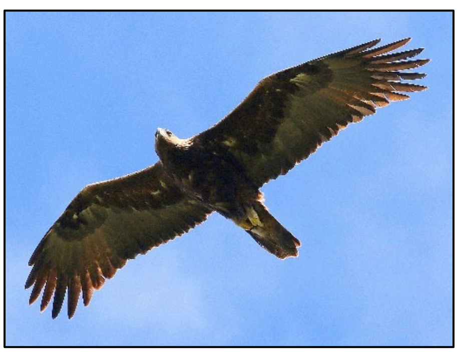

H. T. HARVEY & ASSOCIATES

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Golden Hills Wind Energy Center Postconstruction Fatality Monitoring Project: Final 3-Year Report

Project 3926-01

Prepared for:

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Attention: Renee Culver

Prepared by:

H. T. Harvey & Associates

TAC Approved Final – March 12, 2024

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Alameda County Wind Repowering Technical Advisory Committee Comments

The Altamont Pass Wind Resource Area (APWRA) Technical Advisory Committee (TAC) has reviewed and recommends for approval by California Environmental Quality Act (CEQA) Lead Agency Alameda County Community Development Agency the *Golden Hills Wind Energy Center Postconstruction Fatality Monitoring Project: Final 3-Year Report*, dated March 12, 2024.[1]

The TAC's recommendation recognizes Golden Hills Wind Energy Center's (Project) efforts to minimize and monitor operational impacts on avian and bat species between September 19, 2016 and September 15, 2019 in compliance with the APWRA Repowering Final Programmatic Environmental Impact Report (PEIR; State Clearinghouse #2010082063) Mitigation Measure (MM) BIO-11g: *Implement postconstruction avian fatality monitoring for all repowering projects* (pp. 3.4-111–3.4-113) and PEIR MM BIO-14b: *Implement postconstruction bat fatality monitoring program for all repowering projects* (pp. 3.4-133–135).

The TAC includes the following comments to run with the final report for transparency in understanding Project operational impacts during this three-year operational period.

Tricolored Blackbird: After completion of H. T. Harvey & Associates (2024a), genetic testing of black bird carcasses collected during the Project's post-construction fatality monitoring revealed a higher incidence of observed fatalities of the state-Threatened tricolored blackbird (*Agelaius tricolor*) than originally reported: 18rather than 3 total fatalities as reported in Table ES-1. Distribution of these tricolored blackbird fatalities inspace and time (summed across years) are shown on the following page.

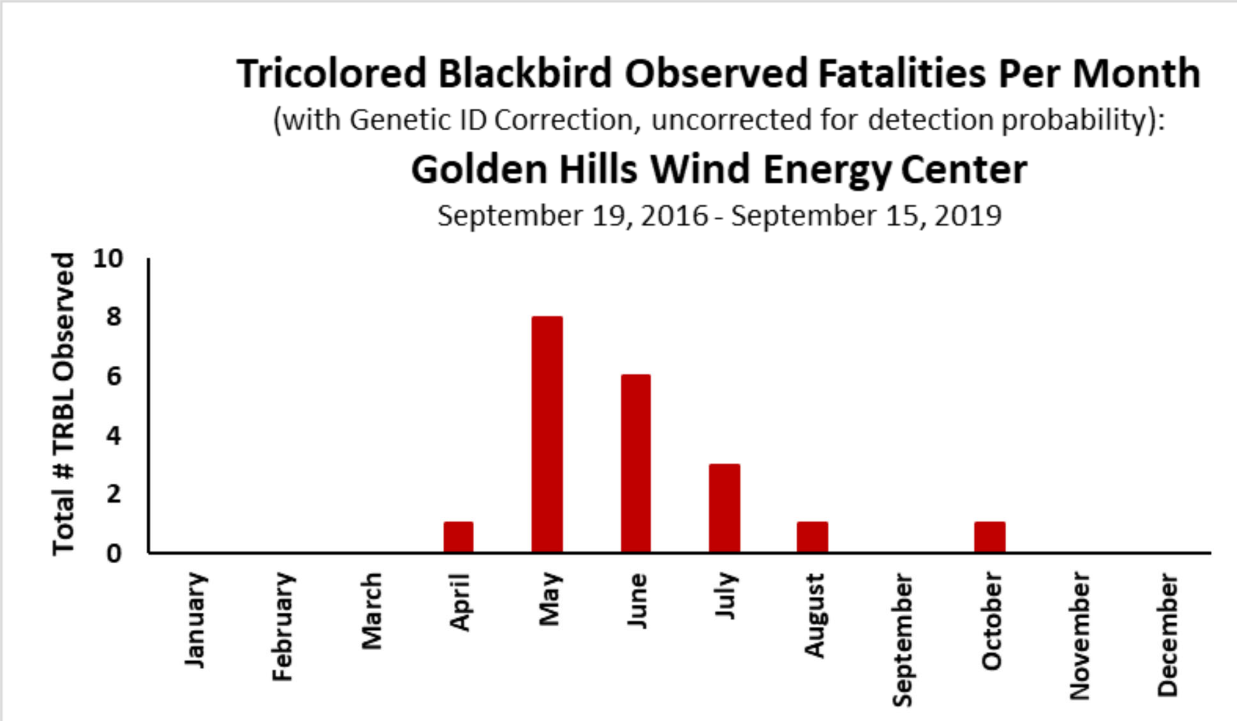
Due to exceeded fatality thresholds reported in H. T. Harvey & Associates (2024a), avian and bat adaptive management monitoring was implemented subsequently in accord with PEIR MM BIO-11i: *Implement an avian adaptive management program* (pp. 3.4-116–3.4-117) and PEIR MM BIO-14d: *Develop and implement a bat adaptive management plan* (pp. 3.4-135–3.4-137) and was reported in H. T. Harvey & Associates (2024b)[2] and Great Basin Bird Observatory and H. T. Harvey & Associates (2024)[3], respectively. This adaptive management monitoring focused on golden eagles, other large raptors, and bats. However, the Project also exceeded the PEIR threshold for all native non-raptors combined (i.e., 5.25 fatalities/MW/year versus baseline threshold of 4.5 fatalities/MW/year) and red-tailed hawks (0.52 fatalities/MW/year versus baseline threshold of 0.44 [or 0.40[4]] MW/year); these exceedances were not directly addressed with adaptive management.

