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Montezuma II Wind Energy Center
Post-construction Monitoring Report, Year-1

Project # 3353-01

Prepared for:

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Section 1.0 Introduction

The Montezuma Wind II, LLC Wind Energy Center (Project) is a 78.2 MW project consisting of 34 2.3-MW Siemens turbines (hub height 80 m; minimum blade clearance 33.5 m above ground; maximum blade-tip height 126.5 m) distributed across approximately 1,105 hectares (2,731 acres) of mixed agricultural land in Solano County, California. This Project, which began producing power in March 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. Accordingly, the Solano County Planning Commission (County) Use Permit (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 substation facilities.
- At least 1 year of monitoring avian activity in the Project area using fixed point counts.
- Opportunistic monitoring for occurrence of 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 first year of the required 3-year post-construction monitoring effort.

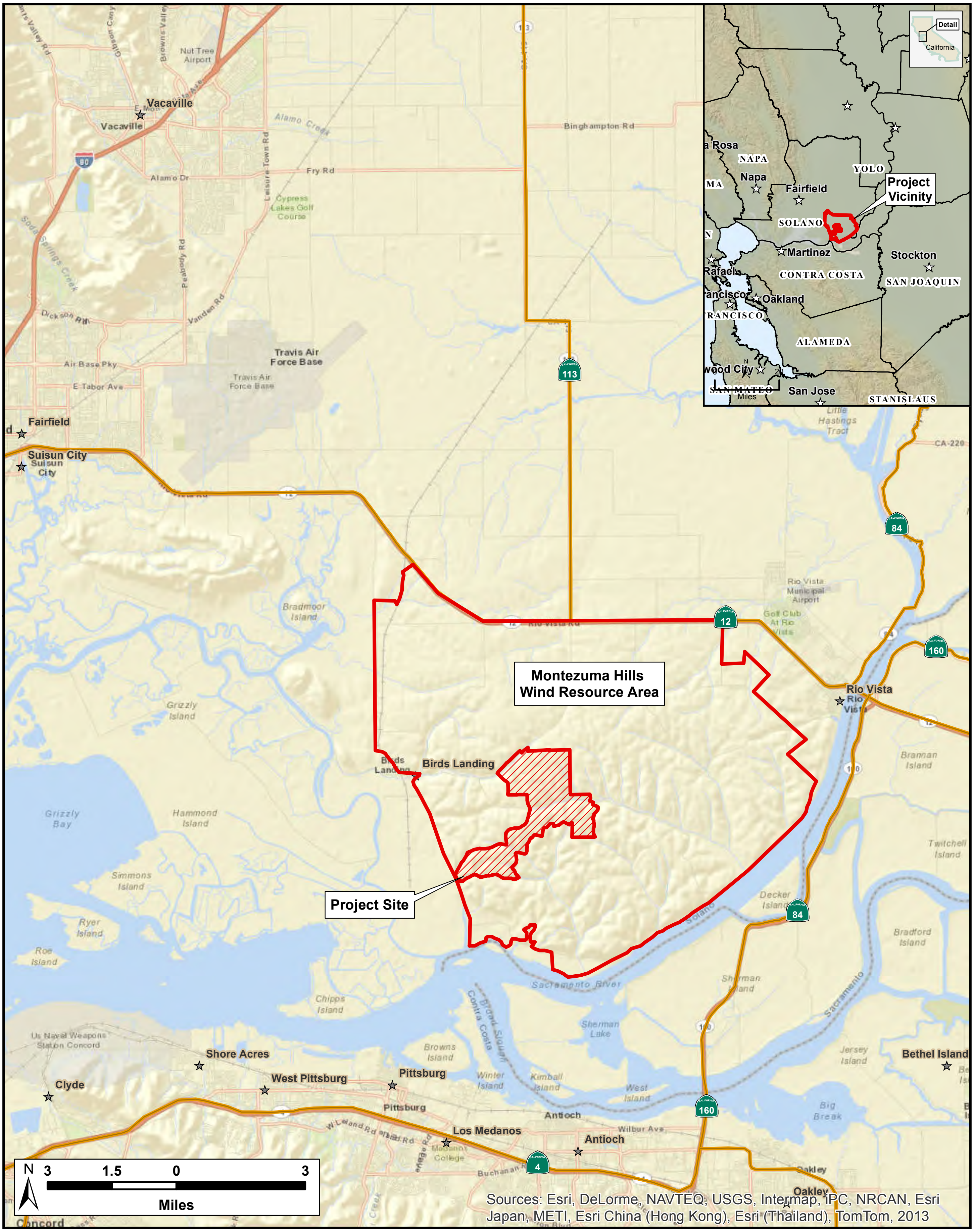

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Figure 1: Study Area Map
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Section 2.0 Methods

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):

North: turbines 107–119

Central: turbines 120–131

South: turbines 132–140

As described further below, we stratified our survey effort accordingly.

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 monitoring 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 objective was for this report to represent a full year of monitoring data, for this study we adjusted the ideal 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

We do not believe this half-month adjustment substantially influenced our analytical results and summaries.

2.1 Bird and Bat Fatality Surveys

2.1.1 Sampling Design

To document bird and bat fatalities at turbine sites and meet the minimum requirements as set forth in the project LUP and ABMP, we conducted weekly bird and bat carcass surveys at 17 (50%) of the 34 turbines (Figure 2) between 4 March 2012 and 2 March 2013. Our three-year sampling design includes a "core" component of eight turbines that we will survey 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. Selection of these turbines comprised a random sample stratified to equitably represent the three geographically disjunct turbine clusters (i.e., three turbines each within the north and central clusters and two turbines within the smaller south cluster) and reasonable spatial dispersion within clusters (Figure 2). We will survey each of the remaining 26 turbines for 1 year, 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 will have already been surveyed. For Year 1, we selected nine 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, 1 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 excessively inclement weather precluded a reasonable and safe search effort (e.g., due to 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,

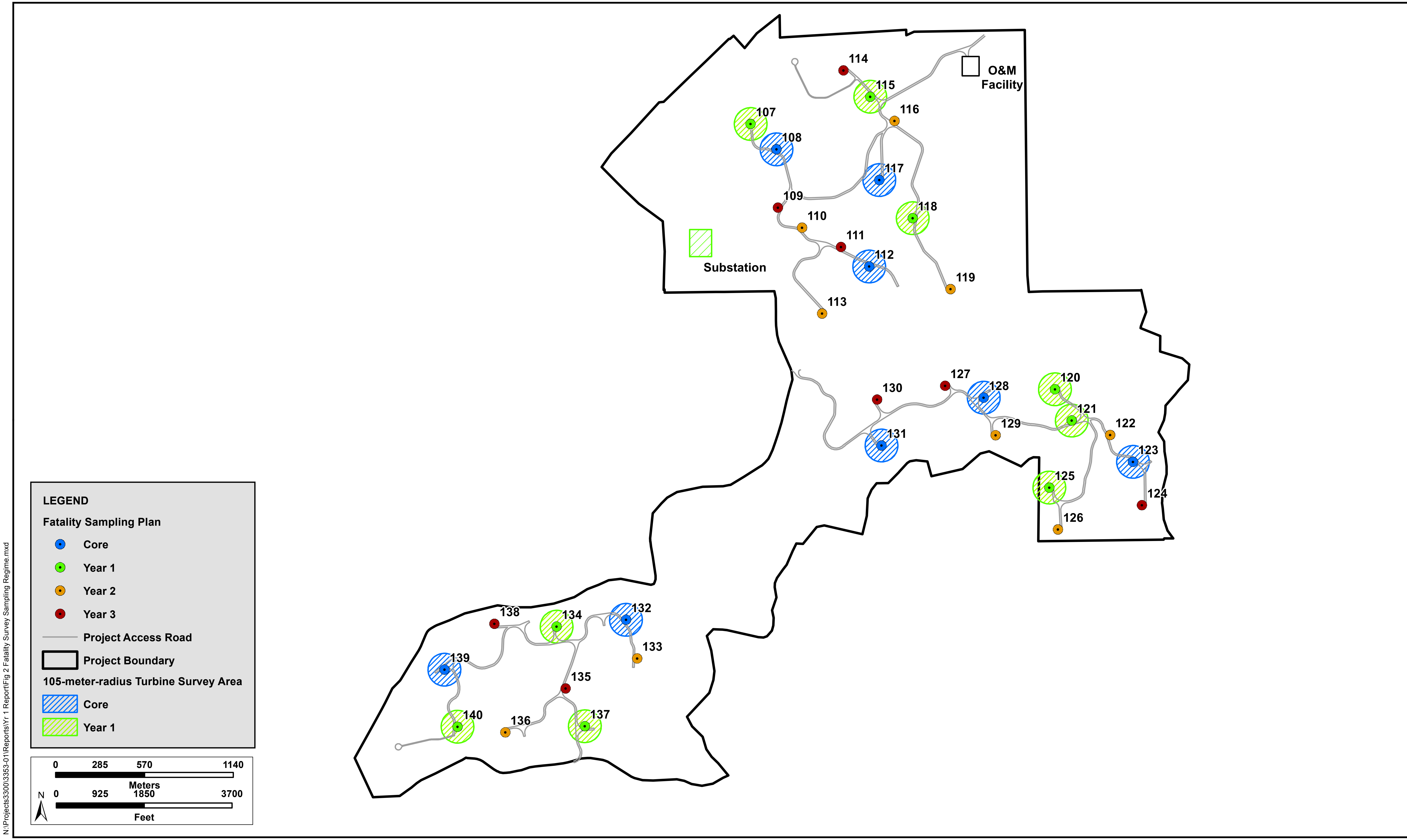

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Figure 2: Fatality Survey Sampling Regime

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sudden illness intervened. Except during 1 week when illness intervened and the Project Manager conducted most of the surveys, a single, experienced individual conducted all of the Year 1 carcasses surveys.

Similar projects often conduct "clean-sweep" or "clearance" surveys of all plots 1–2 days before beginning standard 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) and Shiloh II post-construction studies in MHWRA (Kerlinger et al. 2010, 2012). Each plot consisted of 13 concentric-ring transects beginning 5 m out from the base of the turbine. Spacing was 5 m for 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 (65 m in this case, or 32.5 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. 2010a, 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 (130 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 1 m/second, or about 1 step/second, with the goal of completing each turbine survey in approximately 1 hour.

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 centimeters [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 only truly 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 robust 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], plowed [fine, medium, or coarse], fallow or fallow/grazed [low, medium or high vegetation height], road, turbine pad, etc.), whether the turbine was functional or not, and any relevant search-area access issues.

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 standard 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 is standard practice for assessing bird and bat fatality rates at wind facilities and 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.

Each quarterly assessment involved placing approximately 20 birds and 20 bats for both the searcher efficiency and carcass persistence trials, with the bird carcasses usually including at least 10 small and 10 larger 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" (smaller than a mourning dove), "medium" (between a mourning dove/American kestrel and American crow/northern harrier size), and "large" (common raven/red-tail hawk size or larger), and during each quarterly trial we allocated a mix of medium and large birds to comprise the "larger bird" sample.

For both types of trials, we used only species known or with the potential to occur in the study area, including primarily native species but also a few non-native species that routinely occur in the study area, such as European starling (*Sturnus vulgaris*), rock pigeon (*Columba livia*), and house sparrow (*Passer domesticus*) (CEC and CDFG 2007, Smallwood 2007). For the carcass persistence trials, in particular, we specifically avoided using any 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), 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.

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 estimated searcher efficiency quarterly using blind trials. On several scattered days over the course of 4 weeks around the middle of each quarter, a field supervisor or other technician not involved in standard carcass searches placed trial carcasses in turbine plots and recorded the proportion of placed carcasses that surveyors detected during the course of the standard surveys. For this purpose, we defined quarterly trial periods as the 4 weeks centered on a randomly chosen day selected from among the central 30 days of each quarter. For example, for the first sample quarter (5 June – 4 September 2012), we randomly selected 10 July from among the central 30 days of the quarter (4 July – 2 August), which translated to the 28-day trial period running from 27 June – 24 July. Within each quarterly trial period, we selected 4–7 days when standard 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 standard surveys, with the surveyor unaware of when and where carcasses were placed. Documentation of each location included GPS coordinates, notes about the substrate and carcass placement (e.g., head down deep in vegetation, belly up out in the open, hidden behind large dirt clod, etc.), and a digital photo of the placement location.

Once the surveyor completed the day's surveys, the supervisor/technician communicated with him 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 trail specimen. Throughout the first two quarters and most of the third, the supervisor/technician directed the surveyor to attempt recovery of any missed specimens. This resulted in a very low recovery rate (7% of 55 attempts successful), likely due to a combination of using different GPS devices and the surveyor lacking knowledge of specific landmarks and placement characteristics. In attempt to improve the recovery rate of missed specimens, during the latter portion of the third quarter and throughout the fourth quarter the supervisor/technician who placed the trial specimens also attempted to recover all those that the surveyor missed. A much higher 84% of these 34 attempts were successful.

Within quarters, we selected placement dates and allocated trial carcasses among turbines based on a stratified random approach designed to achieve reasonable distributions of carcasses of different types (birds and bats) and size classes (small, medium, and large) among turbine clusters, among turbines within clusters, and, to the degree possible, among different habitat types and pre-defined habitat/substrate visibility classes (Tables 1 and 2, Appendix A).

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 two 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 cluster.

Several factors precluded achieving a truly 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 due to a 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 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 because we lacked current aerial imagery required 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).

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**
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 follows: low <25 cm, medium = 25–50 cm, or high >50 cm.

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

			Birds			
Season	**Substrate (Visibility Class)**	**Bats**	**Small**	**Medium**	**Large**	**Total**
Spring	Gravel (high)	7		1	1	9
	Plowed-coarse (med)	1	1			2
	Crop-med (low)	3	4	2	2	11
	Fallow-new (high)	5	2	1	1	9
	Fallow-low (med)	4	1	2	1	8
	Fallow-med (low)				1	1
	Spring Total	**20**	**8**	**6**	**6**	**40**
Summer	Gravel (high)	1	2			3
	Plowed-coarse (med)	4	1	2		7
	Plowed-fine/med (high)	1	2	1		4
	Crop-high (low)	4		1	1	6
	Crop-harvested (med)	2	1		1	4
	Fallow-low (med)	7	3	2	1	13
	Fallow-med/high (low)	1	1	1		3
	Summer Total	**20**	**10**	**7**	**3**	**40**
Fall	Gravel (high)	4	1			5
	Plowed-fine/med (high)	6	3	2	1	12
	Crop-harvested (med)	7	4	2	2	15
	Fallow-low (med)	2	2	1	1	6
	Fallow-med (low)	2			1	3
	Fall Total	**21**	**10**	**5**	**5**	**41**
Winter	Gravel (high)	2				2
	Gravel/fallow (med)	1				1
	Crop-new (high)	7	2	1	1	11
	Plowed-fine (high)	1	1	1		3
	Fallow- new/bare (high)	1		2		3
	Fallow-low (med)	7	7	3		17
	Fallow-med (low)		1	1	1	3
	Winter Total	**19**	**11**	**8**	**2**	**40**
Total		**80**	**39**	**26**	**16**	**161**

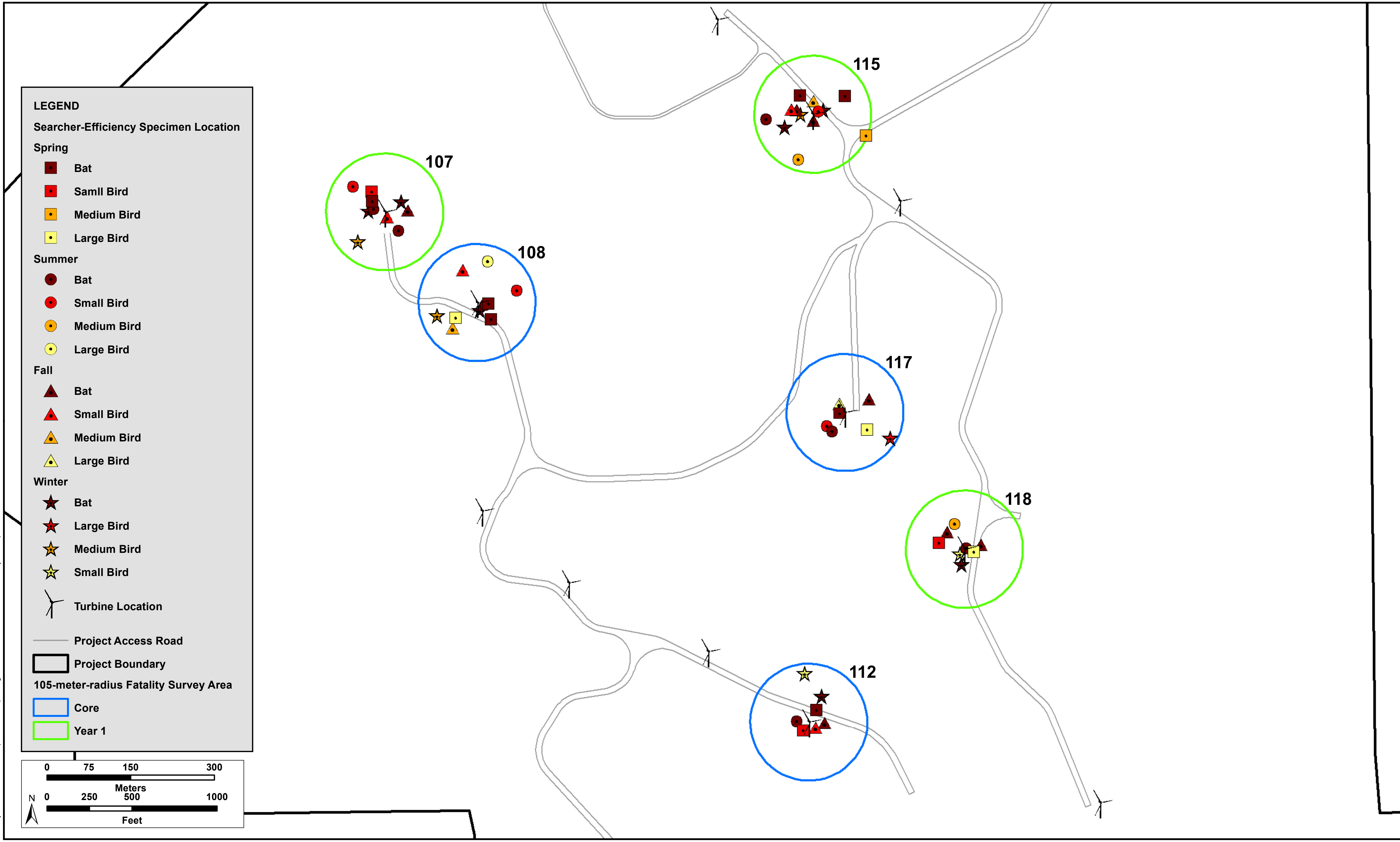

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Figure 3: Placement of Searcher-Efficiency Trial Specimens in the North Turbine Cluster: Year 1
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2.2.2 Carcass Persistence

To quantify carcass persistence, during each quarterly season we placed at least 10 small birds, 10 larger birds, and 20 bats among the turbine plots subject to standard carcass surveys (Appendix B). 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, or until such time as the specimen was removed or had been scavenged to the degree that it no longer would have 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, usually avoiding 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 cluster, representative habitat/substrate variants, and specimen types and sizes (Table 3). We limited placement of relevant carcasses to 1) no more than two fresh carcasses per plot; 2) no more than one large carcass per plot; and 3) generally avoid 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 cluster. The standard surveyor placed and monitored all persistence trial specimens. At each check, the surveyor classified the carcass into one of the following categories, consistent with protocols used in the NextEra WRRS and as described in the project ABMP:

Intact: whole and unscavenged other than by insects.

Scavenged: carcass present but 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.

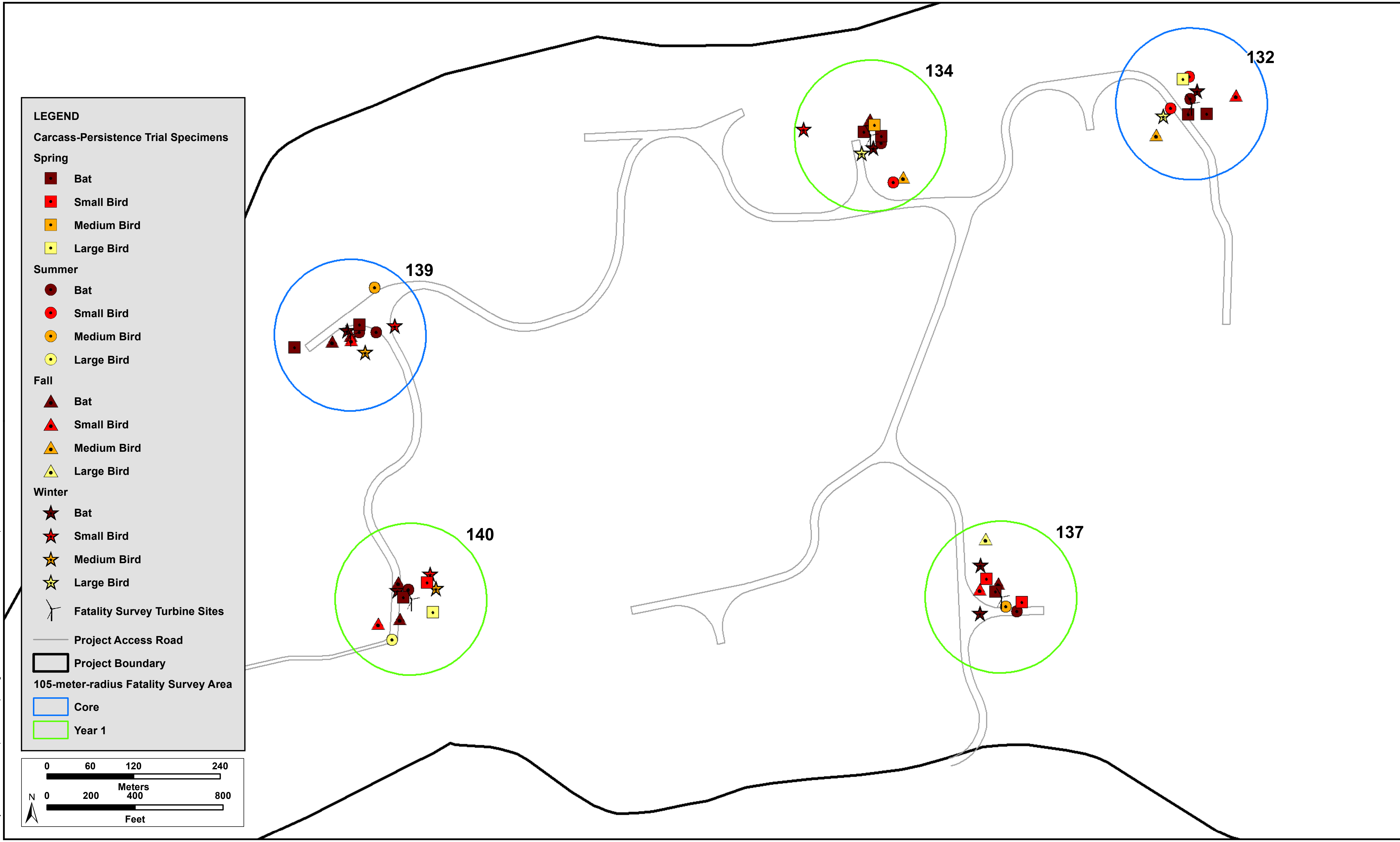
Removed: not enough remains to be considered a fatality during standard surveys, as defined above.

2.2.3 Adjusted Fatality Estimates

We calculated adjusted fatality estimates based on including all incidents discovered during the standard surveys, regardless of carcass age, except that we excluded any specimens classified as "clearance" carcasses. As recently recommended by Point Impact Analysis (2012) to achieve consistency among MHWRA analyses, we calculated adjusted fatality estimates using the USGS estimation software developed by Huso et al. (2012), incorporating adjustments for both searcher efficiency and carcass persistence. The Huso (2011) estimator has increased flexibility compared to previous estimators (e.g., Thompson 1992, Erickson et al. 2000; Johnson et al. 2000, 2003; Schoenfeld 2004; Smallwood 2007), allowing for unequal probability sampling, accounting for potential differences in searchability among plots and variation in detectability due to size of carcass and/or type of habitat, 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

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

			Birds			
Season	**Substrate**	**Bats**	**Small**	**Medium**	**Large**	**Total**
Spring	Gravel/barren	5	2			7
	Gravel + Fallow-low	1				1
	Plowed-coarse	1	1		1	3
	Crop-low	1	1		2	4
	Crop-med	2	1	1	1	5
	Fallow-low	9	3	2	3	17
	Fallow-med	1	1		1	3
	Spring Total	**20**	**9**	**3**	**8**	**40**
Summer	Turbine transformer	1				1
	Gravel/barren	8	3	2		13
	Plowed-coarse	3			2	5
	Plowed-coarse + Fallow-med			1		1
	Crop-low	1				1
	Crop-med		1		1	2
	Crop-high		1			1
	Crop-harvested	1				1
	Fallow-low	4	3	1	2	10
	Fallow-med	2	2	1		5
	Summer Total	**20**	**10**	**5**	**5**	**40**
Fall	Concrete pad	1				1
	Gravel/barren	5	4			9
	Plowed-fine	6		3		9
	Crop-low	1				1
	Crop-high		1			1
	Crop-harvested	3	2	2	2	9
	Fallow-low	4	4	1	1	10
	Fall Total	20	11	6	3	40
Winter	Gravel/barren	2		1		3
	Gravel + Fallow-low	1	1			2
	Plowed-fine/med	1	1			2
	Crop-new	3	5	1	1	10
	Fallow-low	11	2	4	1	18
	Fallow-med + Gravel	1				1
	Fallow-med	3	1		2	6
	Winter Total	22	10	6	4	42
Total		82	40	20	20	162



N:\Projects3300\3353-01\Reports\Yr 1 Report\Fig 4 Placement of Carcass-Persistence Trial Specimens in the South Turbine Cluster Year 1.mxd

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Figure 4: Placement of Carcass-Persistence Trial Specimens in the South Turbine Cluster
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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 USGS software allows for searcher efficiency and carcass persistence to be modeled with or without covariates. We modeled visibility class (i.e., the visibility of a carcass to an observer based on habitat cover; Table 1) and quarterly season as covariates. For searcher efficiency trials, we based the visibility classification on the substrate/habitat characteristics in the specific area where we placed a carcass. For the fatality incidents, the estimation software scales up the results to all turbines and allows for characterization of visibility only at the whole-plot level. Therefore, we assigned only plot-level visibility classifications to each fatality incident.

