Years 1 and 2 but not in Year 3. Commonly occurring species for which the detection rates declined noticeably through the study included northern harrier, rough-legged hawk (*Buteo lagopus*), great horned owl, long-billed curlew (*Numenius americanus*), American wigeon (*Anas americana*), mourning dove, red-winged blackbird, tricolored blackbird, Brewer's blackbird, western meadowlark, savannah sparrow (*Passerculus sandwichensis*), and white-crowned sparrow. Other commonly occurring species that we detected noticeably less often in Years 2 and 3 included most of the other raptors (American kestrel, red-tailed hawk, burrowing owl [*Athene cunicularia*], ferruginous hawk [*Buteo regalis*], golden eagle, and white-tailed kite [*Elanus leucurus*]), common ravens, Canada geese (*Branta canadensis*), American goldfinch (*Spinus tristis*), house finch, and loggerhead shrike.

In contrast to the above patterns, the Year 2 detection rates were ≥50% higher than in Year 1 for 22 species, including 11 species seen in Year 2 but not in Year 1 (see Table 23 in Discussion section). Similarly, the Year 3 detection rates were ≥25% higher than in Year 1 for 26 species and ≥25% higher than in Year 2 for 27 species, including nine species that were detected only in Year 3. Species for which the detection rates increased each year were American crow, yellow-billed magpie (*Pica nuttalli*), great blue heron (*Ardea alba*), mallard (*Anas platyrhynchos*), Eurasian collared dove, rock pigeon, barn swallow (*Hirundo rustica*), and white-throated swift (*Aeronautes saxatalis*). Other species for which the detection rates were noticeably higher in Years 2 and 3 compared to Year 1 included American white pelican, killdeer (*Charadrius vociferous*), cliff swallow (*Petrochelidon pyrrhonota*), northern rough-winged swallow (*Stelgidopteryx serripennis*), and lesser goldfinch (*Spinus psaltria*). In addition, the average detection rate for Prairie falcons (*Falco mexicanus*) was approximately twice as high in Year 3 as it was in Years 1 and 2.

In Year 3, we recorded 21 species at all four count sites and 14 species at only one site (usually only one or two individuals; Table 13). We recorded the highest species richness in the south section (41 species), moderate species richness in the north section (36), and lower species richness at the two count sites in the central section (30–32 species). Species recorded at most or all count sites during all four quarterly seasons were: American kestrel, red-tailed hawk, turkey vulture, killdeer, mourning dove, rock pigeon, common raven, Brewer's blackbird, European starling, horned lark, and western meadowlark. Other species recorded during all four seasons at one or more sites included northern harrier, mallard, red-winged blackbird, house finch, loggerhead shrike, northern mockingbird (*Mimus polyglottos*), Say's phoebe (*Sayornis saya*), and white-throated swift. Tricolored blackbirds, savannah sparrows, and American pipits were relatively common and widespread outside of the summer season, and we recorded golden eagles at most sites during all seasons except summer. Cliff swallows were moderately common and widespread, except during winter.

#### 3.3.3.1 Raptors

In Year 3, the overall site-wide detection rate for raptors as a group averaged highest in summer (8.3 detections per hour), slightly lower in spring (7.9), and lowest in fall (6.1) and winter (6.0). The raptor GLM confirmed significant year, season, and site effects (Table 14). Raptor detection rates averaged significantly lower overall in Year 2 than in Year 1, and higher in Year 3 than in Year 2, but still significantly lower than in Year 1. Across the 3 years of study, the raptor detection rate averaged significantly higher in summer than in fall and especially winter, and averaged significantly higher in the south section (Site 4) than in the north section (Site 1). Plots of estimated means by year, season, and site illustrated some variations on these overarching patterns (Figure 10). For example, the overall difference in detection rates between Sites 1 and 4 was not evident in Year 2, nor during winter in Year 1, and the spring detection rates averaged higher in Year 3 than in Year 1 at most sites.

Considering special-status raptors, we recorded no burrowing owls during the Year 3 BUCs, unlike in Year 1 but similar to Year 2. We also recorded no short-eared owls (*Asio flammeus*) during the Year 3 surveys, unlike in Year 2 but similar to Year 1. As in previous years, we continued to record both male and female adult northern harriers throughout Year 3 in primarily the central and south sections (Figure 11) and, unlike in Year 2 but similar to Year 1, we recorded a single juvenile harrier on several occasions between July and October in the central section. In Years 2 and 3, we recorded no white-tailed kites during the BUCs, whereas in Year 1 they commonly occurred in the area during fall and winter. Conversely, whereas we recorded only one Swainson's hawk during Year 2, the detection rate in Year 3 increased again to a level comparable to Year 1, with most of the Year 3 detections (23 total) concentrated in the central section during April and May. Each year of the study we recorded 1 or 2 peregrine falcons during the BUCs hunting pigeons; in Year 3, the single sighting was unusual because it occurred in mid-June rather than winter/early spring. We detected golden eagles on multiple occasions during the Year 3 BUCs in all seasons except summer, mostly in the west-central section of the facility (Figure 12). The lack of summer golden eagle detections in Year 3 was atypical for the 3-year study. Otherwise, the overall Year 3 golden eagle detection rate was 76% higher than in Year 2, but 35% lower than in Year 1, when we documented a nest that was briefly active but failed on a transmission tower adjacent to the central section. This nest was not active again in either 2013 or 2014.

Among other common raptor species, the overall average detection rate for red-tailed hawks declined 54% between Year 1 and Year 2, and remained 28% below the Year 1 level in Year 3 (Figure 11). In Year 3, detection rates of red-tailed hawks consistently averaged highest in the central section, slightly lower in the south section, and lowest in the north section. In Year 2, the same pattern of highest average activity in the central section applied, but red-tailed hawk activity averaged higher in the north section than in the south section in all seasons. Red-tailed hawks were present year-round and their detection rates did not follow any consistent seasonal pattern.

**Table 14. Generalized Linear Model Results for Raptors Evaluating Variation in Average Detections per Hour by Year, Season, and Count Site**

| Effect | Df | Sum of Squares | Mean Square | *F* | *P* |
|---|---|---|---|---|---|
| Year | 2 | 104.68 | 52.34 | 11.00 | <0.001 |
| Season | 3 | 52.40 | 17.47 | 3.67 | 0.020 |
| Site | 3 | 74.87 | 24.96 | 5.24 | 0.004 |
| Residuals | 39 | 185.58 | 4.76 | – | – |
| **Coefficients[1]** | | **Estimate** | **SE** | ***t*** | ***P*** |
| (Intercept) | | 7.444 | 0.945 | 7.88 | <0.001 |
| Year2013/2014 | | -3.601 | 0.771 | -4.67 | <0.001 |
| Year2014/2015 | | -2.094 | 0.771 | -2.72 | 0.010 |
| Spring | | 0.400 | 0.891 | 0.45 | 0.656 |
| Summer | | 2.076 | 0.891 | 2.33 | 0.025 |
| Winter | | -0.783 | 0.891 | -0.88 | 0.385 |
| Site 2 | | 0.648 | 0.891 | 0.73 | 0.471 |
| Site 3 | | 1.344 | 0.891 | 1.51 | 0.139 |
| Site 4 | | 3.331 | 0.891 | 3.74 | 0.001 |

[1] Reference values: Year = 2012/2013, Season = Fall, and Site = Site 1 (see Figure 5 for count site locations).

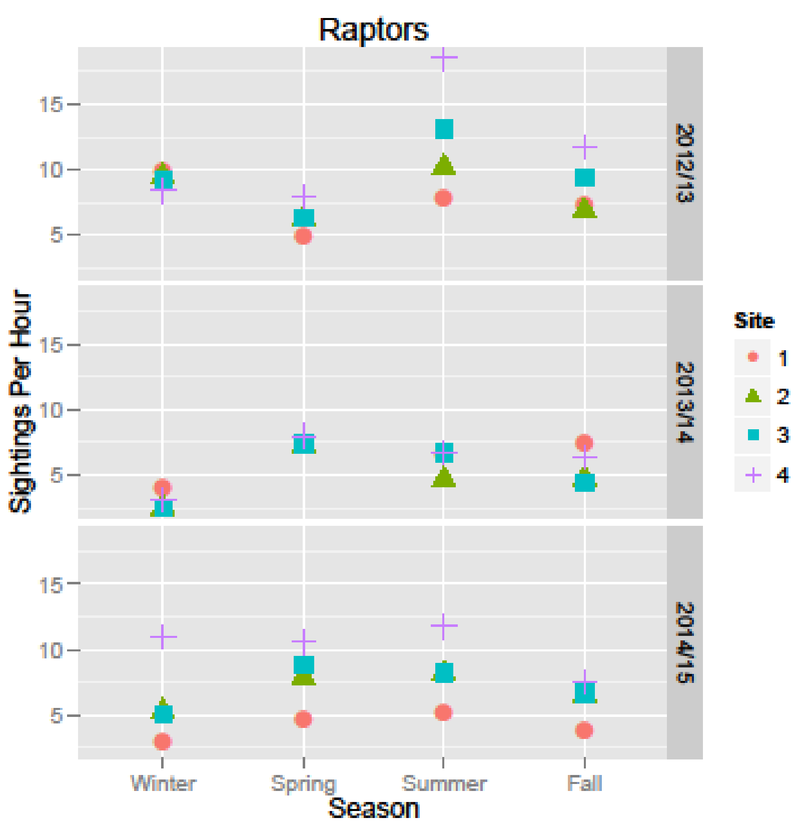



**Figure 10. Average Detections per Hour for Raptors by Year, Season, and Count Site**

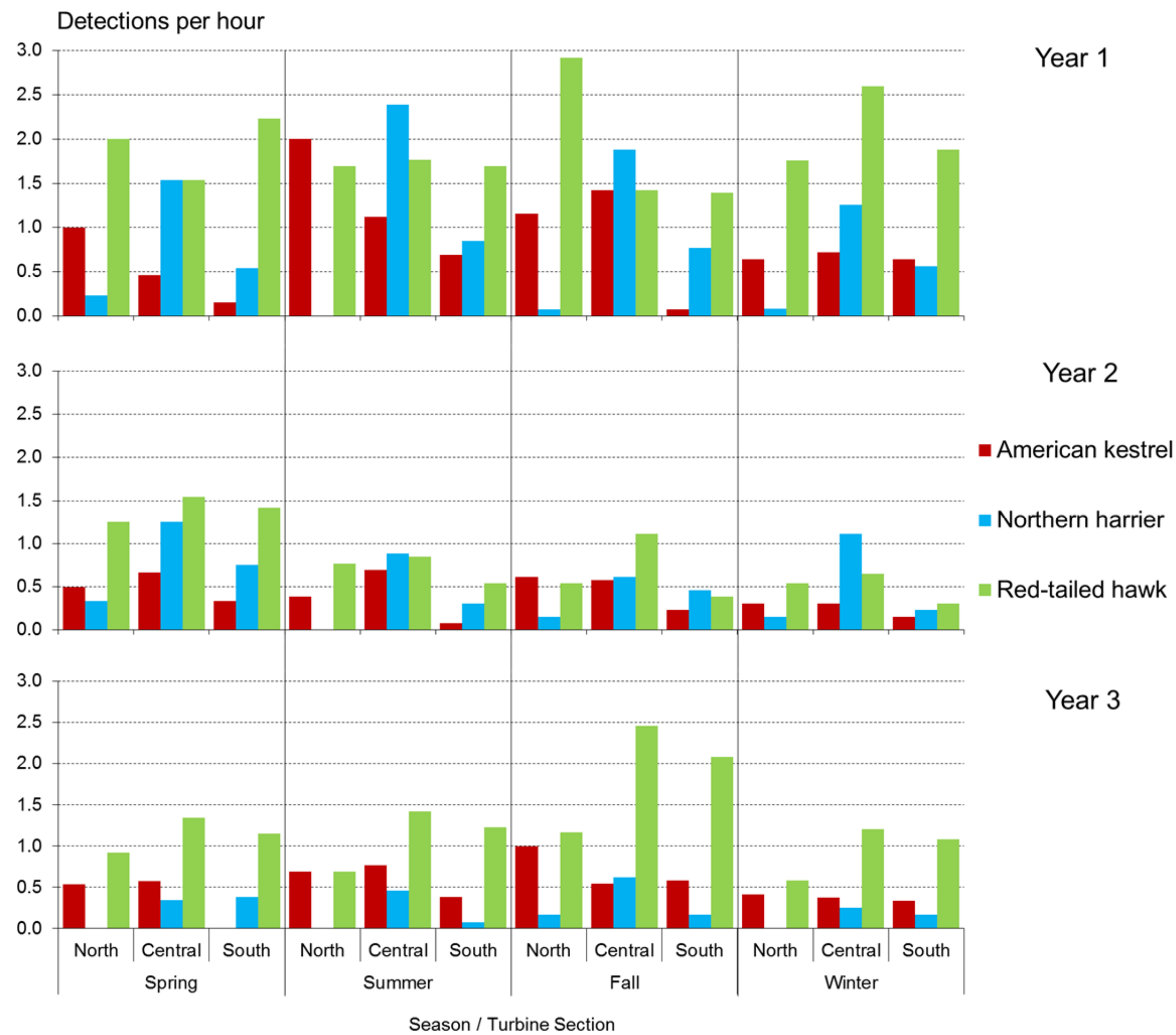



**Figure 11. Detection Rates for American Kestrels, Northern Harriers, and Red-tailed Hawks by Year, Season, and Turbine Section**

The overall average detection rate for American kestrels declined 49% between Year 1 and Year 2, and remained 39% below the Year 1 level in Year 3 (Figure 11). Throughout the study, kestrel detection rates generally averaged higher in the north and central sections than in the south section. Like red-tailed hawks, American kestrels were present year-round and their detection rates did not follow any consistent seasonal pattern; however, kestrel detection rates were noticeably higher in summer and fall in both Year 1 and Year 3.

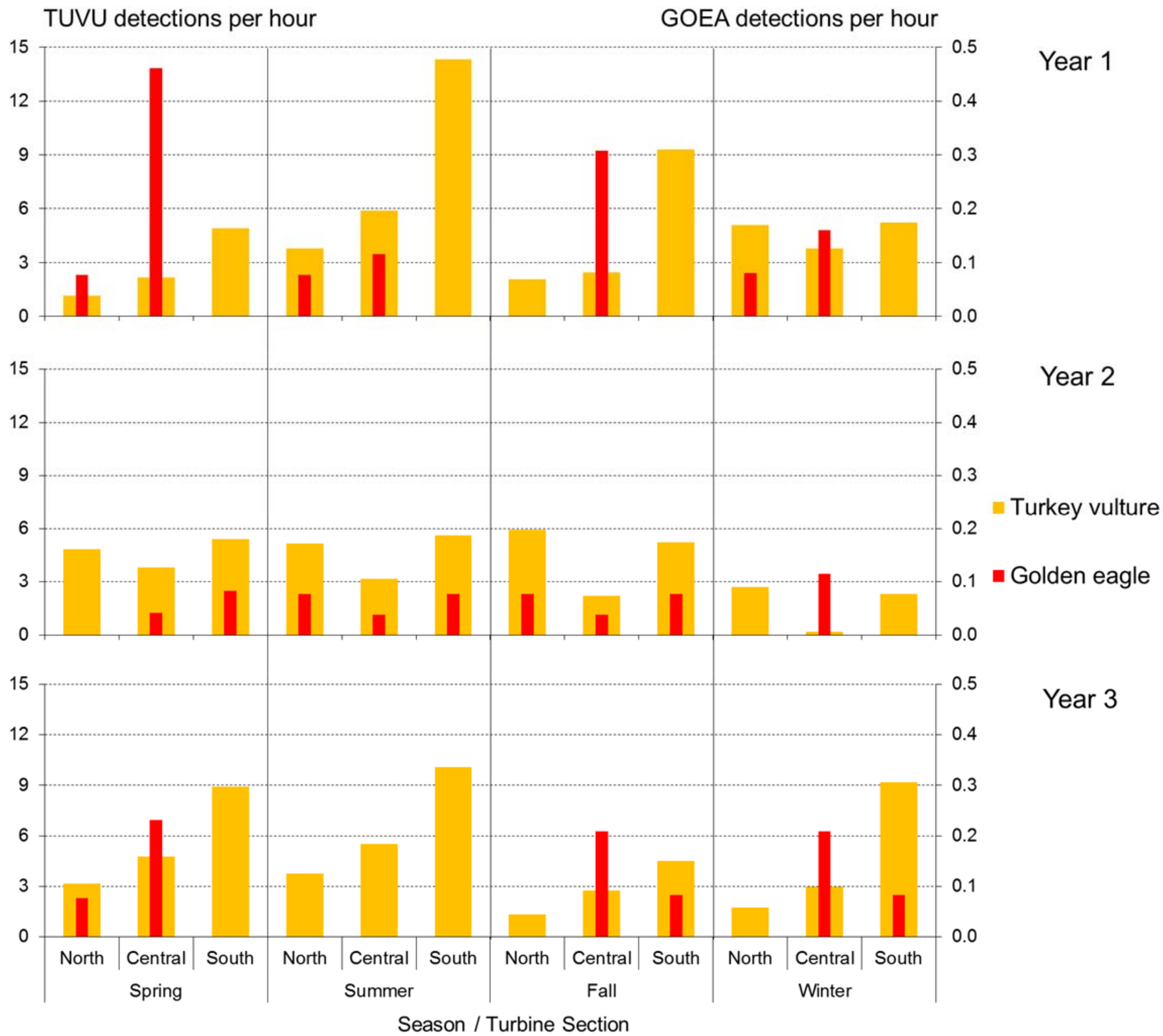



**Figure 12. Detection Rates for Golden Eagles and Turkey Vultures by Year, Season, and Turbine Section**

The overall average detection rate for turkey vultures was 25% lower in Year 2, but was the same in Years 1 and 3 (Figure 12). In Year 3, turkey vultures showed a strong pattern of increasing activity from north to south in all seasons. The same pattern was evident during the first three quarters of Year 1, but thereafter through Year 2, vulture activity tended to be similar in the north and south sections and lower in the central section. Like kestrels and red-tailed hawks, turkey vultures were always present year-round and their detection rates did not follow any consistent seasonal pattern.

#### 3.3.3.2 Corvids

The corvid group comprised mostly common ravens. In Year 3, corvid detection rates were highest in winter (2.7 detections per hour), declined through spring (2.2) and summer (1.4), and increased again slightly in fall (2.0). The corvid GLM confirmed a significant year effect, no overall season effect, and a marginally significant site effect (Table 15). Corvids showed the same overall interannual pattern of variation as raptors, with detection rates averaging significantly lower overall in Year 2 than in Year 1, and higher in Year 3 than in Year 2, but still significantly lower than in Year 1 (Figure 13). Corvid detection rates tended to be higher in the south section; however, the three-way plots showed that neither the year nor site overarching patterns applied consistently throughout the study.

#### 3.3.3.3 Waterbirds

In year 3, waterbird detection rates followed a similar seasonal pattern as for corvids: highest in winter (8.9 detections per hour), declining through spring (1.3) and summer (0.6), and increasing again slightly in fall (0.9). The Kruskall-Wallis analysis for waterbirds indicated no overall year effect but both season and site effects (Table 16). Pairwise comparisons confirmed higher average detection rates in winter than in other seasons, and higher detection rates in the south section than in the central section. The three-way plots showed that the pattern of higher activity in winter applied most prominently in Years 2 and 3; that the pattern of higher activity in the south section was most pronounced in Year 1 and in winter; and that Year 1 was unusual in showing high detection rates in the south section in summer and fall, as well as in winter (Figure 14). The tendency for waterbird detection rates to be higher in the south section probably reflects being nearer to the aquatic and marsh habitats of the nearby Sacramento River and delta system (Figure 1).

#### 3.3.3.4 Columbids

In Year 3, detection rates for pigeons and doves averaged highest in winter (24.5 detections per hour), lowest in spring (6.9) and summer (7.7), and higher again in fall (19.0). The Kruskall-Wallis analysis indicated no overall year or season effects, but a significant site effect (Table 17). Detection rates averaged highest in the north section and west-central section (Site 2), and consistently lowest in the south section (Figure 15). The three-way plots indicated that columbid detection rates were generally highest in the north section in Years 1 and 3, but were higher in the west-central section during most seasons in Year 2. In addition, although the pattern was not shown in Year 1, a common seasonal pattern was evident in Years 2 and 3, with detection rates generally increasing from spring through winter. The higher activity levels of pigeons and doves in the north and west-central sections likely reflect being closer to the active farmsteads north of the facility.

#### 3.3.3.5 Blackbirds and Starlings

In Year 3, average detection rates for the blackbird and starling group were high in winter (153.0 detections per hour), much lower in spring (18.3) and especially summer (6.5), and highest in fall (162.9). The Kruskall-Wallis analysis confirmed a significant overall season effect, following the same pattern as in Year 3, but no overall year or site effects (Table 18). The fall detection rate was particularly high in Year 1 (Figure 16), when blackbird flocks numbering in the thousands were common, especially in the central section, and included high proportions of tricolored blackbirds.

**Table 15. Generalized Linear Model Results for Corvids Evaluating Variation in Average Detections per Hour by Year, Season, and Count Site**

| Effect | df | Sum of Squares | Mean Square | *F* | *P* |
|---|---|---|---|---|---|
| Year | 2 | 46.14 | 23.07 | 10.60 | <0.001 |
| Season | 3 | 4.56 | 1.52 | 0.70 | 0.559 |
| Site | 3 | 17.44 | 5.81 | 2.67 | 0.061 |
| Residuals | 39 | 84.92 | 2.18 | – | – |
| **Coefficients**[1] | | **Estimate** | **SE** | ***t*** | ***P*** |
| (Intercept) | | 2.660 | 0.639 | 4.16 | <0.001 |
| Year2013/2014 | | -2.364 | 0.522 | -4.53 | <0.001 |
| Year2014/2015 | | -1.548 | 0.522 | -2.97 | 0.005 |
| Spring | | 0.339 | 0.602 | 0.56 | 0.577 |
| Summer | | 0.773 | 0.602 | 1.28 | 0.207 |
| Winter | | 0.697 | 0.602 | 1.16 | 0.254 |
| Site 2 | | 0.022 | 0.602 | 0.04 | 0.970 |
| Site 3 | | 0.400 | 0.602 | 0.66 | 0.511 |
| Site 4 | | 1.484 | 0.602 | 2.46 | 0.018 |

[1] Reference values: Year = 2012/2013, Season = Fall, and Site = Site 1 (see Figure 5 for count site locations).

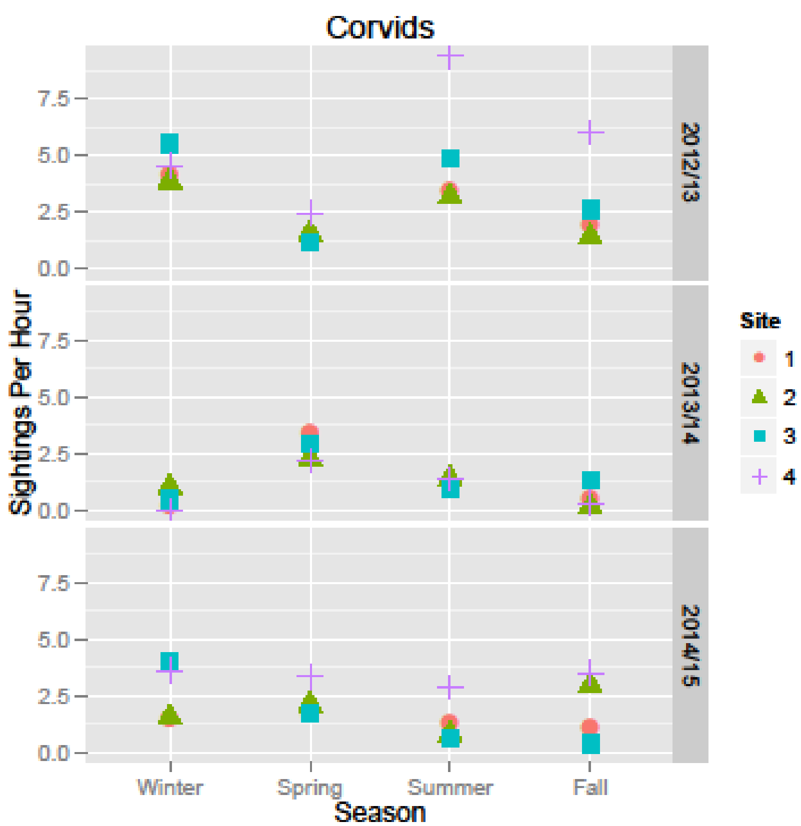



**Figure 13. Average Detections per Hour for Corvids by Year, Season, and Count Site**

**Table 16. Kruskall-Wallis Analysis Results for Waterbirds Evaluating Variation in Average Detections per Hour by Year, Season, and Count Site**

| **Effect** | **$\chi^2$** | **df** | ***P*** |
|---|---|---|---|
| Year | 0.57 | 2 | 0.752 |
| Season | 7.81 | 3 | 0.050 |
| Site[1] | 11.04 | 3 | 0.012 |
| | **Pairwise Comparisons (U-tests, *P*)** | | |
| | Spring | Summer | Fall |
| Summer | 0.012 | – | – |
| Fall | 0.045 | 0.488 | – |
| Winter | 0.046 | 0.506 | 0.954 |
| | Site 1 | Site 2 | Site 3 |
| Site 2 | 0.174 | – | – |
| Site 3 | 0.149 | 0.908 | – |
| Site 4 | 0.149 | 0.005 | 0.008 |

[1] See Figure 5 for count site locations.