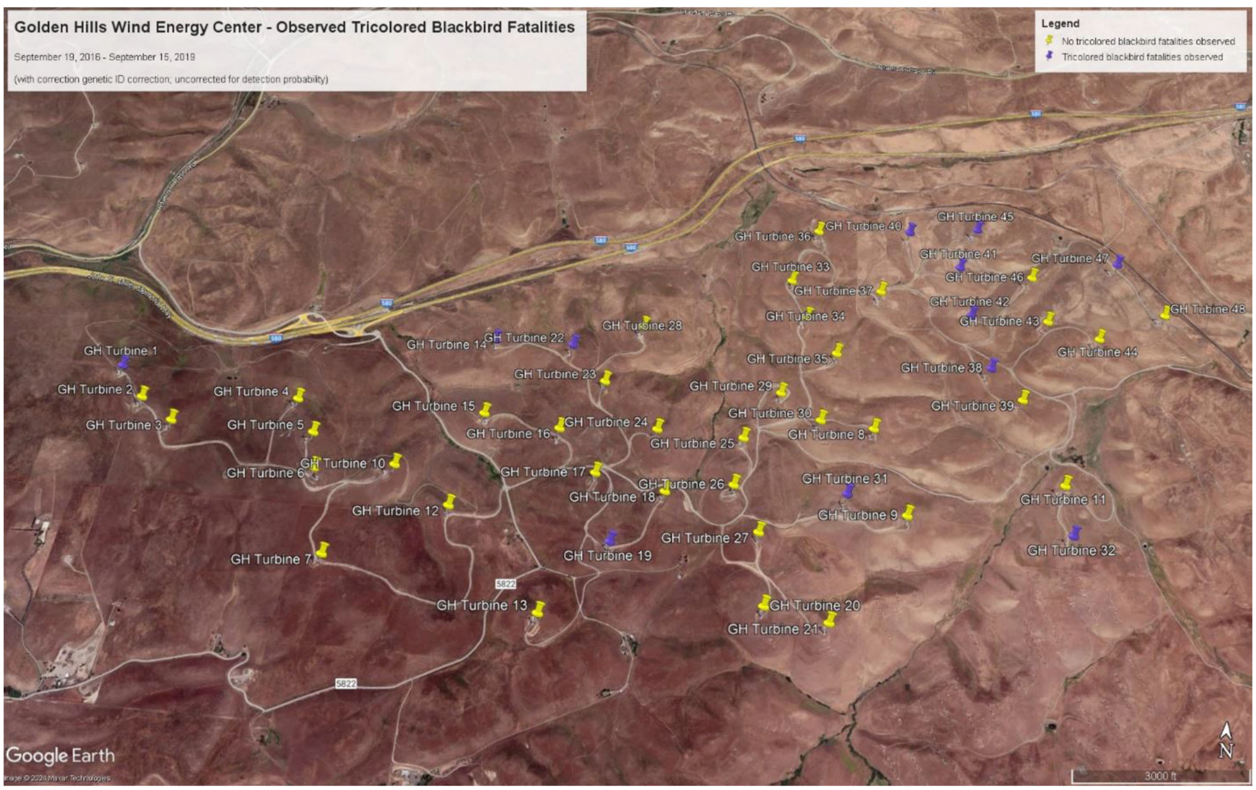
1 H. T. Harvey & Associates. 2024a. *Golden Hills Wind Energy Center Postconstruction Fatality Monitoring Project: Final 3-Year Report.* March 12, 2024. Project 3926-01. Prepared for Golden Hills Wind, LLC, Livermore, CA. 84 pp. + appendices.

2 H. T. Harvey & Associates. 2024b. *Golden Hills Wind Energy Center Golden Eagle Adaptive Management Monitoring Project: Final 3-Year Report.* March 12, 2024. Project 3926-03. Los Gatos, CA. Prepared for Golden Hills Wind, LLC, Livermore, CA. 33 pp. + appendices.

3 Great Basin Bird Observatory and H. T. Harvey & Associates. 2024. *2023–2025 Post-construction Curtailment and Mortality Monitoring for Bats at Golden Hills Wind, California Year 1 Report.* DRAFT: February 1, 2024. Prepared for Golden Hills Wind, LLC, Livermore, CA. 19 pp. + appendices.

4 See H. T. Harvey & Associates 2024a: Table 20.


Tricolored Blackbird Observed Fatalities Per Month
(with Genetic ID Correction, uncorrected for detection probability):
Golden Hills Wind Energy Center
September 19, 2016 - September 15, 2019
Total # TRBL Observed
10
8
6
4
2
0
January
February
March
April
May
June
July
August
September
October
November
December


Golden Hills Wind Energy Center - Observed Tricolored Blackbird Fatalities
September 19, 2016 - September 15, 2019
(with correction genetic ID correction; uncorrected for detection probability)
Legend
No tricolored blackbird fatalities observed
Tricolored blackbird fatalities observed
GH Turbine 1
GH Turbine 2
GH Turbine 3
GH Turbine 4
GH Turbine 5
GH Turbine 6
GH Turbine 7
GH Turbine 8
GH Turbine 9
GH Turbine 10
GH Turbine 11
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GH Turbine 40
GH Turbine 41
GH Turbine 42
GH Turbine 43
GH Turbine 44
GH Turbine 45
GH Turbine 46
GH Turbine 47
GH Tubine 48
5822
Google Earth
3000 ft
N

Milestones

Submitted to TAC on: January 8, 2020

Deadline for TAC Review and Comments: March 8, 2020

TAC Reviews and Comments Received: June 9, 2020, July 29, 2020, February 3, 2021

Revised Final Draft Returned to TAC: April 12, 2021

Additional TAC Preface Content Received and Report Approved Pending Addition: March 11, 2024

Final TAC-Approved Draft: March 12, 2024

Executive Summary

The Golden Hills Wind Energy Center (GHWEC) is an 85.92-megawatt (MW) repowered facility comprising 48 1.79-MW General Electric turbines located in the Altamont Pass Wind Resource Area (APWRA) of Alameda County, California. The facility is owned and operated by Golden Hills Wind, LLC, a subsidiary of NextEra Energy Resources, LLC, and began commercial operation in December 2015. This report summarizes the results of 3 years of postconstruction bird and bat fatality monitoring (Project) required to meet the conditions of approval outlined in the Conditional Use Permit (PLN2014-00032) issued for the GHWEC by the East County Board of Zoning Adjustments in 2014. The Alameda County Technical Advisory Committee (TAC) approved the monitoring plan, and H. T. Harvey & Associates implemented the monitoring effort beginning on September 19, 2016.

Field and Analytical Methods

This Project involved conducting comprehensive bird and bat fatality surveys throughout the year at all 48 turbines, with four raptor species of focal interest: golden eagle, red-tailed hawk, American kestrel, and burrowing owl (see Appendix A of the main report for scientific names of all relevant bird and bat species). Fatality surveys covered 105-meter (m) radius search areas around all turbines. Each year a different spatially balanced, randomized array of 16 turbines was searched at 7-day intervals; each year's remaining 32 turbines were searched at 28-day intervals. Scent-detection dogs and their handlers conducted all 7-day surveys and the 28-day surveys in Year 1; human searchers conducted the 28-day surveys in Years 2 and 3.

We conducted field trials throughout the study to provide a basis for developing season-specific annual fatality estimates adjusted for carcass detectability. We used freshly dead, frozen, and thawed bat and bird carcasses placed in small numbers most weeks based on spatially balanced, annual sampling designs for the 7-day and 28-day survey plots. We used species known or with the potential to occur in the study area, or similar surrogates, obtained as fatalities during the Project or elsewhere in central California. In Year 1, persistence monitoring yielded separate estimates of searcher efficiency (SE), carcass persistence (CP), and bleed-through (BT). A simplified approach used in Years 2 and 3 involved no follow-up carcass monitoring and yielded single *Big D* estimates of carcass detectability (CD) that integrated the influences of SE, CP, and BT in one summary metric. We used *GenEst* 1.4.4 to produce adjusted annual fatality estimates for each survey year, with each year's independent analyses tailored to the unique features of the annual datasets.