We fit models to estimate searcher efficiency and carcass persistence for bats, small birds, and larger birds separately, using visibility class as a covariate for searcher efficiency and season as a covariate for carcass persistence. The fitted models estimated searcher efficiency and carcass persistence with 95% confidence intervals for each possible visibility class and season, respectively. In some cases, the model without the covariate was the better model based on consideration of Akaike's Information Criterion (AIC). For the purpose of this exercise (estimating searcher efficiency and carcass persistence for visibility classes and seasons, respectively), however, we retained the covariates in the models regardless of whether they resulted in the best model, in order to derive relevant estimates for each season and visibility class.

We calculated adjusted fatality estimates based on applying the estimator to all of the incident data (excluding clearance and incidental finds), accounting for potential differences due to taxon/size class (bat, small bird, and larger bird), visibility class, and season. We also modeled the interaction between taxon/size class and visibility class. We compared the "full" model to all simpler models based on AIC values to determine the best model to use in estimating fatality. Initial estimates revealed little difference in the persistence of small bird and bats carcasses. Therefore, we modeled carcass persistence in terms of only size class (small birds/bats and larger birds), season, and the interaction between the two, and again identified the best fitting model based on AIC scores.

2.3 Bird Use Counts

We conducted point counts to document bird occurrences and estimate activity 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, non-overlapping views of the surrounding terrain out to 800 m, and near-complete coverage of all turbine locations. In addition, 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 clusters, and two sites to represent the more extensive central cluster (Figure 5). 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 two days each week (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 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 sightings 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 perspective, while using high quality 8–10x binoculars for detection and species identification.

The surveyor classified bird behaviors as follows:

(V)oice only
(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

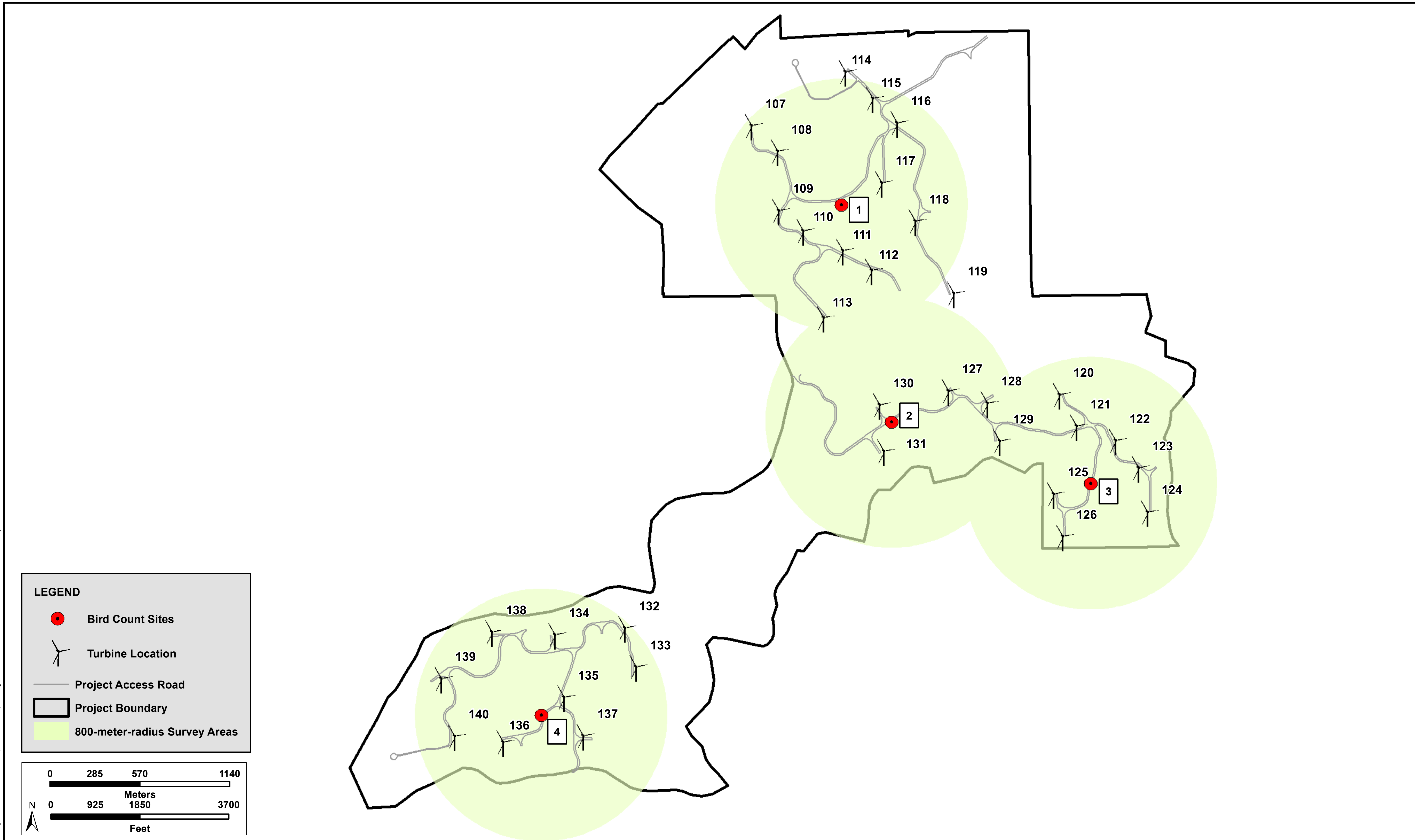

Figure 5: Bird Use Count Sites and Associated Survey Areas

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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.

Our protocols called for the surveyor to classify 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, but consistent with reasonable approximation of elevated flight heights)

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

Due to a misunderstanding, however, classifications during most of the first year were more accurately described as:

LOW = up to turbine hub height (80 m)

MED = above turbine hub height up to approximately 250 m

HIGH = above approximately 250 m

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.

Relevant habitat categories included turbine pad/roadway, other roadway, substation, plowed field, crop [status], grassland, fallow field, fallow/grazed field, eucalyptus grove, marsh/wetland, etc., and included various qualifiers concerning other relevant features such as fencelines, puddles, powerlines, etc.

The surveyor also 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, and wind speed and direction.

2.3.1 Data Analysis

To describe patterns of variation in bird activity levels across sites, species and species groups, and seasons, and to render data comparable to those presented in several previous reports from the MHWRA (e.g., Kerlinger et al. 2010, Curry & Kerlinger 2011), we translated the raw survey counts into estimates of bird sightings per hour. For summary purposes, we classified species into four groups: raptors (hawks, eagles, falcons, owls, and vultures), crows and ravens, doves and pigeons, waterbirds (waterfowl, gulls, shorebirds, cormorants, etc.), quail and pheasants, blackbirds and starlings, and other small birds (passerines, hummingbirds, swallows, swifts, woodpeckers, etc.).

2.4 Documenting Raptor Prey and Carcass Scavengers

During the fatality and BUC surveys, the surveyor opportunistically recorded observations of potential raptor prey species and carcass scavengers seen on or near the turbine plots. In addition, while traveling between survey locations within the wind facility, the primary surveyor, and to lesser degrees other field staff, routinely searched for and recorded other raptor-prey and carcass-scavenger sightings. We limited these supplementary roadside surveys so that they did not require substantially more time than would otherwise apply to traveling between survey points. The surveys focused on detecting non-domesticated animals and bird species not seen regularly during the standard carcass and BUC surveys. They involved detection only by naked eye, with 8–10x binoculars used only during brief stops for species confirmation. These surveys were inherently haphazard in nature, depending on the daily schedule of carcass surveys and point counts.

Section 3.0 Results

3.1 Habitat Conditions

In the north cluster, two of the six surveyed turbine plots and one other turbine area along the western edge of the cluster remained as fallow habitats, variably grazed by sheep, throughout the survey period (Table 4). The exception was that roughly the eastern 15% of the T108 plot comprised a plowed field after April 2012, until it began growing wheat in mid-January 2013. Three of the remaining four survey plots within the north cluster, along with most of the other turbine areas in this cluster, remained fallow during March and April, and then were plowed fields until wheat began growing in December or January. The fourth survey plot was already plowed in March and began growing wheat in January 2013.

Most of the central cluster, including five of the six surveyed plots, had grain crops growing when we started surveys in March (Table 4). These crops were harvested in July and August. The plots were then grazed (again primarily by sheep but sometimes by cattle) and left fallow for the remainder of the survey year. The remaining survey plot (T128), as well as two other adjacent turbine areas in the center of the cluster, remained fallow and variably grazed by sheep throughout the survey year.

In the south cluster, two of the five surveyed plots and three other turbine areas in the southeastern section remained fallow and variably grazed by sheep throughout the survey year (Table 4). Two other surveyed plots and one other turbine area in the northwestern section remained fallow in March and April, then were plowed fields until grain crops began growing in December or January. The fifth surveyed plot (T140) in the southwestern section supported a grain crop when we began surveys in March, was harvested in July/August, and then was grazed by sheep and remained fallow for the rest of the survey year.

All of the fallow-field survey areas supported some medium-height and moderate to high-density vegetation during a portion of the 2012 growing season and/or late-winter period in early 2013. In most cases, however, relatively intensive sheep and cattle grazing (and in some cases mowing) precluded fallow vegetation exceeding the 50-cm threshold for being classified as “high” vegetation. The primary exception was the T118 plot, of which approximately 20% was ungrazed and variably supported tall, dense mustard and other medium to high fallow vegetation during most of the survey year. Only six other survey plots periodically showed up to 5% high, fallow vegetation, mostly during late summer 2012.

Similarly, only the six survey plots that were planted in early 2012 and harvested during the summer resulted in crop vegetation that exceeded the 50-cm height threshold for “high” vegetation. Also note that although other crops such as rape seed (source of canola oil) are sometimes planted in this agricultural area (e.g., see Johnston et al. in press), only grain crops, mostly wheat, were grown in the Project area in 2012 and planted during late-winter in early 2013.

Table 4. Number of Fatality Surveys Conducted by Turbine and Month (March 2012 – February 2013) in Relation to Plot Substrate/Habitat Characteristics

		Month												
Turbine	**Substrate**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**Total**
107	Fallow/grazed-low	3	3											6
	Fallow/grazed-low/med		1	5	4	4	5	4	5	2	4	5	4	43
108	Fallow/grazed-low	3	1											4
	Fallow/grazed-low/med		3											3
	Fallow/grazed-low/med + Plowed-coarse[1]			5	1									6
	Fallow/grazed-low/med + Plowed-med				3	4	2							9
	Fallow/grazed-low/med + Plowed-fine						3	4	5	4	4	1		21
	Fallow/grazed-low/med + Crop-low											4	4	8
112	Plowed-coarse	3	4	3	4									14
	Plowed-coarse w/ mustard			2										2
	Plowed-med					4								4
	Plowed-fine						5	4	5	4	4			20
	Crop-low											5	3	8
	Crop-med												1	1
115	Fallow/grazed-low	4	5	1										10
	Plowed-coarse			2	2									4
	Plowed-med				1									1
	Plowed-fine				1	5	4	4	5	4	4			27
	Crop-new/low										1	4	4	9
117	Fallow/grazed-low	4	5											9
	Plowed-coarse			4	4									8
	Plowed-med					2								2
	Plowed-fine					3	4	4	5	4	4			24
	Crop-low										1	3	4	8
118	Fallow/grazed-low	4												4
	Fallow/grazed-low/high + Plowed-fine		2											2
	Fallow/grazed-med/high + Plowed-coarse		3	4										7
	Plowed-coarse + Fallow-med/high				4	5	4							13
	Plowed-med + Fallow-med/high							4	4					8
	Plowed-fine + Fallow-med/high								1	4	1			6
	Crop-low + Fallow-med/high										4	3	1	8
	Crop-med + Fallow-med/high												3	3
120	Crop-low	3												3
	Crop-med	1	4											5
	Crop-high			4	5	2								11
	Crop-harvested					2	5	4						11
	Fallow/grazed-low/med								4	5	4	5	4	22

Turbine	Substrate	Month												Total
		3	4	5	6	7	8	9	10	11	12	1	2	
121	Crop-low	3												3
	Crop-med	1	4											5
	Crop-high			5	4	2								11
	Crop-harvested					3	4	3						10
	Fallow/grazed-low/med							1	5	4	4	5	4	23
123	Crop-low	1												1
	Crop-med	2	4	1										7
	Crop-high			4	4	5								13
	Crop-harvested						4	3						7
	Fallow/grazed-low/med							1	5	4	4	5	4	23
125	Crop-low + Fallow-low	3												3
	Crop-med + Fallow-low	1	4	1										6
	Crop-high + Fallow-med			4	4	5								13
	Crop-harvested + Fallow-med						4	2						6
	Fallow-low/med							2	5	4	4	5	4	24
128	Fallow/grazed-low	4	1		5									10
	Fallow/grazed-med/barren							4	4	5	2			15
	Fallow/grazed-low/med		3	4		4	5				2	5	4	27
131	Crop-low	1												1
	Crop-med	3	4	1										8
	Crop-high			3	5									8
	Crop-harvested					4	4							8
	Fallow/grazed-low/med						1	4	4	5	4	5	4	27
132	Fallow/grazed-low	4	4											8
	Fallow/grazed-low/med/barren							3	5					8
	Fallow/grazed-low/med		1	4	4	5	4	1		4	5	4	4	36
134	Fallow/grazed-low/med	4	3	1										8
	Plowed-coarse			3	4	4	5							16
	Plowed-med							4	1		1			6
	Plowed-fine								4	4	2			10
	Crop-low										1	5	1	7
	Crop-med												3	3
137	Fallow/grazed-low	4	2											6
	Fallow/grazed-low/med/barren							4	4					8
	Fallow/grazed-low/med		2	5	4	4	5		1	4	4	5	4	38
139	Fallow/grazed-low	4	2											6
	Fallow/grazed-low/med		2	2										4
	Fallow/grazed-med/high + Plowed-coarse			1										1
	Plowed-coarse			2	4	5	4							15
	Plowed-med							4	2					6

Turbine	Substrate	Month												Total
		3	4	5	6	7	8	9	10	11	12	1	2	
	Plowed-fine								3	4	1			8
	Crop-low										3	4	1	8
	Crop-med												3	3
140	Crop-low + Plowed-fine	2												2
	Crop-low + Plowed-coarse	2												2
	Crop-low/med		4	4	4									12
	Crop-med/high					5	3							8
	Crop-harvested w/ barren areas						1	3						4
	Fallow/grazed-low/med/barren							1	5					6
	Fallow/grazed-low/med									4	5	4	4	17
Total Surveys		**64**	**71**	**75**	**71**	**77**	**76**	**68**	**82**	**69**	**73**	**77**	**68**	**871**

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

3.2 Fatality Surveys

3.2.1 Survey Effort

Of 884 scheduled fatality surveys, 99% (871) occurred on or within 1–2 days of the scheduled date (Appendix C). Two scheduled surveys did not occur due to recent or active crop spraying; three were skipped due to active turbine maintenance/repair activities; two were skipped due to active plowing; three did not occur due to unexpected scheduling glitches; and three did not occur due to surveyor illness. Five other surveys were stopped early due to fertilizer/herbicide spraying, the presence of an aggressive sheep dog, turbine maintenance activities, heavy rain, and excessive mud. In all cases, crew limitations and logistical constraints precluded make-up surveys in an appropriate timeframe.

The time it took to complete an individual turbine survey averaged 75 ± 5 (SD) minutes, ranging from 58–135 minutes. Conditions that resulted in slower than expected progress included heavy mud in plowed fields after rain, dense mature crops, high fallow vegetation, and occasionally factors such as high temperatures and smoky conditions from nearby agricultural burning that constrained physical activity.

All 52 weekly substation/powerline surveys occurred as scheduled (Appendix C). The time it took to complete an individual survey averaged 19 ± 4 minutes, ranging from 15–30 minutes.

3.2.2 Composition of Incidents

During the course of the first year's carcass surveys, we discovered 24 fatalities during the standard turbine surveys, including one scavenged, adult red-tailed hawk classified as a "clearance" carcass (Appendix D). We discovered no incidents during the substation/powerline surveys. We documented 11 fatalities and 1 injured turkey vulture (*Cathartes aura*) as incidental finds (Appendix D). The 23 incidents discovered during the turbine surveys and qualified for inclusion in the analyses of adjusted fatality estimates included 2 bats, 5 small birds, 8 medium-sized birds, and 7 large birds (Table 5). The two bats were species commonly found as fatalities in the MHWRA (hoary bat *Lasiurus cinereus* and Mexican free-tailed bat *Tadarida brasiliensis*) and both showed evidence of blade-strike trauma (Appendix D). The small birds included three blackbirds, one horned lark feather spot, and one intact white-throated swift (*Aeronautes saxatalis*) that showed evidence of collision trauma. The blackbirds included two feather spots not identified to species and a female red-winged blackbird taken by a merlin (*Falco columbarius*). The surveyor saw the merlin drop the blackbird, which was headless upon recovery. The medium-sized birds included three raptors, a western grebe (*Aechmophorus occidentalis*; rear-end and legs removed by a blade strike), a mourning dove (wing only), two rock pigeons (one feather spot and one decayed carcass), and a feather spot that we were unable to identify conclusively but appeared to be a pied-billed grebe (*Podilymbus podiceps*). The raptors included two male American kestrels (cause of death not discerned due to scavenging/predation), an intact adult male northern harrier, and an intact barn owl (*Tyto alba*; evidence of blade strike across one wing). The large birds included a subadult glaucous-winged gull (*Larus glaucescens;* evidence of blade strike across one wing), two adult red-tailed hawks (evidence of blade-strike trauma: 1 cut in half, 1 broken neck), and four turkey vultures. Two of the vultures (1 adult, 1 juvenile) showed clear evidence of blade-strike trauma. The third vulture carcass (adult) was intact and showed no obvious, outward signs of trauma. The fourth vulture carcass (unknown age) appeared to have been purposefully buried under a pile of cut wheat stalks and was too decayed to determine a cause of death.

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

		Season / Visibility Class[1]								
		Spring	Summer		Fall			Winter		
Taxon	Size	Med	High	Med	High	Med	Low	High	Med	Total
Bats	Small				1	1				2
Birds	Small		1					3	1	5
	Medium	1		1		2		1	3	8
	Large	3		1	1	2	1			8
Total		**4**	**1**	**2**	**2**	**5**	**1**	**4**	**4**	**23**

[1] See Table 1 for examples of how we classified different habitat types in terms of visibility classes.

The incidental finds included one intact hoary bat, one Mexican free-tailed bat with a broken back and neck, three male American kestrels (2 adults), two barn owls, one adult male northern harrier, and four turkey vultures (Appendix D). The kestrels included one found during February 2012 on the T107 plot before the standard surveys began, which had a broken wing and neck. The Project Manager found another tail-less kestrel with a possible broken neck on the T131 plot during a bias-trial placement outing, which the primary surveyor did not find later that day (confirmed still present after the survey but gone 2 weeks later). The primary surveyor found the third kestrel at a known raptor plucking perch near T118, but outside the survey plot. The primary surveyor found the two barn owls roughly 200 m from the nearest turbines (T117 and T122). We believe a great horned owl that lived in the area killed one of these owls (trail of feathers leading back to the great horned owl's roost area). The remains of the other owl were limited to a scattered pile of feathers and a foot. The surveyor found the northern harrier near the base of a non-survey turbine (T136), intact but desiccated. The turkey vultures included an adult initially discovered by a rancher within but near the outside edge of the T108 survey plot (96 m from turbine), which had sustained an irreparable blade-strike injury to its wing and was later euthanized at the Lindsay Wildlife Museum. Given this bird's injured status (still ambulatory) and distance from the turbine, the likelihood of it remaining to be discovered on the survey plot during the next standard survey (2 days later) was highly uncertain, so we left the find as an incidental record and did not include it in the calculations of adjusted fatality estimates. The surveyor found the other three dead vultures within 24–33 m of non-survey turbines: one intact and desiccated (T137), one freshly dead and intact except for its tail and legs having been severed by a blade strike (T122), and one freshly killed by a blade strike (T137) that our surveyor witnessed.

3.2.3 Temporal Distribution of Incidents

Fatalities discovered during the turbine surveys occurred during all months except August (Figure 6). Higher numbers occurred during the fall and winter quarters (8 each) than during spring (5) and summer (3), with a similar seasonal pattern applicable to the incidental finds. We documented no large-bird fatalities or injuries during the winter quarter, whereas fatalities of both small and medium-sized birds were particularly prevalent during winter. The latter included all of the American kestrel and most of the barn owl fatalities, as well as several dove, pigeon, and blackbird fatalities that may have resulted from predation rather than blade strikes. We confirmed that one female blackbird was taken by a merlin, and bird-eating peregrine falcons (*Falco peregrinus*) and Cooper's hawks (*Accipiter cooperi*) also were present in the area at the time. Three of the eight turkey vulture incidents occurred during summer (the rest during the fall quarter), but we documented no other raptor fatalities during the summer quarter. The two northern harrier fatalities occurred during the spring and fall quarters, as did the four bat fatalities. The glaucous-winged gull and western grebe fatalities occurred during spring, whereas the unconfirmed but probable pied-billed grebe fatality occurred during the summer. The small-bird fatalities were most concentrated during winter, but some occurred in all seasons.

3.2.4 Spatial Distribution of Incidents

Fifty percent of all the incidents documented during standard surveys and incidentally (and 50% of the finds in each category) occurred in the central cluster (Figure 6, Appendix D). The other standard-survey finds were equally distributed between the north and south clusters, whereas 33% of the remaining incidental finds occurred in the north cluster and 17% in the south cluster. For bats and raptors, 50% and 54%, respectively, of all the fatalities occurred in the central cluster, with equal but lesser proportions found in the north and south clusters (25% and 18%, respectively). For vultures, the concentration in the central cluster was even more pronounced, with 6 of 8 (75%) found there and 1 each (12.5%) found in the north and south clusters. The opposite pattern applied to small birds, with only 1 of 5 (20%) found in the central cluster and 2 each

(40%) found in the north and south clusters. For the remaining medium and large bird fatalities, prevalence decreased from north to south, with 3 (50%) in the north cluster, 2 (33%) in the central cluster, and 1 (17%) in the south cluster.

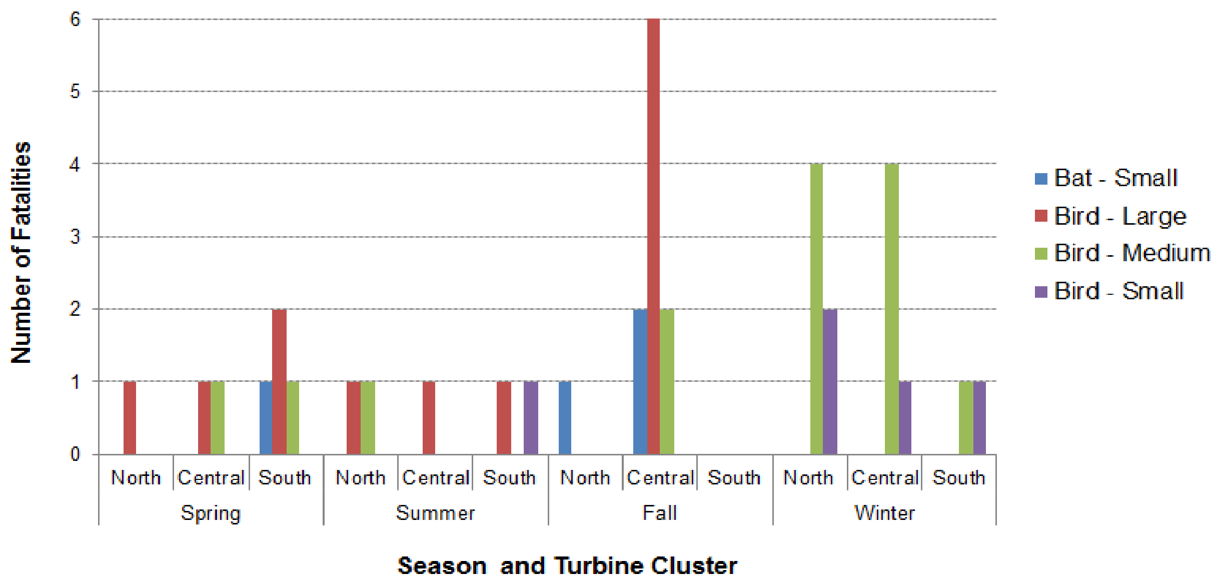

Figure 6. Fatality Incidents (Including Incidental Finds) by Season and Turbine Cluster: Year 1

We documented no fatalities during standard surveys at 3 of the 17 surveyed turbines (2 north cluster, 1 central cluster), one fatality each at 10 turbines, and two fatalities each at three turbines (2 north cluster, 1 south cluster) (Appendix D). In contrast, eight fatalities (33% of the total) occurred at T128 in the central cluster (Figure 7), including a bat, three species of raptors, a blackbird, a dove, and a grebe (Appendix D). The incidental finds added a vulture injury to the north-cluster T108 area, where we documented no fatalities during the standard surveys, and increased the tally at north-cluster T117 to three fatalities. All of the other incidental finds occurred near non-survey turbines. Notably, 3 of the 11 incidental finds occurred at T127 immediately adjacent to T128, further emphasizing the concentration of incidents in this area, especially for turkey vultures (4 of 8 incidents; Figure 7). The concentration of vulture fatalities in this area (including two other incidents nearby at turbines 121 and 122) likely resulted from the concentration of sheep carcasses that accumulated in the area in late August and September. These carcasses also attracted golden eagles, red-tailed hawks, and ravens to the area.