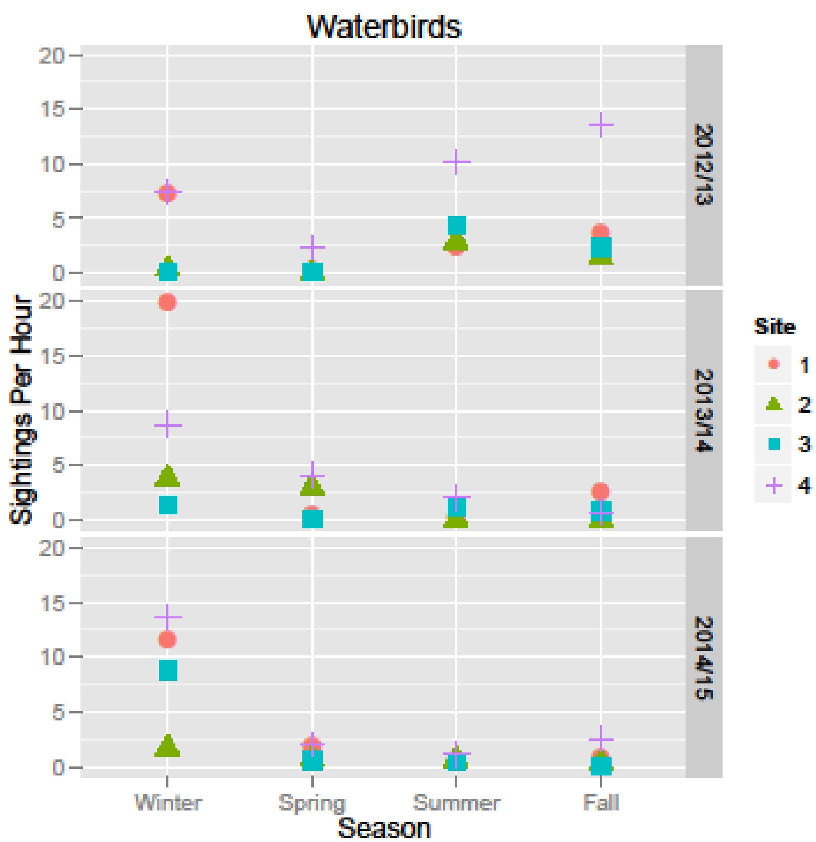



**Figure 14. Average Detections per Hour for Waterbirds by Year, Season, and Count Site**

**Table 17. Kruskall-Wallis Analysis Results for Pigeons and Doves Evaluating Variation in Average Detections per Hour by Year, Season, and Count Site**

| Effect | $\chi^2$ | df | *P* |
|---|---|---|---|
| Year | 3.07 | 2 | 0.216 |
| Season | 4.83 | 3 | 0.184 |
| Site[1] | 29.44 | 3 | <0.001 |
| **Pairwise Comparisons (U-tests, *P*)** | | | |
| | Site 1 | Site 2 | Site 3 |
| Site 2 | 0.443 | | |
| Site 3 | <0.001 | 0.002 | |
| Site 4 | <0.001 | <0.001 | 0.073 |

[1] See Figure 5 for count site locations.

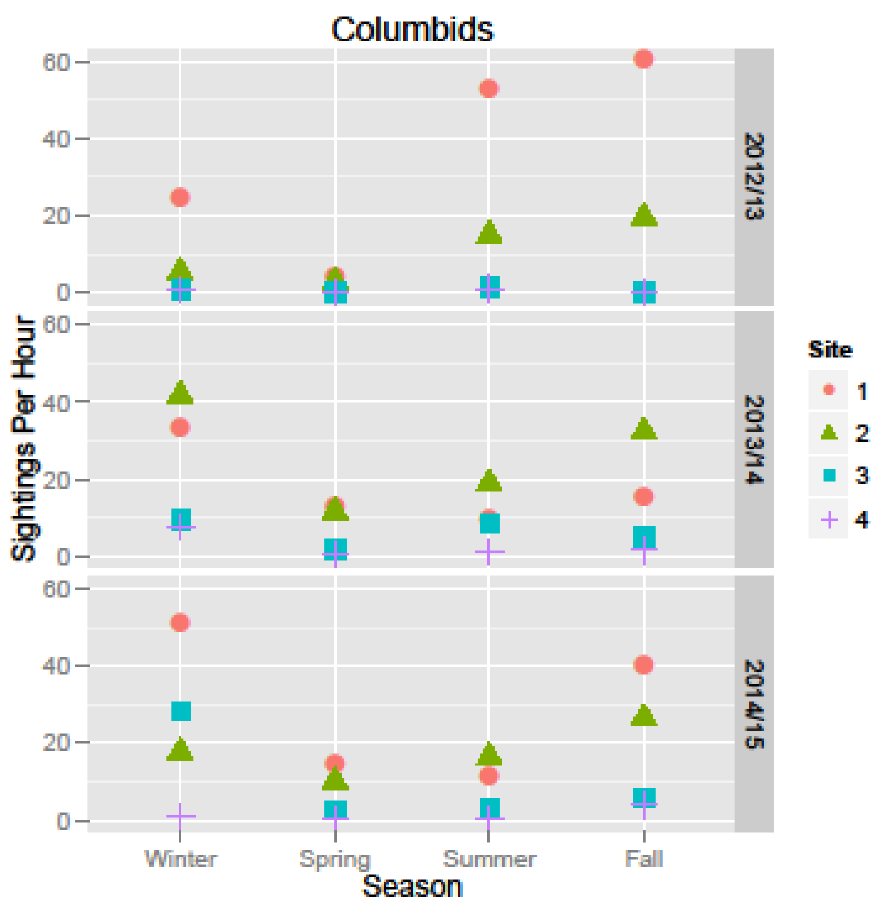



**Figure 15. Average Detections per Hour for Pigeons and Doves by Year, Season, and Count Site**

**Table 18. Kruskall-Wallis Analysis Results for Blackbirds and Starlings Evaluating Variation in Average Detections per Hour by Year, Season, and Count Site**

| Effect | $\chi^2$ | df | *P* |
|---|---|---|---|
| Year | 0.69 | 1 | 0.407 |
| Season | 13.69 | 3 | 0.003 |
| Site[1] | 2.78 | 3 | 0.426 |
| **Pairwise Comparisons (U-tests, *P*)** | | | |
| | Spring | Summer | Fall |
| Summer | 0.007 | | |
| Fall | 0.065 | 0.001 | |
| Winter | 0.721 | 0.015 | 0.235 |

[1] See Figure 5 for count site locations.

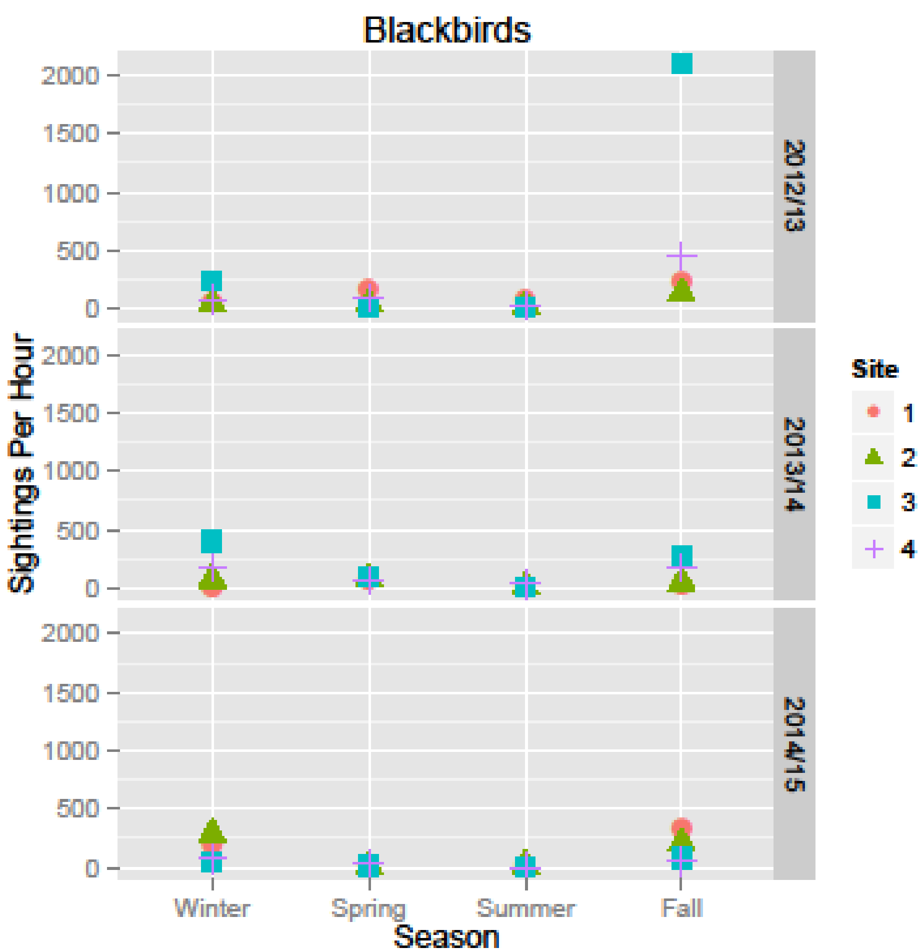



**Figure 16. Average Detections per Hour for Blackbirds and Starlings by Year, Season, and Count Site**

#### 3.3.3.6 Other Small Birds

In Year 3, average detection rates for other small birds were moderate in winter (21.6 detections per hour) and spring (25.3), much lower in summer (4.3), and highest in fall (44.7). The GLM model indicated significant year and season effects, and a marginally significant site effect (Table 19). Detection rates averaged higher overall in Year 1 than in Years 2 and 3; higher overall in fall, and to a lesser degree winter, than in other seasons, especially summer; and higher overall in the west-central section, and to a lesser degree the south section (Figure 17). The three-way plots further indicated that detection rates were highest during fall in Years 1 and 3, but highest during winter in Year 2. Detection rates also tended to increase from north to south in Year 2, but not in Years 1 and 3. The high activity levels in fall and winter were driven primarily by aggregations of American goldfinches (Year 1 only), American pipits (also prevalent in spring in Years 1 and 3), house finches (Years 1 and 3 only), horned larks (relatively common year-round), savannah sparrows (primarily Years 1 and 2; also abundant in winter), and western meadowlarks (relatively common year-round).

### 3.3.4 Flight Heights and Turbine Collision Risk

We classified the flight altitudes for 13,921 bird detections in Year 3. Forty-four percent of these observations involved birds flying at LOW altitudes (below turbine rotor-swept zone), 25% at variable LOW/MED altitudes, 22% at MED altitudes (in turbine risk zone), 2% at variable MED/HIGH altitudes, and 7% at HIGH altitudes (above risk zone) (Table 20, Figure 18). Raptors as a group flew primarily at MED (35%) and HIGH altitudes (44%; plus 2% at variable MED/HIGH altitudes). Only golden eagles (29%), red-tailed hawks (11%), and turkey vultures (58%) flew above the risk zone (Table 20). For most raptors, ≥25% of the flights overlapped the MED altitude risk zone: golden eagle 35%, merlin (*Falco columbarius*) 25%, prairie falcon 100%, peregrine falcon (100%), red-tailed hawk 62%, Swainson's hawk 100% (83% in the LOW/MED transition zone), and turkey vulture 40%. American kestrels and northern harriers also flew in the risk zone 19% of the time, but mostly flew below the risk zone, which was also true for the remaining merlin sightings.

In Year 3, waterbirds flew at altitudes that overlapped the turbine risk zone 35% of the time, but a higher proportion flew above the risk zone (53%) (Table 20, Figure 18). Waterbird species detected flying only or primarily above the risk zone were American white pelican (100%), greater white-fronted goose (*Anser albifrons*; 100%), snow goose (100%), Canada goose (61%; the rest in the risk zone), and a flock of unidentified gulls (Table 20). Species that flew primarily in the risk zone included three species of duck (75%), double-crested cormorant (*Phalacrocorax auritus*; 67%), and a small flock of domestic geese.

Other species groups for which ≥50% of the in-flight detections overlapped the turbine risk zone were columbids (56%; primarily rock pigeons) and blackbirds and starlings (53%; primarily Brewer's and red-winged blackbirds, with high proportions in the LOW/MED transition zone). Other species for which ≥50% of flights overlapped the risk zone were American crow (100%), barn swallow (77%; all in LOW/MED transition zone), an atypical flock of house sparrows, lesser goldfinch (100%; 43% in LOW/MED transition zone), and white-throated swift (60%). Other species for which ≥25% of flights overlapped the risk zone were common raven (47%), European starling (35%), house finch (28%), and cliff swallow (35%).

**Table 19. Generalized Linear Model Results for Other Small Birds Evaluating Variation in Average Detections per Hour by Year, Season, and Count Site**

| Effect | Df | Sum of Squares | Mean Square | *F* | *P* |
|---|---|---|---|---|---|
| Year | 2 | 4084.30 | 2042.15 | 7.49 | 0.002 |
| Season | 3 | 13810.96 | 4603.65 | 16.88 | <0.001 |
| Site | 3 | 2006.55 | 668.85 | 2.45 | 0.078 |
| Residuals | 39 | 10634.38 | 272.68 | – | – |
| **Coefficients[1]** | | **Estimate** | **SE** | ***t*** | ***P*** |
| (Intercept) | | 59.923 | 7.150 | 8.38 | <0.001 |
| Year2013/2014 | | -17.886 | 5.838 | -3.06 | 0.004 |
| Year2014/2015 | | -20.900 | 5.838 | -3.58 | 0.001 |
| Spring | | -29.703 | 6.741 | -4.41 | <0.001 |
| Summer | | -46.066 | 6.741 | -6.83 | <0.001 |
| Winter | | -16.297 | 6.741 | -2.42 | 0.020 |
| Site 2 | | 17.175 | 6.741 | 2.55 | 0.015 |
| Site 3 | | 4.298 | 6.741 | 0.64 | 0.528 |
| Site 4 | | 10.310 | 6.741 | 1.53 | 0.134 |

[1] Reference values: Year = 2012/2013, Season = Fall, and Site = Site 1 (see Figure 5 for count site locations).

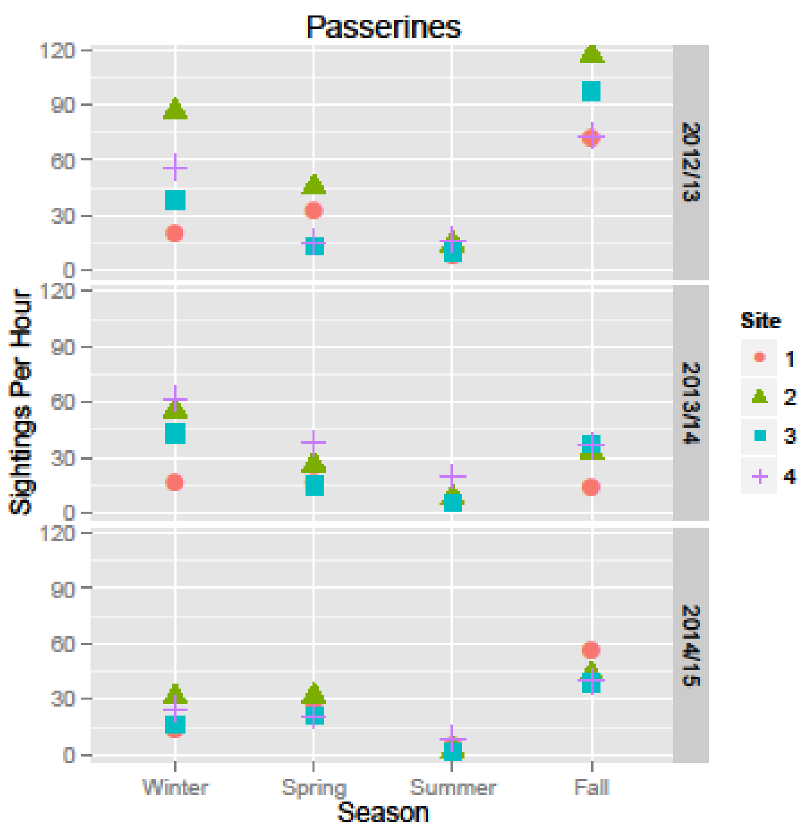



**Figure 17. Average Detections per Hour for Other Small Birds by Year, Season, and Count Site**


**Figure 18. Proportions of Flying Birds Observed Below (Low), Within (Medium), and Above (High) the Approximate Rotor-Swept Zone of Turbines in Year 2 and Year 3**

For all species groups, the proportion of in-flight detections that occurred within or above the turbine risk zone increased in Year 3 compared to Year 2 (Figure 18). For the raptor and corvid groups, however, the proportion of flights that overlapped the risk zone was similar in both years: 41–44% for raptors and 45–48% for corvids. The largest increases in risk exposure in Year 3 occurred for pigeons and blackbirds. Red-tailed hawk exposure also increased from 37% of flights in Year 2 to 59% in Year 3. Conversely, whereas 89% of nine golden eagle flights crossed the risk zone in Year 2, only 35% of 14 flights did so in Year 3. Similarly, the risk of turbine exposure for turkey vultures declined from 69% in Year 2 to 38% in Year 3.

**Table 20. Observations of Flying Birds Recorded in Year 3 during Bird Use Counts by Species and Flight Altitude**

| Group | Species | Number of Detections | Detections by Flight Altitude (%)[1] | | | | |
|---|---|---|---|---|---|---|---|
| | | | Low | Low/Med | Med | Med/High | High |
| **Raptors** | American kestrel | 68 | 81 | 16 | 3 | 0 | 0 |
| | Golden eagle | 14 | 36 | 7 | 21 | 7 | 29 |
| | Merlin | 4 | 75 | 0 | 25 | 0 | 0 |
| | Northern harrier | 53 | 81 | 11 | 8 | 0 | 0 |
| | Peregrine falcon | 1 | 0 | 0 | 100 | 0 | 0 |
| | Prairie falcon | 8 | 0 | 0 | 100 | 0 | 0 |
| | Red-tailed hawk | 173 | 26 | 18 | 41 | 3 | 11 |
| | Swainson's hawk | 23 | 0 | 83 | 17 | 0 | 0 |
| | Turkey vulture | 884 | 1 | 1 | 37 | 2 | 58 |
| | Unknown raptor | 1 | 0 | 0 | 0 | 0 | 100 |
| | **All Raptors** | **1,229** | **13** | **6** | **35** | **2** | **44** |
| **Waterbirds** | American white pelican | 9 | 0 | 0 | 0 | 0 | 100 |
| | Canada goose | 49 | 14 | 0 | 24 | 0 | 61 |
| | Cinnamon teal | 2 | 0 | 0 | 100 | 0 | 0 |
| | Double-crested cormorant | 12 | 0 | 0 | 67 | 0 | 33 |
| | Domestic goose | 7 | 0 | 0 | 100 | 0 | 0 |
| | Greater white-fronted goose | 4 | 0 | 0 | 0 | 0 | 100 |
| | Killdeer | 15 | 73 | 20 | 7 | 0 | 0 |
| | Mallard | 23 | 0 | 0 | 74 | 0 | 26 |
| | Northern pintail | 1 | 0 | 0 | 100 | 0 | 0 |
| | Northern shoveler | 2 | 0 | 0 | 50 | 0 | 50 |
| | Snow goose | 7 | 0 | 0 | 0 | 0 | 100 |
| | Unidentified gull | 18 | 0 | 0 | 0 | 0 | 100 |
| | **All Waterbirds** | **149** | 12 | 2 | 33 | 0 | 53 |
| **Pigeons & Doves** | Eurasian collared-dove | 3 | 33 | 0 | 0 | 0 | 67 |
| | Mourning dove | 133 | 98 | 0 | 2 | 0 | 1 |
| | Rock pigeon | 2,070 | 34 | 0 | 60 | 0 | 6 |
| | **All Pigeons & Doves** | **2,206** | 38 | 0 | 56 | 0 | 6 |
| **Corvids** | American crow | 9 | 0 | 0 | 100 | 0 | 0 |
| | Common raven | 352 | 15 | 9 | 38 | 0 | 38 |
| | Yellow-billed magpie | 1 | 100 | 0 | 0 | 0 | 0 |
| | **All Corvids** | **362** | **15** | **9** | **39** | **0** | **36** |

| Group | Species | Number of Detections | Detections by Flight Altitude (%)[1] | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | Low | Low/Med | Med | Med/High | High |
| **Blackbirds & Starlings** | Brewer's blackbird | 3,059 | 9 | 71 | 13 | 7 | 0 |
| | European starling | 309 | 65 | 17 | 18 | 1 | 0 |
| | Red-winged blackbird | 1,612 | 35 | 47 | 18 | 0 | 0 |
| | Tricolored blackbird | 2,936 | 86 | 2 | 12 | 0 | 0 |
| | Unidentified blackbird | 9 | 78 | 0 | 22 | 0 | 0 |
| | **All Blackbirds & Starlings** | **7,925** | **45** | **39** | **14** | **3** | **0** |
| **Other Small Birds** | American goldfinch | 111 | 100 | 0 | 0 | 0 | 0 |
| | American pipit | 329 | 82 | 18 | 0 | 0 | 0 |
| | American robin | 3 | 100 | 0 | 0 | 0 | 0 |
| | Barn swallow | 44 | 23 | 77 | 0 | 0 | 0 |
| | Cliff swallow | 128 | 65 | 33 | 2 | 0 | 0 |
| | House finch | 224 | 70 | 24 | 4 | 0 | 2 |
| | Horned lark | 524 | 89 | 10 | 1 | 0 | 0 |
| | House sparrow | 5 | 0 | 0 | 100 | 0 | 0 |
| | Lesser goldfinch | 14 | 0 | 43 | 57 | 0 | 0 |
| | Loggerhead shrike | 30 | 100 | 0 | 0 | 0 | 0 |
| | Northern flicker | 1 | 100 | 0 | 0 | 0 | 0 |
| | Northern mockingbird | 5 | 80 | 0 | 20 | 0 | 0 |
| | Northern rough-winged swallow | 5 | 100 | 0 | 0 | 0 | 0 |
| | Say's phoebe | 3 | 100 | 0 | 0 | 0 | 0 |
| | Savannah sparrow | 8 | 100 | 0 | 0 | 0 | 0 |
| | Tree swallow | 52 | 100 | 0 | 0 | 0 | 0 |
| | Western kingbird | 2 | 100 | 0 | 0 | 0 | 0 |
| | Western meadowlark | 356 | 88 | 12 | 0 | 0 | 0 |
| | White-throated swift | 206 | 2 | 11 | 49 | 0 | 38 |
| | **All Other Small Birds** | **2,050** | **74** | **15** | **6** | **0** | **4** |
| **All Species** | | **13,921** | **44** | **25** | **22** | **2** | **7** |

[1] Low = <30 m - below the rotor swept zone; Med (medium) = 30–150 m - within the approximate rotor swept zone; and High = >150 m - above the rotor-swept zone of turbines.

## 3.4 Raptor Prey and Carcass Scavengers

### 3.4.1 Raptor Prey

The surveyors noted the presence of potential raptor food sources other than birds, including occasional mammals, reptiles, notable insect concentrations, and livestock carcasses, during only 3% of the Year 3 fatality surveys (Appendix G). During the Year 3 BUCs, the surveyor occasionally noted raptors hunting various birds (e.g., a merlin taking a tricolored blackbird and a peregrine falcon hunting rock pigeons), feeding on livestock carcasses, and in one case a turkey vulture feeding on a jackrabbit carcass. The supplementary road surveys on the site also only infrequently revealed additional noteworthy observations in Year 3.

In Year 3, known mammalian prey seen on several occasions, or for which sign was noted, included black-tailed jackrabbit (*Lepus californicus*), California ground squirrel (*Otospermophilus beecheyi*), and unidentified mice and voles (Appendix G). Jackrabbits were seen in the north section (T108, T112, T114, T117), central section (T127, T128, T130), south section (T132, T135), and at the Substation. Ground squirrels were seen along the fencelines running near T109/T110 and T134. Two mouse carcasses (*Peromyscus* spp.) were found on one occasion at T128, and others were occasionally seen scampering across roadways. An active skunk den was located on the T138 turbine plot.

Documented reptile sightings were scarce in Year 3, with only one dead gopher snake (*Pituophis catenifer*) recorded on the T131 survey plot (Appendix G). Insects observed and known to comprise prey for American kestrels, Swainson's hawks, and burrowing owls included grasshopper (Orthoptera) concentrations in June in the central and south sections; field crickets (Gryllinae) and dragonflies (Odonata) found in abundance on the T139 plot in April and September, respectively; and occasional Jerusalem crickets (*Stenopelmatus* spp.) found, for example, on the T130 plot in December (Appendix G).

### 3.4.2 Carcass Scavengers

During 12% of the Year 3 fatality surveys, the surveyor recorded observations of one or more potential carcass scavengers (Appendix G). These sightings included common ravens on 20 occasions (2% of the surveys), turkey vultures on 45 occasions (5%), and various raptors on 33 occasions (5%), scattered across all surveyed areas and times of year. These supplemental sightings included three raptor species that were not recorded during the BUCs in Year 3: an adult bald eagle (*Haliaeetus leucocephalus*) soaring over the central section in November, a great horned owl flushed and flying along a riparian corridor near T128 in October, and a ferruginous hawk foraging near T128 in December. The fatality surveyors also occasionally noted foxes and coyotes, or their sign in several areas, and the skunk den and live skunks on the T139 plot. During the Year 3 BUCs, the surveyor recorded only various raptors, vultures, and ravens as potential carcass scavengers. Relevant observations recorded at other times included a skunk at T138, a juvenile bald eagle feeding on a sheep carcass near the main gate to the central section in November, and an adult golden eagle perched immediately adjacent to the old Callahan nest site in the north section in February 2015. Based on a crude metric—the number of fatality, BUC, and road survey records of occurrence, without regard to number of individuals per record—the observed activity rate of potential carcass scavengers in Year 3 increased in spring, varied but overall remained relatively stable through fall, then dropped off again in winter (Figure 19).