GenEst was designed to accommodate independent estimation of SE, CP, and BT, which the Year 1 detectability trials supported, whereas developing estimates for Years 2 and 3 required a customized approach tailored to "binomial" CD field trials (i.e., carcass is placed and either found or not during the relevant annual survey period, with no limits on time to discovery). In all cases, we developed independent predictive models for bats and for birds of various size classes. *Size Class* for birds included small (average species mass <100 g; smaller than a mourning dove), medium (101–500 g; mourning dove to crow/harrier size), and large (>500 g; buteo/raven size or larger), with the latter two classes lumped as needed to bolster covariate-class samples. Other potential predictors considered in factorial models were *Survey Type* (7-day or 28-day interval searches) and a season variable. The season variable took one of four possible forms considered independently: *Season*: fall = September – November; winter = December – February; spring = March – May; summer = June – August); *Season2A*: fall/winter and spring/summer; *Season2B*: winter/spring and summer/fall; or *Season2C*: fall/spring migration seasons and winter/summer nonmigration seasons.

For bats and each relevant *Size Class* of birds, we considered as potential final *GenEst* SE/CP and CD models only those models based on a minimum of 10 detectability trial cases per covariate-class combination. For the Years 2 and 3 analyses, the selected models included a season variable if any such model had a ΔAICc ≤2.00 compared to the top model. The latter approach reflected the following factors:

- Both the fatality and detectability data were expected to vary seasonally
- The spatially and temporally randomized distribution of trial carcasses throughout each monitoring year was explicitly designed to support developing seasonal adjustments for carcass detectability, if warranted
- It was recommended to bolster use of the customized *GenEst* routine for handling binomial detectability trials.

We used *GenEst* to generate adjusted annual fatality estimates for all bats, all nonraptors, all native nonraptors, and all raptors, as well as species-specific estimates for all species documented as fatalities during a given survey year. In summarizing the results, we focus on the following groups and species:

- Three primary species groups: bats, nonraptors, and raptors
- Two commonly encountered bat species and another less common species of regional conservation concern: Mexican free-tailed bat, hoary bat, and western red bat
- Four *focal raptor species*: golden eagle, red-tailed hawk, American kestrel, and burrowing owl
- Other species identified as of local conservation concern in the Programmatic Environmental Impact Report (PEIR) developed to guide APWRA repowering: Swainson's hawk, prairie falcon, barn owl, loggerhead shrike, and tricolored blackbird
- Four other species for which we typically documented five or more fatalities each year (the minimum number needed to produce a meaningful fatality estimate): horned lark, western meadowlark, white-throated swift, and house wren

We collectively refer to the four focal raptor species and other species of local conservation concern emphasized in the PEIR as *PEIR-emphasis species*.

We present summary statistics as adjusted fatalities per turbine per year, adjusted fatalities per MW per year, and facility-wide total adjusted fatalities per year. We present all *GenEst* adjusted estimates as medians with 95% confidence intervals (CI).

For bats in Year 2, few documented fatalities and no CD trial detections for human searchers on 28-day plots required producing adjusted fatality estimates based on extrapolating the results of the 7-day surveys conducted by detection-dog teams at 16 turbines. All other annual fatality estimates were based on data from both the 7-day and 28-day surveys.

To illustrate the spatial distributions of nonraptor and raptor fatalities across the study, we prepared maps that displayed the 3-year-aggregate fatality totals for each turbine. Color-coded symbols of different sizes portrayed the degree to which each turbine-specific 3-year total deviated from the average value for all turbines. Deviation was measured as the number of standard deviations (SDs) away from the mean; negative values indicated deviation below the mean, and positive values indicated deviation above the mean, binned as follows: <-1.5, -1.5 to -0.51, -0.50 to +0.49, +0.5 to +1.49 (*low hotspot*), +1.5 to +2.49 (*moderate hotspot*), and ≥+2.5 (*strong hotspot*). For raptors as a group and three of the four focal raptor species, we prepared maps based on adjusted fatality totals, whereas for golden eagles, we based the maps on unadjusted fatality totals. For bats, because we were unable to develop useful adjusted fatality estimates for 28-day turbines in Year 2, we illustrated variation among turbines based on only year-specific estimates for each turbine derived from the 7-day surveys conducted by detection-dog teams. We then binned the turbine-specific estimates based on deviation from the mean across all turbines to portray similar, though potentially biased, evaluations compared to those for raptors. In either case, this approach to classifying apparent fatality hotspots yielded insight that was strictly relative within a given species or species group, without factoring in consideration of the actual fatality totals as a potential further indicator of relative concern.

Results and Discussion

Carcass Detectability

The Year 1 SE and CP trial data could not be translated to exact equivalents of the Years 2 and 3 CD estimates, because the strategy for placing trial carcasses differed in Year 1. Nevertheless, estimated CD for bats on 7-day plots surveyed by detection-dog teams was higher in Year 1 (75%) than in Years 2 and 3 (53–59%). For birds on 7-day plots, the patterns of interannual variation differed slightly for small, medium, and large birds, but no significant variation was evident based on broadly overlapping 95% CIs. The study results emphasized the high value of using scent-detection dogs to survey for bats and small birds. Estimated annual CD on 7-day plots surveyed by detection dogs was sustained between 53–63% for bats and 36–60% for small birds, whereas CD rates for these taxa on 28-day plots surveyed by humans was ≤20%. Moreover, the combined Years 2 and 3 detection rates for humans surveying at 28-day intervals in our study were similar to the rates during the Vasco Winds study. In contrast, the detection-dog teams and human searchers performed comparably in detecting larger birds during this Project. Thus, whether or not absorbing the considerably greater expense and complexity of working with detection-dog teams compared to only human searchers would be cost-effective for other projects will depend on priorities.

Composition of Fatality Incidents

Across the 3-year study, we documented 486 bat fatalities involving seven native species, and 798 fatalities of volant birds involving 3 nonnative species and 45 native species, including 14 species of raptors and vultures. We excluded from fatality estimates 27 bats and 21 birds for which carcass aging suggested deposition occurred more than one search interval before the study began (reflecting 9 months of prior facility operation). To compose the datasets for estimating adjusted fatality rates, we excluded Year 1 *aged-out carcasses* deposited more than one search interval before the Project began, off-plot incidental finds, and a few on-plot incidental finds. We excluded the latter carcasses because they were found and left on survey plots by non-surveyors, and then were never found during a standard survey. The filtered datasets comprised 195 bats and 268 birds for Year 1, 120 bats and 218 birds for Year 2, and 126 bats and 212 birds for Year 3.