A distinct pattern of distribution of fatalities in relation to habitat types also was apparent, with 75% found within fallow-field plots, 11% within new-crop plots, 8% within plowed plots, and 6% within harvested-crop plots.

3.2.5 Adjusted Fatality Estimates

Searcher efficiency estimates.—The overall (not modeled) searcher-efficiency estimates were 88% for large birds (14 raptors of 4 species and 2 gulls detected), 62% for medium birds (12 smaller raptors of 5 species, 14 individuals of 8 other species), 51% for small birds (39 individuals of 20 species), and 28% for bats (80 individuals of 10 species) (Appendix A). The two large birds that the surveyor failed to detect included a red-shouldered hawk (*Buteo lineatus*) placed in a low visibility situation (dense crop), and a red-tailed hawk placed in a high visibility situation, but which a scavenger likely dragged outside the plot before the surveyor conducted the relevant survey (found several days later). The best model for searcher efficiency included visibility class, taxon/size class, and no interaction term. Modeled searcher-efficiency estimates ranged from 0.45–0.83 for larger birds, 0.20–0.60 for small birds, and 0.08–0.34 for bats, depending on the visibility class (Table 6). The estimates of searcher efficiency for the low visibility class were consistently the lowest and least precise, but there were essentially no differences for any of taxon/size classes between estimates for the low and medium visibility classes (Table 6).

Table 6. Searcher-Efficiency Estimates by Carcass Taxon and Size Generated by the USGS Fatality Estimator Software Using the Model: SE ≈ Taxon.Size + Visibility Class

Taxon / Size	Visibility Class	Number Placed	Searcher Efficiency	95% CI
Bats	High	34	0.27	0.15 – 0.65
	Medium	36	0.34	0.21 – 0.63
	Low	10	0.08	0.02 – 0.92
Small birds	High	13	0.52	0.31 – 0.71
	Medium	20	0.60	0.39 – 0.76
	Low	6	0.20	0.05 – 0.78
Larger birds	High	13	0.78	0.14 – 0.91
	Medium	18	0.83	0.14 – 0.94
	Low	11	0.45	0.20 – 0.70

Carcass persistence estimates.—The overall (non-modeled) average persistence time for large birds was 16.2 ± 10.4 (SD) days (range 2–29 days), for medium birds 6.7 ± 5.2 days (range 1–21 days), for small birds 6.5 ± 6.5 days (range 1–28 days), and for bats 5.7 ± 4.6 days (range 1–27 days). Put another way, 67% of the bats, 60% of the small birds, 50% of the medium birds, and 35% of the large birds disappeared within a shorter period than the weekly search interval.

Using the estimator software, the best model for carcass persistence was the full model based on a log-logistic failure time distribution, and included season, size class, and the interaction term (Table 7). Preliminary analyses indicated that the small differences in carcass persistence for small birds and bats—ranging from 3.2–7.5 days for bats and 4.9–7.1 days for small birds, depending on the season—did not warrant modeling

Species	Turbine Survey (T)	Clearance Carcass (C)	Incidental Find (I)
American Kestrel	△ (yellow)		● (yellow)
Barn Owl	△ (orange)		● (orange)
Glaucous-winged Gull	△ (red)		● (red)
Hoary Bat	△ (dark red)		● (dark red)
Horned Lark	△ (light green)		
Mexican Free-tailed Bat	△ (green)		● (green)
Mourning Dove	△ (teal)		
Northern Harrier	△ (cyan)		● (cyan)
Rock Pigeon	△ (light blue)		
Red-tailed Hawk	△ (blue)	■ (blue)	
Red-winged Blackbird	△ (pale blue)		
Turkey Vulture	△ (pink)		● (pink)
Unidentified Blackbird	△ (magenta)		
Pied-billed Grebe?	△ (lavender)		
Western Grebe	△ (purple)		
White-throated Swift	△ (dark purple)		

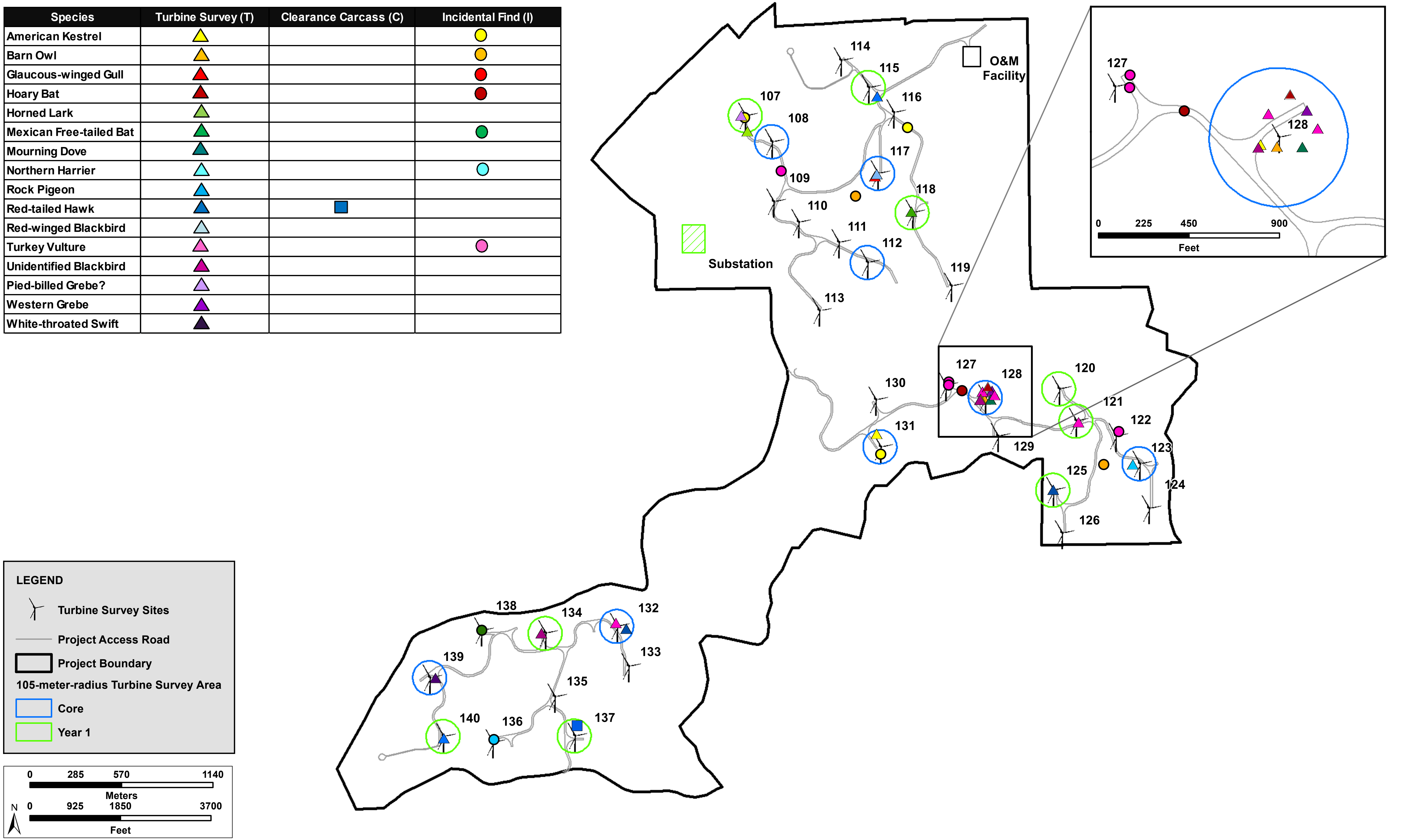

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Figure 7: Distribution of Fatality Incidents: Year 1
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the two groups separately. With these two groups combined in the model, carcass persistence always averaged at least slightly longer for larger birds than for small birds and bats, and seasonal differences in carcass persistence were much greater for larger birds (Table 7). The modeled carcass-persistence estimates, assuming a 7-day search interval, ranged from 49–96% for large birds and from 44–65% for small birds and bats, depending on the season (Table 7).

Table 7. Carcass-Persistence Estimates by Size and Season Generated by the USGS Fatality Estimator Software Using the Model: CP ≈ Size + Season + Size x Season

Carcass Size	Season	Placed	Carcass Persistence Time (days)	95% CI	Carcass Persistence Proportion	95% CI
Large	Spring	11	25.4	13.3 – 57.4	0.96	0.90 – 0.99
	Summer	10	10.5	5.6 – 22.9	0.86	0.70 – 0.96
	Fall	9	2.9	1.2 – 8.1	0.49	0.26 – 0.80
	Winter	10	5.6	2.3 – 10.4	0.70	0.42 – 0.86
Small	Spring	29	3.3	2.0 – 5.4	0.53	0.39 – 0.69
	Summer	30	4.8	3.4 – 6.2	0.65	0.55 – 0.73
	Fall	31	2.5	1.7 – 3.5	0.44	0.34 – 0.55
	Winter	32	4.4	3.2 – 5.7	0.63	0.52 – 0.71

Adjusted fatality estimates.—For bats, which we documented as standard-survey fatalities only during fall, the adjusted annual fatality estimates were 2.1 bats per turbine and 71 bats for the whole facility (Table 8). For small birds, the fatality estimates were 2.3–2.4 times higher in winter than in summer, and the overall annual estimates (1.0 fatalities per turbine and 33 fatalities for the whole facility) were less than half those of bats, despite our having documented three times more small bird fatalities (Table 8). This difference reflects searcher efficiency having been roughly twice as high for small birds as for bats (Table 6). For larger birds other than raptors, the fatality estimates for spring and fall were similar, whereas the winter estimate was slightly higher, and the overall annual estimates (0.5 per turbine and 17 for the whole facility) were roughly half those for small birds (Table 8). The fatality estimates for raptors, for which we documented fatalities in all four seasons, were more variable among seasons. They ranged from a low of 0.1 fatalities per turbine in summer to a high of 0.6 fatalities per turbine in fall, with the winter rate slightly higher than for spring and both more than three times lower than for fall (Table 8). The overall annual estimates for raptors (1.1 per turbine and 36 for the whole facility) were similar to those for bats.

The 95% confidence intervals (CI) for the adjusted fatality estimates for bats and raptors during fall were substantially wider than for raptors in other seasons and for the other species groups (Table 6). In both cases, the season-specific confidence intervals varied in proportion to the magnitude of the estimates. As mentioned previously, the reason for the relatively high, adjusted fatality estimates and wide confidence intervals for bats was low overall searcher efficiency and high variability among visibility classes. For raptors, the relatively high variability in fatality estimates among seasons, and especially the higher fall estimate, reflects both a higher number of documented fatalities during fall (Table 8) and much lower estimated carcass persistence for large birds during that season (Table 7). For large birds and bats, in general, the precision of the fatality estimates was slightly less than for small birds.

Table 8. Adjusted Annual Fatality Estimates by Species Group and Season

Group	Season	Number Found	Per Turbine Estimate	95% CI	Site Estimate	95% CI
Bats	Fall	2	2.06	0.29 – 7.69	71	10 – 262
Small Birds	Summer	1	0.14	0.11 – 0.54	5	4 – 19
	Winter	4	0.68	0.17 – 1.52	24	6 – 52
	Total	**5**	**0.82**	**0.29 – 1.67**	**28**	**10 – 57**
Raptors	Spring	2	0.15	0.07 – 0.66	6	3 – 23
	Summer	1	0.08	0.07 – 0.57	3	3 – 20
	Fall	5	0.63	0.15 – 3.13	22	5 – 107
	Winter	2	0.20	0.08 – 0.92	7	3 – 32
	Total	**10**	**1.05**	**0.33 – 5.50**	**36**	**12 – 188**
Other Larger Birds	Spring	2	0.15	0.07 – 0.79	5	3 – 27
	Summer	1	0.08	0.07 – 0.60	3	3 – 21
	Fall	1	0.14	0.09 – 1.04	5	4 – 36
	Winter	2	0.21	0.08 – 1.16	8	3 – 40
	Total	**6**	**0.58**	**0.17 – 2.87**	**20**	**6 – 98**

The annual fatality estimates for all species combined were 4.6 fatalities per turbine (95% CI 1.84–12.56), 2.0 fatalities per MW (95% CI 0.81–5.47), and 156 total fatalities (95% CI 63–428) (Table 9). Annual estimates for species documented as casualties during the standard fatality surveys ranged from 0.1–1.7 fatalities per turbine and from 3–57 total fatalities (Table 9). The facility-wide species-specific estimates ranged from 3–17 fatalities for raptors, 3–8 for other larger birds, 5–12 for small birds, and 14–57 for bats. Within these different groups, the species for which the estimates were highest included turkey vulture (raptors), rock pigeon (other larger birds), blackbirds (small birds), and Mexican free-tailed bat (bats). Among the non-vulture raptors, the fatality estimates for red-tailed hawks and American Kestrels were similar and more than twice the estimates for barn owls and northern harriers. Among the other larger birds, the fatality estimate for mourning doves was only slightly lower than for rock pigeons, with both of those estimates more than twice as high as for the three confirmed or probable waterbirds (Table 9). For bats, the higher fatality estimates for the Mexican free-tailed bat compared to the hoary bat, despite our having documented only single fatalities for both species, reflect the fact that the former was found on a plot classified as a low visibility plot (combination of plowed and ungrazed medium/high fallow vegetation), whereas the latter was found on a plot classified as a medium visibility plot (grazed fallow field with low/flattened vegetation). This difference also clearly points to the disadvantage that results from trying to extrapolate annual and facility-wide estimates based on very few documented fatalities.

Table 9. Species-Specific Adjusted Annual Fatality Estimates

Species	Number Found	Per Turbine Estimate	95% CI	Per MW Estimate	95% CI	Site Total Estimate	95% CI
Hoary bat	1	0.40	0.25 – 1.66	0.18	0.12 – 0.73	14	9 – 57
Mexican free-tailed bat	1	1.67	0.28 – 7.70	0.73	0.13 – 3.35	57	10 – 262
All Bats	**2**	**2.06**	**0.29 – 7.69**	**0.91**	**0.13 – 3.35**	**71**	**10 – 262**
Horned lark	1	0.15	0.11 – 0.55	0.06	0.05 – 0.24	5	4 – 19
Red-winged blackbird	1	0.19	0.14 – 0.80	0.09	0.06 – 0.36	7	5 – 28
Unidentified blackbird	2	0.34	0.13 – 0.96	0.15	0.06 – 0.42	12	5 – 33
White-throated swift	1	0.14	0.11 – 0.54	0.06	0.05 – 0.24	5	4 – 19
All Small Birds	**5**	**0.82**	**0.29 – 1.67**	**0.36**	**0.13 – 0.73**	**28**	**10 – 57**
American kestrel	2	0.20	0.08 – 0.92	0.09	0.04 – 0.41	7	3 – 32
Barn owl	1	0.07	0.07 – 0.50	0.04	0.04 – 0.22	3	3 – 17
Northern harrier	1	0.08	0.07 – 0.57	0.04	0.04 – 0.26	3	3 – 20
Red-tailed hawk	2	0.22	0.07 – 1.24	0.10	0.04 – 0.55	8	3 – 43
Turkey vulture	4	0.49	0.08 – 2.21	0.22	0.04 – 0.97	17	3 – 76
All Raptors	**10**	**1.05**	**0.33 – 5.50**	**0.46**	**0.15 – 2.40**	**36**	**12 – 188**
Glaucous-winged gull	1	0.07	0.06 – 0.54	0.04	0.04 – 0.24	3	3 – 19
Mourning dove	1	0.14	0.09 – 1.04	0.06	0.05 – 0.46	5	4 – 36
Rock pigeon	2	0.21	0.08 – 1.16	0.10	0.04 – 0.51	8	3 – 40
Western grebe	1	0.07	0.07 – 0.50	0.04	0.04 – 0.22	3	3 – 17
Pied-billed grebe?	1	0.08	0.07 – 0.60	0.04	0.04 – 0.27	3	3 – 21
All Other Larger Birds	**6**	**0.58**	**0.17 – 2.87**	**0.26**	**0.08 – 1.25**	**20**	**6 – 98**
All Species	**23**	**4.51**	**1.78 – 12.61**	**1.97**	**0.78 – 5.49**	**154**	**61 – 429**

3.3 Bird Use Counts

3.3.1 Survey Effort

Of 416 individual counts scheduled to occur between 4 March 2012 and 2 March 2013, 411 (99%) occurred as scheduled or within 1 day of the original scheduled date (Appendix E). One morning count did not occur during Week 6 due to unsafe survey conditions (shots fired in close proximity to survey plot: shepherd after coyote) and four afternoon counts did not occur during Week 45 due to surveyor illness. Excessive rain shortened 14 other counts (mix of AM and PM counts), crop spraying shortened one morning count, and two other "AM" counts actually began shortly after instead of before noon. In all cases, crew limitations and logistical constraints precluded make-up surveys in an appropriate timeframe.

3.3.2 Species Composition

Across all counts, we recorded an estimated 62,603 individual bird sightings involving 52 identified species (Table 10). These included 15 species of raptors, 10 species of waterbirds, 5 species of blackbirds and starlings, 2 species of pigeons and doves, 1 species of raven, 1 species of pheasant, and 18 species of passerines and other small birds. The surveyor was unable to identify to species <1% of the total individual sightings. Special-status species recorded during the counts included Swainson's hawk (*Buteo swainsoni*; CA Threatened), golden eagle (CA Fully Protected), peregrine falcon (CA Fully Protected), white-tailed kite (*Elanus leucurus*; CA Fully Protected), burrowing owl (*Athene cunicularia*; CA Species of Special Concern [CSSC]), northern harrier (CSSC breeding), loggerhead shrike (*Lanius ludovicianus*; CSSC breeding), and tricolored blackbird (*Agelaius tricolor*; CSSC breeding). Another special-status raptor recorded on the site, but only during a fatality survey, was the short-eared owl (*Asio flammeus*; CSSC - breeding), which the primary surveyor saw on one occasion in October near T118. Based on the number of individual surveys during which at least one individual of a species was seen, the 10 species most frequently observed during the BUCs were, in descending order of prevalence, red-tailed hawk, western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), turkey vulture, northern harrier, common raven, red-winged blackbird (*Agelaius phoeniceus*), American kestrel, Brewer's blackbird (*Euphagus cyanocephalus*), and loggerhead shrike (Table 10). Based on total counts and average sighting rates, however, the top-10 list looked much different, with tricolored blackbird topping the list, followed in descending order of abundance by red-winged blackbird, Brewer's blackbird, rock pigeon, savannah sparrow (*Passerculus sandwichensis*), western meadowlark, horned lark, house finch (*Passer domesticus*), American goldfinch (*Spinus tristis*), and European starling (Table 10).

3.3.3 Temporal and Spatial Distribution of Activity

The overall activity rate for raptors as a group averaged highest in summer (12.3 sightings/hour), lower and similar in fall (8.8) and winter (9.2), and lowest in spring (6.4) (Figure 8). A similar pattern was evident for ravens, with summer activity highest (5.2 sightings/hour) and spring activity lowest (1.6), but winter activity (3.8) slightly higher than in fall (3.0)). For waterbirds, the overall activity rate was highest and similar in summer and fall (4.9 and 5.2, respectively), slightly lower in winter (3.8), and much lower in spring (0.7). For the smaller birds, fall tended to be the busiest time, but the different groups varied beyond that. For pigeons and doves, fall activity was slightly higher (20.2) than in summer (17.7), winter activity was about half (7.7) the summer rate, and spring activity was lowest (1.7). For blackbirds and starlings, fall activity was much higher than in any other season (724.49), followed by winter (99.5), spring (75.9), and summer (31.9). For other small birds, fall activity was highest (89.5), followed by winter (50.5), spring (26.7), and summer (12.5).

Table 10. Frequency of Occurrence, Total Counts, and Sighting Rates for Birds by Species and Count Site

	Frequency of Occurrence[1]					Total Count					Sightings Per Hour				
Species Site	**1**	**2**	**3**	**4**	**Combined**	**1**	**2**	**3**	**4**	**Combined**	**1**	**2**	**3**	**4**	**Combined**
Raptors															
American Kestrel	48	44	23	16	131	62	66	29	20	177	1.208	1.291	0.578	0.388	0.867
Burrowing Owl	21		1		22	21		1		22	0.421		0.020		0.110
Cooper's Hawk	2				2	2				2	0.039				0.010
Ferruginous Hawk	1				1	2				2	0.039				0.010
Great Horned Owl	8	1			9	8	1			9	0.155	0.019			0.044
Golden Eagle	3	20	5		28	3	21	6		30	0.058	0.408	0.118		0.146
Merlin	1	2	1	1	5	1	2	1	1	5	0.019	0.039	0.020	0.019	0.024
Northern Harrier	4	60	70	30	164	5	82	99	35	221	0.097	1.602	1.936	0.675	1.075
Peregrine Falcon		1			1		1			1		0.019			0.005
Prairie Falcon	1	1	2	1	5	1	1	2	1	5	0.019	0.019	0.039	0.019	0.024
Rough-legged Hawk		1	6	1	8		1	6	1	8		0.019	0.118	0.019	0.039
Red-tailed Hawk	75	74	70	74	293	107	94	88	90	379	2.097	1.845	1.799	1.794	1.884
Swainson's Hawk	4	4	2	4	14	4	4	3	13	24	0.078	0.078	0.059	0.252	0.117
Turkey Vulture	29	36	36	64	165	149	133	229	433	944	3.000	2.612	4.446	8.476	4.634
White-tailed Kite	5	6	4		15	9	10	8		27	0.194	0.214	0.176		0.146
Unidentified Buteo			5	2	7			6	2	8			0.118	0.039	0.039
All Raptors	**98**	**103**	**100**	**97**	**398**	**374**	**416**	**478**	**596**	**1864**	**7.425**	**8.165**	**9.426**	**11.682**	**9.174**
Waterbirds															
American Wigeon				1	15				6	6				0.117	0.029
Canada Goose	3	2	3	7	8	30	36	59	123	248	0.583	0.699	1.157	2.345	1.196
Double-crested Cormorant	1	1	2	4	1	1	2	2	7	12	0.019	0.039	0.039	0.136	0.058
Great Egret				1	29				1	1				0.019	0.005
Killdeer	25	2	1	1	3	127	3	1	6	137	2.709	0.058	0.020	0.117	0.727
Long-billed Curlew	1			2	1	3			33	36	0.058			0.641	0.175
Long-billed Dowitcher				1	1				19	19				0.369	0.092
Mute Swan				1	2				1	1				0.019	0.005

		Frequency of Occurrence[1]					Total Count					Sightings Per Hour			
Species	**Site**	**1**	**2**	**3**	**4**	**Combined**	**1**	**2**	**3**	**4**	**Combined**	**1**	**2**	**3**	**4**	**Combined**
Tundra Swan					2	2				7	7				0.121	0.030
White-faced Ibis				1	1	8			3	1	4			0.059	0.019	0.019
Unidentified Duck			2	2	4	8		17	22	32	71		0.019		3.612	0.910
Unidentified Gull			1		10	11		1		186	187		0.330	0.431	0.825	0.397
All Waterbirds		**30**	**8**	**8**	**28**	**74**	**161**	**59**	**87**	**422**	**729**	**3.369**	**1.146**	**1.706**	**8.340**	**3.645**
Pigeons & Doves																
Mourning Dove		45	11	2	1	59	280	70	10	3	363	5.524	1.359	0.196	0.058	1.788
Rock Pigeon		33	31	3	2	69	1505	474	16	17	2012	30.280	9.204	0.314	0.330	10.055
All Pigeons & Doves		**65**	**39**	**4**	**3**	**111**	**1785**	**544**	**26**	**20**	**2375**	**35.804**	**10.563**	**0.510**	**0.388**	**11.844**
Quail & Pheasants																
Ring-necked Pheasant					**5**	**5**				**5**	**5**				**0.097**	**0.024**
Crows & Ravens																
Common Raven		**33**	**28**	**32**	**53**	**146**	**138**	**127**	**173**	**284**	**722**	**2.718**	**2.466**	**3.500**	**5.612**	**3.574**
Blackbirds & Starlings																
Brewer's Blackbird		29	26	27	43	125	1239	1584	1809	3731	8363	24.058	30.757	35.471	77.107	41.864
European Starling		40	10			50	998	200			1198	19.379	3.883			5.830
Great-tailed Grackle		1				1	2				2	0.039				0.010
Red-winged Blackbird		43	35	34	31	143	2007	590	4762	1971	9330	39.058	11.456	93.270	38.272	45.398
Tricolored Blackbird		10	3	20	7	40	2064	480	23862	2387	28793	41.402	9.320	472.686	44.291	141.120
Unidentified Blackbird		2	3	1		6	85	14	4		103	1.650	0.272	0.078		0.501
All Blackbirds & Starlings		**79**	**61**	**66**	**72**	**278**	**6395**	**2868**	**12942**	**7489**	**29694**	**125.586**	**55.689**	**601.505**	**159.671**	**234.723**
Other Small Birds																
American Goldfinch		1	9	4		14	81	781	381		1243	1.573	15.165	7.471		6.049
American Pipit		11	8	4	5	28	228	461	68	84	841	4.427	8.951	1.333	1.631	4.092
Black Phoebe		5	1	3	2	11	5	1	3	2	11	0.097	0.019	0.059	0.039	0.054
Cliff Swallow			3	2	11	16		13	10	68	91		0.252	0.196	1.320	0.443
House Finch		22	28	18	13	81	224	577	320	199	1320	4.350	11.291	6.265	3.864	6.443
Horned Lark		43	62	43	57	205	226	522	450	439	1637	4.417	10.194	8.853	8.500	7.989