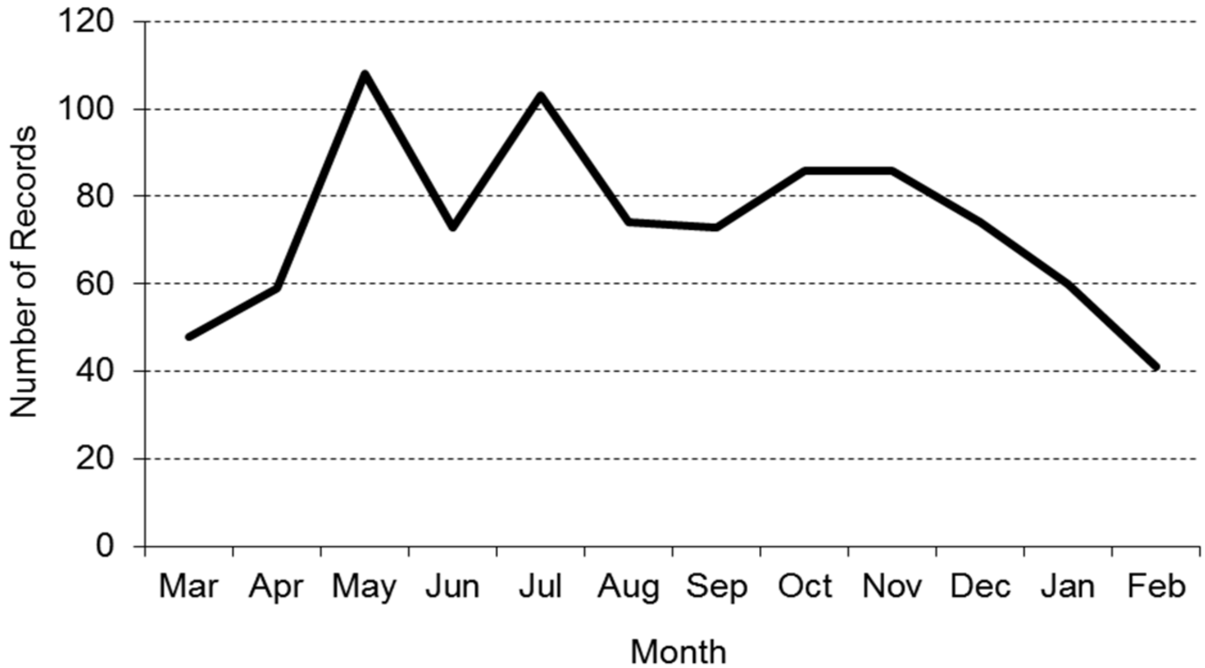



**Figure 19. Frequency of Carcass Scavenger Observation Records by Month in Year 3**

# Section 4.0 Discussion

## 4.1 Bias Trials

### 4.1.1 Searcher Efficiency

Combining data from across the 3-year study to boost sample sizes within each visibility class resulted in more consistent and precise estimates of searcher efficiency to support more robust estimation of adjusted fatality rates. In particular, the combined-year analysis yielded a more logical progression of searcher efficiency declining from high visibility to low visibility categories, whereas the year-specific analyses we used in Years 1 and 2 showed higher searcher efficiency in moderate visibility circumstances than in high visibility circumstances. Nevertheless, for all three taxon/size-class groups, the difference in searcher efficiency in high and medium visibility circumstances was relatively small (25–28% reduction for bats and small birds, and 6% for medium/large birds) compared to the further reduction in low visibility circumstances (64–70% reduction for bats and small birds, and 29% for medium/large birds). Most importantly, searcher efficiency of only 7–13% for bats and small birds effectively precludes gathering useful information about fatality rates of these taxa in low visibility circumstances.

Our estimates of searcher efficiency for this project generally fall within the range of other studies (e.g., see Point Impact Analysis 2012), especially in comparison to contemporary studies at Shiloh III (Kerlinger et al. 2013b), Solano Wind III (AECOM 2013), and Montezuma I (ICF International 2013). Most of the other available study reports either do not present searcher efficiency values broken down by habitat visibility classes or do not present comparable visibility-class statistics. For this reason, it is difficult to compile a rigorous comparison across studies. That said, using raw overall detectability statistics from our study for bats (23%), small birds (34%), medium birds (77%), large birds (83%), and medium/large birds combined (80%) provides a reasonable basis for comparing values across projects. Comparable values from four other projects (Shiloh I–III [Kerlinger et al. 2006, 2009, 2013a, 2013b] and Solano Wind [Burleson Consulting 2010]) for bats ranged from 20–57%. Comparable values from six other projects (Shiloh I–III, Solano Wind, Solano Wind III, and Montezuma I) for small birds ranged from 19–67%. Comparable values from four other projects (Shiloh I–III and Solano Wind) ranged from 47–89% for medium birds and 97–100% for large birds. Comparable values from three other projects (Shiloh II years 1 and 2, Solano Wind III year 1, and Montezuma I year 1) for medium/large birds combined range from 71–100%. In addition, compared to the more recent studies that have presented searcher efficiency statistics for different habitat visibility classes, our results generally show similar reductions in detectability as vegetation height and complexity increase (Kerlinger et al. 2013a, 2013b; ICF International 2013).

### 4.1.2 Carcass Persistence

Our estimates of carcass persistence are similar to those from previous MHWRA studies, but lie at the low end of the scale, especially for bats in Year 2 (33–43%) and small birds in Years 2 and 3 (40–54%). The year-specific estimates of carcass persistence from several previous and concurrent studies (Shiloh I, Shiloh II, Solano Wind, Solano Wind III, and Montezuma I) have ranged from 0.38–0.71 for bats, 0.60–0.85 for small birds, 0.42–0.97 for small birds and bats combined (Montezuma I), 0.43–0.94 for medium and large birds considered separately (Shiloh I and Solano Wind), and 0.63–1.00 for medium and large birds combined (Shiloh II, Montezuma I, and Solano Wind III) (Point Impact Analysis 2012, ICF International 2013). Of these studies, only the Montezuma I study produced season-specific estimates of carcass persistence (ICF International 2013). This two-year assessment showed little seasonal variation in the estimated carcass persistence proportion for larger birds in both study years (97–100%), and for small birds during the second study year (81–90%), but did show a marked seasonal difference in the persistence proportion for small birds in the first year: 97% in summer and 42% in winter. Across the 3-year study, our results indicated comparatively high seasonal variability in the estimated persistence proportions for medium/large birds (84–91% in spring/summer vs. 66–80% in fall/winter). Seasonal variation within years was less pronounced for small birds, with low variation in Year 1 (58–63%), moderate variation in Year 2 (40–54%), and no variation in Year 3 (53%). In addition, unlike during Year 2 of the Montezuma I study, the estimated persistence proportions of small birds were higher in fall/winter during Years 1 and 2 of our study. Lastly, our results for bats indicated comparable seasonal variation in persistence proportions across the 3 years, but with the probability of persistence higher in spring/summer in Years 1 and 3 (59% vs. 49–50% in fall/winter), but higher in fall/winter in Year 2 (43% vs. 33% in spring/summer).

As discussed in our Year 1 report, the pronounced seasonal difference in carcass persistence demonstrated for large birds in Year 1 of our study is partly attributable to variation in the species of large and medium birds used for the trials in different seasons. Our data showed that the persistence time for large corvids (ravens) and raptors (e.g., red-tailed hawk, prairie falcon, great horned owl, and turkey vulture) averaged much longer than for any other species groups, including smaller raptors and corvids, large waterfowl, and other large birds such pheasants (Table 21). Therefore, the mixes of bird species used in carcass persistence trials (often constrained by the availability of suitable carcasses), limiting covariate data to coarse-scale size-class categories without consideration of the species involved, and limited trial sample sizes can profoundly affect estimates of carcass persistence and influence adjusted fatality estimates.

Nevertheless, based on the available data, it is apparent that both seasonal and interannual variation in carcass persistence can sometimes be substantial in the MHWRA. Few consistent patterns have emerged, however, except that the estimated carcass persistence times and proportions were generally relatively short during our 3-year study, probably reflecting the influence of prolonged drought. Therefore, including season and year as covariates in models to estimate carcass persistence should always be considered a priority to ensure that estimation of adjusted fatality rates accurately accounts for potential temporal variation in the activity patterns of carcass scavengers and other abiotic factors that reduce carcass persistence and thereby influence the ability of surveyors to detect fatalities. In other words, if substantial seasonal or interannual variation in carcass persistence occurs, using an average value instead of season- and year-specific persistence values may significantly underestimate fatalities if actual persistence is skewed low during certain seasons, but just as easily could significantly overestimate fatalities if actual persistence is skewed high during certain seasons.

**Table 21. Variation in Carcass Persistence Times for Different Species Groups Based on 28-day Trials**

| Species Group | Number of Trial Specimens | Persistence Time (days) | |
|---|---|---|---|
| | | Average | Standard Deviation |
| Large corvids | 2 | 28.0 | 0.0 |
| Large raptors | 33 | 22.8 | 8.4 |
| Small/medium corvids | 17 | 7.9 | 8.5 |
| Medium raptors | 19 | 7.3 | 6.1 |
| Waterbirds | 26 | 5.4 | 6.4 |
| Other small birds | 98 | 4.6 | 4.3 |
| Bats | 207 | 4.4 | 3.3 |
| Blackbirds and starlings | 15 | 4.1 | 4.6 |
| Columbids | 21 | 3.6 | 6.2 |
| Gallinaceous birds | 4 | 3.0 | 0.6 |
| Small raptors | 10 | 2.9 | 2.1 |
| **Total** | **452** | **6.1** | **6.9** |

## 4.2 Adjusted Fatality Estimates

Variations in survey protocols, the nature of specimens used in bias trials, and the fatality estimators used complicates direct comparisons of adjusted fatality estimates across projects with the MHWRA (Point Impact Analysis 2012). With the important caveat, the updated all-bird, adjusted annual fatality estimates of 0.93 birds per MW in Year 1, 1.55 birds per MW in Year 2, and 0.98 birds per MW in Year 3 fall within the range of estimates from previous MHWRA studies conducted since 2003, but rank among the lowest rates observed to date (Table 22). Our 3-year average of 1.15 bird fatalities per MW is 83% lower than the 3-year average from the earlier Shiloh I study and 83% lower than the initial 2-year average from the contemporary Montezuma I study. Our 3-year average is also 50–55% lower than the first-year estimates from the Shiloh III and Solano III projects, but is similar to the 2-year averages from the neighboring High Winds and Shiloh II projects, and is approximately six times higher than for the 22-month Solano Wind project.

The most noteworthy result from our Year 1 fatality assessment was the number of documented turkey vulture fatalities (eight, including incidentals), which was a higher total, unadjusted fatality count than in any other previous or concurrent study. During 1–3 years of post-construction monitoring at the High Winds,

**Table 22. Adjusted Fatality Rates (Incidents per MW per Year) for All Birds Combined from Various Monitoring Studies in the Montezuma Hills Wind Resource Area**

| | High Winds 2003–2005 | Shiloh I 2006–2009 | Shiloh II 2009–2012 | Shiloh III 2012 | Solano Wind 2008–2010 | Solano III 2012–2013 | Montezuma I 2011–2013 | Montezuma II 2012–2015 |
|---|---|---|---|---|---|---|---|---|
| Year 1 | 1.62 | 11.97 | 1.51 | 3.3 | 0.34 | 2.55 | 5.19 | 0.93 |
| Year 2 | 1.10 | 8.60 | 2.39 | – | | – | 8.91 | 1.55 |
| Year 3 | – | 2.82 | – | – | – | – | – | 0.98 |
| Average | 1.36 | 6.96 | 1.95 | – | 0.34 | – | 7.06 | 1.15 |

[1] Previous study data summarized in Point Impact Analysis (2012) and derived from Kerlinger et al. (2006, 2009, 2013a, 2013b), Burleson Consulting (2010), AECOM (2013), and ICF International (2013).

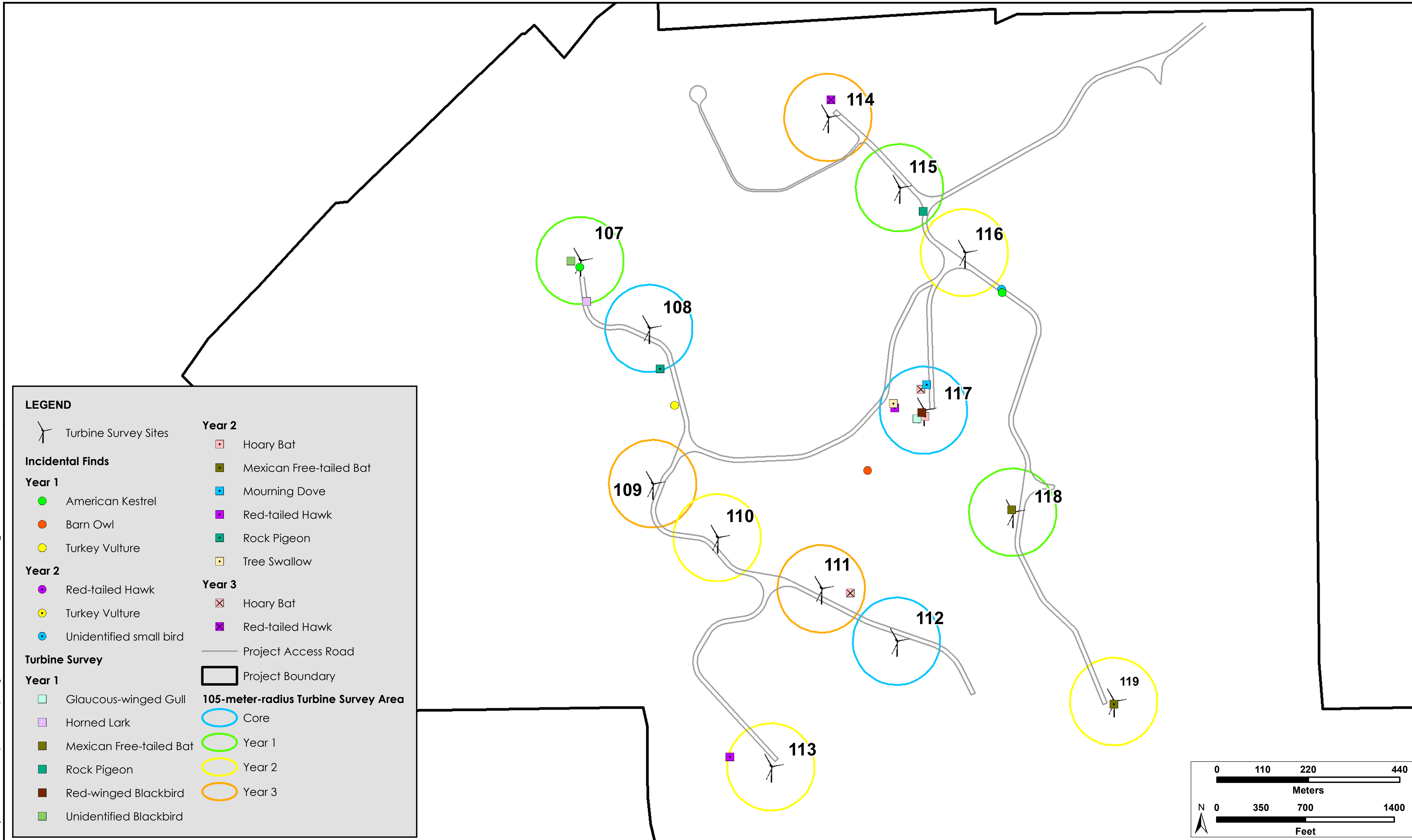
Shiloh I, Shiloh II, Shiloh III, Solano Wind, and Solano Wind III project sites, which occurred at various times from 2004–2012, only nine vulture fatalities were documented (Burleson Consulting 2010; Kerlinger et al. 2006, 2009, 2013a, 2013b; AECOM 2013). In contrast, the first 2 years of monitoring at the Montezuma I site in 2011 and 2012 yielded eight vulture fatalities (three incidentals and five during fatality surveys; ICF International 2013). Thus, although previous studies here and elsewhere have generally concluded that turkey vultures tend to be less susceptible to turbine-related mortality than other raptors, both of the recent Montezuma I and II studies have shown an elevated mortality rate for this species. In the case of our study, a distinct proliferation of sheep carcasses on the landscape during the fall and winter of 2012/2013 in close proximity to several turbines likely contributed to the situation. Poor landscape conditions likely contributed to the apparently high sheep mortality rate by reducing the availability of quality forage for the sheep and increasing depredation by coyotes, while also increasing the scavenging draw for vultures as well as other raptors and ravens.

In response to the high vulture fatality rate and perceived reason for the unusually high rate, in early 2013 NextEra crafted and successfully implemented a new policy, in cooperation with relevant landowners, to reduce the availability of livestock carcasses on the landscape. After that, our field biologists and NextEra field personnel routinely and immediately reported any dead livestock to the facility field manager, who in turn informed the relevant landowner to arrange for the carcass to be removed or buried as quickly as possible. This new system appeared to reduce, but not entirely eliminate, the risk of vulture (and potentially other raptor) mortality. We discovered three additional turkey vulture fatalities in Year 2 (two during fatality surveys and one incidental), but only one in Year 3 (during a fatality survey) despite an overall BUC detection rate that was comparable to Year 1.

The overall low numbers of documented fatalities generally preclude drawing definitive conclusions about fatality hotspots. With that caveat, in Year 1, portions of the central turbine section were associated with a disproportionately high number of fatalities, including both turkey vultures and a broad range of other taxa: a bat, a kestrel, an owl, a grebe, a dove, and a blackbird. In Year 2, the primary hotspot turbines from Year 1, T127 (no fatality surveys) and T128 (core fatality-survey turbine), contributed only two additional fatalities (an incidental red-tailed hawk and a fatality-survey blackbird); however, a disproportionate share of all Year 2 fatalities occurred in the central section (52% of fatality-survey fatalities, plus 80% of the incidental finds), including all kestrel (2) and turkey vulture incidents (3), four of seven red-tailed hawk incidents (including incidentals), and 50% of the bat and nonraptor bird incidents. One of the three Year 2 central-section fatality "hotspots" was at T129 (four incidents: turkey vulture, kestrel, bat, and a fatally injured but still partially mobile red-tailed hawk), immediately adjacent to T128. The other central section hotspots in Year 2 were located farther east (T122, fatality surveys with four incidents) and south/southeast (T124, two incidental finds, and T126, fatality surveys with four incidents). In Year 3, the central section continued to stand out as a fatality concentration area, with 50% of all bat fatalities and 60% of all bird fatalities found there. T128 again stood out as a concentration point for bat fatalities, with all three central-section fatalities documented there. For birds, the documented fatalities were spread out, but were most concentrated in the southeast portion of the central section at T123 and T124 (4 of 8 central section fatalities). Across the 3 study years, this central-section concentration effect applied primarily to bats (50% of all documented fatalities) and medium and large birds (52% and 66% of all fatalities, respectively). Small-bird fatalities were more equally represented in the central (43%) and south sections (39%), especially considering that fewer turbines were surveyed in the smaller south section.

Summarized across the 3-year study, with data for bats and birds and fatality-survey and incidental finds combined and fatality totals for core turbines adjusted to per year averages, the highest per turbine incident totals all occurred in the central section, with 4–6 incidents each documented at 6 of 12 turbines, all located in the central and southeastern portions of this turbine section (compare Figures 20–22). The south section produced a comparatively moderate concentration of incidents, with three incidents per year documented at 4 of 9 turbines, scattered throughout the section (Figure 22). In contrast, the north section produced relatively few incidents, with more than one incident per year (2–3) documented at only 3 of 13 turbines (T107 in the northwest and T116 and T117 in the east-central portion of the section) (Figure 20).

Besides the high level of vulture mortality seen in Year 1 caused by variable proliferation of sheep carcasses, especially in the central section, another factor that appears to have contributed to the apparent concentrations of fatalities as outlined above is landscape cover. Across the study, 59% of all documented fatalities were found in fallow fields, with only 18% in active crop fields, 16% in plowed fields, and 8% in barren/gravel areas. In Year 1 and Year 2, surveyed plots in both the central and south sections contained much greater proportions of fallow habitat than the north section and, although less true in Year 3 (Figure 6), all Year 3 incidents documented in the north section were in fallow habitat. We acknowledge that some of this apparent difference may be a result of reduced detectability in maturing crop fields; however, this limitation applies equally to fallow fields in which the vegetation as grown tall. Regardless, the observed patterns suggest that the probability of fatalities occurring, whether caused by turbine collisions or increased predator activity, is greater in areas of fallow habitat for both birds and bats. This pattern likely reflects the greater potential for fallow habitat to support both prey animals and their predators compared to plowed fields and cultivated grain crops.




N:\Projects3300\3353-01\Reports\Final Report\Fig 20 Distribution of All Incidents Discovered_North.mxd

H.T. HARVEY & ASSOCIATES
Ecological Consultants

**Figure 20: Distribution of All Incidents Discovered During the Montezuma II Postconstruction Fatality Surveys in the North Turbine Section**

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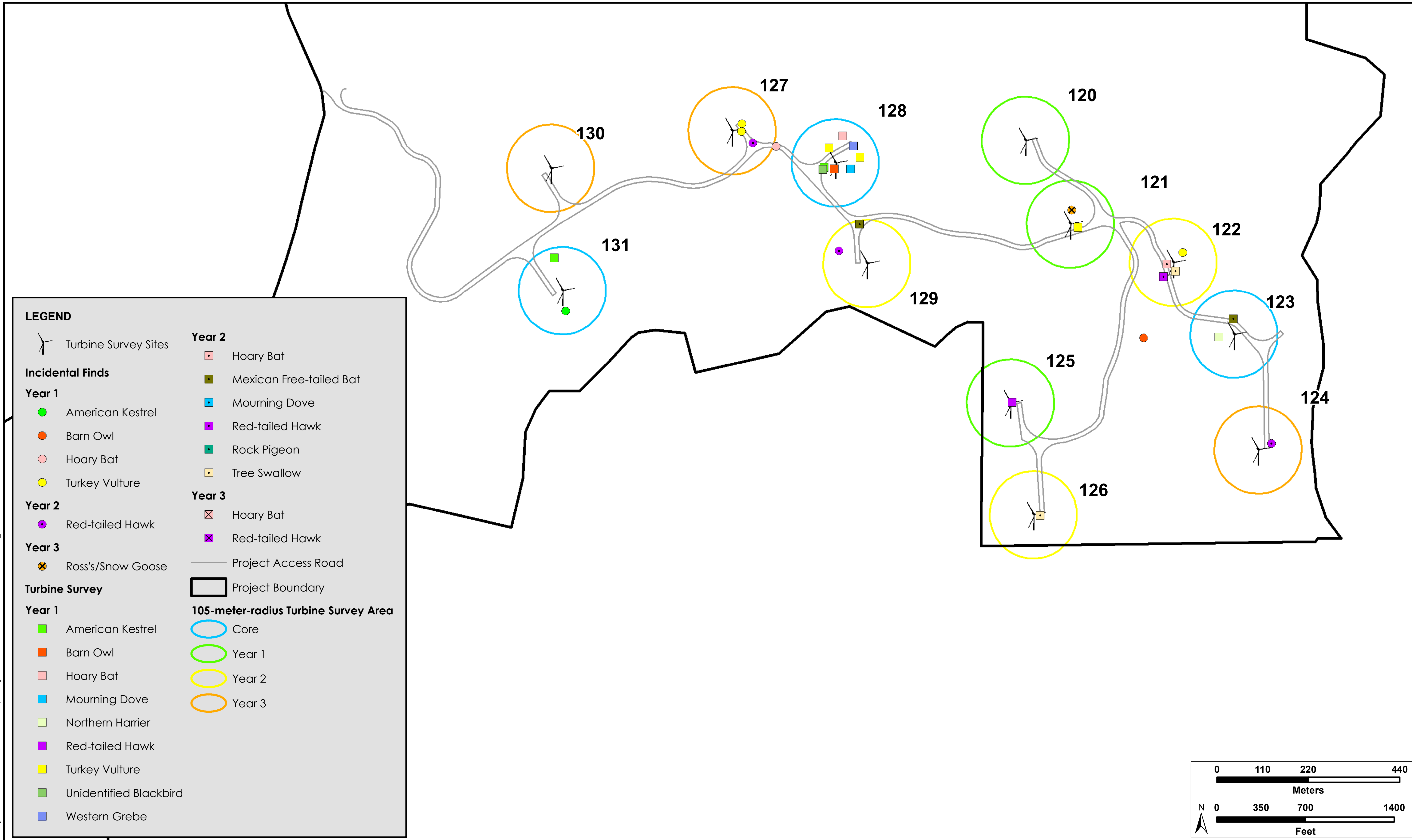


N:\Projects3300\3353-01\Reports\Final Report\Fig 21 Distribution of All Incidents Discovered _Central.mxd

H.T. HARVEY & ASSOCIATES
Ecological Consultants

**Figure 21: Distribution of All Incidents Discovered During the Montezuma II Postconstruction Fatality Surveys in the Central Turbine Section**

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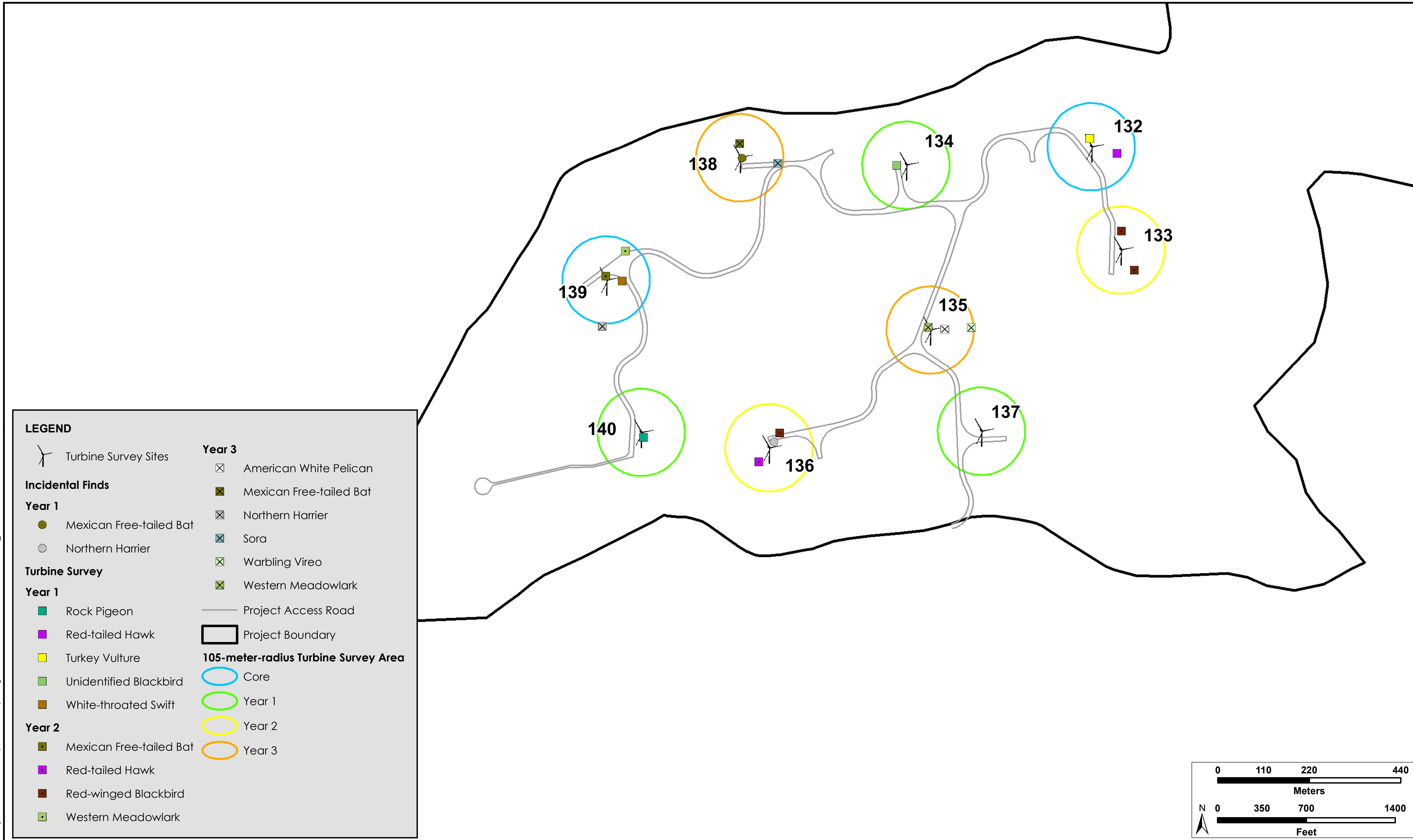


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**Figure 20: Distribution of All Incidents Discovered During the Montezuma II Postconstruction Fatality Surveys in the South Turbine Section**

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## 4.3 Bird Use Counts

Much of the sometimes considerable variation in total-detections tallies recorded during different studies in the MHWRA reflects variation in the scale of effort, in terms of both temporal sampling intensity and the overall spatial extent of the studies (Kerlinger et al. 2006). Translating records to average detections per unit of effort and per unit of spatial area helps minimize this comparison problem, as long as variation in the overall spatial extents of the studies is not too great (Strickland et al. 2011). In the case of MHWRA avian use studies, all have utilized similar 800-m-radius survey plots, so translating raw counts to estimates of average detections per hour works well for within-area comparisons (e.g., as done in Kerlinger et al. 2009, Curry & Kerlinger 2011).