The documented bat incidents comprised mostly Mexican free-tailed bats and hoary bats, but also one individual each of two California species of special concern (CA-SSC): western red bat and western mastiff bat. The documented bird incidents included 11 species afforded special-status protection in California: golden eagle (California fully protected [CA-FP] and federally protected under the Bald and Golden Eagle Protection Act), peregrine falcon (CA-FP), white-tailed kite (CA-FP), northern harrier (CA-SSC), burrowing owl (CA-SSC), short-eared owl (CA-SSC), tricolored blackbird (California threatened [CA-T] species), loggerhead shrike (CA-SSC), Vaux's swift (CA-SSC), grasshopper sparrow (CA-SSC), and yellow warbler (CA-SSC). Of the nine PEIR-emphasis species, only Swainson's hawk was not represented among the fatalities during this study.

Three bat species and 10 bird species were not confirmed as fatalities during the prior Vasco Winds, Buena Vista, Diablo Winds, and APWRA-wide studies: California myotis, silver-haired bat, western mastiff bat; western grebe, rough-legged hawk, sharp-shinned hawk, rufous hummingbird, western kingbird, orange-crowned warbler, hermit warbler, fox sparrow, grasshopper sparrow, and black-headed grosbeak.

Fatality Estimates and Comparisons with Other APWRA Projects

The *GenEst* annual adjusted fatality estimates for focal groups and species are summarized in Table ES-1. The number of golden eagle fatalities found on and off survey plots (excluding Year 1 aged-out carcasses) was lower than the *GenEst* median estimates of total fatalities in all years, especially in Years 2 and 3. The differences equated to a highly improbable estimate of eight additional, undocumented eagle fatalities over the course of the study.

Compared to the adjusted fatality rates generated by other multi-year APWRA post-repowering studies, which were based on disparate monitoring regimes and analytical approaches, the 3-year average annual per MW fatality rates from this Project ranked marginally to significantly higher than all previous estimates for bats, all native nonraptors combined, loggerhead shrikes, golden eagles, and red-tailed hawks; above-average for all raptors combined; and below average for American kestrels and burrowing owls (Table ES-2). For the other PEIR-emphasis species, the fatality numbers and estimates from this Project were similar or nominally higher than those from previous post-repower studies; however, the project-specific fatality totals have been consistently too low for all such species during the post-repower period to produce meaningful fatality estimates and comparisons.

As new, larger turbines have replaced smaller, older-generation turbines, concern has risen about taller turbines increasing the probability of bat fatalities. Unfortunately, a lack of credible information about pre-repower bat fatality rates in the APWRA precludes a confident assessment of possible repowering effects on bats. Importantly, the PEIR threshold value established for bats did not effectively represent pre-repowering fatality rates in the APWRA, but rather constituted a largely meaningless national average with little direct applicability.

Table ES-1. Interannual Comparisons of *GenEst* Estimated Facility-Wide Adjusted Fatality Totals for Focal Groups and Species

	Year 1			Year 2			Year 3		
Taxon	**Contributing Fatalities[1]**	**Median**	**95% CI[2]**	**Contributing Fatalities**	**Median**	**95% CI**	**Contributing Fatalities**	**Median**	**95% CI**
All bats	195	477	360–680	116	508	393–740	126	447	243–1767
Mexican free-tailed bat	113	270	204–398	64	283	211–426	64	133	95–205
Hoary bat	73	185	133–283	44	200	140–303	49	270	99–1566
Western red bat	5	11	5–21	2	8	2–22	4	6	4–13
All birds	260	548	441–713	217	688	399–1674	213	469	367–646
Small birds	166	422	324–583	127	566	278–1549	147	388	289–563
Medium birds	19	25	19–37	38	48	41–61	28	35	28–47
Large birds	75	93	81–141	52	70	60–93	37	44	38–56
Nonraptors – all species	177	436	337–597	132	573	285–1555	156	399	301–574
Nonraptors – native only	173	427	326–607	127	534	240–1869	150	391	285–549
Raptors	83	104	90–155	85	111	97–144	56	69	60–84
Golden eagle[3]	***6***	***8***	***6–15***	***14***	***19***	***14–27***	***8***	***9***	***8–12***
Red-tailed hawk	55	67	58–104	28	38	30–53	23	28	23–38
American kestrel	4	6	4–10	9	11	9–14	7	9	7–14
Prairie falcon	0	0	–	1	1	1–2	0	0	–
Burrowing owl	2	3	2–6	22	29	23–39	13	16	13–24
Barn owl	2	3	2–6	3	4	3–4	0	0	–
Loggerhead shrike	0	0	–	1	14	1–101	0	0	–
Tricolored blackbird	1	2	1–5	0	0	–	2	5	2–18
Horned lark	41	98	70–143	34	178	72–690	23	60	37–102
Western meadowlark	23	65	41–107	15	52	19–192	28	79	50–131
White-throated swift	15	42	24–72	19	59	23–204	14	40	22–74
House wren	23	54	35–79	1	2	1–6	7	19	8–43

[1] Excludes (a) Year 1 fatalities deposited before the Project started; (b) incidental off-plot finds; (c) incidental on-plot finds that were left in place but never discovered by a searcher; and (d) Year 1 bat fatalities discovered on 28-day survey plots.
[2] CI = confidence interval.
[3] ***See Section 4.3.2 in the main report for discussion of appropriate mortality indices for this species.***

Table ES-2. Facility-Wide Estimates of Fatalities per MW per Year (95% CIs) for Bats, Nonraptors, Raptors, and PEIR-Emphasis Species from This Project and Other Monitoring Studies in the Altamont Pass Wind Resource Area

Study[1]	All Bats	All Native Nonraptors	Loggerhead Shrike	Tricolored Blackbird	All Raptors	Golden Eagle[2]	Red-tailed Hawk	Swainson's Hawk	American Kestrel	Prairie Falcon	Burrowing Owl	Barn Owl
This Project: 3-year average	5.55 (5.15–5.95)	5.25 (4.26–6.23)	0.05 (0.00–0.16)	0.03 (0.00–0.06)	1.12 (0.81–1.43)	***0.14*** ***(0.07–0.22)***	0.52 (0.25–0.79)	0	0.10 (0.07–0.14)	0.01 (0.00–0.01)	0.19 (0.02–0.35)	0.02 (0.00–0.05)
Vasco Winds: 3-year average	3.21 (3.06–3.36)	1.94 (1.10–2.77)	0.02 (0.00–0.07)	0.02 (0.00–0.06)	0.64 (0.20–1.09)	0.05 (0.02–0.07)	0.21 (0.04–0.38)	0	0.28 (0.07–0.49)	0.01 (0.00–0.03)	0.06 (0.00–0.17)	0.02 (0.00–0.05)
Buena Vista: 3-year average	0.67	1.01	0	0	0.36	0.07	0.17	0	0.09	nd[3]	0	nd
Diablo Winds: 5-year average	0.78	2.51	nd	nd	1.21	0.02 (0.02–0.02)	0.28 (0.24–0.32)	nd	0.07 (0.05–0.09)	nd	0.58 (0.39–0.77)	nd
APWRA-wide Pre-repower: 2005–13 average[4]	0.12–0.26	nd	0.15 (0.06–0.24)	0.01 (0.01–0.02	2.01 (1.46–2.55)	0.09 (0.07–0.10)	0.40 (0.33–0.47)	0.001 (0.001–0.001)	0.56 (0.37–0.74)	0.02 (0.01–0.02)	0.67 (0.44–0.90)	0.18 (0.14–0.21)
Average Estimates Reflected in Programmatic EIR [4]												
Repowered Vasco Winds Year 1	nd	2.09	–	–	0.64	0.03	0.25	–	0.30	–	0.05	0.03
Repowered Buena Vista 3-year	0.48–1.08	1.01	–	–	0.31	0.04	0.10	–	0.15	0.00	0	0.00
Repowered Diablo Winds 5-year	0.78	2.51	0.00	–	1.21	0.01	0.20	–	0.09	–	0.84	0.02
Nonrepowered APWRA-wide, 7-year	0.26	4.50	0.19	–	2.43	0.08	0.44	0.00	0.59	0.02	0.78	0.24