	Frequency of Occurrence[1]					Total Count					Sightings Per Hour				
Species **Site**	**1**	**2**	**3**	**4**	**Combined**	**1**	**2**	**3**	**4**	**Combined**	**1**	**2**	**3**	**4**	**Combined**
House Sparrow	1				1	3				3	0.058				0.015
Loggerhead Shrike	47	17	9	12	85	49	17	9	13	88	0.951	0.340	0.176	0.252	0.431
Northern Flicker	1				1	1				1	0.019				0.005
Say's Phoebe	3	4	8	2	17	3	4	8	2	17	0.058	0.078	0.157	0.039	0.083
Savannah Sparrow	16	22	11	18	67	485	528	295	515	1823	9.596	10.350	6.588	10.053	9.153
Song Sparrow				1	1				1	1				0.019	0.005
Tree Swallow	1	1	3	16	21	3	3	16	92	114	0.058	0.087	0.314	1.786	0.562
Violet-green Swallow	1				1	3				3	0.058				0.015
White-crowned Sparrow	2				2	23				23	0.447				0.112
Western Kingbird				2	2				2	2				0.039	0.010
Western Meadowlark	38	73	76	72	259	373	447	438	592	1850	7.282	8.689	8.833	11.534	9.085
White-throated Swift		1	1	17	19		4	2	41	47	0.000	0.078	0.039	0.796	0.229
Unidentified Sparrow	2				2	4				4	0.078				0.019
All Other Small Birds	**90**	**99**	**97**	**100**	**386**	**1711**	**3358**	**2000**	**2050**	**9119**	**33.470**	**65.495**	**40.284**	**39.874**	**44.792**
All Species	**102**	**103**	**102**	**103**	**410**	**10564**	**7372**	**33201**	**11466**	**62603**	**208.373**	**143.524**	**656.931**	**225.664**	**307.776**

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

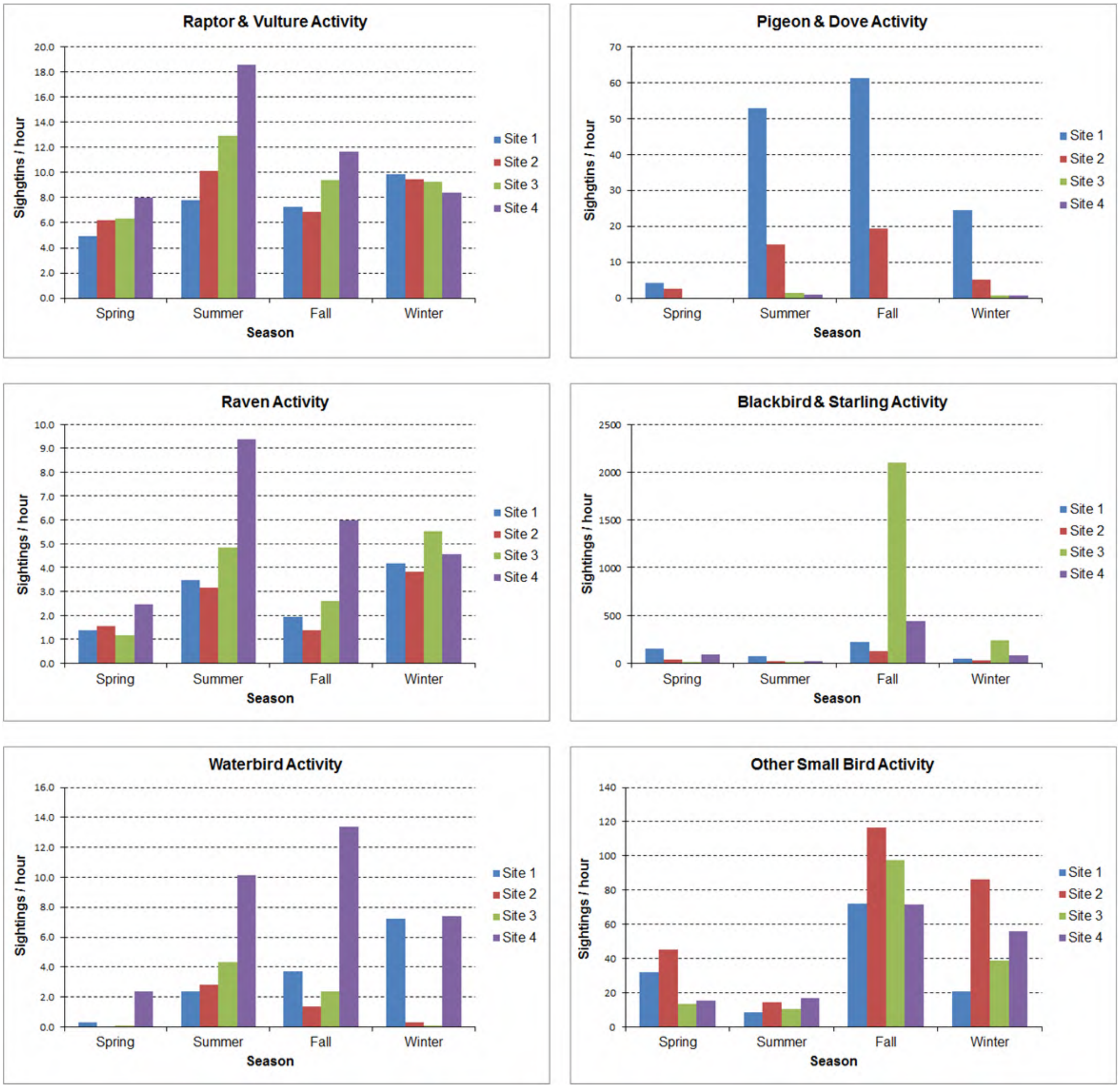

Figure 8. Activity Rates for Bird Groups by Season and Count Site

We observed 25 species at all four count sites and 16 species at only one site (usually only once or twice; Table 10). We recorded slightly more species at the north (39) and south (38) count sites than at the two central count sites (33–34). Species that occurred at all four count sites during all four quarterly seasons included Brewer's and red-winged blackbirds, common raven, house finch, horned lark, western meadowlark, American kestrel, red-tailed hawk, and turkey vulture, with northern harrier and loggerhead shrike also nearly ubiquitous. Other species that were ubiquitous or nearly so during fall and winter included tricolored blackbird, Say's phoebe (*Sayornis saya*), and savannah sparrow. Other species recorded during all four seasons at one or more sites included golden eagle, mourning dove, Canada goose (*Branta canadensis*), killdeer

(*Charadrius vociferus*), rock pigeon, and European starling. Other species recorded at all count sites during at least one quarterly season included Swainson's hawk during summer, and killdeer and tree swallow (*Tachycineta bicolor*) during winter.

For raptors as a group, average abundance generally increased from north (Site 1) to south (Site 4), except during winter (Figure 8). Ravens also tended to be more common in the south cluster except during winter. Waterbird sightings tended to be more common at all times of year in the south cluster (Figure 8), which likely reflects this cluster's relatively close proximity to the aquatic habitats of the nearby Sacramento River and associated marshlands to the west and south (Figure 1). Conversely, blackbirds and starlings as a group generally were more common in the north cluster during spring and summer, but were more common in the central and south clusters during fall and winter when tricolored blackbirds occurred in great numbers (Figure 8). We recorded starlings only in the north and west-central (Site 2) clusters, however, with pigeons and doves as a group also consistently most common in the north and west-central clusters at all times of year. For other smaller birds as a group, there were no distinct seasonal patterns of abundance across the different count sites, although counts for this group averaged highest in the west-central cluster during all seasons except summer (Figure 8).

Among the special-status raptors, thus far we have recorded burrowing owls only during fall and winter. The BUC records include only a single owl that occupied a series of ground-squirrel burrows along the fence adjacent to T109 throughout the winter. While traveling through the area in the early morning, we also documented at least two other owls in the central cluster during winter. Both adult male and adult female northern harriers routinely occurred in the central and south clusters throughout the year, and at least one juvenile harrier inhabited each of these areas after July, suggesting that nesting occurred somewhere within or near both areas. The primary surveyor observed harriers hunting blackbirds, horned larks, and pigeons at various times. At least two white-tailed kites frequented both the north and central clusters throughout the winter, often seen hunting blackbirds. The surveyor recorded only a single unknown-age peregrine falcon during the BUCs in the central cluster during November; however, other observations confirmed the presence of at least two birds, including one adult, in the area during the winter hunting pigeons.

We recorded Swainson's hawks during all seasons except winter, but mostly during spring and summer, and in all three turbine clusters. Our observations confirmed that a distinct dark-morph adult routinely hunted in the Talbert Lane area (see Figure 1) along the south margins of the south cluster in June and July, with another light-morph adult also often present there. On several occasions, the surveyor noted Swainson's hawks attacking red-winged blackbird nesting colonies located in fencerow vegetation.

During the BUCs, the surveyor recorded golden eagles during all seasons and at all count sites except Site 4 in the south cluster. The majority of the spring sightings reflected the temporary presence of an active golden eagle nest located on an electrical transmission tower just south of the substation, which was visible from the count site. This nest was located approximately 2 km south-southwest of the eucalyptus grove in which the historic Callahan-territory nest used to be located in the midst of the north turbine cluster (Kerlinger et al.

2011). The pair (both full adults) began incubating in early March, but abandoned the effort by 29 March. After they abandoned the nest, the pair continued to hunt in the area on a regular basis throughout the year, often feeding on abundant sheep carcasses in the area along with many vultures.

3.3.4 Flight Heights and Turbine Collision Risk

We recorded flight-altitude classifications for 11,627 individual bird sightings. Overall, 97% of these observations involved birds flying at LOW altitudes, 3% at MED altitudes, and <1% at HIGH altitudes (1 golden eagle sighting) (Table 11). The one species group for which this general pattern did not apply was waterbirds, where 46% of 574 observations were classified as flying LOW and 54% as MED. The waterbird species that were frequently detected flying at MED heights included various ducks (87% of 77 sightings), various gulls (76% of 187 sightings), and Canada geese (42% of 248 sightings), as well as a cormorant (8% of sightings). Otherwise, only nine other species flew at MED heights during the standard surveys. Among raptors, these included golden eagle (8% of sightings), red-tailed hawk (1%), Swainson's hawk (4%), turkey vulture (1%), and 4 of 7 unidentified buteos. Ravens also occasionally flew at MED heights (2% of 610 sightings), as did blackbirds (<1% of 6,146 sightings), horned larks (3% of 269 sightings), and white-throated swifts (4% of 46 sightings).

Table 11. Observations Recorded During Bird Use Counts by Species and Flight Height

		Flight Height[1]				%		
Group	**Species**	**Low**	**Medium**	**High**	**Total**	**Low**	**Medium**	**High**
Raptors & Vultures	American Kestrel	60			60	100		
	Cooper's Hawk	2			2	100		
	Ferruginous Hawk	1			1	100		
	Great Horned Owl	21	2	1	24	88	8.3	4.2
	Golden Eagle	4			4	100		
	Merlin	192			192	100		
	Northern Harrier	1			1	100		
	Peregrine Falcon	5			5	100		
	Prairie Falcon	4			4	100		
	Rough-legged Hawk	142	2		144	99	1.4	
	Red-tailed Hawk	23	1		24	96	4.2	
	Swainson's Hawk	820	6		826	99	0.7	
	Turkey Vulture	19			19	100		
	Unknown buteo	3	4		7	43	57.1	
All Raptors & Vultures		**1297**	**14**	**1**	**1313**	**99**	**46.0**	**0.1**
Waterbirds	American Wigeon	6			6	100		
	Canada Goose	185	63		248	58	41.5	
	Double-crested Cormorant	11	1		12	92	8.3	
	Long-billed Curlew	19			19	100		
	Long-billed Dowitcher	19			19	100		
	Mute Swan	1			1	100		
	Tundra Swan	7			7	100		

Group	Species	Flight Height[1] Low	Medium	High	Total	% Low	Medium	High
	White-faced Ibis	4			4	100		
	Unidentified Duck	9	62		71	13	87.3	
	Unidentified Gull	45	142		187	24	75.9	
All Waterbirds		**306**	**268**		**574**	**53**	**46.7**	
Pigeons & Doves	Mourning Dove	33			33	100		
	Rock Pigeon	1139			1139	100		
All Pigeons & Doves		**1172**			**1172**	**100**		
Crows and Ravens	Common Raven	**600**	**10**		**610**	**98**	**1.6**	
Blackbirds & Starlings	Brewer's Blackbird	2277	1		2278	100		
	European Starling	82			82	100		
	Great-tailed Grackle	2			2	100		
	Red-winged Blackbird	1580	16		1596	99	1.0	
	Tricolored Blackbird	2255			2255	100		
	Unidentified Blackbird	7	10		17	41	58.8	
All Blackbirds & Starlings		**6203**	**27**		**6230**	**100**	**0.4**	
Other Small Birds	American Pipit	144			144	100		
	Cliff Swallow	91			91	100		
	House Finch	654			654	100		
	Horned Lark	260	9		269	97	3.3	
	Loggerhead Shrike	6			6	100		
	Savannah Sparrow	56			56	100		
	Tree Swallow	108			108	100		
	Violet-green Swallow	3			3	100		
	Western Meadowlark	351			351	100		
	White-throated Swift	44	2		46	96	4.3	
All Other Small Birds		**1717**	**11**	**0**	**1728**	99	0.6	
All Species		**11255**	**371**	**1**	**11627**	97	3.2	

[1] Low = below turbine tower height (~60 m); medium = above tower height up to ~250 m; high = above ~250 m.

3.4 Raptor Prey and Carcass Scavengers

3.4.1 Raptor Prey

During 24% of the fatality surveys, the surveyor noted the presence of potential raptor prey species or other food sources, including various birds, occasional mammals, a few reptiles and notable insect concentrations, and livestock carcasses (Table 12). During the BUCs, the surveyor often noted raptors hunting various birds and eating prey, which undoubtedly included some mammals (none specifically identified), and he often recorded vultures and other raptors feeding on livestock carcasses (Table 12). The supplementary road surveys within the site only infrequently revealed additional noteworthy observations (Table 12).

Table 12. Observations of Raptor Prey Species and Food Sources Other Than Birds, and Predation/Scavenging Events Recorded During Fatality Surveys, Bird Use Counts, and Road Surveys

Date	Survey	Location	Observation
06-Mar-12	Fatality	T121	Old sheep carcass
06-Mar-12	Fatality	T125	Rodent burrows along fenceline
12-Mar-12	Fatality	T140	Black-tailed jackrabbit on plot
13-Mar-12	Fatality	T121	Old sheep carcass
13-Mar-12	Fatality	T125	Rodent burrows along fenceline
20-Mar-12	Fatality	T121	Old sheep carcass
20-Mar-12	Fatality	T125	CA ground squirrel burrows along fenceline
22-Mar-12	BUC	Site 4	Lamb carcass in area
28-Mar-12	Fatality	T108	CA ground squirrel burrows along fencelines
29-Mar-12	Fatality	T128	Sick sheep on plot
02-Apr-12	Fatality	T118	CA ground squirrel burrows along fencelines
02-Apr-12	Fatality	T132	Sheep carcasses (3 lamb, 2 adult) nearby
11-Apr-12	Fatality	T137	Several sheep carcasses on or near plot
17-Apr-12	Fatality	T125	CA ground squirrel burrows along fenceline
25-Apr-12	Fatality	T108	CA ground squirrel burrows along fencelines
26-Apr-12	BUC	Site 2	RTHA eating prey
01-May-12	Fatality	T125	CA ground squirrel burrows along fenceline
03-May-12	Road	Between T128 and T129	Gopher snake sunning on road
04-May-12	BUC	Site 1	SWHA preyed upon RWBL nesting colony
09-May-12	Fatality	T107	Black-tailed jackrabbit adult and nest on plot
09-May-12	Fatality	T108	CA ground squirrel burrows along fencelines
09-May-12	Fatality	T137	Black-tailed jackrabbit on plot
15-May-12	Fatality	T125	Black-tailed jackrabbit on plot
15-May-12	Fatality	T139	Vole carcass on plot cut up by disking
24-May-12	Road	Between T128 and T130	(2) Gopher snakes crossing road
25-May-12	BUC	Site 2	NOHA chasing ROPI
25-May-12	BUC	Site 3	Possible carcass in area
29-May-12	Road	Talbert Lane	Gopher snake sunning on road
31-May-12	Fatality	T107	Black-tailed jackrabbit on plot
31-May-12	Fatality	T134	Black-tailed jackrabbit on plot
01-Jun-12	Fatality	T128	Black-tailed jackrabbit on plot
06-Jun-12	Fatality	T134	Black-tailed jackrabbit on plot
11-Jun-12	Fatality	T140	Black-tailed jackrabbit on plot
12-Jun-12	Fatality	T121	Black-tailed jackrabbit on plot
14-Jun-12	Fatality	T120	Black-tailed jackrabbit on plot with young

Date	Survey	Location	Observation
18-Jun-12	Road	Talbert Lane	Gopher snake crossing road
19-Jun-12	Fatality	T121	Black-tailed jackrabbit on plot
19-Jun-12	Fatality	T125	Large number of grasshoppers in wheat
22-Jun-12	Fatality	Substation	Feral cat carcass in area
25-Jun-12	Fatality	T140	Black-tailed jackrabbit on plot
26-Jun-12	Fatality	T121	Black-tailed jackrabbit on plot
26-Jun-12	Fatality	T123	Feral cat on road with vole in mouth
26-Jun-12	Fatality	T125	Black-tailed jackrabbit on plot
26-Jun-12	Fatality	T139	(10+) Dragonflies flying low over plot; livestock carcass attracting TUVU/CORA ~1/2 km away
28-Jun-12	Fatality	T120	Black-tailed jackrabbit on plot
28-Jun-12	Road	Gate to central section	Dragonflies hunting in a meadow
02-Jul-12	Fatality	T140	Black-tailed jackrabbit and northern pacific rattlesnake on plot; sheep carcass at gate leading to T140
03-Jul-12	Fatality	T139	(11) TUVU on sheep carcass nearby
05-Jul-12	Fatality	T108	CA ground squirrel burrows along fencelines
06-Jul-12	Fatality	T120	Black-tailed jackrabbit on plot
09-Jul-12	Fatality	T140	Black-tailed jackrabbit on plot
10-Jul-12	Fatality	T121	Black-tailed jackrabbit on plot
11-Jul-12	Fatality	T112	TUVU feeding on sheep carcass off plot
12-Jul-12	BUC	Site 2	Sheep carcass in area
13-Jul-12	BUC	Site 4	Sheep and lamb carcasses in area
19-Jul-12	BUC	Site 4	Sheep carcass in area
19-Jul-12	Fatality	T120	Vole seen running to burrow
19-Jul-12	Fatality	T128	Black-tailed jackrabbit on plot
20-Jul-12	BUC	Site 1	Sheep carcass near T117
20-Jul-12	BUC	Site 4	Sheep and lamb carcasses in area
23-Jul-12	Fatality	T117	Lots of TUVU molted feathers near where sheep carcass had been
24-Jul-12	Fatality	T125	Black-tailed jackrabbit on plot
25-Jul-12	Fatality	T134	(8) CORA (16) TUVU on carcass 130 m away
26-Jul-12	BUC	Site 4	Sheep carcass in area
26-Jul-12	Fatality	T120	Black-tailed jackrabbit on plot
27-Jul-12	BUC	Site 2	Sheep carcass in area
27-Jul-12	BUC	Site 4	(2) Sheep carcasses in area
30-Jul-12	Fatality	T117	Grasshoppers and dragonflies present
31-Jul-12	Fatality	T121	Black-tailed jackrabbit on plot
03-Aug-12	BUC	Site 4	Sheep carcass in area
07-Aug-12	Fatality	T139	(8) TUVU on sheep carcass 300 m from turbine
09-Aug-12	BUC	Site 4	Sheep carcass in area
10-Aug-12	BUC	Site 3	Sheep carcass in area
13-Aug-12	Fatality	T140	Sheep carcass 300 m from turbine

Date	Survey	Location	Observation
16-Aug-12	BUC	Site 3	Cow carcass in area
16-Aug-12	BUC	Site 4	Sheep carcass in area
16-Aug-12	Fatality	T120	Black-tailed jackrabbit on plot
17-Aug-12	BUC	Site 2	RTHA eating prey
17-Aug-12	Fatality	T137	Black-tailed jackrabbit on plot
23-Aug-12	BUC	Site 2	NOHA eating prey
23-Aug-12	Fatality	T120	Black-tailed jackrabbit on plot
24-Aug-12	BUC	Site 3	Sheep carcass in area
27-Aug-12	Fatality	T117	TUVU feeding on black-tailed jackrabbit carcass 90 m from turbine
29-Aug-12	Fatality	T137	Many grasshoppers on plot
30-Aug-12	Fatality	T128	Sick sheep on plot
04-Sep-12	Fatality	T125	PEFA chasing (6) ROPI
07-Sep-12	BUC	Site 3	NOHA eating prey
07-Sep-12	BUC	Site 4	Lamb carcass in area
14-Sep-12	BUC	Site 2	NOHA after HOLA on road
20-Sep-12	BUC	Site 3	NOHA chasing TCBL
20-Sep-12	Fatality	T128	TUVU/CORA feeding on sheep carcass
25-Sep-12	Fatality	T121	Fresh sheep carcass attracting TUVU/CORA
25-Sep-12	Fatality	T125	Many TUVU/CORA due to multiple sheep carcasses
27-Sep-12	BUC	Site 4	Sheep carcass in area
02-Oct-12	Fatality	T121	(3) sheep carcasses on plot
02-Oct-12	Fatality	T125	(27) TUVU due to many sheep carcasses
02-Oct-12	Fatality	T139	TUVU on carcass 200 m from turbine
03-Oct-12	Fatality	T134	Sheep carcass just off plot at fenceline
04-Oct-12	Fatality	T120	(2) TUVU on new sheep carcass 120 m from turbine
05-Oct-12	BUC	Site 4	Sheep carcass in area
12-Oct-12	BUC	Site 3	Little flying with several raptors in area
23-Oct-12	Fatality	T139	TUVU around cow carcass 800 m from turbine
26-Oct-12	BUC	Site 2	RTHA eating prey
29-Oct-12	Road	Talbert Lane	RTHA eating gopher snake on power pole
06-Nov-12	Fatality	T125	New sheep carcass 250 m from turbine
14-Nov-12	Fatality	T128	Black-tailed jackrabbit on plot
15-Nov-12	BUC	Site 2	NOHA eating prey
15-Nov-12	BUC	Site 3	Went quiet when MERL arrived
16-Nov-12	BUC	Site 3	NOHA eating prey
24-Nov-12	BUC	Site 2	MERL appears to have killed HOFI or HOLA
17-Dec-12	Fatality	T118	CA ground squirrel burrows along fencelines
18-Dec-12	Fatality	T125	CA ground squirrel burrows along fenceline
28-Dec-12	BUC	Site 3	Sheep carcass in area

Date	Survey	Location	Observation
28-Dec-12	BUC	Site 3	RTHA feeding on sheep carcass
02-Jan-13	Fatality	T125	CA ground squirrel burrows along fenceline
02-Jan-13	Road	Near gate to T134	CA ground squirrel burrows along fenceline
03-Jan-13	Road	Near gate to T134	CA ground squirrel burrows along fenceline
03-Jan-13	Road	Between T109 and T110	CA ground squirrel burrows along fenceline
04-Jan-13	Road	Near gate to T127	CA ground squirrel burrows along fenceline
05-Jan-13	BUC	Site 2	WTKI went after RWBL
05-Jan-13	BUC	Site 3	Sheep carcass in area
07-Jan-13	Fatality	T140	Scavenged lamb carcass on road near turbine
09-Jan-13	Fatality	T108	Jerusalem cricket
09-Jan-13	Fatality	T121	Black-tailed jackrabbit on plot
10-Jan-13	Fatality	T120	(2) PEFA (1 adult, 1 unknown age) chasing pigeons nearby
14-Jan-13	Road	Near gate to T134	CA ground squirrel burrows along fenceline
15-Jan-13	Road	Near gate to T127	CA ground squirrel burrows along fenceline
16-Jan-13	Road	Between T109 and T110	CA ground squirrel burrows along fenceline
17-Jan-13	Fatality	T128	RTHA feeding on lamb carcass near turbine
17-Jan-13	Fatality	T128	GOEAs (1 older subadult, 1 SY) feeding on fresh lamb carcass 171 m from turbine
18-Jan-13	BUC	Site 2	Sheep carcass in area
18-Jan-13	Fatality	Substation	Black-tailed jackrabbit on plot
21-Jan-13	Road	Near gate to T134	CA ground squirrel burrows along fenceline
22-Jan-13	Fatality	T139	Black-tailed jackrabbit on plot; (20+) TUVU circling carcass ~1 km away
23-Jan-13	Fatality	T108	Black-tailed jackrabbit on plot
23-Jan-13	Road	Between T109 and T110	CA ground squirrel burrows along fenceline
24-Jan-13	Road	Near gate to T127	CA ground squirrel burrows along fenceline
30-Jan-13	Fatality	T137	Black-tailed jackrabbit on plot
30-Jan-13	Road	Between T109 and T110	CA ground squirrel burrows along fenceline
31-Jan-13	BUC	Site 4	Sheep carcass in area
31-Jan-13	Fatality	T120	Young lambs in area
04-Feb-13	Fatality	T132	MERL caught RWBL; AMKE harassed MERL and ended up with prey
05-Feb-13	Fatality	T121	GOEA (older subadult) feeding on lamb carcass 74 m from turbine
07-Feb-13	BUC	Site 3	Sheep carcass in area
07-Feb-13	Fatality	T120	Lamb carcass near--possible coyote kill
08-Feb-13	BUC	Site 3	Sheep carcass in area
11-Feb-13	Fatality	T140	Active gopher(?) burrows
12-Feb-13	Fatality	T125	Rabbit fur at base of fencepost
15-Feb-13	BUC	Site 1	RTHA eating unknown prey

Potential avian prey species frequently recorded during both the BUCs and fatality surveys included blackbirds, horned larks, meadowlarks, American pipits (*Anthus rubescens*), goldfinches, house finches, savannah sparrows, pigeons, and doves. Other potential avian prey species for raptors occasionally seen during both surveys included killdeer, Say's phoebe, Canada goose, and long-billed curlew (*Numenius americanus*). One bird species that was not recorded during the BUCs but was observed during one fatality survey in November was yellow-rumped warbler (*Dendroica coronata*; single flock of 22 birds), which occurs frequently in the general region especially during migration periods and winter.