Our BUC results reflect a suite of species and relative abundance patterns similar to those from other pre- and post-construction studies conducted in the MHWRA (Table 23). Species for which our average detection rates were higher than the grand average from previous and concurrent studies in the MHWRA in all three years were Brewer's blackbird, double-crested cormorant, European starling, horned lark, house finch, killdeer, merlin, mourning dove, peregrine falcon, red-winged blackbird, rock pigeon, Say's phoebe, tricolored blackbird, turkey vulture, western meadowlark, and white-throated swift (Table 23). Conversely, species seen in a majority survey years at other project sites for which we consistently recorded below average detection rates were American crow, American kestrel, American white pelican, barn swallow, ferruginous hawk, golden eagle, mallard, northern flicker (*Colaptes auratus*), red-tailed hawk, rough-legged hawk, western kingbird, and white-crowned sparrow.

We recorded no special-status species not previously reported in the MHWRA, and the only raptors and special-status species recorded in the MHWRA during previous avian activity studies that we did not record were osprey (*Pandion haliaetus*), red-shouldered hawk (*Buteo lineatus*), and black swift (*Cypseloides niger*) (Table 23). Black swifts were recorded infrequently at the Shiloh II, Shiloh III, and proposed Collinsville sites (Curry & Kerlinger 2011). Ospreys and red-shouldered hawks were recorded during only two studies.

Our Year 1 overall blackbird detection rate ranked considerably higher than for all other previous and concurrent projects in the MHWRA, except the neighboring High Winds site and the preconstruction evaluation at the Shiloh IV site (Table 23). That distinction diminished in Years 2 and 3, however. The distribution of tricolored blackbirds, in particular, can be highly variably and ephemeral on a site-specific basis from year to year (Beedy 2008).

The activity rate we documented for golden eagles in Year 1 also was high compared to most projects, largely because of the presence of a nearby nest that was active for a brief period in 2012 on the neighboring Shiloh IV project site. The golden eagle detection rate at Montezuma II then dropped below the levels seen at most other projects in Year 2, but then rose again back to a moderately high level in Year 3, despite an absence of golden eagle activity in summer that year. The only projects that have recorded comparable or higher golden eagle activity rates than at Montezuma II in Year 1 are the neighboring High Winds project and the

**Table 23. Estimates of Bird Detections per Hour from Various Pre- and Post-Construction Studies in the Montezuma Hills Wind Resource Area**

| | High Winds | | Shiloh I | Shiloh II | Shiloh III | | Shiloh IV | Montezuma II | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Post | Post | | |
| **Species** | **Aug 00– Aug 01** | **Aug 03– Aug 05** | **Jan 04– Dec 04** | **Apr 09– May 12** | **Apr 07– Apr 08** | **Jan 12– Dec 12** | **Apr 07– Apr 08** | **Mar 12– Feb 13** | **Mar 13– Feb 14** | **Mar 14– Feb 15** | **Grand Average** | **SD** |
| American avocet | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| American coot | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.455 | 0.035 | 0.126 |
| American crow | 0.610 | 0.156 | 0.320 | 0.040 | 0.000 | 0.150 | 0.000 | 0.000 | 0.005 | 0.045 | 0.120 | 0.176 |
| American goldfinch | 0.050 | 0.000 | 0.000 | 0.847 | 0.000 | 1.550 | 0.000 | 6.049 | 0.260 | 1.395 | 0.911 | 1.659 |
| American kestrel | 2.270 | 1.532 | 1.470 | 0.570 | 0.840 | 0.850 | 0.590 | 0.866 | 0.441 | 0.530 | 0.972 | 0.574 |
| American pipit | 3.770 | 4.954 | 1.130 | 0.690 | 0.110 | 1.050 | 1.500 | 4.092 | 1.275 | 4.835 | 2.288 | 2.236 |
| American robin | 0.020 | 0.000 | 0.000 | 0.007 | 0.000 | 0.010 | 0.000 | 0.000 | 0.000 | 0.015 | 0.005 | 0.007 |
| American white pelican | 0.200 | 0.188 | 0.400 | 0.503 | 0.000 | 0.560 | 0.690 | 0.000 | 0.059 | 0.045 | 0.295 | 0.336 |
| American wigeon | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.029 | 0.010 | 0.000 | 0.003 | 0.008 |
| Anna’s hummingbird | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| Barn swallow | 0.890 | 1.258 | 0.060 | 0.780 | 13.490 | 0.320 | 0.720 | 0.000 | 0.196 | 0.220 | 1.596 | 3.610 |
| Black phoebe | 0.020 | 0.000 | 0.000 | 0.013 | 0.000 | 0.000 | 0.000 | 0.054 | 0.000 | 0.000 | 0.009 | 0.015 |
| Black swift | 0.000 | 0.000 | 0.000 | 0.000 | 0.050 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.014 |
| Brewer's blackbird | 2.060 | 2.860 | 3.440 | 2.670 | 0.970 | 1.790 | 5.540 | 41.926 | 31.417 | 23.110 | 9.537 | 13.569 |
| Brown-headed cowbird | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.049 | 0.000 | 0.004 | 0.014 |
| Burrowing owl | 0.000 | 0.024 | 0.000 | 0.013 | 0.000 | 0.010 | 0.000 | 0.109 | 0.000 | 0.000 | 0.016 | 0.031 |
| California gull | 0.000 | 0.000 | 0.000 | 0.073 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.017 | 0.042 |
| Canada goose | 0.220 | 0.743 | 0.890 | 0.640 | 0.000 | 0.020 | 0.000 | 1.207 | 0.211 | 0.245 | 0.477 | 0.443 |
| Chipping sparrow | 0.220 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.017 | 0.061 |
| Chukar | 0.000 | 0.000 | 0.000 | 0.000 | 0.050 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.014 |
| Cinnamon teal | 0.000 | 0.000 | 0.000 | 0.007 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.002 | 0.004 |
| Cliff swallow | 1.050 | 0.118 | 0.230 | 1.690 | 0.650 | 1.410 | 0.000 | 0.443 | 1.676 | 0.640 | 0.877 | 0.729 |
| Cooper's hawk | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.015 | 0.000 | 0.002 | 0.005 |
| Common raven | 2.310 | 2.289 | 1.020 | 0.787 | 1.490 | 0.690 | 1.150 | 3.577 | 1.186 | 1.975 | 1.564 | 0.884 |
| Dark-eyed junco | 0.000 | 0.000 | 0.000 | 0.070 | 0.000 | 0.080 | 0.000 | 0.000 | 0.000 | 0.000 | 0.022 | 0.043 |
| Double-crested cormorant | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.058 | 0.108 | 0.060 | 0.017 | 0.035 |
| Domestic goose | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.035 | 0.003 | 0.010 |
| Dunlin | 0.000 | 0.000 | 0.000 | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.008 |

| | High Winds | | Shiloh I | Shiloh II | Shiloh III | | Shiloh IV | Montezuma II | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** | **Pre** | **Post** | **Post** | **Post** | | |
| **Species** | **Aug 00– Aug 01** | **Aug 03– Aug 05** | **Jan 04– Dec 04** | **Apr 09– May 12** | **Apr 07– Apr 08** | **Jan 12– Dec 12** | **Apr 07– Apr 08** | **Mar 12– Feb 13** | **Mar 13– Feb 14** | **Mar 14– Feb 15** | **Grand Average** | **SD** |
| Eurasian collared-dove | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.015 | 0.002 | 0.005 |
| European starling | 0.390 | 1.469 | 0.000 | 3.273 | 0.220 | 0.140 | 6.840 | 5.830 | 6.118 | 4.335 | 2.818 | 2.610 |
| Ferruginous hawk | 0.030 | 0.016 | 0.000 | 0.027 | 0.000 | 0.000 | 0.000 | 0.010 | 0.000 | 0.000 | 0.012 | 0.014 |
| Golden eagle | 0.860 | 0.219 | 0.080 | 0.067 | 0.080 | 0.090 | 0.190 | 0.146 | 0.054 | 0.095 | 0.172 | 0.215 |
| Golden-crowned sparrow | 0.000 | 0.039 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.006 | 0.022 |
| Grasshopper sparrow | 0.000 | 0.016 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.009 |
| Great blue heron | 0.000 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.010 | 0.002 | 0.005 |
| Great egret | 0.030 | 0.016 | 0.030 | 0.030 | 0.030 | 0.030 | 0.010 | 0.005 | 0.034 | 0.000 | 0.022 | 0.019 |
| Great horned owl | 0.000 | 0.000 | 0.000 | 0.017 | 0.000 | 0.020 | 0.000 | 0.044 | 0.010 | 0.000 | 0.010 | 0.013 |
| Great-tailed grackle | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.000 | 0.000 | 0.001 | 0.003 |
| Greater yellowlegs | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| Greater white-fronted goose | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.002 | 0.006 |
| Horned lark | 8.290 | 2.164 | 0.840 | 2.387 | 2.460 | 1.540 | 4.000 | 8.015 | 4.191 | 7.145 | 3.690 | 2.532 |
| House finch | 0.270 | 0.047 | 0.000 | 0.543 | 0.000 | 0.460 | 0.000 | 6.445 | 0.926 | 3.050 | 0.990 | 1.848 |
| House sparrow | 0.000 | 0.000 | 0.000 | 0.040 | 0.000 | 0.000 | 0.000 | 0.015 | 0.005 | 0.045 | 0.014 | 0.034 |
| Killdeer | 0.720 | 0.368 | 0.000 | 0.763 | 0.300 | 0.730 | 0.430 | 0.727 | 2.059 | 1.720 | 0.747 | 0.618 |
| Lesser goldfinch | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.392 | 0.070 | 0.036 | 0.109 |
| Lesser yellowlegs | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| Lincoln's sparrow | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| Loggerhead shrike | 0.430 | 0.391 | 0.760 | 0.303 | 0.160 | 0.430 | 0.230 | 0.431 | 0.265 | 0.320 | 0.363 | 0.162 |
| Long-billed curlew | 0.420 | 0.000 | 0.000 | 0.677 | 0.000 | 0.000 | 0.000 | 0.175 | 0.206 | 0.000 | 0.218 | 0.329 |
| Long-billed dowitcher | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.092 | 0.078 | 0.000 | 0.013 | 0.032 |
| Mallard | 0.050 | 0.078 | 0.000 | 0.570 | 0.000 | 0.150 | 0.000 | 0.000 | 0.093 | 0.115 | 0.175 | 0.259 |
| Merlin | 0.000 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.024 | 0.010 | 0.020 | 0.005 | 0.009 |
| Mountain bluebird | 0.000 | 0.000 | 0.000 | 0.013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.003 | 0.011 |
| Mourning dove | 0.590 | 0.641 | 0.190 | 0.573 | 0.000 | 0.210 | 0.080 | 1.788 | 2.382 | 1.110 | 0.719 | 0.692 |
| Mute swan | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 | 0.000 | 0.000 | 0.001 |
| Northern flicker | 0.070 | 0.000 | 0.020 | 0.017 | 0.030 | 0.030 | 0.010 | 0.005 | 0.010 | 0.005 | 0.018 | 0.020 |
| Northern harrier | 0.520 | 0.657 | 0.400 | 0.533 | 0.380 | 0.460 | 0.030 | 1.078 | 0.627 | 0.270 | 0.514 | 0.263 |
| Northern mockingbird | 0.110 | 0.039 | 0.000 | 0.013 | 0.030 | 0.010 | 0.000 | 0.000 | 0.000 | 0.035 | 0.023 | 0.031 |
| Northern pintail | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 | 0.001 |

| Species | High Winds Pre Aug 00–Aug 01 | High Winds Post Aug 03–Aug 05 | Shiloh I Pre Jan 04–Dec 04 | Shiloh II Post Apr 09–May 12 | Shiloh III Pre Apr 07–Apr 08 | Shiloh III Post Jan 12–Dec 12 | Shiloh IV Pre Apr 07–Apr 08 | Montezuma II Post Mar 12–Feb 13 | Montezuma II Post Mar 13–Feb 14 | Montezuma II Post Mar 14–Feb 15 | Grand Average | SD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern rough-winged swallow | 0.000 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.123 | 0.025 | 0.013 | 0.034 |
| Northern shoveler | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.001 | 0.003 |
| Peregrine falcon | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.010 | 0.005 | 0.002 | 0.003 |
| Prairie falcon | 0.030 | 0.000 | 0.060 | 0.027 | 0.000 | 0.040 | 0.040 | 0.024 | 0.015 | 0.040 | 0.025 | 0.020 |
| Red-shouldered hawk | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| Red-tailed hawk | 2.340 | 4.047 | 2.560 | 1.410 | 5.190 | 1.490 | 1.280 | 1.886 | 0.868 | 1.355 | 2.253 | 1.632 |
| Red-winged blackbird | 2.370 | 33.188 | 13.690 | 7.207 | 4.590 | 3.090 | 9.660 | 45.423 | 22.191 | 12.280 | 15.484 | 16.436 |
| Ring-necked pheasant | 0.040 | 0.008 | 0.000 | 0.013 | 0.270 | 0.050 | 0.000 | 0.024 | 0.015 | 0.015 | 0.036 | 0.072 |
| Rock pigeon | 1.240 | 3.656 | 1.820 | 0.957 | 10.350 | 0.730 | 6.500 | 9.981 | 10.966 | 13.120 | 4.991 | 4.588 |
| Rough-legged hawk | 0.290 | 0.000 | 0.030 | 0.007 | 0.050 | 0.010 | 0.000 | 0.039 | 0.010 | 0.000 | 0.035 | 0.079 |
| Savannah sparrow | 0.050 | 0.227 | 0.000 | 0.663 | 1.350 | 1.080 | 2.030 | 9.192 | 7.662 | 0.600 | 1.877 | 2.977 |
| Say's phoebe | 0.120 | 0.039 | 0.050 | 0.090 | 0.030 | 0.050 | 0.070 | 0.083 | 0.157 | 0.080 | 0.076 | 0.048 |
| Short-eared owl | 0.010 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 | 0.001 | 0.003 |
| Snow goose | 0.000 | 0.000 | 0.000 | 0.133 | 0.000 | 0.550 | 0.000 | 0.000 | 0.000 | 0.035 | 0.076 | 0.180 |
| Snowy egret | 0.030 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.008 |
| Song sparrow | 0.070 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.000 | 0.000 | 0.006 | 0.019 |
| Swainson's hawk | 0.010 | 0.008 | 0.320 | 0.127 | 0.080 | 0.050 | 0.230 | 0.117 | 0.005 | 0.115 | 0.102 | 0.095 |
| Tree swallow | 0.040 | 0.321 | 0.160 | 0.753 | 0.490 | 0.380 | 0.340 | 0.562 | 1.142 | 0.260 | 0.483 | 0.345 |
| Tricolored blackbird | 0.050 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 141.304 | 34.162 | 29.960 | 15.806 | 39.564 |
| Tundra swan | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.034 | 0.054 | 0.000 | 0.007 | 0.017 |
| Turkey vulture | 5.440 | 3.789 | 4.050 | 0.903 | 4.190 | 1.300 | 4.110 | 4.645 | 3.471 | 4.710 | 3.246 | 1.641 |
| Varied thrush | 0.000 | 0.000 | 0.000 | 0.013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.003 | 0.006 |
| Violet-green swallow | 0.160 | 0.180 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.015 | 0.000 | 0.000 | 0.041 | 0.105 |
| Western kingbird | 0.070 | 0.078 | 0.000 | 0.023 | 0.000 | 0.010 | 0.000 | 0.010 | 0.000 | 0.010 | 0.025 | 0.033 |
| Western meadowlark | 3.600 | 2.383 | 0.050 | 3.707 | 2.780 | 3.600 | 6.380 | 9.107 | 8.245 | 3.805 | 4.112 | 2.609 |
| Western scrub-jay | 0.290 | 0.000 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.023 | 0.080 |
| Western tanager | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.003 |
| Whimbrel | 0.070 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.019 |
| White-crowned sparrow | 0.140 | 0.008 | 0.000 | 0.083 | 2.590 | 0.100 | 0.000 | 0.112 | 0.000 | 0.000 | 0.247 | 0.706 |
| White-faced ibis | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.019 | 0.000 | 0.000 | 0.001 | 0.005 |
| White-tailed kite | 0.010 | 0.243 | 0.130 | 0.027 | 0.000 | 0.070 | 0.000 | 0.146 | 0.000 | 0.000 | 0.071 | 0.091 |

| | High Winds | | Shiloh I | Shiloh II | Shiloh III | | Shiloh IV | Montezuma II | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre | Post | Pre | Post | Pre | Post | Pre | Post | Post | Post | | |
| **Species** | **Aug 00– Aug 01** | **Aug 03– Aug 05** | **Jan 04– Dec 04** | **Apr 09– May 12** | **Apr 07– Apr 08** | **Jan 12– Dec 12** | **Apr 07– Apr 08** | **Mar 12– Feb 13** | **Mar 13– Feb 14** | **Mar 14– Feb 15** | **Grand Average** | **SD** |
| White-throated swift | 0.000 | 0.024 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.229 | 0.485 | 1.030 | 0.138 | 0.303 |
| Yellow-billed magpie | 0.000 | 0.008 | 0.000 | 0.007 | 0.080 | 0.000 | 0.000 | 0.000 | 0.005 | 0.010 | 0.010 | 0.022 |
| Yellow-rumped warbler | 0.000 | 0.000 | 0.000 | 0.137 | 0.000 | 0.030 | 0.000 | 0.000 | 0.000 | 0.000 | 0.034 | 0.061 |
| Mixed blackbirds | 344.208 | 601.610 | 103.870 | 26.033 | 51.620 | 24.640 | 214.040 | 0.501 | 0.985 | 12.545 | 156.441 | 244.253 |
| Unidentified corvid | 0.000 | 0.063 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.035 |
| Unidentified duck | 0.000 | 0.203 | 0.000 | 0.067 | 0.000 | 0.000 | 0.000 | 0.397 | 0.000 | 0.000 | 0.077 | 0.154 |
| Unidentified goldfinch | 0.000 | 0.000 | 0.000 | 0.013 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.003 | 0.011 |
| Unidentified gull | 0.000 | 0.024 | 0.000 | 0.287 | 0.000 | 0.140 | 0.000 | 0.910 | 0.132 | 0.090 | 0.168 | 0.280 |
| Unidentified raptor | 0.630 | 0.305 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.010 | 0.096 | 0.214 |
| Unidentified hummingbird | 0.000 | 0.008 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.004 |
| Unidentified songbird | 0.000 | 0.328 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.050 | 0.182 |
| Unidentified sparrow | 0.000 | 0.008 | 0.000 | 0.000 | 0.270 | 0.000 | 0.000 | 0.019 | 0.000 | 0.000 | 0.023 | 0.074 |
| Unidentified swallow | 0.000 | 1.946 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.000 | 0.301 | 0.761 |
| Unidentified bird | 0.000 | 0.000 | 0.000 | 0.083 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.019 | 0.069 |
| **All Birds** | **387.798** | **672.997** | **138.070** | **61.960** | **105.270** | **50.210** | **266.690** | **308.053** | **145.108** | **132.110** | **235.783** | **249.817** |
| **All Birds Except Blackbirds** | **39.110** | **35.340** | **17.070** | **26.050** | **48.090** | **20.690** | **37.450** | **78.899** | **56.353** | **54.215** | **38.516** | **18.019** |

preconstruction study at the Shiloh IV project site. Both of these studies occurred when the nearby Callahan nesting territory (located on the Montezuma II project site) was still active (Kerlinger et al. 2006, 2011). Our observations over the course of this study suggested that the transmission-line corridor that runs north–south through the western section of the MHWRA, which features a broad swath of perennially fallow grassland as well as the ideal substrates for perching (and nesting) provided by the transmission line, is a focal area for golden eagle activity.

Compared to the grand average for other previous and concurrent pre- and post-construction studies in the MHWRA for which comparable data are available, the Montezuma II 3-year-average bird detection rates were ≥50% above average for 18 species seen in previous studies, plus we recorded 16 species not tallied in the other relevant studies (Table 23). Conversely, not including 21 species that we did not record during the surveys, the 3-year-average Montezuma II detection rates were ≥50% below average for 14 species that are frequently seen in the MHWRA. The 3-year average detection rates of American kestrels and red-tailed hawks, two of the most common fatalities in the MHWRA, also were well below average compared to the previous average (43% and 46%, respectively).

Climatic conditions likely contributed to the relatively low activity rates for many species in Years 2 and 3, and in comparing the Montezuma II bird activity data against data from earlier projects. Much of the region experienced a severe and ongoing drought beginning in spring 2012, with the severity increasing markedly during Year 2.

### 4.3.1 Flight Altitudes and Risk of Turbine Collision

With the data properly calibrated beginning in Year 2 (unlike in Year 1), we were able to consider whether the Year 2 and 3 fatality rates correlated with the flight-height characteristics of different species and species groups. Even though the proportion of bird flights classified as overlapping the turbine collision risk zone increased for all species groups except raptors in Year 3 (Figure 18), the bird fatality rates declined for all relevant species and species groups (Table 12). For waterbird species such as American white pelican and Ross's/snow geese, which showed up as fatalities in Year 3, we never detected them during the BUCs flying low enough to comprise a risk of turbine collision. In regards to the Swainson's hawk fatality discovered in Year 3, there was no substantial change in the prevalence of flights that overlapped the turbine risk zone between Years 2 and 3, suggesting that the fatality incident was instead more correlated with the higher activity rate observed in Year 3. In the case of other raptor species commonly subject to collision fatalities, a 19% increase in American kestrel flights overlapping the risk zone in Year 3 clearly did not result in an increase in the number documented fatalities (2 recorded in Year 2, none in Year 3). Similarly, an increase from 37% to 59% of flights detected in the risk zone between Years 2 and 3 did not result in an increase in documented fatalities for red-tailed hawks (4 fatalities in Year 2, 1 in Year 3). In addition, substantial increases in the proportions of blackbirds detected flying in the risk zone in Year 3 (>60% of flights for both red-winged and Brewer's blackbirds) compared to Year 2 (<10%) resulted in no documented fatalities in Year 3, whereas we recorded five in Year 2. In contrast, a three-fold increase in the number of documented western meadowlark fatalities in Year 3 compared to Year 2 potentially could have resulted from an increase in the proportion of flights that extended into the LOW/MED altitude transition zone in Year 3 (changed from 0% of flights in Year 2 to 12% in Year 3).

## 4.4 Comparing Bird Detection and Fatality Rates

Comparing the numbers of documented fatality incidents against average detection rates derived from the BUCs for each year of the study revealed few consistent correlations when examined in relation to turbine sections or seasons. One notable exception was that there appeared to be a positive correlation between detection rates and fatality numbers of non-vulture raptors, with both consistently highest in the central section (Figure 23). No such correlation was shown for vultures, nor were there any other distinct matching patterns for other species groups or with the data organized by season. Interannual comparisons of site-wide fatality numbers and average detection rates for different species groups also generally did not reveal definitive patterns. Exceptions were that the annual average detection rates and fatality numbers for columbids appeared to be negatively correlated, whereas with data for raptors (including vultures) and all birds combined suggested weak positive correlations between annual detection rates and fatality numbers (Figure 24).