1 See Table 21 in the main document for sources of other project information and qualifying details.
2 ***See Section 4.3.2 in the main report for discussion of appropriate mortality indices for this species.***
3 Indicates no suitable estimate was available for comparison.
4 Entries with "–" indicate no relevant species-specific statistics were available for comparison. Discrepancies between these values and those above reflect either (a) post-reporting calculation adjustments made in consultation with NextEra and the Altamont TAC reflected in the PEIR values, or (b) updates reported in subsequent project reports reflecting the collection and analysis of additional years of monitoring data not reflected in the PEIR.

From 2005–2013, only 23 bat fatalities were found in the APWRA during regular searches at monitored turbines. Bat fatalities were discovered at higher rates beginning in 2007 after shorter search intervals were used, but primarily limited to post-repower studies. The number of documented bat fatalities then increased by an order of magnitude when we used scent-detection dogs during Year 1 of this Project. Although most previous studies suggested that bat fatalities were rare in the APWRA, this Project represents the first time that scent-detection dogs have been used for an extended period to conduct fatality searches in the area. Nevertheless, similar estimates of per MW fatality rates for bats from this Project and the post-repower Vasco Winds study suggests that repowering with larger, taller turbines might have contributed to an elevated fatality rate for bats.

Compared to the pre-repower adjusted estimates from the APWRA-wide avian study, the 3-year averages from this Project were slightly higher for all native nonraptors combined, significantly lower for all raptors combined, marginally higher for golden eagles, nonsignificantly higher for red-tailed hawks, and significantly lower for American kestrels and burrowing owls (Table ES-2). Among the other PEIR-emphasis species, meaningful pre- and post-repower comparisons were possible only for loggerhead shrikes and barn owls. Repowering in the APWRA appears to have had a positive outcome in reducing fatality rates for these species, though a clear, statistically significant difference was apparent only for barn owls. The elevated fatality rate for native nonraptors derived from this Project compared to the other post-repower studies and the PEIR threshold value may largely reflect the enhanced ability of detection-dog teams to find fatalities of small bats and birds compared to human searchers, as well as the positive benefit of shorter search intervals compared to the pre-repower estimates. However, variation in the climatological and attendant habitat conditions that prevailed during different studies also likely contributed to the observed differences in detected fatalities. Notably, compared to all previous APWRA fatality studies, during each year of this Project we documented comparatively high numbers of fatalities for both white-throated swift and Vaux's swift (CA-SSC; not documented as a fatality during the overall long-term APWRA-wide avian study). As has been suggested for bats, larger turbines that extend farther up into the airspace may represent a greater problem for high-flying, aerial-foraging swifts than the smaller, older generation turbines that were once prevalent in the APWRA.

The 3-year average annual per MW fatality estimate for all raptors combined from this Project was higher than for two of the three other post-repower studies, but was significantly lower than the pre-repower average from the APWRA-wide avian study. Such variability may partly reflect the influence of variable field and estimation methods, as well as the consequences of evaluating project impacts based on short-term studies that may inadvertently represent atypical conditions, but again, such differences likely also reflect the influences of substantial interannual variation in local and regional climate and landscape conditions, and the attendant effects on wildlife populations.

For golden eagles, the primary conclusion from this Project is an above-average annual fatality rate compared to other post-repower APWRA studies, and a marginally above-average rate compared to the multi-year pre-repower average (Table ES-2). The same conclusion pertained whether the comparison was based on the overinflated *GenEst* adjusted estimate of 0.14 fatalities per MW per year or a more reasonable estimate based on the actual numbers of on- and off-plot fatalities discovered during the Project (0.12 fatalities per MW per year). For multiple reasons discussed in the main report (see Section 4.3.2), it is our informed, professional opinion that unadjusted fatality counts, including all fatalities and injured eagles documented on and off survey plots during a multi-year project by consultants, other biologists, and facility staff, currently provide the best available mortality indices for golden eagles in the APWRA where grazed grassland predominates.

For red-tailed hawks, the primary conclusion from this Project is high interannual variability and a 3-year average per MW fatality rate that at least marginally exceeded the averages from prior pre- and post-repower APWRA studies. However, although the Year 1 fatality estimate was notably high, the Years 2 and 3 estimates were similar or lower than averages from the Vasco Winds post-repower and APWRA-wide pre-repower assessments. In contrast to the case for golden eagles and red-tailed hawks, repowering with fewer, taller turbines has almost certainly contributed to substantially reduced average fatality rates for American kestrels and burrowing owls. Similarly, although the relevant fatality data were often too sparse to support definitive conclusions for other PEIR-emphasis species, a definitive post-repower reduction in fatalities was also evident for barn owls.

Spatiotemporal Distribution and Fatality Hotspots

Across the 3-year study, the adjusted fatality estimates for bats indicated a 3-month fatality peak during fall 2017, a briefer and less substantial peak in fall 2018, and moderate activity during at least the latter half of the fall 2016 and first half of the fall 2019 migration seasons. Bat fatalities also consistently occurred at low to moderate rates from April/May through July, whereas bat fatalities were scarce during winter. Nonraptor fatality activity was generally sustained at moderately high levels from winter 2016/2017 through spring 2018, but dropped off during summer 2018 and again during early spring 2019. Raptor fatalities occurred during every month of the 3-year study. Red-tailed hawk fatalities were much more common throughout the first 8.5 months of the study than during any subsequent period. Beginning about 5 months into the study, we documented golden eagle fatalities broadly distributed throughout the remainder of the study, including commonly in spring and summer. Fatalities of American kestrels and burrowing owls were scarce during Year 1. After that, American kestrel fatalities were most common in fall/winter, and burrowing owl fatalities occurred in all but one of the next 17 months and then were more sporadic again.

The detection-dog teams found at least one bat fatality on every survey plot they assessed across the study, and ≥10 bat fatalities on 9–50% of the plots in a given year. Nonraptor and raptor bird fatalities also were found at most turbines during the study, including nonraptors every year at 42% of the turbines and raptors every year at 38% of the turbines. The hotspot assessments confirmed that above-average turbine-specific fatality rates for bats and nonraptors were broadly distributed across the facility, with a greater overall concentration of bat fatalities and potential hotspots in the western and east-central portions of the facility, and with WTGs 4, 5, and 6 clustered in the western sector a notable multi-year hotspot area for nonraptors.