The most common mammal prey species observed during the fatality surveys was the black-tailed jackrabbit (*Lepus californicus*), which the surveyor recorded on 32 occasions spanning most months of the year and including 10 turbine plots and the substation area (Table 12). Other crewmembers also frequently observed jackrabbits before first light when out placing bias trial specimens early in the morning. Jackrabbit sightings were most common in the central and south clusters in either mature or harvested grain-crop areas or fallow fields with at least moderate-height vegetation. Ground-squirrel burrow complexes occurred in several areas along untilled fencelines, such as near turbines 108, 109/110, 118, 125, 127, and 134. The surveyor noted other rodent burrows (e.g., probable gophers) near turbines 140 and along the fencelines near T125. The surveyor observed a live vole on only one occasion in July at T120, but he also noted a feral cat with a vole in its mouth on one occasion in June near T123, and found a dead vole cut in half by disking near T139 in May. Though not often seen, voles and mice almost certainly comprise important prey species in fallow-field and grassland areas for such raptors as northern harriers, white-tailed kites, American kestrels, Swainson's hawks, wintering rough-legged hawks (*Buteo lagopus*), burrowing owls, and barn owls.

Sightings of reptiles and amphibians in the project area were scarce and nonexistent, respectively. The primary surveyor discovered a northern Pacific rattlesnake (*Crotalus oreganus*) at T140 in July, and he observed gopher snakes on two occasions along roads serving turbines 128–130 in May (Table 12). He also noted gopher snakes on two occasions along Talbert Lane along the southern margin of the south cluster in May and June, and noted a red-tailed hawk feeding on a gopher snake in this area in October.

The primary surveyor only infrequently observed significant concentrations of insects known to comprise prey for some raptor species, such as kestrels, Swainson's hawks, and burrowing owls. This included only five distinct observations of relatively large numbers of grasshoppers (Orthoptera) and dragonflies (Odonata) during the fatality and roadside surveys between June and August in the central cluster (Table 12). Other insects occasionally seen on the turbine plots and taken by American kestrels and burrowing owls included Jerusalem cricket (*Stenopelmatus* spp.). On a few occasions, the surveyor noted high concentrations of other bugs that were clearly attracting foraging blackbirds and meadowlarks; however, one element of our BUC results—relatively low numbers of swallows and swifts (see discussion below)—also suggests that insects were not particularly prevalent during this survey year (Table 10).

During the spring lambing season but more importantly later in the year from July through the winter, sheep carcasses that resulted from "natural" deaths and coyote kills were commonly left out on the landscape near the turbines for extended periods, especially in the central portion of the central turbine cluster. These carcasses routinely attracted turkey vultures, golden eagles, red-tailed hawks, ravens, coyotes, and foxes. Cow carcasses also occasionally attracted these scavengers.

3.4.2 Carcass Scavengers

During 27% of the fatality surveys, the surveyor recorded observations of one or more potential carcass scavengers (Table 12). This included common ravens on 52 occasions (6% of the surveys), turkey vultures on 105 occasions (12%), and various raptors on 77 occasions (9%) scattered across all surveyed areas and times of year. The primary surveyor also noted coyotes or their sign on 10 occasions (1%) scattered across all turbine clusters between April and September, and foxes or their sign on at least 7 occasions (1%), including both red fox (*Vulpes vulpes*; mostly around the substation between August and October) and gray fox (*Urocyon cinereoargenteus*). The surveyor also noted feral cats on 11 occasions, mostly around the substation but also in the central cluster and scattered throughout the year, as well as evidence of American badger predation at a ground squirrel burrow complex near T118 in December. During the BUCs, the surveyor recorded one or more potential avian carcass scavengers on nearly every survey (one or more raptors or vultures on 398 of 411 surveys and ravens on 146 surveys). In contrast, records of non-avian scavengers seen during the BUCs were limited, but included feral cats on several occasions in the central cluster during summer and fall (Table 12). More generally, coyotes were always present across the project area; however, landowners or their shepherds frequently sought to remove coyotes with rifles, and their sheep dogs frequently kept the coyotes away from actively grazed areas. Summarized simply in terms of how many survey-specific records we accrued each month documenting the presence of one or more potential scavengers in the study area, there was a distinct increasing pattern through the year with a particularly high spike in July and August (Figure 9), which primarily corresponded to a distinct uptick in the overall activity rates of raptors, vultures, and ravens (Figure 8).

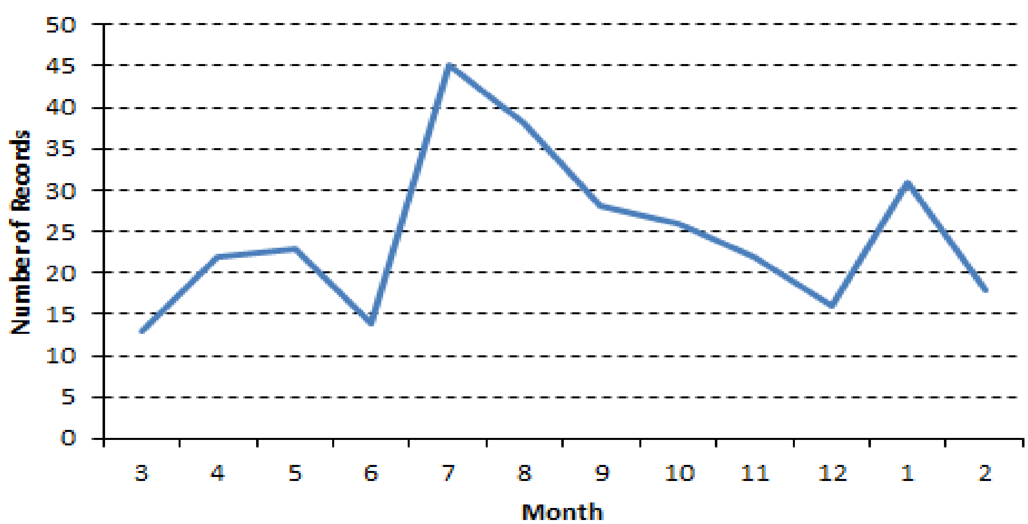

Figure 9. Frequency of Carcass-Scavenger Records by Month (March 2012 – February 2013)

Section 4.0 Discussion

4.1 Bird Use Counts

Our BUC results reflect similar patterns of species composition and relative abundance as most previous pre- and post-construction studies conducted in the MHWRA, including neighboring sites with survey areas that overlapped much of the Montezuma II project area (e.g., see ICF International [2010: Table 4] summarizing results from studies conducted since 2000 in the MHWRA; ICF International [2012] summarizing complete first-year data from the Montezuma I site, although not presented in comparable fashion; and Curry & Kerlinger [2011] summarizing the results of an initial site characterization study for the PG&E Collinsville project). The only novel observations from our study compared to previous MHWRA studies was the sighting at BUC Site 1 in February of two great-tailed grackles (*Quiscalus mexicanus*; a species that has been expanding its range northward from a core distribution area at more southerly latitudes) and a mute swan (*Cygnus olor*) seen flying near Site 4 in November (likely from a nearby domestic flock).

With regard to occurrence of raptor and special-status species, the only such species documented in the MHWRA during previous avian activity studies that we did not record during the course of our study (including a sighting of a short-eared owl outside of the BUCs) were osprey (*Pandion haliaetus*), red-shouldered hawk (*Buteo lineatus*), white pelican (*Pelecanus erythrorhynchos*), and black swift (*Cypseloides niger*). Pelicans were recorded during all other standardized assessments conducted from 2000–2008, at the Montezuma I site, and during the Collinsville site assessment, whereas black swifts were recorded during only a single study (3 sightings) through 2008 and then again during the Collinsville site assessment, and ospreys were recorded during only two studies (1 each) through 2008.

In terms of overall abundance, our estimate of 15,593 tricolored blackbird sightings (Table 10) is several orders of magnitude higher than recorded during any previous studies in the MHWRA (only 6–18 individuals confirmed during only three of the six studies summarized in ICF International [2010: Table 4] and none confirmed during the first-year Montezuma I study [ICF International 2012]). This discrepancy may largely reflect previous studies not distinguishing different blackbird species in large flocks (e.g., see Table 13); however, the distribution of tricolored blackbirds can be highly variably and ephemeral on a site-specific basis from year to year (Beedy 2008). Moreover, during the fall and winter season of our study, large flocks (100s to 1000s) of mostly tricolored blackbirds frequently occurred on the project site foraging in various fields, in addition to other large mixed-species flocks. Other raptor and special-status species for which our total sightings rank among the highest yet recorded include northern harrier and burrowing owl. For burrowing owls, however, this was due to frequent observations throughout the winter of a single owl at one count site. Other such species for which our total sightings rank moderate to high, depending on the site-to-site comparison, include American kestrel, Cooper's hawk, great horned owl, merlin, peregrine falcon, Swainson's hawk, and white-tailed kite. In contrast, our total sightings for ferruginous hawk (*Buteo regalis*), red-tailed

Table 13. Comparison of Bird Sightings per Hour Estimates from Several Pre- and Post-Construction Studies in the Montezuma Hills Wind Resource Area

Species	High Winds Pre-Con Aug 00 –Aug 01	High Winds Post-Con Aug 03 – Aug 04	High Winds Post-Con Aug 04 – Aug 05	Shiloh I Pre-Con Jan 04 – Dec 04	Shiloh III Pre-Con Apr 07 – Apr 08	Montezuma II Post-Con Mar 12 – Feb 13
American coot					0.036	
American crow	0.61	0.109	0.203	0.157	0.054	
American goldfinch	0.05				0.444	6.049
American kestrel	2.27	1.813	1.250	1.576	0.955	0.867
American pipit	3.77	7.813	2.094	1.060	1.021	4.092
American robin	0.02				0.003	
American white pelican	0.2	0.109	0.266	0.553	0.351	
American wigeon					0.024	0.029
Anna's hummingbird	0.01					
Ash-throated flycatcher					0.003	
Barn swallow	0.89	1.109	1.406	0.359	2.652	
Black phoebe	0.02			0.005	0.024	0.054
Black swift					0.009	
Black-necked stilt					0.024	
Brewer's blackbird	2.06	5.438	0.281	2.194	8.562	41.864
Burrowing owl		0.016	0.031	0.009	0.045	0.110
Canada goose	0.22	1.172	0.313	0.267	0.294	1.196
Chipping sparrow	0.22					
Chukar					0.006	
Cinnamon teal					0.009	
Cliff swallow	1.05	0.094	0.141	1.046	0.973	0.443
Cooper's hawk						0.010
Common raven	2.31	2.359	2.219	0.935	1.372	3.574
Dark-eyed junco				0.065	0.378	
Double-crested cormorant					0.006	0.058
European starling	0.39	2.406	0.531		5.225	5.830
Ferruginous hawk	0.03	0.016	0.016		0.054	0.010
Golden eagle	0.86	0.219	0.219	0.138	0.093	0.146
Golden-crowned sparrow		0.078				
Grasshopper sparrow			0.031			
Great blue heron		0.016			0.003	
Great egret	0.03	0.031		0.037	0.024	0.005
Great horned owl				0.018	0.036	0.044
Great-tailed grackle						0.010
Greater yellowlegs					0.012	
Herring gull					0.003	
Horned lark	8.29	2.250	2.078	1.834	5.114	7.989
House finch	0.27	0.047	0.047		0.264	6.443
House sparrow						0.015
Killdeer	0.72	0.516	0.219	0.788	0.820	0.727
Lark sparrow					0.006	
Lesser goldfinch					0.120	

Species	High Winds Pre-Con Aug 00 –Aug 01	High Winds Post-Con Aug 03 – Aug 04	High Winds Post-Con Aug 04 – Aug 05	Shiloh I Pre-Con Jan 04 – Dec 04	Shiloh III Pre-Con Apr 07 – Apr 08	Montezuma II Post-Con Mar 12 – Feb 13
Lesser scaup					0.030	
Lesser yellowlegs	0.01					
Lincoln's sparrow					0.030	
Loggerhead shrike	0.43	0.500	0.281	0.770	0.661	0.431
Long-billed curlew	0.42				6.369	0.175
Long-billed dowitcher						0.092
Mallard	0.05	0.047	0.109	0.138	0.477	
Merlin		0.016		0.005	0.003	0.024
Mourning dove	0.59	0.844	0.438	0.161	2.360	1.788
Mute swan						0.005
Northern flicker	0.07			0.069	0.087	0.005
Northern harrier	0.52	0.813	0.500	0.848	0.249	1.075
Northern mockingbird	0.11	0.047	0.031	0.005	0.033	
Northern rough-winged swallow		0.016				
Osprey				0.005	0.003	
Peregrine falcon					0.003	0.005
Prairie falcon	0.03			0.051	0.048	0.024
Red-shouldered hawk				0.009		
Red-tailed hawk	2.34	6.094	2.000	3.175	1.658	1.884
Red-winged blackbird	2.37	55.188	11.188	5.479	6.240	45.398
Ring-necked pheasant	0.04	0.016		0.037	0.033	0.024
Rock pigeon	1.24	3.453	3.859	0.521	2.048	10.055
Rough-legged hawk	0.29			0.018	0.072	0.039
Savannah sparrow	0.05	0.344	0.109	0.323	2.997	9.153
Say's phoebe	0.12		0.078	0.060	0.096	0.083
Short-eared owl	0.01					
Snow goose				0.461	0.763	
Snowy egret	0.03					
Song sparrow	0.07				0.003	0.005
Swainson's hawk	0.01	0.016		0.124	0.099	0.117
Tree swallow	0.04	0.203	0.438	0.046	0.438	0.562
Tricolored blackbird	0.05			0.028	0.018	141.120
Tundra swan						0.030
Turkey vulture	5.44	3.953	3.625	3.940	3.601	4.634
Varied thrush					0.003	
Violet-green swallow	0.16	0.359				0.015
Western gull					0.003	
Western kingbird	0.07	0.047	0.109		0.069	0.010
Western meadowlark	3.60	3.063	1.703	2.447	10.604	9.085
Western scrub-jay	0.29				0.003	
Whimbrel	0.07					
White-crowned sparrow	0.14		0.016		0.420	0.112
White-faced ibis						0.019
White-tailed kite	0.01	0.266	0.219	0.419	0.018	0.146

Species	High Winds Pre-Con Aug 00 –Aug 01	High Winds Post-Con Aug 03 – Aug 04	High Winds Post-Con Aug 04 – Aug 05	Shiloh I Pre-Con Jan 04 – Dec 04	Shiloh III Pre-Con Apr 07 – Apr 08	Montezuma II Post-Con Mar 12 – Feb 13
White-throated swift		0.047				0.229
Yellow-billed magpie		0.016			0.009	
Yellow-rumped warbler					0.114	
Mixed blackbirds	344.21	855.703	347.516	52.696	56.444	0.501
Unidentified corvid		0.125				
Unidentified duck		0.406				0.397
Unidentified gull		0.016	0.031	0.005	0.258	0.910
Unidentified hawk	0.63	0.516	0.094	0.005		0.039
Unidentified hummingbird			0.016		0.003	
Unidentified songbird		0.656				
Unidentified sparrow		0.016			0.300	0.019
Unidentified swallow		2.469	1.422		0.550	
Total	**389.23**	**960.86**	**385.13**	**52.89**	**126.24**	**307.78**

hawk, rough-legged hawk, and prairie falcon (*Falco mexicanus*) rank more on the low to moderate side. For golden eagle, our tally of 30 BUC sightings ranks average to above average compared to most other previous assessments in the MHWRA that lasted at least 1 year. This includes the 2-year post-construction study at the neighboring High Winds site (28 sightings), conducted from 2003–2005 when the nearby Callahan nesting territory was active (fledged in 2004, failed in 2005) and when 2 golden eagle fatalities were documented in the area (Kerlinger et al. 2006). That said, all subsequent sighting tallies pale in comparison to the 283 total golden eagle sightings recorded during the 1-year High Winds pre-construction study conducted in 2000–2001 (Kerlinger et al. 2006, ICF International 2010).

It is important to note that much of the sometimes-considerable variation in total-sightings 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 sightings 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 MWHRA avian use studies, all have utilized similar 800-m-radius survey plots, so translating raw counts simply to estimates of average sightings per hour works well for within-area comparisons (e.g., as done in Kerlinger et al. 2009, Curry and Kerlinger 2011).

Excluding a few observations other than those already mentioned that are relatively rare for MHWRA studies but not in the region (i.e., long-billed dowitcher *Limnodromus scolopaceus*, tundra swan *Cygnus columbianus*, white-faced ibis *Plegadis chihi*, Cooper's hawk, and double-crested cormorant *Phalacrocorax auritus*), our first-year results showed activity rates that were ≥50% above average for 22 species: American goldfinch, black phoebe (*Sayornis nigricans*), Brewer's blackbird, burrowing owl, Canada goose, common raven, European starling, great horned owl, horned lark, house finch, merlin, mourning dove, northern harrier, peregrine falcon, red-winged blackbird, rock pigeon, savannah sparrow, Swainson's hawk, tree swallow, tricolored blackbird, western meadowlark, and white-throated swift (Table 13). Conversely, our survey data showed sighting rates that were ≥50% below average for nine species that are commonly seen in the MHWRA: ferruginous hawk, golden eagle, great egret (*Ardea alba*), long-billed curlew, northern flicker, rough-legged hawk, song sparrow, violet-green swallow, and western kingbird (*Tyrannus verticalis*). The activity rates of American kestrels and red-tailed hawks, two of the most common fatalities in the MHWRA, also were noticeably below average compared to the previous studies (45% and 38%, respectively). Climatic conditions may have contributed to the relatively low activity rates for these and other species during our study. Much of the region experienced the driest winter on record in 2012/2013, preceded by an exceptionally warm summer, which contributed to poor landscape conditions during much of our survey period.

Due to the aforementioned misunderstanding about classifying flight heights, our first-year BUC results do not accurately reflect the full spectrum of variation in potential risk of exposure to turbine collisions. This is because the data do not clearly differentiate flights that remained below the rotor-swept zone. We have since rectified this misunderstanding and data collected during Years 2 and 3 will afford a more robust opportunity to evaluate whether or not there appears to be a correlation between fatality rates and the flight-height characteristics of different species and species groups.

4.2 Bias Trials

4.2.1 Searcher Efficiency

One aspect that influences modeling of searcher efficiency is the concept of "bleed through" (Warren-Hicks et al. 2013). This pertains to assumptions about whether or not a given carcass that is missed during the first standard survey after it is deposited on a plot is available for detection during subsequent surveys (Strickland et al. 2011). Some approaches to estimating searcher efficiency theoretically give searchers multiple opportunities to discover a specimen, by leaving missed trial specimens in place potentially to be discovered during a subsequent survey. Our trial protocol did not specifically accommodate this possibility. The Huso (2011) estimator also assumes no bleed through. That is, if a given carcass is missed during the first survey after it is deposited, the estimator assumes the carcass is not available to be detected during a subsequent survey, in theory due to factors such as carcass removal by scavengers and/or decay that quickly reduces carcass detectability to negligible. In contrast, the Schoenfeld (2004) estimator, for example, incorporates the concept of bleed through by allowing for the possibility of surveyors finding carcasses on a subsequent survey after missing them during the first survey; however, this estimator model also assumes that the detection rate for a given carcass remains constant over time, which generally is not the case (Smallwood 2007).

In our assessments, we did not seek to formally evaluate the applicability of bleed through; however, our survey results suggest it is was at most a minor factor in this study. We noted previously that we began by having the standard surveyor attempt to recover bias-trial carcasses he had missed, and that resulted in a very low recovery rate (7%) compared to having the person who placed the carcasses retrieve them (84%

recovered). Although this resulted in greater uncertainty about the degree to which rapid carcass removal may have precluded the surveyor finding some trial carcasses, in effect it comprised an evaluation of the applicability of bleed through to our investigations and modeling. The surveyor never found any of the 51 missed and unrecovered carcasses left on the survey plot (but he did subsequently find a red-tailed hawk and an American kestrel several days later outside of the plots where they had been placed; Appendix A). This suggested that bleed through was not an important factor in this study, at least with regard to the probability of detection; however, additional evidence derived from the carcass surveys and persistence trials confirmed the possibility of bleed through and delayed detections.

We classified 4 of 24 (17%) non-clearance fatalities discovered during the standard surveys as >1 week old; however, only one of these carcasses clearly had been in place for more than 1–2 weeks in a "natural" situation. Two other cases involved heavily scavenged bird carcasses for which we could not be sure how long they had been there. The fourth was a turkey vulture carcass that appeared to have been purposefully buried under a dense pile of cut wheat stalks and was not readily detectable until decay had proceeded to a "ripe" level. Thus, the fatality data indicated that at least one case of "natural" bleed through did occur and resulted in a delayed detection. Our carcass-persistence trial data also confirmed that bleed through and delayed detections were at least possible, with 33% of bats, 40% of small birds, 50% of medium birds, and 65% of large birds persisting beyond a week.

As expected (e.g., see Warren-Hicks et al. 2013), our searcher-efficiency estimation model demonstrated a strong dependence on both habitat visibility classes and carcass type/size. Unexpected, however, was the lack of difference in searcher-efficiency estimates for the high and medium visibility classes for all three taxon/size classes (bats, small birds, and larger birds). This suggested that discovery of carcasses in low to moderate cover/complexity habitats was mostly a function of random chance rather than variation in habitat characteristics, whereas a change to high habitat cover/complexity clearly resulted in a substantial decline in the probability of detection for all carcass type/size classes.

We also considered how we classified visibility as another possible explanation for the apparent lack of difference in searcher efficiency in high and medium visibility habitats. Specifically, we sought to determine if classifying visibility based on habitat cover in the immediate vicinity of the trial carcass (scale of a several square meters) versus at the whole-plot level might have affected the outcome of the searcher-efficiency calculations. We supposed that taking into account the larger-scale search area characteristics might better reflect the perception of the surveyor in searching over relatively broad areas (5–10-m swaths). Changing the visibility classifications to plot-level values shifted 16–36% (depending on the taxon/size class) of the trial specimens into the low visibility class, with the shift affecting larger portions of the specimens previously classified as high-visibility as opposed to medium-visibility samples. For this reason, the reclassification mostly had the effect of increasing the overall searcher efficiency estimates (simple rather than modeled estimates) for the low visibility class, in some cases (bats and large birds) rendering the new low-visibility estimates higher than for the high and/or medium visibility classes. The only taxon/size-class group for which the reclassification resulted in an expected change in the searcher efficiency estimates for the high and medium visibility classes was for large birds, where the high visibility estimate changed to 100% (from 78%) and the medium visibility estimate essentially remained the same at 80% (previously 83%; Table 6). For bats, small birds, and medium birds, there remained no substantive difference in the estimates for the high and medium visibility classes. Accordingly, we conclude that the lack of difference in searcher-efficiency estimates for the high and medium visibility classes reflects the reality experienced during this survey year, and is not an artifact of our visibility classification scheme.

4.2.2 Carcass Persistence

Our estimates of carcass persistence are similar to those from previous MHWRA studies. As recently summarized by Point Impact Analysis (2012), the year-specific estimates from four previous studies (Shiloh I, Shiloh II, Solano Wind, and Montezuma I) ranged from 0.60–0.79 for small birds, 0.38–0.71 for bats, 0.42–0.97 for small birds and bats combined (Montezuma I), 0.43–0.94 for large and medium birds considered separately (Shiloh I and Solano Wind), and 0.73–1.00 for larger birds combined (Shiloh II and Montezuma I). Of these studies, only the Montezuma I study produced season-specific estimates of carcass persistence, which showed 97% persistence in summer and 42% in winter for small birds, and essentially no variation between the two seasons for larger birds (100% and 97%). Our results differed in showing much lower persistence for larger birds in fall and winter than in spring and summer, and comparatively little difference among the seasons for small birds and bats. Again we emphasize that this difference may be partly attributable to variation in the species of large and medium birds we used for the trials in different seasons, and to variation in the average persistence of different species groups; i.e., typically longer for large raptors (3, 4, 2, and 1 placed by quarterly season) and shorter for waterfowl, pheasants, and doves/pigeons (3, 1, 3, 3 placed by season). Nevertheless, as suggested by the relatively high fatality rates for vultures during the fall, likely due to the proliferation of sheep carcasses at that time, there is also reason to believe that scavenger activity increased later in the year due to poor habitat conditions (discussed further below).

4.3 Adjusted Fatality Estimates

Our overall, all-bird, adjusted annual fatality estimate of 1.97 birds per MW falls well within the range of estimates from previous MWHRA studies conducted since 2003 (Table 14). Our estimate is less than a third of the three-year average for the Shiloh I project, and is less than half the estimate from the first year of the Montezuma I study. Our estimate is more similar to the two-year averages from the neighboring High Winds project and the more recent Shiloh II study. In contrast, our estimate is more than six times higher than for the 22-month Solano Wind (SMUD) project.