Thus, although the small overall number of fatalities warrants against definitive conclusions, some weak evidence emerged to suggest that the probability of a non-vulture raptor fatality increased as the activity levels of this group increased. The unique nature of this pattern may correlate with raptors being top-level, territorial predators, whereby increasing densities could translate to more social and territorial interactions, as well as fiercer competition for prey resources, all of which increase the risk of distraction and not paying attention to avoiding turbine collisions.

The lack of such relationships for other species groups suggests that other factors besides the general activity rate may have been more important drivers of the probability of a fatality event occurring around the turbines. For example, the substantial declines in bird activity that occurred through the study for several species groups likely reflected drought-related population declines. Despite substantially lower activity levels, the fatality numbers for blackbirds and other small birds increased in Year 2, which may be an indication of drought stress. Malnourished birds may be less observant and less able to effectively avoid turbine collisions, and may also have been at greater risk of pursuit by malnourished predators. The documented reduction in carcass persistence after Year 1 for all taxonomic groups, despite reductions in the frequency of scavenger observations, was another indication that the drought pushed the remaining predator/scavenger community to take full advantage of all possible food sources to an increased degree in Years 2 and 3. The flight height data suggested that flying more often at altitudes that could represent heightened risk of turbine collisions, such as happened for blackbirds and other species groups in Year 3 compared to Year 2, did not necessarily translate to increased numbers of fatalities, again suggesting that other factors, such as predation risk, played a greater role in determining the risk of mortality around the turbines for such species.

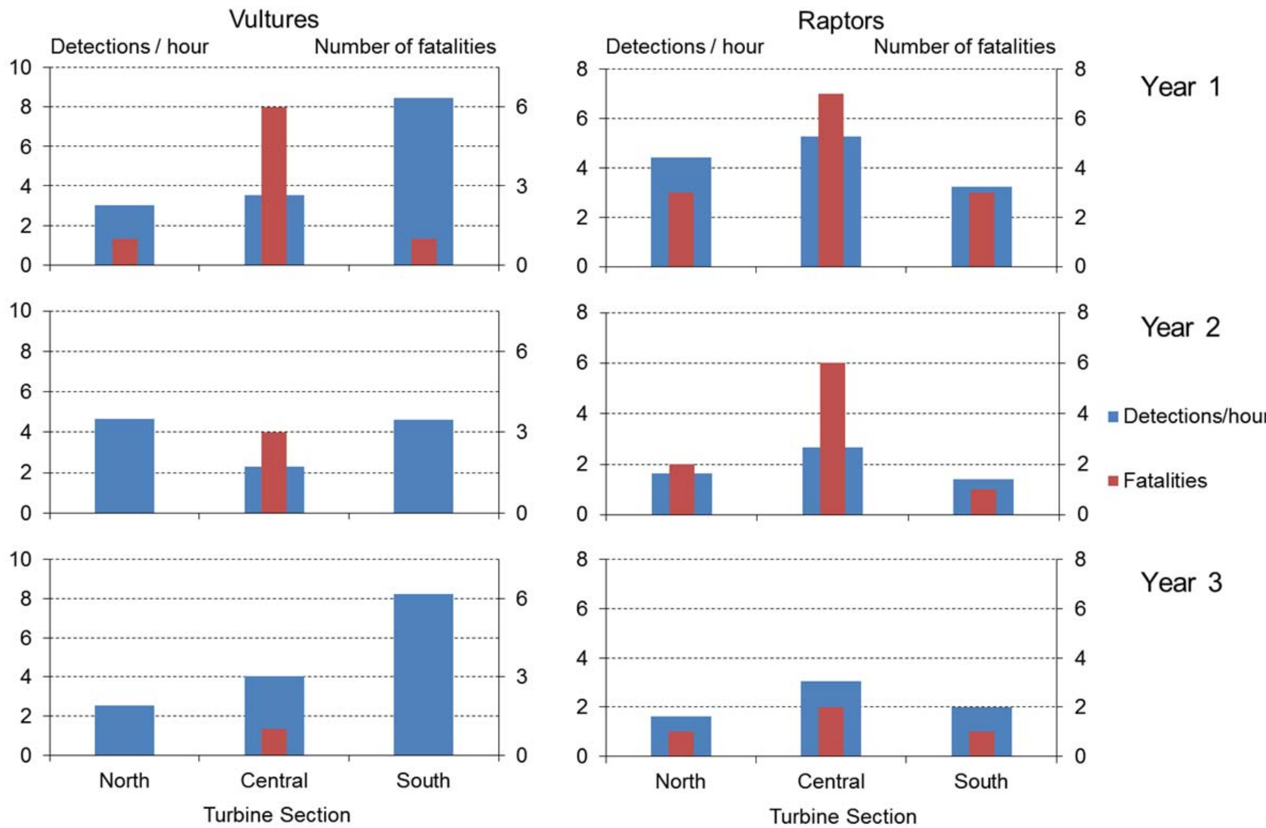


**Figure 23. Interannual Comparisons of Unadjusted Numbers of Fatality Incidents (Including Incidentals) and Average Detection Rates during Bird Use Counts by Turbine Section for Vultures and Other Raptors**

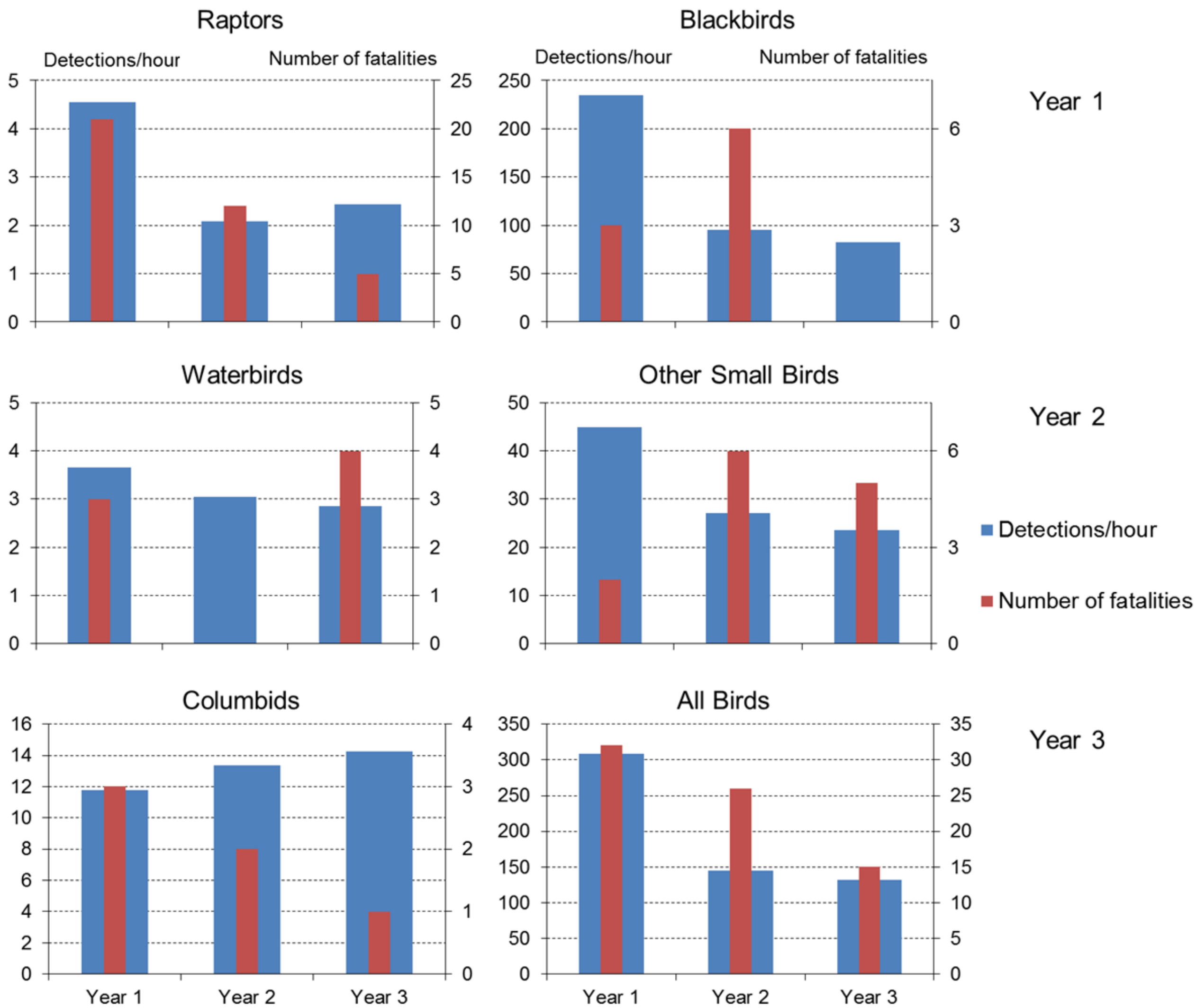


**Figure 24. Interannual Comparisons of Unadjusted Numbers of Fatality Incidents (Including Incidentals) and Average Detection Rates during Bird Use Counts for Different Bird Species Groups**

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## Personal Communications

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# Appendix A. Searcher Efficiency Bias Trial Specimens: Year 3

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T09R1-168 | 4/14/14 | 109 | 61 | 200 | 602907 | 4220875 | Hoary bat | S | Crop-high | 3 / 3 | No | No |
| T09R1-169 | 4/14/14 | 111 | 4 | 275 | 603352 | 4220644 | Cedar waxwing | S | Gravel | 1 / 3 | Yes | Yes |
| T09R1-170 | 4/14/14 | 117 | 38 | 227 | 603567 | 4221090 | Townsend's big-eared bat | S | Fallow-medium | 3 / 3 | No | No |
| T09R1-171 | 4/14/14 | 117 | 42 | 176 | 603581 | 4221055 | Red-tailed hawk | L | Fallow-medium | 3 / 3 | Yes | Yes |
| T09R1-172 | 4/14/14 | 114 | 48 | 166 | 603376 | 4221749 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | Yes |
| T09R2-173 | 4/16/14 | 135 | 38 | 210 | 601550 | 4217823 | Townsend's big-eared bat | S | Fallow-medium | 3 / 3 | No | No |
| T09R2-174 | 4/16/14 | 108 | 39 | 216 | 602904 | 4221295 | House finch | S | Crop-high | 3 / 3 | No | Yes |
| T09R2-175 | 4/16/14 | 108 | 14 | 257 | 602920 | 4220562 | American kestrel | M | Crop-high | 3 / 3 | No | No |
| T09R2-176 | 4/16/14 | 112 | 50 | 28 | 603578 | 4220562 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | No |
| T09R2-177 | 4/16/14 | 112 | 2 | 62 | 603540 | 4220541 | Rock pigeon | M | Gravel | 1 / 3 | Yes | Yes |
| T09R2-178 | 4/16/14 | 138 | 64 | 337 | 601165 | 4218310 | Brewer's blackbird | S | Crop-high | 3 / 3 | No | Yes |
| T09R3-179 | 4/24/14 | 128 | 1 | 219 | 604272 | 4219697 | Mexican free-tailed bat | S | Gravel | 1 / 3 | Yes | Yes |
| T09R3-180 | 4/24/14 | 128 | 42 | 162 | 604265 | 4219660 | Western tanager | S | Crop-high | 3 / 3 | No | Yes |
| T09R3-181 | 4/24/14 | 128 | 20 | 246 | 604248 | 4219694 | Mourning dove | M | Fallow-low | 2 / 3 | No | Yes |
| T09R3-182 | 4/24/14 | 130 | 15 | 291 | 603580 | 4219691 | Townsend's big-eared bat | S | Plowed-coarse | 2 / 3 | No | Yes |
| T09R3-183 | 4/24/14 | 130 | 49 | 223 | 603539 | 4219671 | White-throated swift | S | Plowed-coarse | 2 / 3 | Yes | Yes |
| T09R3-184 | 4/24/14 | 130 | 87 | 24 | 603654 | 4219744 | Sharp-shinned hawk | M | Plowed-coarse | 2 / 3 | Yes | Yes |
| T09R3-185 | 4/24/14 | 131 | 28 | 50 | 603644 | 4219388 | Mexican free-tailed bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T09R3-186 | 4/24/14 | 131 | 43 | 109 | 603634 | 4219350 | Western red bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T09R3-187 | 4/24/14 | 131 | 36 | 219 | 603589 | 4219377 | Barn owl | M | Plowed-coarse | 2 / 2 | Yes | Yes |
| T09R3-188 | 4/30/14 | 112 | 20 | 191 | 603522 | 4220529 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | Yes |
| T09R3-189 | 4/30/14 | 112 | 35 | 125 | 603559 | 4220517 | Townsend's big-eared bat | S | Fallow-high | 3 / 3 | No | No |
| T09R3-190 | 4/30/14 | 112 | 15 | 69 | 603551 | 4220536 | Loggerhead shrike | S | Fallow-high | 3 / 3 | No | Yes |
| T09R3-191 | 4/30/14 | 108 | 33 | 188 | 602923 | 4221260 | Mourning dove | M | Crop-high | 3 / 3 | No | No |
| T09R3-192 | 4/30/14 | 108 | 52 | 26 | 602982 | 4221329 | Big brown bat | S | Crop-high | 3 / 3 | No | Yes |
| T09R3-193 | 4/30/14 | 135 | 10 | 10 | 601594 | 4217837 | House sparrow | S | Fallow-low | 2 / 3 | No | No |
| T09R3-194 | 4/30/14 | 135 | 104 | 208 | 601503 | 4217773 | Great horned owl | L | Fallow-medium | 3 / 3 | No | Yes |

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T09R3-195 | 5/5/14 | 109 | 39 | 259 | 602917 | 4220921 | Townsend's big-eared bat | S | Crop-high | 3 / 3 | No | Yes |
| T09R5-196 | 5/5/14 | 111 | 21 | 338 | 603358 | 4220686 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | No |
| T09R5-197 | 5/5/14 | 111 | 1 | 15 | 603359 | 4220670 | Red-shouldered hawk | L | Gravel | 1 / 3 | Yes | Yes |
| T09R5-198 | 5/5/14 | 114 | 48 | 239 | 603330 | 5221773 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | No |
| T09R5-199 | 5/5/14 | 114 | 20 | 165 | 603380 | 4221777 | Red-winged blackbird | S | Fallow-high | 3 / 3 | No | Yes |
| T09R5-200 | 5/5/14 | 117 | 52 | 125 | 603639 | 4221052 | Turkey vulture | L | Fallow-high | 3 / 3 | No | Yes |
| T09R5-201 | 5/5/14 | 132 | 18 | 285 | 601966 | 4218286 | Mexican free-tailed bat | S | Fallow-low | 2 / 3 | No | No |
| T09R5-202 | 5/5/14 | 132 | 2 | 39 | 601983 | 4218274 | Western red bat | S | Gravel | 1 / 3 | No | Yes |
| T09R5-203 | 5/5/14 | 132 | 44 | 47 | 602017 | 4218278 | Sharp-shinned hawk | M | Fallow-medium | 3 / 3 | Yes | Yes |
| T09R6-204 | 5/6/14 | 123 | 41 | 275 | 605195 | 4219309 | Mexican free-tailed bat | S | Plowed-coarse | 2 / 2 | No | No |
| T09R6-205 | 5/6/14 | 123 | 68 | 310 | 605209 | 4219352 | House sparrow | S | Plowed-coarse | 2 / 2 | No | Yes |
| T09R6-206 | 5/6/14 | 124 | 102 | 286 | 605207 | 4219073 | Northern mockingbird | S | Plowed-coarse | 2 / 2 | No | Yes |
| T09R6-207 | 5/6/14 | 124 | 3 | 103 | 605291 | 4219004 | Oak titmouse | S | Gravel | 1 / 2 | Yes | Yes |
| T09R6-208 | 5/6/14 | 127 | 33 | 85 | 604049 | 4219754 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | Yes |
| T09R6-209 | 5/6/14 | 127 | 16 | 107 | 604032 | 4219763 | Mexican free-tailed bat | S | Crop-medium | 3 / 3 | Yes | Yes |
| T09R6-210 | 5/6/14 | 127 | 100 | 336 | 604047 | 4219874 | Barn owl | M | Crop-high | 3 / 3 | Yes | Yes |
| T09R6-211 | 5/6/14 | 124 | 42 | 233 | 605247 | 4218997 | Red-tailed hawk | L | Plowed-coarse | 2 / 2 | Yes | Yes |
| T09R6-212 | 5/6/14 | 139 | 51 | 309 | 600792 | 4218002 | Western red bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T09R6-213 | 5/6/14 | 139 | 64 | 104 | 600853 | 4217904 | Western gull | L | Plowed-coarse | 2 / 2 | Yes | Yes |
| T10R1-214 | 7/14/14 | 109 | 26 | 142 | 602956 | 4220893 | Western red bat | S | Crop-high | 3 / 3 | No | Yes |
| T10R1-215 | 7/14/14 | 109 | 60 | 59 | 603013 | 4220905 | European starling | S | Crop-high | 3 / 3 | No | Yes |
| T10R1-216 | 7/14/14 | 109 | 101 | 267 | 602856 | 4220944 | Cooper's hawk | M | Crop-high | 3 / 3 | No | Yes |
| T10R1-217 | 7/14/14 | 111 | 27 | 336 | 603361 | 4220696 | Mexican free-tailed bat | S | Fallow-high | 3 / 3 | No | Yes |
| T10R1-218 | 7/14/14 | 111 | 7 | 111 | 603360 | 4220666 | Western tanager | S | Gravel | 1 / 3 | No | Yes |
| T10R1-219 | 7/14/14 | 111 | 78 | 164 | 603332 | 4220596 | Great horned owl | L | Fallow-high | 3 / 3 | No | Yes |
| T10R1-220 | 7/14/14 | 114 | 41 | 173 | 603355 | 4221761 | White-breasted nuthatch | S | Fallow-high | 3 / 3 | No | Yes |
| T10R1-221 | 7/14/14 | 114 | 81 | 200 | 603304 | 4221759 | Rock pigeon | M | Fallow-high | 3 / 3 | Yes | Yes |
| T10R1-222 | 7/14/14 | 117 | 25 | 61 | 603626 | 4221096 | Big brown bat | S | Fallow-high | 3 / 3 | No | Yes |
| T10R1-223 | 7/14/14 | 117 | 11 | 103 | 603614 | 4221092 | Red-winged blackbird | S | Fallow-high | 3 / 3 | Yes | Yes |
| T10R1-224 | 7/14/14 | 117 | 75 | 219 | 603529 | 4221090 | Western gull | L | Fallow-high | 3 / 3 | Yes | Yes |

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T10R1-225 | 7/14/14 | 132 | 40 | 160 | 601968 | 4218246 | Townsend's big-eared bat | S | Plowed-fine | 1 / 2 | No | No |
| T10R1-226 | 7/14/14 | 132 | 68 | 91 | 602037 | 4218240 | Yellow-billed magpie | M | Plowed-fine | 1 / 2 | Yes | Yes |
| T10R2-227 | 7/16/14 | 108 | 53 | 287 | 602909 | 4221332 | Mexican free-tailed bat | S | Crop-high | 3 / 3 | No | Yes |
| T10R2-228 | 7/16/14 | 108 | 91 | 66 | 603032 | 4221273 | Western screech-owl | S | Fallow-low | 2 / 3 | Yes | Yes |
| T10R2-229 | 7/16/14 | 112 | 25 | 330 | 603537 | 4220572 | Western red bat | S | Fallow-high | 3 / 3 | No | Yes |
| T10R2-230 | 7/16/14 | 135 | 33 | 134 | 601596 | 4217804 | House finch | S | Plowed-medium | 2 / 2 | Yes | Yes |
| T10R2-231 | 7/16/14 | 135 | 76 | 308 | 601552 | 4217904 | Red-shouldered hawk | L | Plowed-medium | 2 / 2 | Yes | Yes |
| T10R2-232 | 7/16/14 | 138 | 1 | 184 | 601128 | 4218247 | Mexican free-tailed bat | S | Gravel | 1 / 2 | Yes | Yes |
| T10R3-233 | 7/17/14 | 128 | 48 | 156 | 604275 | 4219649 | Western red bat | S | Crop-harvested | 2 / 2 | No | Yes |
| T10R3-234 | 7/17/14 | 128 | 17 | 201 | 604258 | 4219689 | Brewer's blackbird | S | Crop-harvested | 2 / 2 | Yes | Yes |
| T10R3-235 | 7/17/14 | 130 | 20 | 33 | 603606 | 4219700 | Mexican free-tailed bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T10R3-236 | 7/17/14 | 130 | 73 | 97 | 603609 | 4219754 | Loggerhead shrike | S | Plowed-coarse | 2 / 2 | No | Yes |
| T10R3-237 | 7/17/14 | 131 | 97 | 66 | 603711 | 4219383 | Barn owl | M | Plowed-coarse | 2 / 2 | Yes | Yes |
| T10R4-238 | 7/22/14 | 123 | 24 | 283 | 605214 | 4219306 | Mexican free-tailed bat | S | Plowed-medium | 2 / 2 | No | Yes |
| T10R4-239 | 7/22/14 | 124 | 72 | 179 | 605251 | 4218951 | House finch | S | Plowed-medium | 2 / 2 | No | Yes |
| T10R4-240 | 7/22/14 | 124 | 21 | 103 | 605299 | 4218996 | Red-tailed hawk | L | Plowed-medium | 2 / 2 | Yes | Yes |
| T10R4-241 | 7/22/14 | 127 | 39 | 256 | 603987 | 4219792 | Mexican free-tailed bat | S | Crop-harvested | 2 / 2 | No | Yes |
| T10R4-242 | 7/22/14 | 127 | 27 | 47 | 604050 | 4219778 | Cedar waxwing | S | Crop-harvested | 2 / 2 | No | No |
| T10R4-243 | 7/22/14 | 139 | 54 | 172 | 600780 | 4217897 | Barn owl | M | Plowed-medium | 2 / 2 | Yes | Yes |
| T10R5-244 | 7/31/14 | 128 | 51 | 81 | 604318 | 4219680 | Mexican free-tailed bat | S | Crop-harvested | 2 / 2 | Yes | Yes |
| T10R5-245 | 7/31/14 | 130 | 4 | 128 | 603592 | 4219679 | Big brown bat | S | Gravel | 1 / 2 | Yes | Yes |
| T10R5-246 | 7/31/14 | 130 | 40 | 197 | 603570 | 4219651 | Ring-necked pheasant | L | Plowed-coarse | 2 / 2 | No | Yes |
| T10R5-247 | 7/31/14 | 131 | 17 | 359 | 603935 | 4219650 | Mexican free-tailed bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T10R5-248 | 7/31/14 | 131 | 38 | 208 | 603634 | 4219359 | Western red bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T10R6-249 | 8/5/14 | 127 | 55 | 223 | 603971 | 4219768 | Turkey vulture | L | Crop-harvested | 2 / 3 | Yes | Yes |
| T10R6-250 | 8/5/14 | 139 | 7 | 260 | 600833 | 4217989 | Mexican free-tailed bat | S | Plowed-medium | 2 / 2 | No | Yes |
| T10R6-251 | 8/5/14 | 139 | 62 | 57 | 600873 | 4217954 | White-throated swift | S | Plowed-medium | 2 / 2 | No | Yes |
| T10R6-252 | 8/5/14 | 123 | 68 | 74 | 605298 | 4219260 | Mexican free-tailed bat | S | Plowed-medium | 2 / 2 | No | Yes |
| T10R6-253 | 8/5/14 | 123 | 92 | 301 | 605197 | 4219375 | Barn owl | M | Plowed-medium | 2 / 2 | Yes | Yes |
| T10R6-254 | 8/5/14 | 124 | 2 | 176 | 605286 | 4219008 | Western red bat | S | Gravel | 1 / 2 | No | Yes |