For raptors as a group, three of five moderate hotspots were clustered in the northwestern sector, while two others were located in the southeastern sector of the facility. This pattern reflected the combination of high fatality rates for red-tailed hawks and golden eagles in the northwestern sector, generally high raptor fatality rates along the southeastern edge of the facility near WTGs 39, 11, and 32, and an overall concentration of burrowing owl fatalities in the northeastern sector. For golden eagles, in particular, WTGs 14, 15, and 16 clustered along the east side of the North Flynn Road corridor in the west-central sector was an especially notable fatality hotspot.

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List of Contributors

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Section 1.0 Introduction

The Golden Hills Wind Energy Center (GHWEC) is an 85.92-megawatt (MW) wind-energy facility comprising 48 1.79-MW General Electric turbines located in the Altamont Pass Wind Resource Area (APWRA) of Alameda County, California (Figure 1). The facility is owned and operated by Golden Hills Wind, LLC, a subsidiary of NextEra Energy Resources, LLC, and began commercial operation in December 2015. It is situated in a mixed agricultural landscape where cattle grazing is the primary agricultural land use. The GHWEC occupies space that formerly supported 775 smaller, less efficient, older-generation wind turbines that had been operated for many years. GHWEC repowering represents the second phase of NextEra's efforts to repower their overall APWRA wind-energy operations. In turn, that effort is a component of an overall APWRA repowering program designed to achieve greater and more efficient energy production, while reducing turbine-related fatalities of especially four focal raptor species: golden eagle, red-tailed hawk, American kestrel, and burrowing owl (Alameda County Community Development Agency 2014, CH2M Hill 2016). (See Appendix A for scientific names of all bat and bird species documented as fatalities or otherwise relevant to this study.)

This report summarizes the results of 3 years of postconstruction bird and bat fatality monitoring (Project) required to meet the conditions of approval outlined in the GHWEC Conditional Use Permit (PLN201-00032; East County Board of Zoning Adjustments 2014). The Alameda County Technical Advisory Committee (TAC) approved the monitoring plan and H. T. Harvey & Associates implemented the plan for three 52-week periods from September 19, 2016 through September 15, 2019.

Prior to this Project, a 9-year APWRA-wide avian monitoring study conducted from 2005–2013 provided comprehensive information on avian fatality rates across the APWRA, primarily during the pre-repower phase but also with some coverage of early repowered areas (ICF International 2016). Subsequently, three post-repower monitoring studies were completed prior to this Project at the Buena Vista (Insignia Environmental 2012), Diablo Winds (Western EcoSystems Technology 2006), and Vasco Winds (Brown et al. 2016) facilities. Hereafter, we refer to these four studies by name without further attribution. The turbine locations for the other three post-repower projects, as well as the newer Golden Hills North project, are shown on Figure 1.

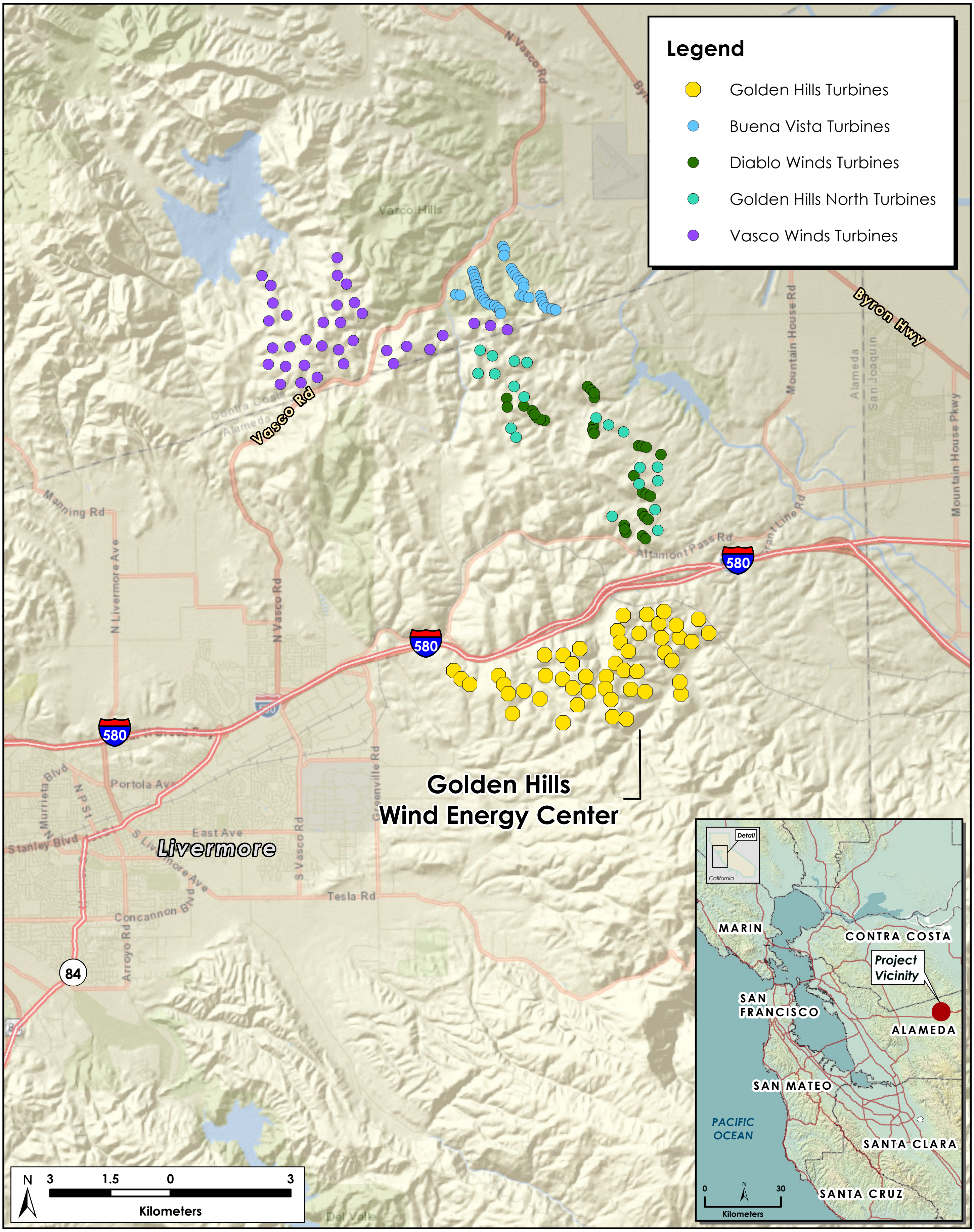

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Figure 1. Study Area Map

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Section 2.0 Methods

2.1 Study Site

The 48 GHWEC turbines have a hub height of 80 m and rotor diameter of 100 m, which translates to a rotor swept zone extending from 30–130 m above ground level. The habitat throughout the facility is rolling hills covered primarily with grazed grassland (predominantly nonnative, annual *Avena fatua*), with sparsely scattered trees and shrubs in intervening drainages. The turbines are situated on hilltops and ridgelines with the vertical relief between hill/ridge tops and intervening valleys mostly ranging from approximately 30–60 m, and occasionally up to as much as 100 m. The turbines are arranged in variable strings, with spacing between turbines typically 250–400 m and the maximum nearest-neighbor distance approximately 600 m. An array of decommissioned old-generation turbines lies immediately south of the GHWEC; whereas, Interstate 580 separates the GHWEC facility from other nearby operational wind facilities to the south (Figure 1). The comingled Golden Hills North and Diablo Winds facilities are the closest with operating turbines (shortest distance to a GHWEC turbine approximately 1.9 km).