The most noteworthy result from this year's post-construction monitoring was the number of documented turkey vulture fatalities (eight total including incidentals). During 2–3 years of post-construction monitoring at the High Winds, Shiloh I, and Shiloh II project sites, which occurred at various times from 2004–2010, only seven vulture fatalities were documented (one clearance carcass and six found during standard surveys, two at each site; Kerlinger et al. 2006, 2010, 2012). In contrast, the first year of monitoring at the Montezuma

Table 14. Adjusted Fatality Rates (Birds Killed per MW per Year) for All Birds Combined from Recent Monitoring Studies in the Montezuma Hills Wind Resource Area

	High Winds 2003–2005	Shiloh I 2006–2009	Shiloh II 2009–2011	Solano Wind 2008–2010	Montezuma I 2011	Montezuma II 2012/2013
Year 1	1.62	11.97	1.51	0.34	5.19	1.97
Year 2	1.10	8.60	2.39		–	–
Year 3	–	2.82	–	–	–	–
Average	1.36	6.96	1.95	–	–	–

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

I site in 2011 yielded five vulture fatalities (two incidentals and three during standard surveys; ICF International 2012). 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 fall and winter 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 hungry coyotes, while also increasing the scavenging draw for hungry vultures as well as other raptors and ravens. Our observations suggested that part of the reason for the particularly noteworthy concentration of sheep carcasses in the west-central portion of the central cluster compared to other areas related to variation in grazing intensity and coyote control. For this reason, we do not believe that any particular characteristics of the central turbines and their locations are of concern. Instead, we believe that better coordination with the landowners to ensure livestock carcasses are not allowed to remain on the landscape within the MHWRA is the solution of interest. In response to the high vulture fatality rate and this 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. Henceforth, consultant and NextEra field personnel will routinely and immediately report any dead livestock to the facility field manager, who in turn will inform the relevant landowner to arrange for the carcass to be removed or buried as quickly as possible.

Besides the high incidence of vulture fatalities in the central cluster around T127 and T128, we also documented a disproportionately high number of other fatalities at T128 (6 during standard surveys). Including incidents recorded during standard surveys and incidentally, we recorded no more than three fatalities at any other individual turbine. The species involved at T128 covered a broad range of taxa, including a bat, a kestrel, an owl, a grebe, a dove, and a blackbird. This does then raise the question of whether there might be some aspect of the T128 location that tends to disproportionately concentrate general bird and bat flight activity, or other problematic behavioral patterns, within the rotor swept zone? In this regard we note that, although trauma evidence confirmed that the hoary bat, western grebe, and barn owl fatalities clearly resulted from blade strikes, all we found of the kestrel, dove, and blackbird was a portion of a wing. Although not clear evidence of predation, as opposed to scavenging following a blade-strike fatality, these three fatalities all occurred during the fall and winter when one or more prairie falcons, peregrine falcons, and merlins (all at least opportunistic bird hunters) hunted in the area on a regular basis. The combination of perennially uncultivated drainages immediately east and north of T128 and the T127–T129 portion of the central cluster having remained fallow throughout 2012 and early 2013 may have led to this area being particularly attractive foraging habitat for these falcons. Although our observations did not provide clear evidence of it, such habitat characteristics also may have concentrated other predators/scavengers such as coyotes, foxes, and feral cats. Otherwise, additional years and repeated seasons of fatality and avian activity monitoring, combined with detailed analyses of bird, bat, and predator/scavenger activity patterns, will be required to carefully evaluate whether the particular location of T128 contributes to a disproportionately high turbine-caused fatality rate.

4.4 Comparing Bird Activity and Fatality Rates

Our bird activity data showed moderate overall activity rates for raptors as a group in the central cluster where the vulture fatality rate was highest; however, during the fall when all of the vulture fatalities occurred in this area, the BUC vulture activity rate was not particularly high there (Figure 10). Accordingly, the overall vulture activity rate appeared not to be the primary determinant of risk. Instead, it appeared that the particular concentration of sheep carcasses in the area in close proximity to several turbines created an atypically dangerous situation for the vultures. At one point, we noted as many as 10 sheep carcasses simultaneously distributed within <200–300 m of several turbines in the central cluster.

All five of the documented kestrel fatalities occurred during winter, particularly late winter, and occurred in either the central section (3) or the north section (2) (Figure 10). In this case, although the fatalities did not occur in seasons with the overall highest activity rates, the BUC data consistently showed more activity for kestrels in the north and west-central sections where all of the fatalities occurred (Figure 10). In contrast, for red-tailed hawks and northern harriers, there was no clear correspondence between the distribution of fatality incidents and the activity rates among sites and seasons (Figure 10). Combining data for all raptors also did not suggest any stronger correlation between overall activity rates and the distribution of raptor fatalities among the three turbine clusters, as was also the case for waterbirds as a group (Figure 10). We submit, though, that the low total numbers of fatalities for all groups, even with incidentals included, renders it difficult to draw any definitive species-specific conclusions about such relationships.

Figure 10. Bird Sighting Rates and Fatality Locations by Turbine Cluster and Season

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Appendix A. Searcher-Efficiency Bias Trial Specimens

Specimen[1]	Date	Place Time	Turbine	Distance (m)	Bearing (°)[2]	UTM E	UTM N	Species	Size Class	Placement Substrate	Visibility Class[3]	Detected?	Recovered?
T1R1-001	3/28/2012	4:59	137	3	359	601717	4217591	Little brown bat	Small	Gravel pad	1 / 2	N	Y
T1R1-002	3/28/2012	4:59	137	13	132	601701	4217585	American robin	Small	Fallow - new	1 / 2	Y	Y
T1R1-003	3/28/2012	5:21	134	2	67	601537	4218228	Mexican free-tailed bat	Small	Gravel pad	1 / 3	N	N
T1R1-004	3/28/2012	5:21	134	100	194	601512	4218194	Barn owl	Medium	Fallow - new	1 / 3	Y	Y
T1R1-005	3/28/2012	6:02	108	32	110	602969	4221263	Mexican free-tailed bat	Small	Fallow - new	1 / 2	N	Y
T1R1-006	3/28/2012	6:02	108	21	80	602964	4221292	Western red bat	Small	Fallow - new	1 / 2	N	N
T1R1-007	3/28/2012	6:02	108	91	235	602905	4221266	Red-tailed hawk	Large	Fallow - new	1 / 2	N	N[4]
T1R1-008	3/28/2012	6:13	107	33	272	602756	4221475	Mexican free-tailed bat	Small	Fallow - new	1 / 2	N	N
T1R1-009	3/28/2012	6:13	107	23	285	602755	4221492	White-crowned sparrow	Small	Fallow - new	1 / 2	Y	Y
T1R1-010	3/28/2012	6:26	112	21	9	603552	4220563	Hoary bat	Small	Plowed - coarse	2 / 2	N	N
T1R1-011	3/28/2012	6:26	112	19	219	603529	4220526	Western tanager	Small	Plowed - coarse	2 / 2	Y	Y
T1R2-012	4/3/2012	6:42	121	78	196	604814	4219476	Myotis spp.	Small	Crop - med	3 / 3	N	N
T1R2-013	4/3/2012	6:42	121	61	194	604818	4219490	European starling	Small	Crop - med	3 / 3	N	N
T1R2-014	4/3/2012	6:51	123	100	24	605290	4219374	Hoary bat	Small	Crop - med	3 / 3	N	N
T1R2-015	4/3/2012	6:51	123	43	64	605279	4219289	Red-shouldered hawk	Large	Crop - med	3 / 3	N	N
T1R2-016	4/3/2012	7:05	125	41	16	604699	4219170	Mexican free-tailed bat	Small	Crop - med	3 / 3	N	N
T1R2-017	4/3/2012	7:05	125	52	151	604728	4219082	White-crowned sparrow	Small	Crop - med	3 / 3	N	N
T1R2-018	4/3/2012	6:08	139	26	174	604691	4219094	Mexican free-tailed bat	Small	Fallow - new	1 / 2	N	N
T1R2-019	4/3/2012	6:08	139	14	273	600801	4217948	California myotis	Small	Fallow - new	1 / 2	N	N
T1R2-020	4/3/2012	6:08	139	2	192	600810	4217947	Mourning dove	Medium	Gravel pad	1 / 2	Y	Y
T1R3-021	4/9/2012	6:33	115	42	291	603523	4221665	Pallid bat	Small	Fallow - low	2 / 2	Y	Y
T1R3-022	4/9/2012	6:33	115	61	57	603604	4221664	Canyon bat	Small	Fallow - low	2 / 2	N	N
T1R3-023	4/9/2012	6:33	115	102	104	603641	4221593	American kestrel	Medium	Fallow - low	2 / 2	N	N[5]
T1R3-024	4/9/2012	6:58	117	54	132	603594	4221095	Myotis spp.	Small	Fallow - low	2 / 2	N	N
T1R3-025	4/9/2012	6:58	117	5	315	603643	4221065	Red-tailed hawk	Large	Gravel pad	1 / 2	Y	Y
T1R3-026	4/9/2012	6:48	118	45	290	603772	4220862	Dark-eyed junco	Small	Fallow - low	2 / 3	Y	Y
T1R3-027	4/9/2012	6:48	118	19	104	603835	4220846	Great horned owl	Large	Fallow - low	2 / 3	Y	Y

Specimen[1]	Date	Place Time	Turbine	Distance (m)	Bearing (°)[2]	UTM E	UTM N	Species	Size Class	Placement Substrate	Visibility Class[3]	Detected?	Recovered?
T1R3-028	4/9/2012	8:12	132	8	336	601967	4218281	Mexican free-tailed bat	Small	Gravel pad	1 / 2	N	N
T1R3-029	4/9/2012	8:12	132	2	194	601977	4218269	Myotis spp.	Small	Gravel pad	1 / 2	Y	Y
T1R3-030	4/9/2012	8:12	132	55	120	602016	4218234	California quail	Medium	Fallow - low	2 / 2	Y	Y
T1R3-031	4/9/2012	7:29	140	20	305	600875	4217597	Western red bat	Small	Fallow - low	2 / 3	N	N
T1R3-032	4/9/2012	7:29	140	18	264	600878	4217578	Burrowing owl	Medium	Crop - med	3 / 3	N	N
T1R4-033	4/12/2012	6:59	120	16	305	604714	4219748	California myotis	Small	Gravel road	1 / 3	N	N
T1R4-034	4/12/2012	6:59	120	37	93	604771	4219758	California towhee	Small	Crop - med	3 / 3	N	N
T1R4-035	4/12/2012	6:59	120	19	215	604720	4219730	Red-tailed hawk	Large	Crop - med	3 / 3	Y	Y
T1R4-036	4/12/2012	6:27	128	2	359	604274	4219707	Little brown bat	Small	Gravel pad	1 / 3	N	N
T1R4-037	4/12/2012	6:27	128	29	311	604240	4219701	Ring-billed gull	Large	Fallow - med	3 / 3	Y	Y
T1R4-038	4/12/2012	5:45	131	100	44	603605	4219493	Mourning dove	Medium	Crop - med	3 / 3	N	N
T1R4-039	4/12/2012	5:45	131	97	275	603507	4219403	American robin	Small	Crop - med	3 / 3	N	N
T1R4-040	4/12/2012	5:45	131	36	302	603566	4219409	Mexican free-tailed bat	Small	Gravel road	1 / 3	N	N
T2R1-001	6/27/2012	5:13	107	16	195	602759	4221461	Mexican free-tailed bat	Small	Fallow - low	2 / 3	Y	Y
T2R1-002	6/27/2012	5:13	107	70	229	602722	4221502	Western scrub-jay	Small	Fallow - low	2 / 3	Y	Y
T2R1-003	6/27/2012	5:35	108	15	357	602959	4221290	Little brown bat	Small	Fallow - low	2 / 3	Y	Y
T2R1-004	6/27/2012	5:35	108	53	96	602956	4221438	Red-tailed hawk	Large	Fallow - low	2 / 3	Y	Y
T2R1-005	6/27/2012	6:00	112	19	202	603517	4220543	Mexican free-tailed bat	Small	Plowed - coarse	2 / 2	N	N
T2R1-006	6/27/2012	7:10	134	12	80	601542	4218242	Pallid bat	Small	Plowed - coarse	2 / 2	N	N
T2R1-007	6/27/2012	6:28	137	52	359	601724	4217642	Myotis spp.	Small	Fallow - low	2 / 3	Y	Y
T2R1-008	6/27/2012	6:28	137	98	238	601614	4217610	Hermit thrush	Small	Fallow - low	2 / 3	Y	Y
T2R2-009	7/2/2012	5:10	115	82	281	603462	4221622	Mexican free-tailed bat	Small	Plowed - fine	1 / 1	N	N
T2R2-010	7/2/2012	5:10	115	7	94	603556	4221636	Horned lark	Small	Plowed - fine	1 / 1	Y	Y
T2R2-011	7/2/2012	5:29	117	38	203	603581	4221062	Pallid bat	Small	Plowed - coarse	2 / 1	N	N
T2R2-012	7/2/2012	5:42	118	52	325	603801	4220897	Cooper's hawk	Medium	Plowed - coarse	2 / 2	Y	Y
T2R2-013	7/2/2012	6:20	132	92	100	602065	4218247	Big brown bat	Small	Fallow - low	2 / 3	Y	Y
T2R2-014	7/2/2012	6:20	132	37	255	601944	4218261	Fox sparrow	Small	Fallow - low	2 / 3	N	N
T2R2-015	7/2/2012	6:52	140	93	208	600832	4217527	Green heron	Medium	Fallow - high	3 / 3	N	N
T2R3-016	7/6/2012	5:15	131	61	159	603644	4219343	Mexican free-tailed bat	Small	Crop - harvested	2 / 2	N	N
T2R3-017	7/6/2012	5:15	131	48	53	603660	4219416	Swainson's thrush	Small	Crop - harvested	2 / 2	Y	Y
T2R3-018	7/6/2012	5:40	120	32	348	604725	4219784	Myotis spp.	Small	Crop - high	3 / 3	N	N

Specimen[1]	Date	Place Time	Turbine	Distance (m)	Bearing (°)[2]	UTM E	UTM N	Species	Size Class	Placement Substrate	Visibility Class[3]	Detected?	Recovered?
T2R3-019	7/6/2012	5:40	120	62	173	604756	4219695	Red-tailed hawk	Large	Crop - high	3 / 3	Y	Y
T2R3-020	7/6/2012	6:10	128	21	79	604297	4219705	Mexican free-tailed bat	Small	Fallow - low/bare	2 / 3	N	N
T2R3-021	7/6/2012	6:10	128	26	182	604277	4219673	Western red bat	Small	Fallow - low/bare	2 / 3	Y	Y
T2R3-022	7/6/2012	6:10	128	56	328	604249	4219748	Rock pigeon	Medium	Fallow - low/bare	2 / 3	Y	Y[6]
T2R4-023	7/11/2012	6:25	134	46	281	601489	4218242	Yellow-billed magpie	Medium	Plowed - coarse	2 / 2	Y	Y
T2R4-024	7/11/2012	6:50	137	52	212	601685	4217554	Big brown bat	Small	Fallow - low	2 / 3	N	N
T2R4-025	7/11/2012	5:31	107	41	140	602803	4221422	Myotis spp.	Small	Fallow - med	3 / 2	Y	Y
T2R4-026	7/11/2012	5:50	108	78	162	602950	4221212	White-breasted nuthatch	Small	Fallow - med	3 / 3	Y	Y[7]
T2R5-027	7/17/2012	5:10	121	44	357	604838	4219596	Mexican free-tailed bat	Small	Crop - harvested	2 / 3	N	N
T2R5-028	7/17/2012	5:10	121	41	30	604869	4219581	Great horned owl	Large	Crop - harvested	2 / 3	Y	Y
T2R5-029	7/17/2012	5:19	123	22	182	605230	4219267	Western red bat	Small	Crop - high	3 / 3	N	N
T2R5-030	7/17/2012	5:19	123	5	283	605224	4219284	European starling	Small	Gravel pad	1 / 3	Y	Y
T2R5-031	7/17/2012	5:45	125	72	132	604738	4219070	Mexican free-tailed bat	Small	Crop - high	3 / 3	N	N
T2R5-032	7/17/2012	5:45	125	52	155	604720	4219075	House finch	Small	Gravel pad	1 / 3	N	N
T2R5-033	7/17/2012	5:45	125	22	356	604695	4219146	Northern flicker	Medium	Crop - high	3 / 3	N	N
T2R5-034	7/17/2012	6:25	139	82	92	600894	4217963	Pipistrelle spp.	Small	Plowed - coarse	2 / 2	N	N
T2R5-035	7/17/2012	6:25	139	5	337	600808	4217961	Western tanager	Small	Plowed - coarse	2 / 2	Y	Y
T2R6-036	7/23/2012	5:30	115	83	198	603520	4221550	American coot	Medium	Plowed - med	1 / 1	N	N[8]
T2R6-037	7/23/2012	6:00	118	4	43	603821	4220853	Mexican free-tailed bat	Small	Gravel pad	1 / 2	Y	Y
T2R6-038	7/23/2012	6:27	140	61	292	600841	4217615	Mexican free-tailed bat	Small	Crop - high	3 / 3	N	Y
T2R6-039	7/23/2012	6:45	132	31	182	601977	4218242	Sharp-shinned hawk	Medium	Fallow - low	2 / 3	Y	Y
T2R6-040	7/23/2012	6:15	117	40	235	603571	4221072	Cedar waxwing	Small	Plowed - med	1 / 1	N	N
T3R1-041	9/11/2012	5:39	121	35	106	604874	4219539	Big brown bat	Small	Crop - harvested	2 / 2	N	N
T3R1-042	9/11/2012	5:39	121	3	345	604833	4219558	European starling	Small	Gravel pad	1 / 2	Y	Y
T3R1-043	9/11/2012	6:10	123	61	168	605215	4219239	Western red bat	Small	Crop - harvested	2 / 2	N	N
T3R1-044	9/11/2012	6:10	123	90	125	605298	4219201	White-breasted nuthatch	Small	Crop - harvested	2 / 2	Y	Y
T3R1-045	9/11/2012	6:33	125	2	130	604694	4219117	Myotis spp.	Small	Gravel pad	1 / 3	Y	Y
T3R1-046	9/11/2012	6:33	125	32	165	604704	4219084	Red-tailed hawk	Large	Crop - harvested	2 / 3	Y	Y
T3R1-047	9/11/2012	7:01	139	4	236	600805	4217950	Mexican free-tailed bat	Small	Gravel pad	1 / 1	N	N
T3R1-048	9/11/2012	7:01	139	28	118	600831	4217933	Sharp-shinned hawk	Medium	Plowed - med	1 / 1	Y	Y
T3R2-049	9/19/2012	5:17	107	45	68	602820	4221458	Little brown bat	Small	Fallow - low	2 / 3	Y	Y

Specimen[1]	Date	Place Time	Turbine	Distance (m)	Bearing (°)[2]	UTM E	UTM N	Species	Size Class	Placement Substrate	Visibility Class[3]	Detected?	Recovered?
T3R2-050	9/19/2012	5:17	107	5	151	602783	4221446	Golden-crowned sparrow	Small	Fallow - low	2 / 3	Y	Y
T3R2-051	9/19/2012	5:30	108	64	355	602919	4221351	House finch	Small	Fallow - low	2 / 2	N	N
T3R2-052	9/19/2012	5:30	108	67	185	602901	4221247	American kestrel	Medium	Fallow - low	2 / 2	Y	Y
T3R2-053	9/19/2012	5:52	112	28	82	603568	4220539	Mexican free-tailed bat	Small	Plowed - fine	1 / 1	N	N
T3R2-054	9/19/2012	5:52	112	9	113	603551	4220531	American robin	Small	Plowed - fine	1 / 1	N	N
T3R2-055	9/19/2012	6:30	134	6	120	601539	4218219	Mexican free-tailed bat	Small	Gravel pad/road	1 / 1	Y	Y
T3R2-056	9/19/2012	6:30	134	49	143	601561	4218189	Northern mockingbird	Small	Plowed - med	1 / 1	Y	Y
T3R2-057	9/19/2012	7:22	137	3	266	601705	4217593	California myotis	Small	Gravel pad/road	1 / 2	Y	Y
T3R2-058	9/19/2012	7:22	137	33	288	601678	4217605	Turkey vulture	Large	Fallow - low	2 / 2	Y	Y
T3R3-059	9/24/2012	5:39	117	48	50	603647	4221120	Mexican free-tailed bat	Small	Plowed - fine	1 / 1	N	N
T3R3-060	9/24/2012	5:54	118	25	62	603848	4220859	California myotis	Small	Plowed - fine	1 / 2	N	Y
T3R3-061	9/24/2012	6:06	115	23	14	603548	4221654	Mourning dove	Medium	Plowed - fine	1 / 1	Y	Y
T3R3-062	9/24/2012	6:06	115	28	277	603517	4221638	Mexican free-tailed bat	Small	Plowed - fine	1 / 1	N	N
T3R3-063	9/24/2012	6:30	132	72	227	601922	4218227	Mexican free-tailed bat	Small	Fallow - med	3 / 2	N	N
T3R3-064	9/24/2012	6:42	140	15	121	600908	4217567	Mexican free-tailed bat	Small	Crop - harvested	2 / 2	Y	Y
T3R3-065	9/24/2012	6:42	140	7	85	600907	4217568	Myotis spp.	Small	Crop - harvested	2 / 2	Y	Y
T3R4-066	9/27/2012	6:25	120	26	182	603547	4219346	Poorwill	Small	Crop - harvested/flat	2 / 2	N	Y
T3R4-067	9/27/2012	6:42	128	50	344	604277	4219761	Hoary bat	Small	Fallow - med	3 / 2	N	Y
T3R4-068	9/27/2012	6:50	131	83	222	604722	4219728	Band-tailed pigeon	Medium	Crop - harvested	2 / 3	N	Y
T3R5-069	10/4/2012	5:31	131	17	32	603630	4219411	Hoary bat	Small	Crop - harvested	2 / 3	N	Y
T3R5-070	10/4/2012	5:35	131	42	89	603661	4219394	Myotis spp.	Small	Crop - harvested	2 / 3	Y	Y
T3R5-071	10/4/2012	6:10	128	85	332	604238	4219775	Red-tailed hawk	Large	Fallow - med	3 / 2	Y	Y[9]
T3R5-072	10/4/2012	6:15	128	22	209	604260	4219681	Mexican free-tailed bat	Small	Fallow - low	2 / 2	N	N
T3R5-073	10/4/2012	6:55	120	52	205	604713	4219705	Band-tailed pigeon	Medium	Crop - harvested	2 / 3	Y	Y
T3R6-074	10/8/2012	6:05	115	11	155	603548	4221619	Little brown bat	Small	Plowed - fine	1 / 1	N	Y
T3R6-075	10/8/2012	6:08	115	38	283	603508	4221639	European starling	Small	Plowed - fine	1 / 1	N	Y
T3R6-076	10/8/2012	6:18	117	16	316	603594	4221112	Ring-billed gull	Large	Plowed - fine	1 / 1	Y	Y
T3R6-077	10/8/2012	6:33	118	42	304	603787	4220881	Mexican free-tailed bat	Small	Plowed - med	1 / 2	N	Y
T3R6-078	10/8/2012	7:06	132	79	338	601966	4218351	Great horned owl	Large	Crop - harvested/flat	2 / 2	Y	Y
T3R6-079	10/8/2012	7:10	132	50	17	601986	4218292	Horned lark	Small	Crop - harvested/flat	2 / 2	Y	Y
T3R6-080	10/8/2012	7:30	140	81	271	600823	4217604	Mexican free-tailed bat	Small	Crop - harvested/flat	2 / 2	N	Y