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T10R7-255 | 8/13/14 | 108 | 41 | 97 | 602974 | 4221266 | Myotis spp. | S | Crop-harvested | 2 / 3 | No | Yes |
| T10R7-256 | 8/13/14 | 108 | 22 | 254 | 602924 | 4221301 | European starling | S | Crop-harvested | 2 / 3 | Yes | Yes |
| T10R7-257 | 8/13/14 | 112 | 24 | 358 | 603548 | 4220564 | Big brown bat | S | Fallow-high | 3 / 3 | No | Yes |
| T10R7-258 | 8/13/14 | 112 | 86 | 77 | 603619 | 4220517 | Ring-necked pheasant | L | Fallow-high | 3 / 3 | No | Yes |
| T10R7-259 | 8/13/14 | 135 | 25 | 203 | 601568 | 4217819 | Mexican free-tailed bat | S | Plowed-medium | 2 / 2 | No | Yes |
| T10R7-260 | 8/13/14 | 138 | 34 | 87 | 601158 | 4218225 | Western red bat | S | Plowed-fine | 1 / 2 | No | Yes |
| T10R7-261 | 8/13/14 | 138 | 7 | 174 | 601126 | 4218239 | White-crowned sparrow | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R1-262 | 11/6/14 | 128 | 58 | 144 | 604377 | 4219448 | Western red bat | S | Crop-harvested | 2 / 3 | No | Yes |
| T11R1-263 | 11/6/14 | 128 | 93 | 189 | 604308 | 4219426 | Barn owl | M | Plowed-coarse | 2 / 3 | No | Yes |
| T11R1-264 | 11/6/14 | 130 | 36 | 319 | 603667 | 4219528 | Mexican free-tailed bat | S | Plowed-fine | 1 / 2 | No | No |
| T11R1-265 | 11/6/14 | 131 | 8 | 106 | 603701 | 4219190 | Hoary bat | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R1-266 | 11/6/14 | 131 | 31 | 238 | 603716 | 4220944 | Red-winged blackbird | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R2-267 | 11/10/14 | 109 | 55 | 344 | 603052 | 4220783 | House sparrow | S | Crop-harvested | 2 / 3 | No | Yes |
| T11R2-268 | 11/10/14 | 109 | 22 | 162 | 603045 | 4220707 | Cooper's hawk | M | Crop-harvested | 2 / 3 | Yes | Yes |
| T11R2-270 | 11/10/14 | 114 | 89 | 4 | 603521 | 4221681 | Great horned owl | L | Plowed-coarse | 2 / 2 | Yes | Yes |
| T11R2-271 | 11/10/14 | 117 | 31 | 77 | 603725 | 4220896 | Mexican free-tailed bat | S | Crop-harvested | 2 / 3 | No | No |
| T11R2-272 | 11/10/14 | 117 | 84 | 310 | 603324 | 4220970 | Sora | S | Crop-harvested | 2 / 3 | No | No |
| T11R3-273 | 11/11/14 | 123 | 25 | 12 | 605244 | 4219308 | Western red bat | S | Plowed-fine | 1 / 1 | Yes | Yes |
| T11R3-274 | 11/11/14 | 123 | 42 | 134 | 605250 | 4219248 | Western scrub-jay | S | Plowed-fine | 1 / 1 | No | No |
| T11R3-275 | 11/11/14 | 124 | 18 | 345 | 605298 | 4219032 | Mexican free-tailed bat | S | Barren | 1 / 1 | No | No |
| T11R3-276 | 11/11/14 | 127 | 81 | 29 | 604098 | 4219812 | Red-shouldered hawk | L | Crop-harvested | 2 / 3 | Yes | Yes |
| T11R3-277 | 11/11/14 | 139 | 69 | 295 | 600761 | 4218003 | Big brown bat | S | Plowed-fine | 1 / 1 | No | Yes |
| T11R3-278 | 11/11/14 | 139 | 10 | 282 | 600800 | 4217961 | Rock pigeon | M | Plowed-fine | 1 / 1 | Yes | Yes |
| T11R4-279 | 11/17/14 | 109 | 18 | 51 | 602969 | 4220923 | Hoary bat | S | Crop-harvested | 2 / 3 | Yes | Yes |
| T11R4-280 | 11/17/14 | 111 | 78 | 53 | 603436 | 4220680 | European starling | S | Plowed-medium | 2 / 2 | No | No |
| T11R4-281 | 11/17/14 | 114 | 2 | 335 | 603374 | 4221806 | Western red bat | S | Gravel | 1 / 3 | No | Yes |
| T11R4-282 | 11/17/14 | 114 | 61 | 146 | 603390 | 4221742 | Western screech-owl | S | Plowed-medium | 2 / 3 | No | No |
| T11R4-283 | 11/17/14 | 117 | 44 | 258 | 603557 | 4221105 | Turkey vulture | L | Plowed-medium | 2 / 2 | Yes | Yes |
| T11R5-284 | 11/20/14 | 108 | 41 | 359 | 602969 | 4221326 | Hoary bat | S | Crop-harvested | 2 / 3 | No | Yes |
| T11R5-285 | 11/20/14 | 108 | 88 | 182 | 602886 | 4221226 | Sharp-shinned hawk | M | Crop-harvested | 2 / 3 | Yes | Yes |

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T11R5-286 | 11/20/14 | 112 | 8 | 347 | 603538 | 4220552 | House finch | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R5-287 | 11/20/14 | 135 | 12 | 181 | 601581 | 4217822 | Western red bat | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R5-288 | 11/20/14 | 135 | 79 | 78 | 601664 | 4217794 | Red-tailed hawk | L | Plowed-fine | 1 / 2 | Yes | Yes |
| T11R5-289 | 11/20/14 | 138 | 4 | 26 | 601137 | 4218249 | Mexican free-tailed bat | S | Gravel | 1 / 2 | No | Yes |
| T11R6-290 | 11/25/14 | 108 | 10 | 24 | 602947 | 4221306 | Big brown bat | S | Crop-harvested | 2 / 3 | No | Yes |
| T11R6-291 | 11/25/14 | 108 | 29 | 183 | 602925 | 4221270 | Brewer's blackbird | S | Fallow-low | 2 / 3 | No | Yes |
| T11R6-292 | 11/25/14 | 108 | 43 | 94 | 602981 | 4221272 | Western gull | L | Crop-harvested | 3 / 3 | Yes | Yes |
| T11R6-293 | 11/25/14 | 112 | 63 | 6 | 603556 | 4220565 | Hermit thrush | S | Plowed-medium | 2 / 2 | No | Yes |
| T11R6-294 | 11/25/14 | 112 | 86 | 88 | 603624 | 4220532 | Barn owl | M | Plowed-medium | 2 / 2 | Yes | Yes |
| T11R6-295 | 11/25/14 | 112 | 52 | 332 | 603536 | 4220595 | Hoary bat | S | Plowed-medium | 2 / 2 | No | Yes |
| T11R7-296 | 11/26/14 | 128 | 33 | 7 | 604288 | 4219725 | White-breasted nuthatch | S | Crop-harvested | 2 / 3 | No | No |
| T11R7-297 | 11/26/14 | 130 | 42 | 106 | 603625 | 4219664 | Hoary bat | S | Plowed-fine | 1 / 1 | No | Yes |
| T11R7-298 | 11/26/14 | 130 | 86 | 324 | 603570 | 4219772 | Cooper's hawk | M | Plowed-fine | 1 / 1 | Yes | Yes |
| T11R7-299 | 11/26/14 | 131 | 21 | 50 | 603636 | 4219406 | Western red bat | S | Plowed-fine | 1 / 1 | No | Yes |
| T11R7-300 | 11/26/14 | 131 | 68 | 222 | 603543 | 4219378 | Western tanager | S | Plowed-fine | 1 / 1 | Yes | Yes |
| T11R8-301 | 12/1/14 | 109 | 63 | 98 | 603012 | 4220901 | Brewer's blackbird | S | Plowed-medium/Fallow-low | 2 / 3 | Yes | Yes |
| T11R8-302 | 12/1/14 | 111 | 25 | 136 | 603363 | 4220642 | Hoary bat | S | Plowed-coarse | 2 / 2 | No | Yes |
| T11R8-303 | 12/1/14 | 111 | 48 | 93 | 603396 | 4220642 | Loggerhead shrike | S | Plowed-coarse | 2 / 2 | No | Yes |
| T11R8-304 | 12/1/14 | 114 | 69 | 120 | 603416 | 4221746 | Western red bat | S | Plowed-medium | 2 / 3 | No | Yes |
| T11R8-305 | 12/1/14 | 114 | 42 | 306 | 603358 | 4221841 | White-crowned sparrow | S | Plowed-medium | 2 / 3 | No | Yes |
| T11R8-306 | 12/1/14 | 117 | 4 | 211 | 603598 | 4221089 | Pipistrelle spp. | S | Gravel | 1 / 2 | Yes | Yes |
| T11R8-307 | 12/1/14 | 117 | 102 | 246 | 603499 | 4221101 | Western screech-owl | S | Plowed-medium | 2 / 2 | Yes | Yes |
| T11R8-308 | 12/1/14 | 132 | 26 | 25 | 602001 | 4218288 | Mexican free-tailed bat | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R8-309 | 12/1/14 | 132 | 72 | 341 | 601984 | 4218347 | Nuttall's woodpecker | S | Plowed-fine | 1 / 2 | No | Yes |
| T11R8-310 | 12/1/14 | 132 | 57 | 115 | 602011 | 4218226 | Red-tailed hawk | L | Plowed-fine | 1 / 2 | Yes | Yes |
| T12R1-311 | 1/7/15 | 108 | 10 | 57 | 602929 | 4221312 | Hoary bat | S | Crop-low | 2 / 3 | No | Yes |
| T12R1-312 | 1/7/15 | 108 | 68 | 252 | 602874 | 4221323 | Loggerhead shrike | S | Crop-medium | 3 / 3 | No | Yes |
| T12R1-313 | 1/7/15 | 112 | 27 | 183 | 603523 | 4220522 | Mexican free-tailed bat | S | Crop-low | 2 / 2 | No | No |
| T12R1-314 | 1/7/15 | 112 | 15 | 100 | 603550 | 4220534 | Red-winged blackbird | S | Crop-low | 2 / 2 | No | Yes |

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T12R1-315 | 1/7/15 | 135 | 51 | 23 | 601632 | 4217854 | Western red bat | S | Crop-low | 2 / 1 | No | No |
| T12R1-316 | 1/7/15 | 135 | 25 | 135 | 601594 | 4217809 | Western tanager | S | Barren | 1 / 1 | No | Yes |
| T12R1-317 | 1/7/15 | 135 | 100 | 297 | 601641 | 4217923 | Cooper's hawk | M | Barren | 1 / 1 | Yes | Yes |
| T12R1-318 | 1/7/15 | 138 | 14 | 10 | 601143 | 4218258 | Western tanager | S | Crop-low | 2 / 1 | No | Yes |
| T12R1-319 | 1/7/15 | 138 | 62 | 165 | 601111 | 4218188 | White-throated swift | S | Crop-low | 2 / 1 | Yes | Yes |
| T12R2-320 | 1/8/15 | 128 | 55 | 106 | 604292 | 4219670 | House finch | S | Fallow-low | 2 / 3 | No | Yes |
| T12R2-321 | 1/8/15 | 128 | 103 | 22 | 604319 | 4219790 | Rock pigeon | M | Fallow-low | 2 / 3 | Yes | Yes |
| T12R2-322 | 1/8/15 | 130 | 36 | 273 | 603571 | 4219710 | Hoary bat | S | Crop-new | 1 / 2 | No | Yes |
| T12R2-323 | 1/8/15 | 130 | 65 | 340 | 603607 | 4219748 | Western gull | L | Crop-new | 1 / 2 | Yes | Yes |
| T12R2-324 | 1/8/15 | 131 | 3 | 152 | 603610 | 4219390 | Mexican free-tailed bat | S | Gravel | 1 / 2 | No | No |
| T12R2-325 | 1/8/15 | 131 | 75 | 263 | 603572 | 4219451 | European starling | S | Crop-new | 1 / 2 | No | Yes |
| T12R3-326 | 1/12/15 | 109 | 91 | 38 | 603043 | 4220970 | Barn owl | M | Fallow-low | 2 / 3 | Yes | Yes |
| T12R3-327 | 1/12/15 | 111 | 19 | 298 | 603356 | 4220689 | Hoary bat | S | Barren | 1 / 2 | No | Yes |
| T12R3-328 | 1/12/15 | 111 | 18 | 258 | 603332 | 4220678 | Nuttall's woodpecker | S | Fallow-low | 2 / 2 | Yes | Yes |
| T12R3-329 | 1/12/15 | 114 | 79 | 350 | 603412 | 4221874 | Western screech-owl | S | Fallow-low | 2 / 2 | Yes | Yes |
| T12R3-330 | 1/12/15 | 117 | 37 | 73 | 603631 | 4221070 | Horned lark | S | Fallow-low | 2 / 2 | No | Yes |
| T12R3-331 | 1/12/15 | 117 | 60 | 72 | 603663 | 4221082 | Rock pigeon | M | Fallow-low | 2 / 2 | Yes | Yes |
| T12R3-332 | 1/12/15 | 132 | 18 | 331 | 601977 | 4218294 | Mexican free-tailed bat | S | Crop-low | 2 / 1 | No | Yes |
| T12R3-333 | 1/12/15 | 132 | 34 | 110 | 601993 | 4218246 | Sharp-shinned hawk | M | Crop-low | 2 / 1 | No | Yes |
| T12R4-334 | 1/20/15 | 123 | 46 | 18 | 605268 | 4219316 | Brewer's blackbird | S | Plowed-fine | 1 / 1 | No | Yes |
| T12R4-335 | 1/20/15 | 124 | 39 | 54 | 605328 | 4219015 | House sparrow | S | Plowed-fine | 1 / 1 | Yes | Yes |
| T12R4-336 | 1/20/15 | 124 | 7 | 25 | 605297 | 4219009 | Sharp-shinned hawk | M | Fallow-low | 2 / 1 | Yes | Yes |
| T12R4-337 | 1/20/15 | 127 | 56 | 105 | 604068 | 4219740 | Big brown bat | S | Fallow-low | 2 / 3 | No | Yes |
| T12R4-338 | 1/20/15 | 139 | 13 | 191 | 600804 | 4217943 | Hoary bat | S | Crop-low | 2 / 2 | Yes | Yes |
| T12R4-339 | 1/20/15 | 139 | 1 | 71 | 600814 | 4217956 | Mexican free-tailed bat | S | Gravel | 1 / 2 | No | Yes |
| T12R4-340 | 1/20/15 | 139 | 94 | 175 | 600783 | 4217864 | Great horned owl | L | Crop-low | 2 / 2 | Yes | Yes |
| T12R5-341 | 1/22/15 | 128 | 20 | 337 | 604281 | 4219717 | Big brown bat | S | Fallow-low | 2 / 3 | No | Yes |
| T12R5-342 | 1/22/15 | 128 | 66 | 248 | 604209 | 4219725 | Red-shouldered hawk | L | Fallow-low | 2 / 3 | Yes | Yes |
| T12R5-343 | 1/22/15 | 130 | 52 | 113 | 603585 | 4219633 | Hoary bat | S | Crop-new | 1 / 2 | No | Yes |
| T12R5-344 | 1/22/15 | 130 | 11 | 34 | 603599 | 4219695 | White-throated swift | S | Crop-new | 1 / 2 | No | Yes |

| Specimen[1] | Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Placement Substrate | Visibility Class[4] | Detected? | Recovered? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T12R5-345 | 1/22/15 | 131 | 36 | 174 | 603623 | 4219356 | Mexican free-tailed bat | S | Crop-new | 1 / 2 | No | Yes |
| T12R5-346 | 1/22/15 | 131 | 14 | 4 | 603617 | 4219404 | Hermit thrush | S | Crop-new | 1 / 2 | No | Yes |
| T12R6-347 | 1/26/15 | 109 | 11 | 348 | 602929 | 4220932 | Mexican free-tailed bat | S | Fallow-low | 2 / 3 | No | Yes |
| T12R6-348 | 1/26/15 | 109 | 23 | 15 | 602967 | 4220944 | European starling | S | Fallow-low | 2 / 3 | Yes | Yes |
| T12R6-349 | 1/26/15 | 111 | 32 | 175 | 603344 | 4220638 | Hoary bat | S | Fallow-low | 2 / 2 | No | Yes |
| T12R6-350 | 1/26/15 | 111 | 63 | 313 | 603334 | 4220731 | Red-tailed hawk | L | Fallow-low | 2 / 2 | Yes | Yes |
| T12R6-351 | 1/26/15 | 114 | 59 | 109 | 603402 | 4221752 | Big brown bat | S | Crop-low | 2 / 2 | No | Yes |
| T12R6-352 | 1/26/15 | 114 | 91 | 47 | 603458 | 4221801 | Western tanager | S | Crop-low | 2 / 2 | No | Yes |
| T12R6-353 | 1/26/15 | 117 | 6 | 201 | 603594 | 4221094 | House finch | S | Barren | 1 / 2 | No | Yes |
| T12R7-354 | 2/3/15 | 123 | 14 | 257 | 605219 | 4219289 | Hoary bat | S | Barren | 1 / 1 | Yes | Yes |
| T12R7-355 | 2/3/15 | 123 | 42 | 130 | 605243 | 4219247 | Red-winged blackbird | S | Crop-low | 2 / 1 | Yes | Yes |
| T12R7-356 | 2/3/15 | 124 | 11 | 191 | 605279 | 4219001 | Mexican free-tailed bat | S | Barren | 1 / 1 | No | Yes |
| T12R7-357 | 2/3/15 | 124 | 65 | 117 | 605334 | 4218966 | Western gull | L | Crop-low | 2 / 1 | Yes | Yes |
| T12R7-358 | 2/3/15 | 127 | 30 | 320 | 604015 | 4219810 | Big brown bat | S | Fallow-medium | 3 / 3 | No | Yes |
| T12R7-359 | 2/3/15 | 127 | 93 | 44 | 604110 | 4219816 | Red-tailed hawk | L | Fallow-low | 2 / 3 | Yes | Yes |

[1] Seasonal Trial # Round # - sequential specimen #.

[2] Corrected for declination.

[3] S = small, M = medium, and L = large.

[4] The first value reflects classification of habitat in the immediate vicinity of the placement location. The second value reflects the plot-level habitat classification. 1= high visibility, 2 = medium visibility, and 3 = low visibility.

# Appendix B. Carcass Persistence Bias Trial Specimens: Year 3

| Specimen[1] | Place Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Substrate | Persistence (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 09-1-109-01 | 3/10/14 | 109 | 5 | 194 | 602952 | 4220916 | Yellow-billed magpie | M | Gravel | 17.5 |
| 09-1-111-01 | 3/12/14 | 111 | 12 | 7 | 603361 | 4220680 | Mexican free-tailed bat | S | Fallow-med | 4.5 |
| 09-1-112-01 | 3/12/14 | 112 | 24 | 88 | 603561 | 4220532 | Mexican free-tailed bat | S | Fallow-med | 5.5 |
| 09-1-114-01 | 3/10/14 | 114 | 69 | 263 | 603306 | 4221823 | Northern mockingbird | S | Fallow-high | 3.5 |
| 09-1-117-01 | 3/10/14 | 117 | 56 | 27 | 603641 | 4221140 | Green-winged teal | M | Fallow-high | 2.5 |
| 09-1-119-01 | 3/10/14 | 119 | 14 | 144 | 604065 | 4220386 | Say's phoebe | S | Fallow-med | 8.0 |
| 09-1-122-01 | 3/12/14 | 122 | 66 | 110 | 605128 | 4219411 | Mexican free-tailed bat | S | Fallow-med | 4.5 |
| 09-1-123-01 | 3/10/14 | 123 | 45 | 222 | 605186 | 4219275 | Mourning dove | M | Fallow-med | 0.5 |
| 09-1-126-01 | 3/10/14 | 126 | 84 | 219 | 604675 | 4218818 | White-crowned sparrow | S | Fallow-med | 8.0 |
| 09-1-128-01 | 3/12/14 | 128 | 9 | 358 | 604280 | 4219710 | Mexican free-tailed bat | S | Crop-high | 4.5 |
| 09-1-129-01 | 3/12/14 | 129 | 37 | 292 | 604318 | 4219479 | Mexican free-tailed bat | S | Crop-high | 6.5 |
| 09-1-131-01 | 3/12/14 | 131 | 47 | 20 | 603657 | 4219416 | Mexican free-tailed bat | S | Fallow-low/med | 5.5 |
| 09-1-132-01 | 3/12/14 | 132 | 17 | 80 | 601997 | 4218267 | Mexican free-tailed bat | S | Fallow-low/med | 6.5 |
| 09-1-133-01 | 3/10/14 | 133 | 71 | 48 | 602117 | 4218036 | Cooper's hawk | M | Fallow-low | 17.5 |
| 09-1-139-01 | 3/10/14 | 139 | 8 | 202 | 600802 | 4217943 | American robin | S | Fallow-low | 1.5 |
| 09-2-108-01 | 4/7/14 | 108 | 72 | 289 | 602886 | 4221341 | Mexican free-tailed bat | S | Crop-high | 5.5 |
| 09-2-109-01 | 4/7/14 | 109 | 48 | 225 | 602908 | 4220909 | Mexican free-tailed bat | S | Crop-high | 3.5 |
| 09-2-111-01 | 4/7/14 | 111 | 61 | 111 | 603406 | 4220628 | Hermit thrush | S | Fallow-high | 8.0 |
| 09-2-114-01 | 4/7/14 | 114 | 78 | 279 | 603303 | 4221837 | Great horned owl | L | Fallow-low | 10.0 |
| 09-2-117-01 | 4/7/14 | 117 | 27 | 307 | 603592 | 4221125 | Mexican free-tailed bat | S | Fallow-low | 0.5 |
| 09-2-119-01 | 4/7/14 | 119 | 59 | 41 | 604116 | 4220418 | Mexican free-tailed bat | S | Fallow-low | 6.5 |
| 09-2-122-01 | 4/7/14 | 122 | 95 | 349 | 605124 | 4219553 | Red-winged blackbird | S | Fallow-low | 5.5 |
| 09-2-126-01 | 4/7/14 | 126 | 19 | 247 | 604004 | 4219773 | Band-tailed pigeon | M | Fallow-med | 1.5 |
| 09-2-128-01 | 4/7/14 | 128 | 21 | 270 | 604242 | 4219715 | Mexican free-tailed bat | S | Crop-high | 12.5 |
| 09-2-131-01 | 4/7/14 | 131 | 91 | 270 | 603535 | 4219439 | Turkey vulture | L | Fallow-med | 28.0 |
| 09-2-132-01 | 4/7/14 | 132 | 1 | 146 | 601977 | 4218273 | Pacific wren | S | Gravel | 3.5 |
| 09-2-133-01 | 4/7/14 | 133 | 46 | 13 | 602081 | 4218053 | Mexican free-tailed bat | S | Fallow-med | 10.0 |

| Specimen[1] | Place Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Substrate | Persistence (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 09-2-139-01 | 4/7/14 | 139 | 19 | 318 | 600805 | 4217973 | Mexican free-tailed bat | S | Fallow-high | 4.5 |
| 09-3-108-01 | 5/5/14 | 108 | 57 | 274 | 602894 | 4221325 | Mexican free-tailed bat | S | Crop-high | 3.5 |
| 09-3-109-01 | 5/5/14 | 109 | 67 | 213 | 602907 | 4220870 | Red-tailed hawk | L | Crop-high | 28.0 |
| 09-3-112-01 | 5/5/14 | 112 | 89 | 205 | 603516 | 4220457 | European starling | S | Fallow-med/high | 3.5 |
| 09-3-114-01 | 5/5/14 | 114 | 24 | 257 | 603347 | 4221796 | Mexican free-tailed bat | S | Fallow-med/high | 5.5 |
| 09-3-123-01 | 5/5/14 | 123 | 33 | 321 | 605211 | 4219314 | Prairie falcon | M | Plowed-coarse | 8.0 |
| 09-3-127-01 | 5/5/14 | 127 | 34 | 264 | 603988 | 4219790 | Mexican free-tailed bat | S | Crop-high | 4.5 |
| 09-3-128-01 | 5/5/14 | 128 | 21 | 2 | 604289 | 4219717 | Mexican free-tailed bat | S | Crop-high | 4.5 |
| 09-3-130-01 | 5/5/14 | 130 | 40 | 321 | 603571 | 4219723 | Bushtit | S | Fallow-low | 2.5 |
| 09-3-132-01 | 5/5/14 | 132 | 7 | 151 | 601980 | 4218268 | Mexican free-tailed bat | S | Barren | 5.5 |
| 09-3-135-01 | 5/5/14 | 135 | 83 | 137 | 601604 | 4217754 | Mexican free-tailed bat | S | Plowed-coarse | 5.5 |
| 10-1-108-01 | 6/2/14 | 108 | 32 | 349 | 602970 | 4221317 | Gadwall | L | Crop-high | 1.5 |
| 10-1-109-01 | 6/2/14 | 109 | 45 | 35 | 602994 | 4220946 | Western screech-owl | S | Crop-high | 4.5 |
| 10-1-111-01 | 6/2/14 | 111 | 104 | 213 | 603291 | 4220592 | Hoary bat | S | Fallow-med/high | 3.5 |
| 10-1-112-01 | 6/2/14 | 112 | 26 | 243 | 603519 | 4220520 | Mexican free-tailed bat | S | Fallow-med/high | 8.0 |
| 10-1-117-01 | 6/2/14 | 117 | 43 | 122 | 603597 | 4221057 | Myotis spp. | S | Fallow-med/high | 1.5 |
| 10-1-123-01 | 6/2/14 | 123 | 2 | 120 | 605232 | 4219287 | House sparrow | S | Plowed-coarse | 4.5 |
| 10-1-124-01 | 6/2/14 | 124 | 31 | 310 | 605312 | 4219032 | Mexican free-tailed bat | S | Plowed-coarse | 5.5 |
| 10-1-127-01 | 6/2/14 | 127 | 90 | 102 | 604115 | 4219768 | Savannah sparrow | S | Crop-high | 0.5 |
| 10-1-128-01 | 6/2/14 | 128 | 69 | 109 | 604306 | 4219640 | Myotis spp. | S | Crop-high | 5.5 |
| 10-1-130-01 | 6/2/14 | 130 | 43 | 320 | 603567 | 4219722 | Sharp-shinned hawk | M | Fallow-low | 3.5 |
| 10-1-131-01 | 6/2/14 | 131 | 40 | 76 | 603654 | 4219387 | Mexican free-tailed bat | S | Fallow-low | 5.5 |
| 10-1-132-01 | 6/2/14 | 132 | 27 | 68 | 602001 | 4218290 | Red-tailed hawk | L | Plowed-coarse | 24.5 |
| 10-1-135-01 | 6/2/14 | 135 | 74 | 220 | 601519 | 4217808 | Dark-eyed junco | S | Plowed-coarse | 3.5 |
| 10-1-138-01 | 6/2/14 | 138 | 54 | 249 | 601077 | 4218256 | Mexican free-tailed bat | S | Plowed-coarse | 3.5 |
| 10-1-139-01 | 6/2/14 | 139 | 14 | 126 | 600816 | 4217938 | Common murre | M | Plowed-coarse | 2.5 |
| 10-2-108-01 | 7/11/14 | 108 | 51 | 178 | 602919 | 4221250 | Mexican free-tailed bat | S | Crop-high | 4.5 |
| 10-2-109-01 | 7/11/14 | 109 | 102 | 230 | 602855 | 4220905 | Turkey vulture | L | Crop-high | 28.0 |
| 10-2-111-01 | 7/11/14 | 111 | 15 | 198 | 603344 | 4220660 | Cedar waxwing | S | Fallow-low/barren | 3.5 |
| 10-2-112-01 | 7/11/14 | 112 | 105 | 205 | 603463 | 4220474 | Chukar | M | Fallow-high/flat | 2.5 |
| 10-2-114-01 | 7/11/14 | 114 | 19 | 116 | 603386 | 4221785 | Mexican free-tailed bat | S | Fallow-high/flat | 3.5 |