2.2 Bird and Bat Fatality Surveys

2.2.1 Sampling Design

Each year of this 3-year study entailed conducting full-plot (105-m radius from turbine base) bird and bat fatality surveys at 7-day intervals at 16 (33%) of the 48 turbines, and at 28-day intervals at 32 (67%) turbines. The three 52-week sampling periods extended from September 19, 2016 through September 17, 2017 (Year 1); September 18, 2017 through September 16, 2018 (Year 2); and September 17, 2018 through September 15, 2019 (Year 3).

Each year's 7-day-interval surveys (hereafter 7-day surveys, turbines, and plots) were conducted at a different non-overlapping set of 16 turbines (Figure 2). We used generalized random-tessellation stratified (GRTS) sampling (Stevens and Olsen 2004) to ensure both balanced annual sampling and spatially and temporally representative 7-day-interval sampling of all turbines over the course of the 3-year study. Each year's 28-day surveys occurred at the remaining 32 turbines, such that all turbines were subject to 7-day surveys for 1 year and 28-day surveys for 2 years during the study.

During the initial 8 weeks of Year 1, we conducted supplementary bat-targeted fatality surveys at all turbines subjected to 7-day full-plot surveys. The supplemental pad/road surveys covered a 10-m radius around the turbines, plus portions of direct turbine-access entry roads that fell within the boundaries of the overall 105-m radius plots (Figure 2). The pad/road survey coverage included three surveys per week at every 7-day turbine (at 2-day intervals during the week, with a 3-day gap over the weekend), with one of the three weekly surveys accomplished as part of a standard 7-day full-plot survey.

Federal and California state agencies recommend that fatality searches occur at some turbines most days each week, in part so that substantial episodic events are more likely to be detected regardless of the scheduled search

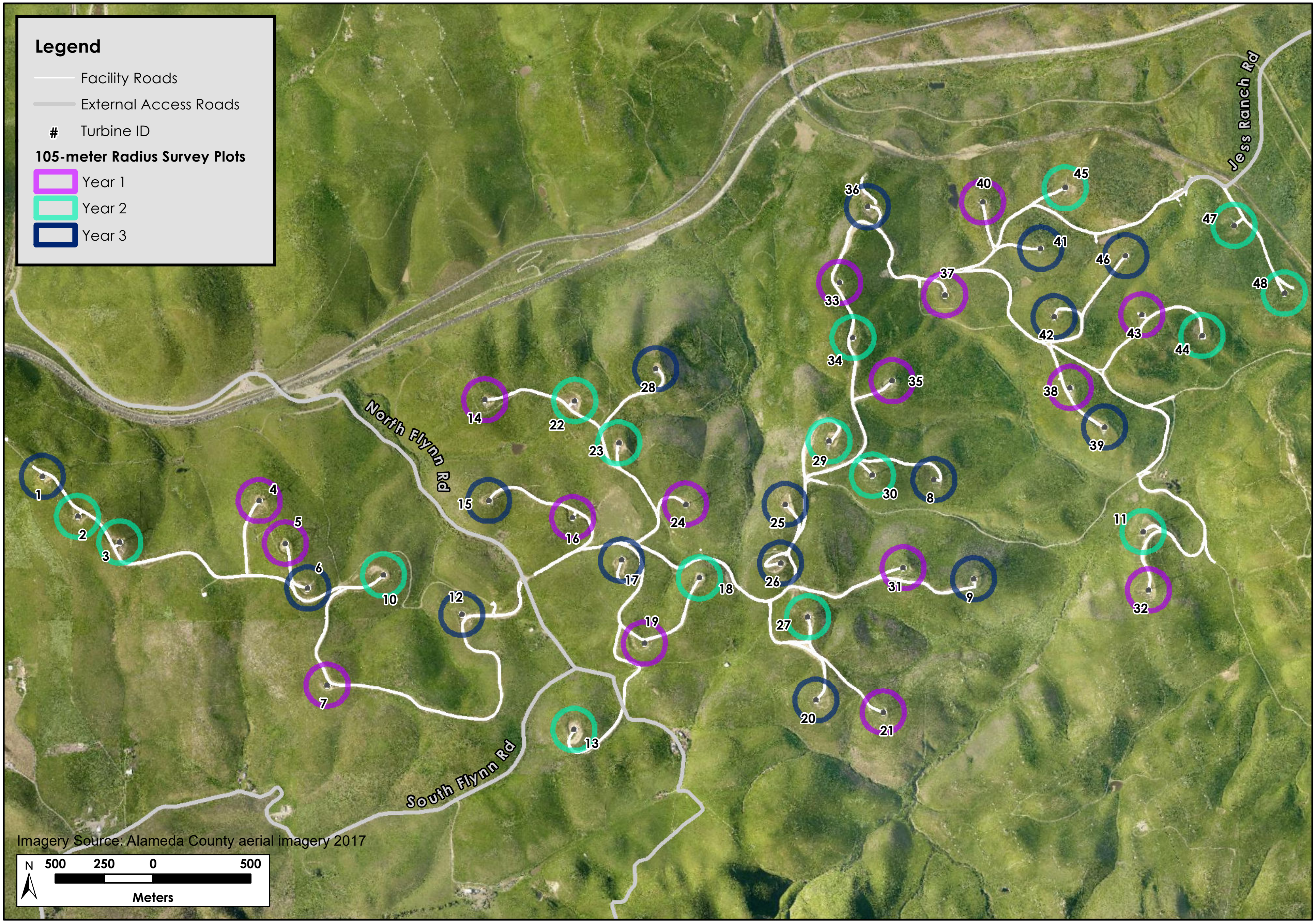

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Figure 2. Annual Arrays of Sampling Plots Subjected to 7-Day-Interval Fatality Surveys with Detection Dogs

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intervals at individual turbines (U.S. Fish and Wildlife Service 2012, California Energy Commission [CEC] and California Department of Fish and Game [CDFG] 2007). Throughout this Project, we scheduled surveys to provide some coverage at least 4 days per week, while maintaining necessary standard search intervals at all survey plots. In all monitoring years, we scheduled each week's 16 7-day surveys to occur across 4–5 weekdays, and the 28-day surveys covered eight plots per week for 4 weeks to constitute one complete round of coverage for 32 relevant turbines.