Specimen[1]	Date	Place Time	Turbine	Distance (m)	Bearing (°)[2]	UTM E	UTM N	Species	Size Class	Placement Substrate	Visibility Class[3]	Detected?	Recovered?
T3R6-081	10/8/2012	7:35	140	53	109	600929	4217546	Oak titmouse	Small	Crop - harvested/flat	2 / 2	N	Y
T4R1-082	12/17/2012	5:55	115	52	241	603496	4221608	Mexican free-tailed bat	Small	Plowed - fine	1 / 1	N	Y
T4R1-083	12/17/2012	5:59	115	17	316	603524	4221631	Mourning dove	Medium	Plowed - fine	1 / 1	Y	Y[10]
T4R1-084	12/17/2012	6:06	117	8	346	604722	4219731	Cliff swallow	Small	Plowed - fine	1 / 1	Y	Y
T4R1-085	12/17/2012	6:16	118	28	170	603813	4220824	Big brown bat	Small	Crop - new	1 / 2	N	Y
T4R1-086	12/17/2012	6:42	132	7	160	601975	4218264	American kestrel	Medium	Fallow - new	1 / 3	Y	Y
T4R1-087	12/17/2012	6:54	140	68	80	600957	4217560	Western scrub-jay	Small	Fallow - low	2 / 3	Y	Y
T4R2-088	12/18/2012	6:16	121	6	21	604837	4219574	Mexican free-tailed bat	Small	Gravel pad - low veg	2 / 3	N	Y
T4R2-089	12/18/2012	6:23	123	14	214	605216	4219316	Big brown bat	Small	Fallow - low	2 / 3	N	Y
T4R2-090	12/18/2012	6:25	123	31	339	605217	4219276	White-crowned sparrow	Small	Fallow - low	2 / 3	N	Y
T4R2-091	12/18/2012	6:36	125	94	106	604746	4219058	Green-winged teal	Medium	Fallow - med	3 / 3	N	N[11]
T4R2-092	12/18/2012	7:09	139	42	19	600844	4217986	Mexican free-tailed bat	Small	Crop - new	1 / 1	N	Y
T4R3-093	12/27/2012	6:30	120	3	230	604724	4219750	Pallid bat	Small	Gravel pad	1 / 3	Y	Y
T4R3-094	12/27/2012	6:34	120	48	182	604713	4219703	European starling	Small	Fallow - low	2 / 3	Y	Y
T4R3-095	12/27/2012	6:52	128	13	49	604287	4219701	Pallid bat	Small	Fallow - low	2 / 3	N	Y
T4R3-096	12/27/2012	6:55	128	14	186	604266	4219682	Pallid bat	Small	Fallow - low	2 / 3	N	Y
T4R3-097	12/27/2012	7:05	131	59	135	603627	4219334	Horned lark	Small	Fallow - med	3 / 3	N	Y
T4R3-098	12/27/2012	7:08	131	21	281	603592	4219392	Barn owl	Medium	Fallow - low	2 / 3	Y	Y
T4R4-099	1/2/2013	6:20	121	88	28	604894	4219614	Horned lark	Small	Fallow - low	2 / 3	N	Y
T4R4-100	1/2/2013	6:29	121	54	200	604811	4219510	Red-tailed hawk	Large	Fallow - med	3 / 3	Y	Y
T4R4-101	1/2/2013	6:41	125	10	306	604687	4219132	Pallid bat	Small	Fallow - low	2 / 3	Y	Y
T4R4-102	1/2/2013	6:47	125	2	105	604696	4219119	Mexican free-tailed bat	Small	Gravel pad	1 / 3	Y	Y
T4R4-103	1/2/2013	7:22	139	22	237	600793	4217942	Pallid bat	Small	Crop - new	1 / 2	N	Y
T4R5-104	1/14/2013	5:45	115	22	37	603565	4221638	Mexican free-tailed bat	Small	Crop - new	1 / 1	Y	Y
T4R5-105	1/14/2013	5:58	117	86	94	603685	4221050	Red-shouldered hawk	Large	Crop - new	1 / 1	Y	Y
T4R5-106	1/14/2013	6:07	118	6	185	603810	4220843	Horned lark	Small	Crop - new	1 / 2	N	Y
T4R5-107	1/14/2013	6:32	132	15	159	601976	4218257	Pallid bat	Small	Fallow - low	2 / 3	N	Y
T4R5-108	1/14/2013	6:44	140	38	149	600898	4217547	White-throated swift	Small	Fallow - low	2 / 3	N	Y
T4R6-109	1/16/2013	5:58	107	13	85	602808	4221474	Pallid bat	Small	Fallow - low	2 / 3	N	N
T4R6-110	1/16/2013	6:01	107	29	248	602749	4221457	Western red bat	Small	Fallow - low/bare	2 / 3	N	Y
T4R6-111	1/16/2013	6:08	108	73	227	602872	4221270	Mourning dove	Medium	Fallow - new	1 / 2	N	Y

Specimen[1]	Date	Place Time	Turbine	Distance (m)	Bearing (°)[2]	UTM E	UTM N	Species	Size Class	Placement Substrate	Visibility Class[3]	Detected?	Recovered?
T4R6-112	1/16/2013	6:18	112	51	360	603562	4220588	Mexican free-tailed bat	Small	Crop - new	1 / 1	N	Y
T4R6-113	1/16/2013	6:48	134	12	36	601541	4218238	Big brown bat	Small	Crop - new	1 / 1	Y	Y
T4R6-114	1/16/2013	7:01	137	23	83	601734	4217586	European starling	Small	Fallow - low	2 / 3	N	Y
T4R6-115	1/16/2013	7:05	137	37	185	601702	4217552	American kestrel	Medium	Fallow - low	2 / 3	N	Y
T4R7-116	1/23/2013	5:58	107	67	198	602730	4221402	Barn owl	Medium	Fallow - low	2 / 3	Y	Y
T4R7-117	1/23/2013	6:03	108	10	125	602949	4221279	Hoary bat	Small	Fallow - low	2 / 2	Y	Y
T4R7-118	1/23/2013	6:16	112	101	340	603529	4220644	Golden-crowned sparrow	Small	Crop - new	1 / 2	N	Y
T4R7-119	1/23/2013	6:43	134	36	180	601519	4218196	Big brown bat	Small	Crop - new	1 / 2	N	Y
T4R7-120	1/23/2013	6:46	134	86	134	601562	4218147	American kestrel	Medium	Crop - new	1 / 2	Y	Y
T4R7-121	1/23/2013	6:54	137	8	165	601712	4217579	Horned lark	Small	Fallow - low	2 / 3	Y	Y

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

[2] Not corrected for declination.

[3] The first value reflects classification of habitat in the immediate vicinity of the placement location. The second value reflects a plot-level habitat classification.

[4] Found later outside of survey plot after odor of decaying carcass attracted surveyor's attention.

[5] Recovered 2 days later 120 m from turbine with no head.

[6] Feather spot and legs only.

[7] Top half missing.

[8] Recovery attempt revealed only one feather.

[9] Scavenged and shredded prior to detection.

[10] Only feathers left and scattered upon detection, mostly on opposite side of turbine from placement location.

[11] Recovery attempt revealed only a few small feathers.

Appendix B. Carcass-Persistence Bias Trial Specimens

Specimen[1]	Place Date	Turbine	Distance (m)	Bearing (°)[1]	UTM E	UTM N	Species	Size Class	Substrate	Persistence (days)
1-1-107-01	26-Mar-12	107	39	128	602810	4221434	Silver-haired bat	Small	Fallow/grazed - low	11
1-1-107-02	26-Mar-12	107	42	80	602819	4221467	Northern flicker	Medium	Fallow/grazed - low	14
1-1-112-01	26-Mar-12	112	40	340	603521	4220581	Red-shouldered hawk	Large	Plowed-coarse	27
1-1-117-01	26-Mar-12	117	62	52	603643	4221151	American robin	Small	Fallow/grazed - low	9
1-1-118-01	26-Mar-12	118	24	197	603808	4220828	Myotis spp.	Small	Fallow/grazed - low	1
1-1-121-01	26-Mar-12	121	34	165	604850	4219510	Mexican free-tailed bat	Small	Fallow – low/flat	11
1-1-121-02	26-Mar-12	121	42	262	604797	4219556	Red-necked phalarope	Large	Crop - low	4
1-1-128-01	26-Mar-12	128	6	147	604280	4219694	Brown-headed cowbird	Small	Gravel	20
1-1-131-01	26-Mar-12	131	40	14	603641	4219426	Mexican free-tailed bat	Small	Crop – new	20
1-1-132-01	26-Mar-12	132	33	108	601999	4218259	Mexican free-tailed bat	Small	Fallow-low/barren	9
1-1-137-01	26-Mar-12	137	8	238	601706	4217598	Mexican free-tailed bat	Small	Gravel	3
1-1-137-02	26-Mar-12	137	32	92	601743	4217583	Chipping sparrow	Small	Fallow/grazed – low	11
1-1-139-01	26-Mar-12	139	75	234	600736	4217936	Hoary bat	Small	Fallow/grazed – low	1
1-1-140-01	26-Mar-12	140	34	111	600927	4217569	Common raven	Large	Crop - low	27
1-2-108-01	15-Apr-12	108	55	136	602984	4221255	Red-tailed hawk	Large	Fallow/grazed – low	21
1-2-108-02	15-Apr-12	108	8	269	602930	4221294	Mexican free-tailed bat	Small	Gravel	4
1-2-115-01	15-Apr-12	115	10	250	603533	4221627	Hoary bat	Small	Fallow/grazed – low	11
1-2-118-01	15-Apr-12	118	73	100	603886	4220827	California towhee	Small	Fallow – medium	2
1-2-120-01	15-Apr-12	120	85	296	604648	4219784	Glaucous-winged gull	Large	Crop – medium	21
1-2-125-01	15-Apr-12	125	6	225	604690	4219120	Mexican free-tailed bat	Small	Bare dirt	11
1-2-125-02	15-Apr-12	125	84	170	604726	4219044	European starling	Small	Crop – new	2
1-2-131-01	15-Apr-12	131	17	224	603604	4219381	Myotis spp.	Small	Crop – medium	3
1-2-131-02	15-Apr-12	131	34	243	603583	4219378	Rock pigeon	Medium	Crop – medium	21
1-2-132-01	15-Apr-12	132	33	349	601966	4218307	Western grebe	Large	Fallow/grazed – low	21
1-2-134-01	15-Apr-12	134	12	8	601548	4218228	Mexican free-tailed bat	Small	Fallow – low/barren	2

Specimen[1]	Place Date	Turbine	Distance (m)	Bearing (°)[1]	UTM E	UTM N	Species	Size Class	Substrate	Persistence (days)
1-2-140-01	15-Apr-12	140	9	287	600886	4217590	Western red bat	Small	Gravel	2
1-2-140-02	15-Apr-12	140	31	35	600919	4217610	House sparrow	Small	Crop – medium	2
1-3-107-01	06-May-12	107	81	16	602826	4221389	Great horned owl	Large	Fallow – medium	27
1-3-112-01	06-May-12	112	7	349	603534	4220547	Western red bat	Small	Gravel	2
1-3-117-01	06-May-12	117	14	321	603593	4221110	Mexican free-tailed bat	Small	Plowed – coarse	1
1-3-117-02	06-May-12	117	72	43	603615	4221169	American robin	Small	Plowed – coarse	1
1-3-120-01	06-May-12	120	16	13	604747	4219750	Mexican free-tailed bat	Small	Crop – medium	2
1-3-120-02	06-May-12	120	19	149	604739	4219736	Hermit thrush	Small	Gravel	9
1-3-128-01	06-May-12	128	19	311	604257	4219715	Mexican free-tailed bat	Small	Fallow - low / barren	3
1-3-128-02	06-May-12	128	50	21	604292	4219751	Ross's goose	Large	Fallow – low	19
1-3-132-01	06-May-12	132	17	190	601973	4218258	Mexican free-tailed bat	Small	Fallow – medium	6
1-3-134-01	06-May-12	134	7	284	601524	4218234	Mexican free-tailed bat	Small	Fallow / gravel edge	11
1-3-134-02	06-May-12	134	15	26	601539	4218244	Mourning dove	Medium	Fallow – low	9
1-3-137-01	06-May-12	137	27	316	601694	4217615	Dark-eyed junco	Small	Fallow – low	6
1-3-139-01	06-May-12	139	15	46	600826	4217967	Mexican free-tailed bat	Small	Fallow/grazed - flat/dry	2
2-1-108-01	12-May-12	108	19	268	602922	4221294	Mexican free-tailed bat	Small	Gravel	9
2-1-108-02	12-May-12	108	15	321	602930	4221308	House finch	Small	Fallow – medium	5
2-1-112-01	12-May-12	112	56	270	603485	4220568	American crow	Medium	Plowed w/ sparse mustard	9
2-1-115-01	12-May-12	115	13	98	603558	4221637	Mexican free-tailed bat	Small	Fallow – low	2
2-1-115-02	12-May-12	115	36	120	603581	4221619	Northern flicker	Medium	Fallow – low	2
2-1-123-01	12-May-12	123	16	244	605213	4219285	Mexican free-tailed bat	Small	Fallow – medium	5
2-1-123-02	12-May-12	123	7	277	605221	4219290	House sparrow	Small	Gravel	7
2-1-125-01	12-May-12	125	61	176	604707	4219064	Turkey vulture	Large	Crop – medium	27
2-1-128-01	12-May-12	128	12	5	604274	4219714	Mexican free-tailed bat	Small	Bare dirt	5
2-1-132-01	12-May-12	132	29	242	601949	4218267	Red-winged blackbird	Small	Fallow – medium	7
2-1-137-01	12-May-12	137	27	134	601736	4217571	Mexican free-tailed bat	Small	Fallow – medium	27
2-1-137-02	12-May-12	137	13	151	601721	4217577	Cooper's hawk	Medium	Fallow – medium	5
2-1-140-01	12-May-12	140	12	339	600894	4217601	Mexican free-tailed bat	Small	Gravel	20
2-2-107-01	11-Jun-12	107	15	130	602785	4221443	Mexican free-tailed bat	Small	Bare dirt	4

Specimen[1]	Place Date	Turbine	Distance (m)	Bearing (°)[1]	UTM E	UTM N	Species	Size Class	Substrate	Persistence (days)
2-2-107-02	11-Jun-12	107	104	180	602779	4221349	House finch	Small	Fallow – flattened	9
2-2-112-01	11-Jun-12	112	14	350	603543	4220555	Mexican free-tailed bat	Small	Plowed – coarse	9
2-2-118-01	11-Jun-12	118	15	90	603830	4220843	Mexican free-tailed bat	Small	Fallow – flattened	11
2-2-118-02	11-Jun-12	118	56	40	603858	4220889	Ring-billed gull	Large	Plowed – coarse	5
2-2-121-01	11-Jun-12	121	30	240	604808	4219538	Mexican free-tailed bat	Small	Gravel	9
2-2-121-02	11-Jun-12	121	59	220	604784	4219524	Mourning dove	Medium	Bare dirt	9
2-2-125-01	11-Jun-12	125	80	130	604739	4219054	American robin	Small	Crop – medium	4
2-2-128-01	11-Jun-12	128	91	212	604197	4219651	Western scrub-jay	Small	Dirt and vinegar weed	5
2-2-131-01	11-Jun-12	131	12	10	603619	4219406	Mexican free-tailed bat	Small	Crop – new	6
2-2-134-01	11-Jun-12	134	18	100	601548	4218219	Mexican free-tailed bat	Small	Plowed – coarse	9
2-2-134-02	11-Jun-12	134	72	140	601565	4218165	European starling	Small	Gravel	11
2-2-139-01	11-Jun-12	139	12	60	600826	4217957	Mexican free-tailed bat	Small	Gravel	6
2-2-140-01	11-Jun-12	140	60	190	600871	4217531	Red-tailed hawk	Large	Dirt w/ sparse low veg	28
2-3-107-01	09-Jul-12	107	27	120	602798	4221443	Mexican free-tailed bat	Small	Fallow – flattened	1
2-3-112-01	09-Jul-12	112	64	290	603482	4220579	American robin	Small	Gravel road	7
2-3-115-01	09-Jul-12	115	3	190	603543	4221631	Mexican free-tailed bat	Small	Top of transformer	1
2-3-117-01	09-Jul-12	117	23	330	603597	4221123	Mexican free-tailed bat	Small	Plowed – coarse	4
2-3-117-02	09-Jul-12	117	77	20	603638	4221167	Great horned owl	Large	Plowed – coarse	6
2-3-120-01	09-Jul-12	120	31	165	604741	4219724	Mexican free-tailed bat	Small	Crop – harvested/flat	2
2-3-120-02	09-Jul-12	120	34	70	604764	4219753	Brewer's blackbird	Small	Crop - high	1
2-3-125-01	09-Jul-12	125	18	210	604683	4219113	Mexican free-tailed bat	Small	Dirt w/ patches of wheat	7
2-3-128-01	09-Jul-12	128	104	250	604168	4219689	Red-tailed hawk	Large	Fallow / low/barren	4
2-3-132-01	09-Jul-12	132	5	350	601976	4218280	Mexican free-tailed bat	Small	Gravel	6
2-3-132-02	09-Jul-12	132	40	360	601975	4218311	House sparrow	Small	Fallow – flattened	4
2-3-139-01	09-Jul-12	139	37	85	600849	4217957	Mexican free-tailed bat	Small	Bare dirt	7
2-3-139-02	09-Jul-12	139	74	30	600847	4218019	Mew gull	Medium	Bare dirt	11
3-1-108-01	20-Aug-12	108	49	310	602910	4221333	Band-tailed pigeon	Medium	Crop – harvested/flat	4
3-1-112-01	20-Aug-12	112	41	280	603506	4220568	Mexican free-tailed bat	Small	Gravel road	5
3-1-115-01	20-Aug-12	115	22	110	603562	4221621	Mexican free-tailed bat	Small	Plowed – fine	2

Specimen[1]	Place Date	Turbine	Distance (m)	Bearing (°)[1]	UTM E	UTM N	Species	Size Class	Substrate	Persistence (days)
3-1-115-02	20-Aug-12	115	18	10	603554	4221648	Northern mockingbird	Small	Gravel road	1
3-1-121-01	20-Aug-12	121	31	160	604840	4219522	Mexican free-tailed bat	Small	Crop – harvested/flat	6
3-1-123-01	20-Aug-12	123	10	90	605243	4219288	Mexican free-tailed bat	Small	Crop – harvested/flat	1
3-1-123-02	20-Aug-12	123	42	10	605251	4219326	Red-shouldered hawk	Large	Crop – harvested/flat	6
3-1-128-01	20-Aug-12	128	28	175	604262	4219674	Mexican free-tailed bat	Small	Bare dirt	2
3-1-131-01	20-Aug-12	131	66	300	603568	4219442	House sparrow	Small	Crop – harvested/flat	2
3-1-132-01	20-Aug-12	132	66	225	601929	4218230	American wigeon	Medium	Fallow/grazed – flattened	1
3-1-137-01	20-Aug-12	137	20	340	601711	4217609	Mexican free-tailed bat	Small	Fallow – low/flat/barren	5
3-1-137-02	20-Aug-12	137	28	280	601685	4217601	Common yellowthroat	Small	Fallow – low/flat/barren	2
3-1-140-01	20-Aug-12	140	30	210	600882	4217560	Mexican free-tailed bat	Small	Crop - scattered wheat	7
3-1-140-02	20-Aug-12	140	58	230	600852	4217553	Western scrub-jay	Small	Crop - high	28
3-2-108-01	17-Sep-12	108	35	60	602976	4221296	Mexican free-tailed bat	Small	Bare dirt	2
3-2-112-01	17-Sep-12	112	15	310	603531	4220552	Mexican free-tailed bat	Small	Gravel	3
3-2-112-02	17-Sep-12	112	51	60	603586	4220553	Mourning dove	Medium	Plowed – fine	3
3-2-117-01	17-Sep-12	117	55	350	603602	4221149	Barn swallow	Small	Gravel road	28
3-2-120-01	17-Sep-12	120	49	58	604780	4219769	Barn owl	Medium	Crop – harvested/flat	7
3-2-125-01	17-Sep-12	125	18	40	604707	4219134	Mexican free-tailed bat	Small	Crop – harvested low	4
3-2-125-02	17-Sep-12	125	90	120	604743	4219046	Black phoebe	Small	Crop - harvested low	4
3-2-131-01	17-Sep-12	131	16	240	603599	4219388	Mexican free-tailed bat	Small	Plowed – fine	3
3-2-131-02	17-Sep-12	131	69	310	603578	4219453	Gadwall	Large	Crop – harvested/flat	3
3-2-132-01	17-Sep-12	132	52	68	602040	4218285	Western meadowlark	Small	Bare dirt	3
3-2-134-01	17-Sep-12	134	18	355	601533	4218251	Mexican free-tailed bat	Small	Plowed – fine	2
3-2-134-02	17-Sep-12	134	76	130	601579	4218171	American crow	Medium	Plowed – fine	1
3-2-139-01	17-Sep-12	139	3	150	600814	4217952	Mexican free-tailed bat	Small	Concrete pad	1
3-3-107-01	15-Oct-12	107	20	80	602796	4221452	Big brown bat	Small	Fallow/grazed – flattened	5
3-3-107-02	15-Oct-12	107	42	192	602756	4221421	American pipit	Small	Fallow – low/barren	7
3-3-115-01	15-Oct-12	115	81	344	603537	4221715	American coot	Medium	Plowed – fine	2
3-3-117-01	15-Oct-12	117	24	198	603588	4221076	Mexican free-tailed bat	Small	Plowed – fine w/ new veg	7
3-3-118-01	15-Oct-12	118	33	60	603847	4220858	Mexican free-tailed bat	Small	Plowed – fine	6

Specimen[1]	Place Date	Turbine	Distance (m)	Bearing (°)[1]	UTM E	UTM N	Species	Size Class	Substrate	Persistence (days)
3-3-121-01	15-Oct-12	121	60	350	604846	4219613	Mexican free-tailed bat	Small	Fallow - flattened wheat	2
3-3-121-02	15-Oct-12	121	41	274	604793	4219568	House sparrow	Small	Fallow – med/flattened	4
3-3-123-01	15-Oct-12	123	25	252	605208	4219293	Big brown bat	Small	Fallow - flattened wheat	2
3-3-125-01	15-Oct-12	125	58	304	604666	4219173	Lesser goldfinch	Small	Fallow - flattened wheat	1
3-3-137-01	15-Oct-12	137	79	330	601693	4217670	Red-shouldered hawk	Large	Fallow – med/flattened	27
3-3-139-01	15-Oct-12	139	20	240	600788	4217944	Mexican free-tailed bat	Small	Plowed – fine	3
3-3-139-02	15-Oct-12	139	7	90	600815	4217946	Western kingbird	Small	Gravel pad	1
3-3-140-01	15-Oct-12	140	31	338	600880	4217610	Mexican free-tailed bat	Small	Gravel road	3
4-1-107-01	26-Nov-12	107	62	292	602726	4221503	Northern pintail	Large	Fallow/grazed – med	2
4-1-108-01	26-Nov-12	108	14	100	602955	4221286	Mexican free-tailed bat	Small	Fallow – low/barren	9
4-1-108-02	26-Nov-12	108	8	10	602946	4221299	Yellow-rumped warbler	Small	Gravel pad w/ low grass	3
4-1-112-01	26-Nov-12	112	38	338	603521	4220575	Hoary bat	Small	Fallow – low/barren	3
4-1-120-01	26-Nov-12	120	30	110	604753	4219734	Mexican free-tailed bat	Small	Fallow – low/barren	5
4-1-120-02	26-Nov-12	120	50	164	604736	4219703	House finch	Small	Fallow – low	6
4-1-128-01	26-Nov-12	128	23	302	604256	421717	Mexican free-tailed bat	Small	Fallow – low/barren	5
4-1-128-02	26-Nov-12	128	70	254	604201	4219705	American kestrel	Medium	Fallow – low/barren	2
4-1-131-01	26-Nov-12	131	11	38	603628	4219397	Mexican free-tailed bat	Small	Fallow – low/barren	7
4-1-134-01	26-Nov-12	134	17	156	601537	4218212	Big brown bat	Small	Plowed – fine/medium	2
4-1-139-01	26-Nov-12	139	64	60	600875	4217966	House finch	Small	Plowed – fine	1
4-1-140-01	26-Nov-12	140	20	286	600878	4217599	Mexican free-tailed bat	Small	Gravel	3
4-1-140-02	26-Nov-12	140	39	50	600932	4217602	Barn owl	Medium	Fallow/grazed - flattened	6
4-2-107-01	02-Jan-13	107	39	21	602740	4221462	Mexican free-tailed bat	Small	Fallow – low	9
4-2-112-01	02-Jan-13	112	41	141	603544	4220501	Western scrub-jay	Small	Crop - new	9
4-2-115-01	02-Jan-13	115	4	252	603540	4221630	Mourning dove	Medium	Gravel	1
4-2-117-01	02-Jan-13	117	25	286	603578	4221101	Big brown bat	Small	Crop - new	9
4-2-117-02	02-Jan-13	117	17	111	603609	4221084	House sparrow	Small	Crop - new	2
4-2-121-01	02-Jan-13	121	1	26	604840	4219552	Big brown bat	Small	Gravel w/ low grass	11
4-2-123-01	02-Jan-13	123	66	237	605174	4219264	Bushtit	Small	Fallow – low/med	13

Specimen[1]	Place Date	Turbine	Distance (m)	Bearing (°)[1]	UTM E	UTM N	Species	Size Class	Substrate	Persistence (days)
4-2-125-01	02-Jan-13	125	13	54	604707	429133	Myotis spp.	Small	Fallow – low	3
4-2-131-01	02-Jan-13	131	88	326	603583	4219474	Barn owl	Medium	Fallow – low	11
4-2-132-01	02-Jan-13	132	42	239	601939	4218256	Turkey vulture	Large	Fallow – low	29
4-2-132-02	02-Jan-13	132	28	8	601986	4218291	Mexican free-tailed bat	Small	Fallow – low	3
4-2-134-01	02-Jan-13	134	99	266	601441	4218238	Yellow-headed blackbird	Small	Crop - new	1
4-3-108-01	18-Jan-13	108	92	227	602854	4221259	Cooper's hawk	Medium	Fallow – low	9
4-3-112-01	18-Jan-13	112	6	123	603541	4220528	Little brown bat	Small	Gravel	11
4-3-115-01	18-Jan-13	115	21	33	603565	4221648	Western red bat	Small	Crop – new	6
4-3-115-02	18-Jan-13	115	23	307	603532	4221651	Myotis spp.	Small	Crop – new	3
4-3-118-01	18-Jan-13	118	10	45	603828	4220855	Mexican free-tailed bat	Small	Fallow – medium	5
4-3-118-02	18-Jan-13	118	88	255	603729	4220846	European starling	Small	Crop – new	2
4-3-120-01	18-Jan-13	120	23	12	604737	4219776	Double-crested cormorant	Large	Fallow – medium	11
4-3-120-02	18-Jan-13	120	37	308	604701	4219781	Mexican free-tailed bat	Small	Fallow – medium	2
4-3-123-01	18-Jan-13	123	8	62	605239	4219282	Mexican free-tailed bat	Small	Fallow – low	9
4-3-131-01	19-Jan-13	131	7	236	603608	4219387	Red-winged blackbird	Small	Fallow – low/barren	8
4-3-131-02	18-Jan-13	131	52	119	603649	4219353	Mexican free-tailed bat	Small	Fallow – low/barren	5
4-3-134-01	18-Jan-13	134	27	186	601521	4218205	Common gallinule	Large	Crop – new	3
4-3-137-01	18-Jan-13	137	49	329	601686	4217634	Mexican free-tailed bat	Small	Fallow – medium	7
4-3-137-02	18-Jan-13	137	35	217	601685	4217568	Mexican free-tailed bat	Small	Fallow – low	11
4-3-139-01	18-Jan-13	139	4	314	600809	4217959	Mexican free-tailed bat	Small	Fallow – medium / gravel	4
4-3-139-02	18-Jan-13	139	34	121	600834	4217929	Mourning dove	Medium	Crop – new	7
4-3-140-01	18-Jan-13	140	43	26	600924	4217622	American robin	Small	Crop – new	11

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

[2] Not corrected for declination.