| Specimen[1] | Place Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Substrate | Persistence (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 10-2-123-01 | 7/11/14 | 123 | 33 | 299 | 605206 | 4219310 | Myotis spp. | S | Plowed-coarse | 4.5 |
| 10-2-128-01 | 7/11/14 | 128 | 62 | 358 | 604287 | 4219763 | Rough-legged hawk | L | Fallow-med | 17.5 |
| 10-2-130-01 | 7/11/14 | 130 | 21 | 329 | 603566 | 4219703 | Mexican free-tailed bat | S | Plowed-med/coarse | 3.5 |
| 10-2-131-01 | 7/11/14 | 131 | 7 | 286 | 603610 | 4219398 | Tree swallow | S | Fallow-med | 3.5 |
| 10-2-132-01 | 7/11/14 | 132 | 26 | 155 | 601976 | 4218250 | Western red bat | S | Plowed-fine | 4.5 |
| 10-2-135-01 | 7/11/14 | 135 | 20 | 164 | 601585 | 4217816 | Mexican free-tailed bat | S | Plowed-coarse | 4.5 |
| 10-2-138-01 | 7/11/14 | 138 | 36 | 37 | 601166 | 4218266 | American coot | M | Plowed-fine | 12.5 |
| 10-2-139-01 | 7/11/14 | 139 | 68 | 249 | 600748 | 4217978 | Western meadowlark | S | Plowed-med | 4.5 |
| 10-3-108-01 | 8/8/14 | 108 | 62 | 349 | 602986 | 4221339 | White-crowned sparrow | S | Fallow-low/flat | 4.5 |
| 10-3-109-01 | 8/8/14 | 109 | 47 | 112 | 602981 | 4220883 | Mexican free-tailed bat | S | Fallow-med/flat | 1.5 |
| 10-3-111-01 | 8/8/14 | 111 | 21 | 52 | 603373 | 4220682 | Mexican free-tailed bat | S | Fallow-high/flat | 12.5 |
| 10-3-114-01 | 8/8/14 | 114 | 61 | 28 | 603424 | 4221836 | American kestrel | M | Fallow-high/flat | 6.5 |
| 10-3-117-01 | 8/8/14 | 117 | 57 | 63 | 603660 | 4221092 | Mexican free-tailed bat | S | Fallow-high/flat | 6.5 |
| 10-3-123-01 | 8/8/14 | 123 | 90 | 75 | 605325 | 4219279 | Cooper's hawk | M | Plowed-coarse | 5.5 |
| 10-3-124-01 | 8/8/14 | 124 | 22 | 103 | 605309 | 4218997 | Big brown bat | S | Plowed-coarse | 1.5 |
| 10-3-127-01 | 8/8/14 | 127 | 12 | 358 | 604029 | 4219790 | Mexican free-tailed bat | S | Fallow-low/flat | 4.5 |
| 10-3-128-01 | 8/8/14 | 128 | 87 | 236 | 604210 | 4219760 | House sparrow | S | Fallow-med/flat | 3.5 |
| 10-3-130-01 | 8/8/14 | 130 | 75 | 247 | 603538 | 4219745 | Ross's goose | L | Plowed-mixed | 1.5 |
| 10-3-132-01 | 8/8/14 | 132 | 31 | 110 | 601994 | 4218248 | Mexican free-tailed bat | S | Plowed-coarse | 1.5 |
| 10-3-135-01 | 8/8/14 | 135 | 26 | 190 | 601572 | 4217816 | Great horned owl | L | Plowed-coarse | 4.5 |
| 10-3-138-01 | 8/8/14 | 138 | 43 | 283 | 601137 | 4218293 | Bushtit | S | Plowed-coarse | 4.5 |
| 10-3-139-01 | 8/8/14 | 138 | 5 | 124 | 600817 | 4217946 | Mexican free-tailed bat | S | Gravel | 4.5 |
| 11-1-108-01 | 9/5/14 | 108 | 6 | 329 | 602942 | 4221306 | American robin | S | Barren | 3.5 |
| 11-1-109-01 | 9/5/14 | 109 | 96 | 56 | 603036 | 4220945 | American kestrel | M | Crop-harvested/flat | 2.5 |
| 11-1-117-01 | 9/5/14 | 117 | 36 | 232 | 603567 | 4221087 | Red-shouldered hawk | L | Barren | 5.5 |
| 11-1-127-01 | 9/5/14 | 127 | 44 | 127 | 604045 | 4219738 | House finch | S | Fallow-low/barren | 2.5 |
| 11-1-128-01 | 9/5/14 | 128 | 85 | 9 | 604330 | 4219761 | Mourning dove | M | Crop-harvested/flat | 0.5 |
| 11-1-138-01 | 9/5/14 | 138 | 59 | 306 | 601100 | 4218295 | Red-tailed hawk | L | Plowed-med | 17.5 |

| Specimen[1] | Place Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Substrate | Persistence (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 11-1-139-01 | 9/5/14 | 139 | 87 | 108 | 600867 | 4217891 | Western scrub-jay | S | Crop-harvested/flat | 5.5 |
| 11-2-108-01 | 10/3/14 | 108 | 24 | 355 | 602961 | 4221310 | Mexican free-tailed bat | S | Fallow-low/flat | 4.5 |
| 11-2-109-01 | 10/3/14 | 109 | 31 | 108 | 602978 | 4220900 | Mexican free-tailed bat | S | Fallow-low/flat | 0.5 |
| 11-2-111-01 | 10/3/14 | 111 | 63 | 134 | 603386 | 4220614 | American crow | M | Fallow-high/flat | 4.5 |
| 11-2-112-01 | 10/3/14 | 112 | 94 | 303 | 603514 | 4220627 | Cooper's hawk | M | Fallow-high/flat | 6.5 |
| 11-2-117-01 | 10/3/14 | 117 | 26 | 75 | 603625 | 4221086 | House sparrow | S | Fallow-med/flat | 4.5 |
| 11-2-123-01 | 10/3/14 | 123 | 18 | 180 | 605215 | 4219281 | Mexican free-tailed bat | S | Plowed-med | 4.5 |
| 11-2-124-01 | 10/3/14 | 124 | 46 | 308 | 605274 | 4219057 | Northern mockingbird | S | Plowed-med | 3.5 |
| 11-2-127-01 | 10/3/14 | 127 | 67 | 274 | 603989 | 4219835 | Mexican free-tailed bat | S | Fallow-low/flat | 4.5 |
| 11-2-128-01 | 10/3/14 | 128 | 16 | 106 | 604288 | 4219693 | Mexican free-tailed bat | S | Fallow-low/barren | 2.5 |
| 11-2-131-01 | 10/3/14 | 131 | 13 | 119 | 603622 | 4219381 | Red-tailed hawk | L | Plowed-med/coarse | 12.5 |
| 11-2-132-01 | 10/3/14 | 132 | 66 | 46 | 602042 | 4218288 | Rock pigeon | M | Plowed-fine | 0.5 |
| 11-2-135-01 | 10/3/14 | 135 | 36 | 27 | 601628 | 4217840 | Mexican free-tailed bat | S | Plowed-coarse | 4.5 |
| 11-2-138-01 | 10/3/14 | 138 | 2 | 128 | 601143 | 4218245 | Mexican free-tailed bat | S | Gravel | 3.5 |
| 11-2-139-01 | 10/3/14 | 139 | 32 | 112 | 600828 | 4217931 | Mexican free-tailed bat | S | Plowed-coarse | 6.5 |
| 11-3-108-01 | 10/31/14 | 108 | 6 | 346 | 603037 | 4221108 | Mourning dove | M | Barren | 0.5 |
| 11-3-109-01 | 10/31/14 | 109 | 2 | 24 | 603049 | 4220728 | Lesser goldfinch | S | Gravel | 8.0 |
| 11-3-111-01 | 10/31/14 | 111 | 37 | 68 | 6034889 | 4220483 | Mexican free-tailed bat | S | Fallow-high/flat | 3.5 |
| 11-3-112-01 | 10/31/14 | 112 | 97 | 84 | 603730 | 4220347 | Western bluebird | S | Fallow-high/flat | 6.5 |
| 11-3-114-01 | 10/31/14 | 114 | 58 | 312 | 603433 | 4221648 | Mexican free-tailed bat | S | Fallow-high/flat | 4.5 |
| 11-3-117-01 | 10/31/14 | 117 | 46 | 181 | 603663 | 4220870 | Mexican free-tailed bat | S | Fallow-high/flat | 1.5 |
| 11-3-123-01 | 10/31/14 | 123 | 22 | 257 | 605308 | 4219098 | Mexican free-tailed bat | S | Plowed-fine | 8.0 |
| 11-3-124-01 | 10/31/14 | 124 | 47 | 20 | 605409 | 4218853 | American kestrel | M | Plowed-fine | 0.5 |
| 11-3-127-01 | 10/31/14 | 127 | 61 | 72 | 604176 | 4219567 | Red-tailed hawk | L | Fallow-low/flat | 28.0 |
| 11-3-130-01 | 10/31/14 | 130 | 105 | 60 | 603786 | 4219477 | Varied thrush | S | Plowed-fine | 1.5 |
| 11-3-131-01 | 10/31/14 | 131 | 26 | 340 | 603700 | 4219224 | Mexican free-tailed bat | S | Plowed-fine | 3.5 |
| 11-3-132-01 | 10/31/14 | 132 | 6 | 263 | 602062 | 4218083 | Mexican free-tailed bat | S | Gravel | 2.5 |
| 11-3-135-01 | 10/31/14 | 135 | 95 | 238 | 601587 | 4217631 | Western scrub-jay | S | Plowed-fine | 6.5 |
| 11-3-138-01 | 10/31/14 | 138 | 50 | 59 | 601278 | 4218049 | Mexican free-tailed bat | S | Plowed-fine | 3.5 |
| 11-3-139-01 | 10/31/14 | 139 | 62 | 77 | 600973 | 4217769 | Barn owl | M | Plowed-fine | 4.5 |

| Specimen[1] | Place Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Substrate | Persistence (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 12-1-108-01 | 11/30/14 | 108 | 21 | 163 | 602937 | 4221272 | Red-winged blackbird | S | Fallow-low | 3.5 |
| 12-1-109-01 | 11/30/14 | 109 | 56 | 145 | 602954 | 4220858 | Mexican free-tailed bat | S | Fallow-low | 2.5 |
| 12-1-111-01 | 11/30/14 | 111 | 85 | 324 | 603347 | 4220755 | Red-shouldered hawk | L | Fallow-low | 10.0 |
| 12-1-114-01 | 11/30/14 | 114 | 44 | 202 | 603341 | 4221770 | Mexican free-tailed bat | S | Fallow-low | 4.5 |
| 12-1-117-01 | 11/30/14 | 117 | 101 | 188 | 603535 | 4221018 | Eurasian collared-dove | M | Fallow-low | 0.5 |
| 12-1-124-01 | 11/30/14 | 124 | 73 | 116 | 605340 | 4218958 | Mexican free-tailed bat | S | Crop-new | 5.5 |
| 12-1-127-01 | 11/30/14 | 127 | 35 | 319 | 604011 | 4219805 | Savannah sparrow | S | Fallow-low | 3.5 |
| 12-1-128-01 | 11/30/14 | 128 | 16 | 12 | 604283 | 4219711 | Mexican free-tailed bat | S | Fallow-low | 0.5 |
| 12-1-130-01 | 11/30/14 | 130 | 62 | 38 | 603649 | 4219708 | Northern pintail | L | Crop-low | 0.5 |
| 12-1-131-01 | 11/30/14 | 131 | 41 | 66 | 603660 | 4219395 | Mexican free-tailed bat | S | Crop-new | 6.5 |
| 12-1-132-01 | 11/30/14 | 132 | 48 | 98 | 602010 | 4218244 | Western scrub-jay | S | Crop-new | 0.5 |
| 12-1-135-01 | 11/30/14 | 135 | 69 | 50 | 601660 | 4217843 | Mexican free-tailed bat | S | Crop-new | 3.5 |
| 12-1-138-01 | 11/30/14 | 138 | 27 | 156 | 601128 | 4218220 | Sharp-shinned hawk | M | Crop-new | 4.5 |
| 12-1-139-01 | 11/30/14 | 139 | 17 | 163 | 600802 | 4217940 | Mexican free-tailed bat | S | Crop-new | 5.5 |
| 12-2-108-01 | 1/9/15 | 108 | 86 | 227 | 602852 | 4221257 | Mexican free-tailed bat | S | Fallow-low | 5.5 |
| 12-2-111-01 | 1/9/15 | 111 | 19 | 288 | 603340 | 4220683 | Mexican free-tailed bat | S | Fallow-low | 1.5 |
| 12-2-112-01 | 1/9/15 | 112 | 83 | 240 | 603431 | 4220471 | House sparrow | S | Fallow-low | 4.5 |
| 12-2-114-01 | 1/9/15 | 114 | 34 | 150 | 603374 | 4221762 | Cooper's hawk | M | Fallow-low | 6.5 |
| 12-2-117-01 | 1/9/15 | 117 | 94 | 286 | 603547 | 4221169 | Ross's goose | L | Fallow-low | 0.5 |
| 12-2-123-01 | 1/9/15 | 123 | 47 | 203 | 605201 | 4219255 | Mexican free-tailed bat | S | Crop-new | 4.5 |
| 12-2-124-01 | 1/9/15 | 124 | 70 | 41 | 605359 | 4219025 | Mexican free-tailed bat | S | Crop-new | 0.5 |
| 12-2-127-01 | 1/9/15 | 127 | 87 | 15 | 604074 | 4219851 | American coot | M | Fallow-low | 10.0 |
| 12-2-128-01 | 1/9/15 | 128 | 15 | 150 | 604271 | 4219686 | Mexican free-tailed bat | S | Fallow-low | 6.5 |
| 12-2-130-01 | 1/9/15 | 130 | 85 | 95 | 603668 | 4219611 | Western meadowlark | S | Crop-new | 5.5 |
| 12-2-132-01 | 1/9/15 | 132 | 63 | 149 | 601987 | 4218213 | Barn owl | M | Crop-new | 3.5 |
| 12-2-135-01 | 1/9/15 | 135 | 8 | 8 | 601596 | 4217843 | Mexican free-tailed bat | S | Crop-new | 3.5 |
| 12-2-138-01 | 1/9/15 | 138 | 29 | 274 | 601112 | 4218263 | Mexican free-tailed bat | S | Crop-new | 5.5 |
| 12-2-139-01 | 1/9/15 | 139 | 21 | 58 | 600833 | 4217949 | Cliff swallow | S | Crop-new | 3.5 |
| 12-3-111-01 | 1/30/15 | 111 | 68 | 238 | 603287 | 4220668 | Northern saw-whet owl | S | Fallow-low | 5.5 |
| 12-3-114-01 | 1/30/15 | 114 | 4 | 330 | 603372 | 4221807 | Western scrub-jay | S | Gravel | 0.5 |
| 12-3-117-01 | 1/30/15 | 117 | 26 | 245 | 603577 | 4221103 | Mexican free-tailed bat | S | Fallow-low | 4.5 |

| Specimen[1] | Place Date | Turbine | Distance (m) | Bearing (°)[2] | UTM East | UTM North | Species | Size Class[3] | Substrate | Persistence (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| 12-3-123-01 | 1/30/15 | 123 | 88 | 359 | 605286 | 4219359 | Band-tailed pigeon | M | Crop-low | 0.5 |
| 12-3-128-01 | 1/30/15 | 128 | 55 | 352 | 604289 | 4219757 | Western scrub-jay | S | Fallow-low | 5.5 |
| 12-3-131-01 | 1/30/15 | 131 | 100 | 278 | 603536 | 4219449 | Cooper's hawk | M | Crop-low | 6.5 |
| 12-3-138-01 | 1/30/15 | 138 | 59 | 287 | 601094 | 4218288 | House sparrow | S | Crop-low | 5.5 |
| 12-3-139-01 | 1/30/15 | 139 | 21 | 91 | 600823 | 4217935 | Northern pintail | L | Crop-low | 1.5 |

[1] Seasonal trial # - round # - turbine # - specimen #.

[2] Corrected for declination.

# Appendix C. Number of Fatality Surveys Conducted by Turbine and Month (March 2014 – February 2015) in Relation to Plot Substrate/Habitat Characteristics

| | | Month | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Turbine** | **Substrate[1]** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **Total** |
| 108 | Fallow-low | | | | | | | | | | | 3 | 3 | 6 |
| | Fallow-low/med | | | | | | | | 3 | 4 | 5 | 1 | 1 | 14 |
| | Fallow-med/high | | | | | | | 3 | 2 | | | | | 5 |
| | Crop-med + Fallow-low/med | 1 | | | | | | | | | | | | 1 |
| | Crop-high + Fallow-low/med | | 3 | | | | | | | | | | | 3 |
| | Crop-high + Fallow-mixed | | 2 | | | | | | | | | | | 2 |
| | Crop-high + Fallow-med/high | 3 | | | | | | | | | | | | 3 |
| | Crop-high + Fallow-high | | | 3 | 4 | 5 | | | | | | | | 12 |
| | Crop-harvested + Fallow-high | | | | | | 4 | 1 | | | | | | 5 |
| 109 | Fallow-low/flat | | | | | | | | | | | | 1 | 1 |
| | Fallow-low/med | | | | | | | | | 3 | 4 | 4 | 3 | 14 |
| | Fallow-med/flat | | | | | | | | | | 1 | | | 1 |
| | Fallow-mixed | | | | | | 3 | 5 | 4 | 1 | | | | 13 |
| | Crop-low + Fallow-low | 2 | | | | | | | | | | | | 2 |
| | Crop-med + Fallow-low | 3 | | | | | | | | | | | | 3 |
| | Crop-high + Fallow-mixed | | 4 | 2 | | | | | | | | | | 6 |
| | Crop-high + Fallow-med/high | | | 2 | 2 | | | | | | | | | 4 |
| | Crop-high + Fallow-high | | | | 3 | | | | | | | | | 3 |
| | Crop-harvested + Fallow-high | | | | | 4 | 1 | | | | | | | 5 |
| 111 | Fallow-low | 1 | | | | | | | | | | 3 | 4 | 8 |
| | Fallow-med | 2 | | | | | | | | | | | | 2 |
| | Fallow-med/high | 1 | | | 2 | | | | | | | | | 3 |
| | Fallow-mixed | 1 | 4 | 4 | 3 | 1 | 4 | 5 | 4 | 1 | | | | 27 |
| | Fallow-high | | | | | 3 | | | | | | | | 3 |
| | Plowed-coarse | | | | | | | | | 2 | | | | 2 |
| | Plowed-med/coarse | | | | | | | | | | 2 | | | 2 |
| | Plowed-med | | | | | | | | | | 3 | 1 | | 4 |
| 112 | Fallow-low | | | | | | | | | | | 3 | 2 | 5 |
| | Fallow-low/flat | | | | | | | | | | 1 | | | 1 |
| | Fallow-low/med | 1 | | | | | | | | | | | 2 | 3 |
| | Fallow-med/high | 3 | | | | | | | | | | | | 3 |
| | Fallow-high | | 5 | 4 | 4 | 5 | 4 | 4 | 5 | 2 | | | | 33 |
| | Plowed-coarse | | | | | | | | | 1 | | | | 1 |
| | Plowed-med/coarse | | | | | | | | | | 1 | | | 1 |
| | Plowed-med | | | | | | | | | 1 | 3 | 1 | | 5 |
| 114 | Fallow-low | 1 | | | | | | | | | | 2 | 4 | 7 |
| | Fallow-med | 2 | | | | | | | | | | | | 2 |
| | Fallow-med/high | | | | 3 | | | | | | | | | 3 |
| | Fallow-mixed | 2 | 4 | 4 | 1 | | | | | | | | | 11 |

| Turbine | Substrate[1] | Month | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| | Fallow-high | | | | 1 | 4 | 4 | 5 | 4 | 1 | | | | 19 |
| | Plowed-coarse | | | | | | | | | 1 | | | | 1 |
| | Plowed-med | | | | | | | | | | 1 | 2 | | 3 |
| | Plowed-med + Fallow-high | | | | | | | | | 2 | 4 | | | 6 |
| 117 | Fallow-low | | | | | | | | | | | 3 | 4 | 7 |
| | Fallow-low/med | 1 | | | | | | | | | | | | 1 |
| | Fallow-med | 2 | | | | | | | | | | | | 2 |
| | Fallow-med/high | | | | 3 | | | | | | | | | 3 |
| | Fallow-mixed | 2 | 4 | 4 | 1 | | | | | | | | | 11 |
| | Fallow-high | | | | 1 | 4 | 4 | 5 | 4 | 2 | | | | 20 |
| | Plowed-coarse | | | | | | | | | 1 | | | | 1 |
| | Plowed-med/coarse | | | | | | | | | | 1 | | | 1 |
| | Plowed-med | | | | | | | | | 1 | 3 | | | 4 |
| | Plowed-fine/med | | | | | | | | | | | 1 | | 1 |
| | Plowed-fine | | | | | | | | | | 1 | | | 1 |
| 123 | Fallow-low/med | 4 | | | | | | | | | | | | 4 |
| | Plowed-coarse + Fallow-low/med | | 1 | | | | | | | | | | | 1 |
| | Plowed-coarse | | 4 | 4 | 5 | 1 | 4 | 1 | 2 | | | | | 21 |
| | Plowed-med | | | | | 1 | | | | 2 | | | | 3 |
| | Plowed-fine/med | | | | | 2 | | | | | | | | 2 |
| | Plowed-fine | | | | | | | 4 | 2 | 2 | 2 | | | 10 |
| | Crop-seeded | | | | | | | | | | 2 | 3 | | 5 |
| | Crop-new | | | | | | | | | | | 1 | 1 | 2 |
| | Crop-low | | | | | | | | | | 1 | | 2 | 3 |
| | Crop-med | | | | | | | | | | | | 1 | 1 |
| 124 | Fallow-low/med | 3 | | | | | | | | | | | | 3 |
| | Fallow-med/high | 1 | | | | | | | | | | | | 1 |
| | Plowed-coarse + Fallow-low/med | | 1 | | | | | | | | | | | 1 |
| | Plowed-coarse | | 4 | 4 | 5 | 1 | 4 | | | | | | | 18 |
| | Plowed-med | | | | | 1 | | | | 2 | | | | 3 |
| | Plowed-mixed | | | | | 1 | | | | | | | | 1 |
| | Plowed-fine/med | | | | | 1 | | 1 | | | | | | 2 |
| | Plowed-fine | | | | | | | 4 | 4 | 2 | 2 | | | 12 |
| | Crop-seeded | | | | | | | | | | 2 | 3 | | 5 |
| | Crop-new | | | | | | | | | | | 1 | 1 | 2 |
| | Crop-low | | | | | | | | | | 1 | | 2 | 3 |
| | Crop-med | | | | | | | | | | | | 1 | 1 |
| 127 | Fallow-low/flat | | | | | | | | | | 1 | | 1 | 2 |
| | Fallow-low/med | | | | | 1 | 4 | 5 | 4 | 4 | 4 | 4 | 3 | 29 |
| | Crop-low/med | 2 | | | | | | | | | | | | 2 |
| | Crop-med/high | 1 | | | | | | | | | | | | 1 |
| | Crop-high | 1 | 5 | 4 | 4 | | | | | | | | | 14 |
| | Crop-harvested | | | | 1 | 3 | | | | | | | | 4 |
| 128 | Fallow-low | | | | | | | | | | 1 | | 1 | 2 |
| | Fallow-low/med | | | | | | | 4 | 5 | 4 | 4 | 4 | 2 | 23 |
| | Fallow-med | | | | | | 4 | | | | | | 1 | 5 |
| | Crop-med | 1 | | | | | | | | | | | | 1 |

| Turbine | Substrate[1] | Month | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | |
| | Crop-med/high | 1 | | | | | | | | | | | | 1 |
| | Crop-high | 2 | 4 | 5 | 3 | | | | | | | | | 14 |
| | Crop-harvested | | | | 1 | 5 | | | | | | | | 6 |
| 130 | Fallow-low/med | 4 | 3 | | | | | | | | | | | 7 |
| | Fallow-mixed + Plowed-coarse | | 1 | | | | | | | | | | | 1 |
| | Plowed-coarse | | | 5 | 3 | | | | | | | | | 8 |
| | Plowed-med/coarse | | | | 1 | 5 | | | | | | | | 6 |
| | Plowed-mixed | | | | | | 2 | | | | | | | 2 |
| | Plowed-fine/med | | | | | | 2 | 4 | 5 | 3 | | | | 14 |
| | Crop-seeded | | | | | | | | | 1 | 1 | | | 2 |
| | Crop-new | | | | | | | | | | 4 | | | 4 |
| | Crop-low | | | | | | | | | | | 3 | | 3 |
| | Crop-med | | | | | | | | | | | 1 | 2 | 3 |
| | Crop-med/high | | | | | | | | | | | | 1 | 1 |
| | Crop-high | | | | | | | | | | | | 1 | 1 |
| 131 | Fallow-low/med | 4 | 3 | | | | | | | | | | | 7 |
| | Plowed-coarse | | 1 | 5 | 4 | 2 | 1 | | | | | | | 13 |
| | Plowed-med/coarse | | | | | 3 | 3 | | | | | | | 6 |
| | Plowed-fine/med | | | | | | | 4 | 5 | 3 | | | | 12 |
| | Crop-seeded | | | | | | | | | 1 | 1 | | | 2 |
| | Crop-new | | | | | | | | | | 4 | | | 4 |
| | Crop-low | | | | | | | | | | | 3 | | 3 |
| | Crop-med | | | | | | | | | | | 1 | 2 | 3 |
| | Crop-med/high | | | | | | | | | | | | 1 | 1 |
| | Crop-high | | | | | | | | | | | | 1 | 1 |
| 132 | Fallow-low | 5 | | | | | | | | | | | | 5 |
| | Fallow-low/med | | 3 | 3 | | | | | | | | | | 6 |
| | Fallow-low/med + Plowed-coarse | | | 1 | | | | | | | | | | 1 |
| | Plowed-coarse | | | | 5 | 3 | 3 | | | | | | | 11 |
| | Plowed-med/coarse | | | | | | 1 | | | | | | | 1 |
| | Plowed-fine/med | | | | | 1 | | | | 3 | 1 | | | 5 |
| | Plowed-fine | | | | | | | 5 | 4 | 1 | | | | 10 |
| | Crop-seeded | | | | | | | | | | 2 | | | 2 |
| | Crop-new | | | | | | | | | | 2 | 2 | | 4 |
| | Crop-low | | | | | | | | | | | 2 | 3 | 5 |
| | Crop-med | | | | | | | | | | | | 1 | 1 |
| 135 | Fallow-low | 1 | | | | | | | | | | | | 1 |
| | Fallow-low/med | 3 | 2 | | | | | | | | | | | 5 |
| | Fallow-mixed | | 3 | | | | | | | | | | | 3 |
| | Plowed-coarse + Fallow-med | | | 1 | | | | | | | | | | 1 |
| | Plowed-coarse | | | 3 | 4 | 5 | 2 | | | | | | | 14 |
| | Plowed-med | | | | | | 1 | | | 2 | | | | 3 |
| | Plowed-fine/med | | | | | | 1 | | | | | | | 1 |
| | Plowed-fine | | | | | | | 4 | 5 | 2 | 1 | | | 12 |
| | Crop-seeded | | | | | | | | | | 2 | | | 2 |
| | Crop-new | | | | | | | | | | | 2 | | 2 |
| | Crop-low | | | | | | | | | | 1 | 2 | 2 | 5 |

| | | Month | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Turbine** | **Substrate[1]** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **Total** |
| | Crop-med | | | | | | | | | | | | 1 | 1 |
| | Crop-high | | | | | | | | | | | | 1 | 1 |
| 138 | Fallow-low | 2 | | | | | | | | | | | | 2 |
| | Fallow-low/med | | 2 | | | | | | | | | | | 2 |
| | Fallow-med | 1 | 1 | | | | | | | | | | | 2 |
| | Fallow-med/high | 1 | | | | | | | | | | | | 1 |
| | Fallow-high | | 1 | | | | | | | | | | | 1 |
| | Plowed-coarse | | | 5 | 3 | 3 | | | | | | | | 11 |
| | Plowed-med/coarse | | | | | 1 | | | | | | | | 1 |
| | Plowed-med | | | | | | | | | 2 | | | | 2 |
| | Plowed-fine/med | | | | 1 | 1 | 4 | 4 | 2 | | | | | 12 |
| | Plowed-fine | | | | | | | | 3 | 2 | 1 | | | 6 |
| | Crop-seeded | | | | | | | | | | 3 | | | 3 |
| | Crop-new | | | | | | | | | | | 2 | | 2 |
| | Crop-low | | | | | | | | | | 1 | 2 | 2 | 5 |
| | Crop-med | | | | | | | | | | | | 1 | 1 |
| | Crop-high | | | | | | | | | | | | 1 | 1 |
| 139 | Fallow-low/med/flat | 1 | | | | | | | | | | | | 1 |
| | Fallow-low/med | | 3 | | | | | | | | | | | 3 |
| | Fallow-med | 1 | | | | | | | | | | | | 1 |
| | Fallow-med/high | 2 | 2 | | | | | | | | | | | 4 |
| | Plowed-coarse | | | 4 | 2 | | | | 1 | | | | | 7 |
| | Plowed-med | | | | | | | | | 2 | | | | 2 |
| | Plowed-fine/med | | | | 3 | 4 | 2 | | | | | | | 9 |
| | Plowed-fine | | | | | | 2 | 5 | 3 | 2 | 2 | | | 14 |
| | Crop-seeded | | | | | | | | | | 1 | | | 1 |
| | Crop-new | | | | | | | | | | 1 | 1 | | 2 |
| | Crop-low | | | | | | | | | | 1 | 2 | | 3 |
| | Crop-low/med | | | | | | | | | | | 1 | 1 | 2 |
| | Crop-med | | | | | | | | | | | | 2 | 2 |
| | Crop-high | | | | | | | | | | | | 1 | 1 |
| Substation | Gravel/Crop | 4 | 4 | 5 | 4 | | | | | | | | | 17 |
| | Gravel/Fallow | | | | | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 34 |
| **Total** | | **73** | **74** | **72** | **77** | **76** | **68** | **77** | **76** | **67** | **83** | **68** | **68** | **879** |

[1] Secondary habitat components are listed when they composed ≥10% of the total survey area.

# Appendix D. Fatality Surveys Conducted during Year 3 by Date and Location

| | | Turbine | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | Date | 108 | 109 | 111 | 112 | 114 | 117 | 123 | 124 | 127 | 128 | 130 | 131 | 132 | 135 | 138 | 139 | Substation | Total |
| 1 | 03-Mar-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 04-Mar-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 05-Mar-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 06-Mar-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 07-Mar-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 2 | 10-Mar-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 11-Mar-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 12-Mar-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 13-Mar-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 14-Mar-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 3 | 17-Mar-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 18-Mar-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 19-Mar-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 20-Mar-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 21-Mar-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 4 | 24-Mar-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 25-Mar-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 26-Mar-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 27-Mar-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 5 | 31-Mar-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 01-Apr-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 02-Apr-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 03-Apr-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 04-Apr-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 6 | 07-Apr-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 08-Apr-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 09-Apr-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 10-Apr-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 7 | 14-Apr-14 | | 1 | 1 | | 1 | 1 | | | | | | | nd[1] | | | | | 4 |
| | 15-Apr-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 16-Apr-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |

| Week | Date | Turbine | | | | | | | | | | | | | | | | Substation | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 108 | 109 | 111 | 112 | 114 | 117 | 123 | 124 | 127 | 128 | 130 | 131 | 132 | 135 | 138 | 139 | | |
| | 17-Apr-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 18-Apr-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 8 | 21-Apr-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 22-Apr-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 23-Apr-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 24-Apr-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 25-Apr-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 9 | 28-Apr-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 29-Apr-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 30-Apr-14 | 1 | | | 1 | | | | | | | | | | 1 | | | | 3 |
| | 01-May-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 02-May-14 | | | | | | | | | | | | | | | 1 | | 1 | 2 |
| 10 | 05-May-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 06-May-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 07-May-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 08-May-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 11 | 12-May-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 13-May-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 14-May-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 15-May-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 16-May-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 12 | 19-May-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 20-May-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 21-May-14 | nd[2] | | | 1 | | | | | | | | | | 1 | 1 | | | 3 |
| | 22-May-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 23-May-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 13 | 27-May-14 | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | | | 1 | | | 1 | | 9 |
| | 28-May-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 29-May-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 30-May-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 14 | 02-Jun-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 03-Jun-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 04-Jun-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 05-Jun-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 06-Jun-14 | | | | | | | | | | | | | | | | | 1 | 1 |

| Week | Date | Turbine | | | | | | | | | | | | | | | | Substation | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 108 | 109 | 111 | 112 | 114 | 117 | 123 | 124 | 127 | 128 | 130 | 131 | 132 | 135 | 138 | 139 | | |
| 15 | 09-Jun-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 10-Jun-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 11-Jun-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 12-Jun-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 13-Jun-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 16 | 15-Jun-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 17-Jun-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 18-Jun-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 19-Jun-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 20-Jun-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 17 | 23-Jun-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 24-Jun-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 25-Jun-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 26-Jun-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 18 | 29-Jun-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 30-Jun-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 02-Jul-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 03-Jul-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 19 | 07-Jul-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 08-Jul-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 09-Jul-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 10-Jul-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 20 | 14-Jul-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 15-Jul-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 16-Jul-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 17-Jul-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 21 | 21-Jul-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 22-Jul-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 23-Jul-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 24-Jul-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 22 | 28-Jul-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 29-Jul-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 30-Jul-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 31-Jul-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 23 | 04-Aug-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |

| | | Turbine | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Week** | **Date** | **108** | **109** | **111** | **112** | **114** | **117** | **123** | **124** | **127** | **128** | **130** | **131** | **132** | **135** | **138** | **139** | **Substation** | **Total** |
| | 05-Aug-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 06-Aug-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 07-Aug-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 24 | 11-Aug-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 12-Aug-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 13-Aug-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 14-Aug-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 25 | 18-Aug-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 19-Aug-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 20-Aug-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 21-Aug-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 26 | 25-Aug-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 26-Aug-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 27-Aug-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 28-Aug-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 27 | 02-Sep-14 | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | | | 1 | | | 1 | | 9 |
| | 03-Sep-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 04-Sep-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 05-Sep-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 28 | 08-Sep-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 09-Sep-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 10-Sep-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 11-Sep-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 29 | 15-Sep-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 16-Sep-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 17-Sep-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 18-Sep-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 30 | 22-Sep-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 23-Sep-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 24-Sep-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 25-Sep-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| | 26-Sep-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| 31 | 29-Sep-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 30-Sep-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 01-Oct-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |

| Week | Date | Turbine | | | | | | | | | | | | | | | | Substation | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 108 | 109 | 111 | 112 | 114 | 117 | 123 | 124 | 127 | 128 | 130 | 131 | 132 | 135 | 138 | 139 | | |
| | 02-Oct-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 32 | 06-Oct-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 07-Oct-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 08-Oct-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 09-Oct-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 10-Oct-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 33 | 13-Oct-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 14-Oct-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 16-Oct-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | 1 | 1 | | | 7 |
| | 17-Oct-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 34 | 20-Oct-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 21-Oct-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 23-Oct-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | 1 | 1 | | | 7 |
| | 24-Oct-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 35 | 27-Oct-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 28-Oct-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 30-Oct-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | 1 | 1 | | | 7 |
| | 31-Oct-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 36 | 03-Nov-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 04-Nov-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 06-Nov-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | 1 | 1 | | | 7 |
| | 07-Nov-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 37 | 10-Nov-14 | | 1 | nd[3] | | 1 | 1 | | | | | | | 1 | | | | | 4 |
| | 11-Nov-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 12-Nov-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 13-Nov-14 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 14-Nov-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 38 | 17-Nov-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 18-Nov-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 20-Nov-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | 1 | 1 | | | 7 |
| | 21-Nov-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 39 | 23-Nov-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 24-Nov-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 25-Nov-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 26-Nov-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |

| Week | Date | Turbine | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 108 | 109 | 111 | 112 | 114 | 117 | 123 | 124 | 127 | 128 | 130 | 131 | 132 | 135 | 138 | 139 | Substation | Total |
| 40 | 01-Dec-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 02-Dec-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 03-Dec-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 04-Dec-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 41 | 08-Dec-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 09-Dec-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 10-Dec-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | nd[3] | 1 | | | 6 |
| | 11-Dec-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 42 | 15-Dec-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 16-Dec-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 17-Dec-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 18-Dec-14 | | | | | | | | | | 1 | 1 | 1 | | | | | nd[4] | 3 |
| 43 | 22-Dec-14 | | 1 | 1 | | 1 | 1 | | | | | | | | | | | | 4 |
| | 23-Dec-14 | | | | | | | 1 | 1 | 1 | | | | 1 | | | 1 | | 5 |
| | 24-Dec-14 | 1 | | | 1 | | | | | | 1 | 1 | 1 | | 1 | 1 | | | 7 |
| | 27-Dec-14 | | | | | | | | | | | | | | | | | 1 | 1 |
| 44 | 28-Dec-14 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 29-Dec-14 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 30-Dec-14 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 31-Dec-14 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 45 | 05-Jan-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 06-Jan-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 07-Jan-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 08-Jan-15 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 46 | 12-Jan-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 13-Jan-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 14-Jan-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 15-Jan-15 | | | | | | | | | | | | | | | | | 1 | 1 |
| | 16-Jan-15 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| 47 | 19-Jan-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 20-Jan-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 21-Jan-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 22-Jan-15 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 48 | 26-Jan-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 27-Jan-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |

| Week | Date | Turbine | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **108** | **109** | **111** | **112** | **114** | **117** | **123** | **124** | **127** | **128** | **130** | **131** | **132** | **135** | **138** | **139** | **Substation** | **Total** |
| | 28-Jan-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 29-Jan-15 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 49 | 02-Feb-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 03-Feb-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 04-Feb-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 05-Feb-15 | | | | | | | | | | 1 | 1 | 1 | | | | | | 3 |
| | 06-Feb-15 | | | | | | | | | | | | | | | | | 1 | 1 |
| 50 | 09-Feb-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 10-Feb-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 11-Feb-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 12-Feb-15 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 51 | 16-Feb-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 17-Feb-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 18-Feb-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 19-Feb-15 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| 52 | 23-Feb-15 | | 1 | 1 | | 1 | 1 | | | | | | | 1 | | | | | 5 |
| | 24-Feb-15 | | | | | | | 1 | 1 | 1 | | | | | | | 1 | | 4 |
| | 25-Feb-15 | 1 | | | 1 | | | | | | | | | | 1 | 1 | | | 4 |
| | 26-Feb-15 | | | | | | | | | | 1 | 1 | 1 | | | | | 1 | 4 |
| Total | | **51** | **52** | **51** | **52** | **52** | **52** | **52** | **52** | **52** | **52** | **52** | **52** | **51** | **51** | **52** | **52** | **51** | **879** |

[1] No data: equipment malfunction precluded survey.
[2] No data: datasheet lost.
[3] No data: active plowing precluded survey.
[4] No data: illness precluded survey.

# Appendix E. Fatality and Injury Incidents Recorded During Year 3

| Incident# | Type[1] | Date | Turbine | Distance from Turbine (m) | Species | Condition | Cause[2] | Time Dead | Substrate | Visibility Class[3] |
|---|---|---|---|---|---|---|---|---|---|---|
| 20140304-01 | T | 04-Mar-14 | 123 | 2 | Western meadowlark | Scavenged | Unknown | <1 month | Turbine pad and base | 1 / 3 |
| 20140410-01 | T | 10-Apr-14 | 130 | 3 | White-crowned sparrow | Intact | Blade Strike A: broken neck | Fresh | Gravel pad | 1 / 3 |
| 20140429-01 | T | 29-Apr-14 | 127 | 24 | Swainson's hawk | Intact | Blade Strike A: head and shoulder | <1 week | Gravel road | 1 / 3 |
| 20140430-01 | T | 30-Apr-14 | 135 | 101 | Warbling vireo | Scavenged | Blade Strike A: belly | <1 week | Fallow/grazed-low | 2 / 3 |
| 20140521-01 | T | 21-May-14 | 135 | 35 | American white pelican | Scavenged | Blade Strike A: severed head | <1 week | Plowed-coarse | 2 / 2 |
| 20140527-01 | T | 27-May-14 | 111 | 73 | Hoary bat | Scavenged | Unknown | >1 month | Fallow-grass and high mustard | 3 / 3 |
| 20140609-01 | T | 09-Jun-14 | 114 | 27 | Red-tailed hawk | Intact | Blade Strike B | >1 month | Fallow-grass and high mustard | 3 / 3 |
| 20140805-01 | T | 05-Aug-14 | 139 | 103 | Northern harrier | Scavenged | Unknown | <1 week | Fallow/harvested crop-low | 2 / 2 |
| 20140805-02 | T | 05-Aug-14 | 124 | 74 | Mourning dove | Feather spot | Unknown | Unknown | Plowed-medium | 2 / 2 |
| 20140827-01 | T | 27-Aug-14 | 138 | 97 | Sora | Intact | Blade Strike A: severed legs | <1 week | Gravel | 1 / 2 |
| 20140917-01 | T | 17-Sep-14 | 138 | 15 | Mexican free-tailed bat | Intact | Blade Strike A: broken wing | Fresh | Plowed-fine/medium | 2 / 2 |
| 20140918-01 | T | 18-Sep-14 | 128 | 15 | Mexican free-tailed bat | Intact | Blade Strike C | Fresh | Crop-harvested | 2 / 3 |
| 20140918-02 | T | 18-Sep-14 | 128 | 83 | Western meadowlark | Feather spot | Unknown | <1 week | Crop-harvested | 2 / 3 |
| 20140930-01 | T | 30-Sep-14 | 124 | 54 | Barn owl | Intact | Blade Strike A: neck | Fresh | Plowed-fine | 1 / 1 |
| 20141016-01 | T | 16-Oct-14 | 135 | 2 | Western meadowlark | Intact | Tower Collison A: broken neck | Fresh | Turbine tower stair step | 1 / 1 |

| Incident# | Type[1] | Date | Turbine | Distance from Turbine (m) | Species | Condition | Cause[2] | Time Dead | Substrate | Visibility Class[3] |
|---|---|---|---|---|---|---|---|---|---|---|
| 20141016-02 | T | 16-Oct-14 | 131 | 90 | Turkey vulture | Feather spot | Blade Strike B | <1 week | Plowed-fine | 1 / 2 |
| 20141016-03 | T | 16-Oct-14 | 128 | 60 | Mexican free-tailed bat | Intact | Blade Strike C | <1 month | Crop-harvested | 2 / 3 |
| 20141103-01 | T | 03-Nov-14 | 117 | 47 | Hoary bat | Intact | Blade Strike A: broken wing | <1 week | Fallow-high mustard/star thistle | 3 / 3 |
| 20150120-01 | T | 20-Jan-15 | 123 | 27 | Ross's goose | Intact | Blade Strike A: belly and severed wing | Fresh | Gravel road | 1 / 1 |
| 20150120-02 | I | 20-Jan-15 | 121 | 31 | Ross's or snow goose | Feather spot | Unknown | Fresh | Bare dirt | 1 / 2 |
| 20150219-01 | T | 19-Feb-15 | 128 | 15 | Mexican free-tailed bat | Intact | Blade Strike C | Fresh | Fallow-low | 2 / 3 |

[1] I = incidental find – excluded from adjusted fatality estimates; T = found during turbine survey – included in adjusted fatality estimates.

[2] Blade Strike / Tower Collision A = a carcass that shows evidence of blade-strike or tower-collision trauma. Blade Strike B = a rarely depredated species found within the turbine search radius. Blade Strike C: an intact carcass with no apparent injuries found within the turbine search radius.

[3] The first value reflects classification of habitat in the immediate vicinity of the fatality. The second value reflects the plot-level habitat classification used, where relevant, in modeling to estimate facility-wide, adjusted fatality estimates.

# Appendix F. Bird Use Counts Conducted in Year 3 by Date and Count Site

| | | | Count Site | | | | |
|---|---|---|---|---|---|---|---|
| **Week** | **Date** | **Period** | **1** | **2** | **3** | **4** | **Total** |
| 1 | 06-Mar-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 07-Mar-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 2 | 13-Mar-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 14-Mar-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 3 | 20-Mar-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 21-Mar-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 4 | 27-Mar-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 28-Mar-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 5 | 03-Apr-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 04-Apr-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 6 | 10-Apr-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 11-Apr-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 7 | 17-Apr-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 18-Apr-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 8 | 24-Apr-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 25-Apr-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 9 | 01-May-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 02-May-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 10 | 08-May-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 09-May-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 11 | 15-May-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 16-May-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 12 | 23-May-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 23-May-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 13 | 30-May-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 30-May-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 14 | 05-Jun-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 06-Jun-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 15 | 12-Jun-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 13-Jun-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 16 | 19-Jun-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 20-Jun-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 17 | 26-Jun-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 26-Jun-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 18 | 03-Jul-14 | AM | 1 | 1 | 1 | 1 | 4 |

| Week | Date | Period | Count Site 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|---|---|
| | 03-Jul-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 19 | 10-Jul-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 10-Jul-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 20 | 17-Jul-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 17-Jul-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 21 | 24-Jul-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 24-Jul-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 22 | 31-Jul-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 31-Jul-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 23 | 07-Aug-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 07-Aug-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 24 | 14-Aug-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 14-Aug-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 25 | 21-Aug-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 21-Aug-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 26 | 27-Aug-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 27-Aug-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 27 | 04-Sep-14 | PM | 1 | 1 | 1 | 1 | 4 |
| | 05-Sep-14 | AM | 1 | 1 | 1 | 1 | 4 |
| 28 | 11-Sep-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 11-Sep-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 29 | 18-Sep-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 18-Sep-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 30 | 25-Sep-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 25-Sep-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 31 | 02-Oct-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 02-Oct-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 32 | Datasheets lost | | | | | | |
| 33 | 16-Oct-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 17-Oct-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 34 | 23-Oct-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 24-Oct-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 35 | 30-Oct-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 31-Oct-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 36 | 06-Nov-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 07-Nov-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 37 | 13-Nov-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 14-Nov-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 38 | 20-Nov-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 21-Nov-14 | PM | 1 | 1 | 1 | 1 | 4 |

| Week | Date | Period | Count Site 1 | Count Site 2 | Count Site 3 | Count Site 4 | Total |
|---|---|---|---|---|---|---|---|
| 39 | 26-Nov-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 26-Nov-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 40 | 04-Dec-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 04-Dec-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 41 | 11-Dec-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 12-Dec-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 42 | No surveys due to illness | | | | | | |
| 43 | 26-Dec-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 27-Dec-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 44 | 31-Dec-14 | AM | 1 | 1 | 1 | 1 | 4 |
| | 31-Dec-14 | PM | 1 | 1 | 1 | 1 | 4 |
| 45 | 08-Jan-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 08-Jan-15 | PM | 1 | 1 | 1 | 1 | 4 |
| 46 | 15-Jan-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 15-Jan-15 | PM | 1 | 1 | 1 | 1 | 4 |
| 47 | 22-Jan-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 22-Jan-15 | PM | 1 | 1 | 1 | 1 | 4 |
| 48 | 29-Jan-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 29-Jan-15 | PM | 1 | 1 | 1 | 1 | 4 |
| 49 | 06-Feb-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 06-Feb-15 | PM | 1 | 1 | 1 | 1 | 4 |
| 50 | 12-Feb-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 12-Feb-15 | PM | 1 | 1 | 1 | 1 | 4 |
| 51 | 19-Feb-15 | PM | 1 | 1 | 1 | 1 | 4 |
| | 20-Feb-15 | AM | 1 | 1 | 1 | 1 | 4 |
| 52 | 26-Feb-15 | AM | 1 | 1 | 1 | 1 | 4 |
| | 26-Feb-15 | PM | 1 | 1 | 1 | 1 | 4 |
| **Total** | | | **305** | **305** | **305** | **305** | **1220** |

# Appendix G. Raptor Foraging Events and Prey Species/Food Sources Other Than Birds Observed during Fatality Surveys, Bird Use Counts, and Road Surveys

| Date | Survey | Location | Observation |
|---|---|---|---|
| 13-Mar-14 | BUC | S3 | RTHA (3), NOHA (2), AMKE (2), CORA (3) - no small birds seen or heard while around |
| 13-Mar-14 | BUC | S4 | CORA (1) NOHA (2) - no small birds seen or heard while around |
| 14-Mar-14 | BUC | S4 | CORA (11) on carcass |
| 03-Apr-14 | Fatality | T128 | Mouse carcasses (2) found at turbine base |
| 04-Apr-14 | BUC | S1 | TUVU (1) feeding on jackrabbit |
| 15-Apr-14 | Fatality | T127 | Black-tailed jackrabbit scat on plot |
| 15-Apr-14 | Fatality | T139 | Large number of black field crickets calling on plot |
| 07-May-14 | Fatality | T108 | Black-tailed jackrabbits (2) on plot |
| 14-May-14 | Fatality | T138 | Sheep carcass near turbine base - removed by ranch hand |
| 16-May-14 | Fatality | SUBSTATION | Black-tailed jackrabbits (2) in area |
| 23-May-14 | BUC | S4 | TUVU (7) attracted to carcass on Shiloh 1 |
| 03-Jun-14 | Fatality | T123 | Grasshoppers (many) on plot |
| 03-Jun-14 | Fatality | T124 | Grasshoppers (many) on plot |
| 19-Jun-14 | BUC | S3 | PEFA (1) hunting ROPI |
| 25-Jun-14 | Fatality | T135 | Grasshoppers (many) on plot |
| 17-Jul-14 | BUC | S4 | TUVU (15) CORA (6) attracted to carcass on Shiloh 1 |
| 22-Jul-14 | Fatality | T123 | Grasshoppers (many) on plot in plowed area |
| 07-Aug-14 | BUC | S4 | TUVU (8) flew to carcass on another site |
| 21-Aug-14 | Fatality | T128 | Black-tailed jackrabbit on plot |
| 02-Sep-14 | Fatality | T117 | Black-tailed jackrabbit on plot |
| 09-Sep-14 | Fatality | T139 | dragonflies (100+) on plot |
| 15-Sep-14 | Fatality | T109 | California ground squirrels along fenceline |
| 17-Sep-14 | Fatality | T112 | Black-tailed jackrabbit on plot |
| 18-Sep-14 | Fatality | T128 | Black-tailed jackrabbit on plot |
| 27-Oct-14 | Fatality | T132 | Black-tailed jackrabbit on plot |
| 03-Nov-14 | Fatality | T114 | Black-tailed jackrabbit on plot |
| 10-Nov-14 | Fatality | T117 | Black-tailed jackrabbit on plot |
| 14-Nov-14 | BUC | S2 | NOHA (2) - no small birds seen or heard while around |
| 14-Nov-14 | BUC | S3 | RTHA (4) hunting from ground |
| 04-Dec-14 | BUC | S1 | MERL (1) captured TRBL |
| 04-Dec-14 | BUC | S2 | MERL (1) chasing AMKE |
| 24-Dec-14 | Fatality | T130 | Jerusalem cricket found on plot |
| 24-Dec-14 | Fatality | T131 | Gopher snake (18") chopped in half on plot |
| 26-Dec-14 | BUC | S4 | GOEA (1) harassed by CORA |

| Date | Survey | Location | Observation |
|---|---|---|---|
| 6-Jan-15 | Road | South | California ground squirrels along fenceline near T134 gate |
| 7-Jan-15 | Road | South | Black-tailed jackrabbit near T135 |
| 22-Jan-15 | Fatality | T128 | Fresh lamb carcass on plot-body opened and freshly cleaned |
| 29-Jan-15 | BUC | S3 | TUVU (3) at cow carcass |
| 06-Feb-15 | Fatality | SUBSTATION | Black-tailed jackrabbits (2) inside fence |
| 10-Feb-15 | Road | Central | Black-tailed jackrabbit running down road near T130 |
| 23-Feb-15 | Road | North | California ground squirrels along T109/T110 fenceline |