Appendix C. Fatality Surveys Conducted during Year 1 by Date and Location

		Turbine																		
Week	Date	107	108	112	115	117	118	120	121	123	125	128	131	132	134	137	139	140	Substation	Total
1	05-Mar-12				1	1	1							1				1		5
	06-Mar-12								1	1	1						1			4
	07-Mar-12	1	1	*[1]											1	1				4
	08-Mar-12							1				1	1							3
	09-Mar-12																		1	1
2	12-Mar-12				1	1	1							1				1		5
	13-Mar-12								1	1	1						1			4
	14-Mar-12	1	1	1											1	1				5
	15-Mar-12							1				1	1							3
	16-Mar-12																		1	1
3	19-Mar-12				1	1	1							1				1		5
	20-Mar-12								1	**	1						1			3
	21-Mar-12	*	*	1											1	1				3
	22-Mar-12							1				1	1							3
	23-Mar-12																		1	1
4	26-Mar-12				1	1	1							1				1		5
	27-Mar-12								1	1	1						1			4
	28-Mar-12	1	1	**1**[2]											1	1				5
	29-Mar-12							1				1	1							3
	30-Mar-12																		1	1
5	02-Apr-12				1	1	1							**1**				***		4
	03-Apr-12								1	1	1						1			4
	04-Apr-12	1	1	1											1	1				5
	05-Apr-12							1				1	1							3
	06-Apr-12																		1	1

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
6	09-Apr-12				1	1	1							1				1		5
	10-Apr-12								1	1	1						1			4
	11-Apr-12	1	1	1										**		1				4
	12-Apr-12							1				1	1							3
	13-Apr-12																		1	1
7	16-Apr-12				1	1	1							1				1		5
	17-Apr-12								1	1	1						1			4
	18-Apr-12	1	1	1											1	1				5
	20-Apr-12							1				1	1						1	4
8	23-Apr-12				1	1	1							1				1		5
	24-Apr-12								1	1	1						1			4
	25-Apr-12	1	1	1											1	1				5
	26-Apr-12							1				1	1							3
	27-Apr-12																		1	1
9	30-Apr-12				1	1	1							1				1		5
	01-May-12								1	1	1						1			4
	02-May-12	1	1	1										**		1				4
	03-May-12							1				1	1							3
	04-May-12																		1	1
10	07-May-12				1	1	1							1				1		5
	08-May-12								1	1	1						1			4
	09-May-12	1	1	1											1	1				5
	10-May-12							1				1	1							3
	11-May-12																		1	1
11	14-May-12				*	1	1							1				1		4
	15-May-12								1	1	1						1			4
	16-May-12	1	1	1											1	1				5
	17-May-12							1				1	1							3

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	18-May-12																		1	1
12	21-May-12				1	1	1							1				1		5
	22-May-12								1	1	1						1			4
	23-May-12	1	1	1											1	1				5
	24-May-12							1				1	1							3
	25-May-12																		1	1
13	29-May-12				1	1	1							1				1		5
	30-May-12								1	1	1						1			4
	31-May-12	1	1	1											1	1				5
	01-Jun-12							1				1	1							3
	02-Jun-12																		1	1
14	04-Jun-12				1	1	1							1				1		5
	05-Jun-12								1	1	1						1			4
	06-Jun-12	1	1	1											1	1				5
	07-Jun-12							1				1	1							3
	08-Jun-12																		1	1
15	11-Jun-12				1	1	1							1				1		5
	12-Jun-12								1	1	1						1			4
	13-Jun-12	1	1	1											1	1				5
	14-Jun-12							1				1	1							3
	15-Jun-12																		1	1
16	18-Jun-12				1	1	1							1				1		5
	19-Jun-12								1	1	1						1			4
	20-Jun-12	1	1	1											1	1				5
	21-Jun-12							1				1	1							3
	22-Jun-12																		1	1
17	25-Jun-12				1	1	1							1				1		5
	26-Jun-12								1	1	1						1			4

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	27-Jun-12	1	1	1											1	1				5
	28-Jun-12							1				1	1							3
	29-Jun-12																		1	1
18	02-Jul-12				1	1	1							1				1		5
	03-Jul-12								1	1	1						1			4
	05-Jul-12	1	1	1											1	1				5
	06-Jul-12							1				1	1							3
	07-Jul-12																		1	1
19	09-Jul-12				1	1	1							1				1		5
	10-Jul-12								1	1	1						1			4
	11-Jul-12	1	1	1											1	1				5
	12-Jul-12							1				1	1							3
	13-Jul-12																		1	1
20	16-Jul-12				1	1	1							1				1		5
	17-Jul-12								1	1	1						1			4
	18-Jul-12	1	1	1											1	1				5
	19-Jul-12							1				1	1							3
	20-Jul-12																		1	1
21	23-Jul-12				1	1	1							1				1		5
	24-Jul-12								1	1	1						1			4
	25-Jul-12	1	1	1											1	1				5
	26-Jul-12							1				1	1							3
	27-Jul-12																		1	1
22	30-Jul-12				1	1	1							1				1		5
	31-Jul-12								1	1	1						1			4
	01-Aug-12	1	1	1											1	1				5
	02-Aug-12							1				1	1							3
	03-Aug-12																		1	1

		Turbine																
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
23	06-Aug-12				1	1	1							1				1		5
	07-Aug-12								1	1	1						1			4
	08-Aug-12	1	1	1											1	1				5
	09-Aug-12							1				1	1							3
	10-Aug-12																		1	1
24	13-Aug-12				1	1	1							1				1		5
	16-Aug-12							1	1	1	1	1	1							6
	17-Aug-12	1	1	1											1	1			1	6
	18-Aug-12																1			1
25	20-Aug-12				1	1	1							1				1		5
	21-Aug-12								1	1	1						1			4
	22-Aug-12	1	1	1											1	1				5
	23-Aug-12							1				1	1							3
	24-Aug-12																		1	1
26	27-Aug-12				1	1	1							1				1		5
	28-Aug-12								1	1	1						1			4
	29-Aug-12	1	1	1											1	1				5
	30-Aug-12							1				1	1							3
	31-Aug-12																		1	1
27	03-Sep-12				1	1	1							1				1		5
	04-Sep-12								1	1	1						1			4
	05-Sep-12	1	1	1											1	1				5
	06-Sep-12							1				1	1							3
	07-Sep-12																		1	1
28	10-Sep-12				1	1	1							1				1		5
	11-Sep-12								1	1	1						1			4
	12-Sep-12	1	1	1											1	1				5
	13-Sep-12							1				1	1							3

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	14-Sep-12																		1	1
29	17-Sep-12				1	1	1							1				1		5
	18-Sep-12								1	1	1						1			4
	19-Sep-12	1	1	1											1	1				5
	20-Sep-12							1				1	1							3
	21-Sep-12																		1	1
30	24-Sep-12				1	1	1							1				1		5
	25-Sep-12								1	1	1						1			4
	26-Sep-12	1	1	1											1	1				5
	27-Sep-12							1				1	1							3
	28-Sep-12																		1	1
31	01-Oct-12				1	1	1							1				1		5
	02-Oct-12								1	1	1						1			4
	03-Oct-12	1	1	1											1	1				5
	04-Oct-12							1				1	1							3
	05-Oct-12																		1	1
32	08-Oct-12				1	1	1							1				1		5
	09-Oct-12								1	1	1						1			4
	10-Oct-12	1	1	1											1	1				5
	11-Oct-12							1				1	1							3
	12-Oct-12																		1	1
33	15-Oct-12				1	1	1							1				1		5
	16-Oct-12								1	1	1						1			4
	17-Oct-12	1	1	1											1	1				5
	18-Oct-12							1				1	1							3
	19-Oct-12																		1	1
34	22-Oct-12				1	1	1							1				1		5
	23-Oct-12								1	1	1						1			4

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	24-Oct-12	**1**	1	1											1	1				5
	25-Oct-12							1				1	1							3
	26-Oct-12																		1	1
35	29-Oct-12				1	1	1							1				1		5
	30-Oct-12								1	1	1						1			4
	31-Oct-12	1	1	1											1	1				5
	01-Nov-12							1				1	1							3
	02-Nov-12																		1	1
36	05-Nov-12				1	1	1							1				1		5
	06-Nov-12								1	1	1						1			4
	07-Nov-12	1	1	1									1		1	1				6
	08-Nov-12							1				1								2
	09-Nov-12																		1	1
37	12-Nov-12				1	1	1							1				1		5
	13-Nov-12								1	1	1						1			4
	14-Nov-12	***	1	1								1			1	1				5
	15-Nov-12							1					1							2
	16-Nov-12																		1	1
38	18-Nov-12				1	1	1							1				1		5
	19-Nov-12								1	1	1						1			4
	20-Nov-12	***	1	1											1	1				4
	21-Nov-12							1				1	1						1	4
39	26-Nov-12				1	1	1			1				1				1		6
	27-Nov-12								1		1						1			3
	28-Nov-12	1	1	1											1	1				5
	29-Nov-12							1				1	1							3
	30-Nov-12																		1	1
40	03-Dec-12				1	1	1							1				1		5

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	04-Dec-12								1	1	1						1			4
	05-Dec-12	1	1	1											1	1				5
	06-Dec-12							1				1	1							3
	07-Dec-12																		1	1
41	10-Dec-12				1	1	1							1				1		5
	11-Dec-12								1	1	1						1			4
	12-Dec-12	1	1	**1**											1	1				5
	13-Dec-12							1				1	1							3
	14-Dec-12																		1	1
42	17-Dec-12				1	1	1							1				1		5
	18-Dec-12								1	1	1						1			4
	19-Dec-12	1	1	1											1	1				5
	20-Dec-12							1				1	1							3
	21-Dec-12																		1	1
43	23-Dec-12				1	1	1							1				1		5
	24-Dec-12								1	1	1						1			4
	26-Dec-12	1	1	1											1	1				5
	27-Dec-12							1				1	1							3
	28-Dec-12																		1	1
44	31-Dec-12				1	1	1							1				1		5
	02-Jan-13								1	1	1						1			4
	03-Jan-13	1	1	1											1	**1**				5
	04-Jan-13							1				1	1							3
	05-Jan-13																		1	1
45	07-Jan-13				1	****	****							1				1		3
	08-Jan-13										1						****			1
	09-Jan-13	1	1	1					1	1										5
	10-Jan-13							1				1	1		1	1				5

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	11-Jan-13																		1	1
46	14-Jan-13				1	1	1							1				1		5
	15-Jan-13								1	1	1						1			4
	16-Jan-13	1	1	1											1	1				5
	17-Jan-13							1				1	1							3
	18-Jan-13																		1	1
47	21-Jan-13				1	1	1							1				1		5
	22-Jan-13								1	1	1						1			4
	23-Jan-13	1	1	1											1	1				5
	24-Jan-13							1				1	1							3
	25-Jan-13																		1	1
48	28-Jan-13				1	1	1							1				1		5
	29-Jan-13								1	1	1						1			4
	30-Jan-13	1	1	1											1	1				5
	31-Jan-13							1				1	1							3
	01-Feb-13																		1	1
49	04-Feb-13				1	1	1							1				1		5
	05-Feb-13								1	1	1						1			4
	06-Feb-13	1	1	1											1	1				5
	07-Feb-13							1				1	1							3
	08-Feb-13																		1	1
50	11-Feb-13				1	1	1							1				1		5
	12-Feb-13								1	1	1						1			4
	13-Feb-13	1	1	1											1	1				5
	14-Feb-13							1				1	1							3
	15-Feb-13																		1	1
51	18-Feb-13				1	1	1							1				1		5
	19-Feb-13								1	1	1						1			4

		Turbine																		
Week	**Date**	**107**	**108**	**112**	**115**	**117**	**118**	**120**	**121**	**123**	**125**	**128**	**131**	**132**	**134**	**137**	**139**	**140**	**Substation**	**Total**
	20-Feb-13	1	1	1											1	1				5
	21-Feb-13							1				1	1							3
	22-Feb-13																		1	1
52	25-Feb-13				1	1	1							1				1		5
	26-Feb-13								1	1	1						1			4
	27-Feb-13	1	1	1											1	1				5
	28-Feb-13							1				1	1							3
	01-Mar-13																		1	1
	Total	**49**	**51**	**51**	**51**	**51**	**51**	**52**	**52**	**51**	**52**	**52**	**52**	**52**	**50**	**52**	**51**	**51**	**52**	**923**

[1] * = survey not conducted due to plowing or agricultural spraying; ** = survey not conducted due to scheduling glitches; *** = survey not conducted due to turbine repair/maintenance work; **** = survey not conducted due to surveyor illness.

[2] Bold highlighting indicates surveys that were cut short due to factors such as excessive rain or mud, onset of agricultural spraying or turbine maintenance/repair activities, and the presence of an aggressive sheep dog.

Appendix D. Fatality and Injury Incidents Recorded During Year 1

Incident #	Type[1]	Date	Turbine	Distance from Turbine (m)	Species	Condition	Cause	Time Dead	Substrate	Visibility Class[2]
20120210-01	I	10-Feb-12	107	15	American kestrel	Intact	Blade strike A: wing/neck	<1 week	Gravel road (fallow/grazed – low)	1 / 2
20120314-01	C	14-Mar-12	137	59	Red-tailed hawk	Scavenged	Blade strike B	>1 month	Fallow/grazed – low	2 / 2
20120328-01	T	28-Mar-12	117	24	Glaucous-winged gull	Intact	Blade strike A: wing	Fresh	Fallow/grazed – low	2 / 2
20120409-01	T	09-Apr-12	132	64	Red-tailed hawk	Cut in half	Blade strike A: body	<1 week	Fallow/grazed – low	2 / 2
20120412-01	T	12-Apr-12	128	12	Barn owl	Intact	Blade strike A: wing	Fresh	Fallow/grazed – low/medium	2 / 2
20120506-01	T	05-Jun-12	139	44	White-throated swift	Intact	Blade strike A: bleeding nostrils	Fresh	Gravel pad (plowed – coarse)	1 / 2
20120517-01	T	17-May-12	128	60	Western grebe	Intact	Blade strike A: severed legs	Fresh	Fallow/grazed – low/medium	2 / 2
20120519-01	I	19-May-12	138	8	Mexican free-tailed bat	Intact	Blade strike A: neck/back	<1 month	Gravel road (fallow/grazed – low/med)	1 / 2
20120525-01	I	25-May-12	136	23	Northern harrier	Intact, dry	Blade strike B	<1 month	Gravel road (plowed – coarse)	1 / 2
20120627-01	T	27-Jun-12	107	14	Pied-billed grebe?	Feather spot	Unknown	<1 month	Fallow/grazed – low/med/flat	2 / 2
20120716-01	I	16-Jul-12	108	96	Turkey vulture	Injured / euthanized	Blade strike A: wing	Injured	Fallow – medium	3 / 3
20120723-01	T	23-Jul-12	132	19	Turkey vulture	Intact	Blade strike A: back	Fresh	Fallow/grazed	2 / 2

Incident #	Type[1]	Date	Turbine	Distance from Turbine (m)	Species	Condition	Cause	Time Dead	Substrate	Visibility Class[2]
									– low/med/flat	
20120830-01	I	30-Aug-12	127	30	Turkey vulture	Intact	Blade strike B	<1 month	Dirt and vinegar weed	2 / 2
20120911-01	T	11-Sep-12	121	21	Turkey vulture	Feathers and bones	Blade strike B	<1 month	Buried in cut wheat stalks	3 / 2
20120911-02	I	11-Sep-12	127	24	Turkey vulture	Intact	Blade strike A: belly/breast - witnessed	Fresh	Dirt and vinegar weed	2 / 2
20120913-01	T	13-Sep-12	128	38	Mourning dove	Wing only	Unknown	<1 week	Fallow/grazed – low/med/flat	2 / 2
20120920-01	I	20-Sep-12	127	114	Hoary bat	Intact	Blade strike C	Fresh	Gravel road (fallow/grazed – low/med)	1 / 2
20120925-01	T	25-Sep-12	128	57	Turkey vulture	Intact	Blade strike B	Fresh	Fallow/grazed – low/med/flat	2 / 2
20120927-01	T	27-Sep-12	128	35	Turkey vulture	Intact	Blade strike A: belly/breast	<1 week	Dirt and vinegar weed	2 / 2
20121008-01	T	08-Oct-12	118	1	Mexican free-tailed bat	Intact	Blade strike A: neck/back	Fresh	Gravel pad (plowed – fine + fallow – med/high)	1 / 3
20121009-01	T	09-Oct-12	125	5	Red-tailed hawk	Intact	Blade strike A: neck	Fresh	Gravel pad (fallow/grazed – low/med)	1 / 2
20121018-01	T	18-Oct-12	128	60	Hoary bat	Intact	Blade strike C	Fresh	Fallow/grazed – low/med/flat	2 / 2
20121113-01	I	13-Nov-12	122	33	Turkey vulture	Intact	Blade strike A: severed tail and legs	Fresh	Fallow – low	2 / 2
20121120-01	T	20-Nov-12	123	36	Northern harrier	Intact	Blade strike B	Fresh	Fallow/grazed – low/med/flat	2 / 2
20121227-01	I	27-Dec-12	131	54	American kestrel	Intact	Blade strike A: broken neck?	Fresh	Fallow – medium	3 / 3

Incident #	Type[1]	Date	Turbine	Distance from Turbine (m)	Species	Condition	Cause	Time Dead	Substrate	Visibility Class[2]
20121231-01	T	31-Dec-12	117	4	Red-winged blackbird	Intact, headless	Merlin predation	Fresh	Gravel pad (crop – seeded)	1 / 1
20130107-01	T	07-Jan-13	140	13	Rock pigeon	Feathers and bones	Unknown	<1 month	Fallow/grazed – low/med	2 / 2
20130107-02	T	07-Jan-13	115	82	Rock pigeon	Feather spot	Unknown	<1 week	Plowed/sparse new wheat	1 / 1
20130109-01	T	09-Jan-13	107	95	Horned lark	Feather spot	Unknown	<1 week	Gravel road (fallow/grazed – low/med)	1 / 2
20130110-01	T	10-Jan-13	134	19	Unidentified blackbird	Feather spot	Unknown	<1 week	Plowed/sparse new wheat	1 / 1
20130110-02	T	10-Jan-13	131	85	American kestrel	Scavenged / depredated	Unknown	<1 month	Fallow/grazed – low/med	2 / 2
20130119-01	I	19-Jan-13	116	132	American kestrel	Scavenged / depredated	Unknown	<1 week	Fallow – medium	3 / 3
20130121-01	I	21-Jan-13	117	193	Barn owl	Scavenged / depredated	Great horned owl predation?	<1 week	Sparse new wheat	1 / 1
20130124-01	I	24-Jan-13	122	192	Barn owl	Scavenged / depredated	Unknown	<1 week	Fallow – low / old cut wheat	2 / 2
20130221-01	T	21-Feb-13	128	27	American kestrel	Wing only	Unknown	<1 week	Fallow/grazed – low	2 / 2
20130221-02	T	21-Feb-13	128	33	Unidentified blackbird	Wing only	Unknown	<1 week	Fallow/grazed – low	2 / 2

[1] C = found during turbine survey - clearance carcass; I = incidental find; T = found during turbine survey – included in adjusted fatality estimates.

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

Appendix E. Bird Use Counts Conducted during Year 1 by Date and Count Site

			Site				
Week	Date	Period	1	2	3	4	Total
1	08-Mar-12	PM	1	1	1	1	4
	09-Mar-12	AM	1	1	1	1	4
2	15-Mar-12	PM	1	1	1	1	4
	16-Mar-12	AM	1	1	1	1	4
3	22-Mar-12	PM	1	1	1	1	4
	23-Mar-12	AM	1	1	1	1	4
4	29-Mar-12	PM	1	1	1	1	4
	30-Mar-12	AM	1	1	1	1	4
5	05-Apr-12	PM	1	1	1	1	4
	06-Apr-12	AM	1	1	1	1	4
6	12-Apr-12	PM	1	1	1	1	4
	13-Apr-12	AM	1	1	**1**[1]	1	4
7	19-Apr-12	PM	1	1	1	1	4
	20-Apr-12	AM	1	1	1	1	4
8	26-Apr-12	PM	1	1	1	1	4
	27-Apr-12	AM	1	1	1	1	4
9	03-May-12	PM	1	1	1	1	4
	04-May-12	AM	1	1	1	1	4
10	10-May-12	PM	1	1	1	1	4
	11-May-12	AM	1	1	1	1	4
11	17-May-12	PM	1	1	1	1	4
	18-May-12	AM	1	1	1	1	4
12	24-May-12	PM	1	1	1	1	4
	25-May-12	AM	1	1	1	1	4
13	01-Jun-12	PM	1	1	1	1	4
	02-Jun-12	AM	1	1	1	1	4
14	07-Jun-12	PM	1	1	1	1	4
	08-Jun-12	AM	1	1	1	1	4
15	14-Jun-12	PM	1	1	*[2]	1	3
	15-Jun-12	AM	1	1	1	1	4
16	21-Jun-12	PM	1	1	1	1	4
	22-Jun-12	AM	1	1	1	1	4
17	28-Jun-12	PM	1	1	1	1	4
	29-Jun-12	AM	1	1	1	1	4
18	06-Jul-12	PM	1	1	1	1	4
	07-Jul-12	AM	1	1	1	1	4
19	12-Jul-12	PM	1	1	1	1	4
	13-Jul-12	AM	1	1	1	1	4
20	19-Jul-12	PM	1	1	1	1	4
	20-Jul-12	AM	1	1	1	1	4
21	26-Jul-12	PM	1	1	1	1	4

Week	Date	Period	Site 1	2	3	4	Total
	27-Jul-12	AM	1	1	1	1	4
22	02-Aug-12	PM	1	1	1	1	4
	03-Aug-12	AM	1	1	1	1	4
23	09-Aug-12	PM	1	1	1	1	4
	10-Aug-12	AM	1	1	1	1	4
24	16-Aug-12	PM	1	1	1	1	4
	17-Aug-12	AM	1	1	1	1	4
25	23-Aug-12	PM	1	1	1	1	4
	24-Aug-12	AM	1	1	1	1	4
26	30-Aug-12	PM	1	1	1	1	4
	31-Aug-12	AM	1	1	1	1	4
27	06-Sep-12	PM	1	1	1	1	4
	07-Sep-12	AM	1	1	1	1	4
28	13-Sep-12	PM	1	1	1	1	4
	14-Sep-12	AM	1	1	1	1	4
29	20-Sep-12	PM	1	1	1	1	4
	21-Sep-12	AM	1	1	1	1	4
30	27-Sep-12	PM	1	1	1	1	4
	28-Sep-12	AM	1	1	1	1	4
31	04-Oct-12	PM	1	1	1	1	4
	05-Oct-12	AM	1	1	1	1	4
32	11-Oct-12	PM	1	1	1	1	4
	12-Oct-12	AM	1	1	1	1	4
33	18-Oct-12	PM	1	1	1	1	4
	19-Oct-12	AM	1	1	1	1	4
34	25-Oct-12	PM	1	1	1	1	4
	26-Oct-12	AM	1	1	1	1	4
35	01-Nov-12	PM	1	1	1	1	4
	02-Nov-12	AM	1	1	1	1	4
36	08-Nov-12	PM	1	1	1	1	4
	09-Nov-12	AM	1	1	1	1	4
37	15-Nov-12	PM	1	1	1	**1**	4
	16-Nov-12	AM	1	1	1	1	4
38	24-Nov-12	AM	1	1	1	1	4
	24-Nov-12	PM	1	1	1	1	4
39	29-Nov-12	PM	1	1	1	1	4
	30-Nov-12	AM	1	1	1	1	4
40	06-Dec-12	PM	1	1	**1**	1	4
	07-Dec-12	AM	1	1	1	1	4
41	13-Dec-12	PM	1	1	1	1	4
	14-Dec-12	AM	1	1	1	**1**	4
42	20-Dec-12	PM	1	1	1	1	4
	21-Dec-12	AM	**1**	1	1	1	4
43	27-Dec-12	PM	1	1	1	1	4
	28-Dec-12	AM	1	1	1	1	4
44	04-Jan-13	PM	1	1	1	1	4
	05-Jan-13	AM	1	1	1	1	4

Week	Date	Period	Site 1	Site 2	Site 3	Site 4	Total
45	10-Jan-13	PM	**[3]	**	**	**	0
	11-Jan-13	AM	**1**	1	1	**1**	4
46	17-Jan-13	PM	1	1	1	1	4
	18-Jan-13	AM	1	1	1	1	4
47	24-Jan-13	PM	**1**	**1**	**1**	**1**	4
	25-Jan-13	AM	**1**	**1**	**1**	**1**	4
48	31-Jan-13	PM	1	1	1	1	4
	01-Feb-13	AM	1	1	1	1	4
49	07-Feb-13	PM	1	1	1	1	4
	08-Feb-13	AM	1	1	1	1	4
50	14-Feb-13	PM	1	1	1	1	4
	15-Feb-13	AM	1	1	1	1	4
51	21-Feb-13	PM	1	1	1	1	4
	22-Feb-13	AM	1	1	1	1	4
52	28-Feb-13	PM	1	1	1	1	4
	01-Mar-13	AM	1	1	1	1	4
Total			**103**	**103**	**102**	**103**	**411**

[1] Bold highlighting indicates surveys that were cut short due to excessive rain or agricultural spraying.

[2] Schedule survey not conducted due to unsafe conditions (shots fired nearby – shepherd after coyotes).

[3] Scheduled surveys not conducted due to surveyor illness.