To minimize the potential for spatiotemporal sampling biases, we preselected the daily survey arrays to disperse sampling across the facility within each weekly period, while also ensuring reasonable logistical efficiency on a given day (i.e., minimizing back-and-forth travel across the facility). In addition, each day's surveys began at a randomly chosen (from among that day's relevant plots) start point(s) and then proceeded in the most efficient manner to cover that day's remaining plots.

2.2.2 Survey Protocols

In Year 1, we conducted all surveys using variable teams of scent-detection dogs and their handlers. In Year 2, with TAC approval, we shifted to conducting the 28-day surveys with human searchers to increase the logistical efficiency and cost-effectiveness of the effort.

The daily timing of surveys varied seasonally and depending on whether detection-dog teams or human surveyors were involved. Access constraints designed to protect sensitive amphibians constrained survey times to no earlier than 30 minutes after sunrise and no later than 30 minutes before sundown from November through mid-June. Otherwise, during summer the detection-dog surveys generally began as early as possible in the morning (earliest start time 04:20 H Pacific Standard Time [PST]) and tended to begin and end 1–2 hours earlier than at other times of year. It was also sometimes necessary to recommence a given day's surveys during evening hours to avoid the midday heat. Human surveyors were less constrained by the heat, but also generally began (earliest start time 06:36 H PST) and ended their surveys 1–2 hours earlier in summer than during other times of year.

Surveys proceeded according to predetermined schedules unless challenging weather precluded a safe and effective effort (e.g., heavy rain, lightning, or excessive heat) or other health and safety matters intervened (e.g., livestock-related constraints, excessive wildfire smoke during summer, and occasional turbine and roadway/weed-control maintenance activities). When 7-day surveys could not be completed as scheduled, we rescheduled the surveys in a manner that did not alter the search interval for any of the 7-day plots by more than 1–2 days, or skipped the missed surveys if that was not feasible. When 28-day surveys could not be completed as scheduled, we generally rescheduled them to occur as quickly as possible during the same week without altering the planned schedule for other surveys that week.

On the first day of surveying each individual plot at the beginning of the study, we classified all carcasses found using standard indicators to help distinguish fresh from older carcasses, and then eliminated all carcasses with an estimated time since death greater than the relevant search interval for a given plot. This approached helped ensure that the estimated fatality totals for the first survey interval were equivalent to the estimates for all subsequent weeks in representing fatalities accumulated during either a 7-day or 28-day period.

2.2.2.1 Detection-Dog Teams

All primary handlers and detection dogs involved in this Project had prior experience conducting bird and bat fatality surveys. During Year 1, five individual handlers and five individual detection dogs collectively accomplished all surveys. During Years 2 and 3, a single handler and the same five detection dogs accomplished most of the 7-day surveys, with three other handlers periodically assisting.

Throughout the study, the dog teams typically completed four full-plot 7-day surveys each day from Monday through Thursday, with a second dog team completing the 28-day and supplemental pad/road surveys during Year 1. A single handler and detection dog typically accomplished each individual plot-specific survey; however, excessive heat, high numbers of fatalities, difficult vegetation, or other dog management issues (e.g., variable sensitivity to other people and livestock on the landscape) sometimes required using a second dog to finish a given plot. More generally, an individual handler typically alternated use of two dogs to complete four full-plot surveys in a given day.

Detection-dog surveys were performed by using and adjusting to wind patterns. A handler used body movements, hand signals, verbal cues, and whistles to control a dog's movements relative to wind speed and direction to ensure full coverage of the designated survey plots. At the handler's discretion, the dog searched downwind of the intended survey area at a distance appropriate for the wind speed and direction. This technique created a flexible search pattern, allowing the handler to adjust the dog's movements and ensure full coverage. The detection distances and number of survey passes required depended on the wind speed (i.e., more survey passes at closer spacing in light wind and fewer survey passes spaced farther apart in strong wind). The handler also discretionarily directed the detection dog to increase the search intensity in areas of high habitat complexity (e.g., uneven ground and thick vegetation).

The wind conditions within the Project survey area usually provided ideal search conditions for detection-dog teams. Unpublished studies performed by H. T. Harvey & Associates have indicated that scent-detection dogs consistently identify target scents emanating up to 24 m away from the transect line walked by a handler in light wind conditions (2–3 kilometers per hour [kph]). The detection distance extends to well over 30 meters (m) in moderate to high wind conditions (16–24 kph) (also see Paula et al. 2011). However, winds in excess of 40 kph may hinder a dog's ability to detect target scents. Across the 2-year survey period, the wind speed (30-second average) recorded at the beginning of each detection-dog survey was <10 kph 59% of the time, 10–24 kph 36% of the time, 25–40 kph 4% of the time, and >40 kph <1% of the time.

2.2.2.2 Human Surveyors

In Year 2, two field biologists conducted most of the 28-day human surveys, with two other individuals periodically assisting. They covered each survey plot by walking 10 concentric transects around the turbine, with the first transect located 10 m from the turbine base and 10-m spacing between all subsequent transects. To maintain appropriate distances while proceeding along transects, surveyors developed a systematic approach to using an angle-compensated laser rangefinder to periodically check and adjust their distance relative to the turbine tower. While walking along each transect, the surveyors scanned approximately 5 m to each side to achieve coverage out to approximately 105 m from the turbine base.

2.2.2.3 General Applicability

We followed guidelines for classifying avian fatalities typically applied in the APWRA (Altamont Monitoring Team 2007, CEC and CDFG 2007). To qualify as a fatality, bird feather spots must have included either ≥10 feathers total or at least five tail feathers or two primaries located within ≤5 m of each other, whereas any bird or bat carcass that included bones, skin, or flesh qualified as a fatality. Upon finding a fatality, the handler or surveyor temporarily marked each location with flagging and then either returned after searching the entire plot to record data on all finds using a standard data form, or enlisted the help of another support biologist to collect the carcasses and record relevant data.

To record specimen data and digital photographs, biologists used iPads® equipped with a Geographic Positioning System (GPS); geographic information system (GIS) software (GIS Pro®, Garafa LLC, Provo, Utah); relevant aerial imagery; and Project infrastructure, turbine location, and transect overlays. Data recorded for every fatality incident included:

1. Unique incident number composed of the year, month, date, and a sequential fatality number for that day; e.g., the third specimen found on October 11, 2016, would be #20161011-03
2. Date and time found
3. Number of closest operational turbine (presumed to be the focal turbine if during a standard fatality search)
4. GPS coordinates: Universal Transverse Mercator (UTM), North American Datum 1983 (NAD83), accurate to ±3–4 m
5. Distance (m) and direction (degrees) from the nearest operational turbine
6. If closer to the carcass than the nearest turbine, distance (m) and direction (degrees) from other nearby structure that could pose a fatality or injury risk for bats or birds
7. Description of other nearest non-turbine structure, if relevant
8. Description of substrate on which carcass was found, determined at the scale of approximately a few square meters centered on the carcass (i.e., turbine pad, road, bare dirt/disturbed soil, grazed/short grass, or tall fallow grass/forb)
9. Species or closest taxonomic group possible; e.g., red-tailed hawk, unknown buteo, or, as a last resort, unknown large raptor, or California myotis, unknown myotis, or, as a last resort, unknown small bat. If an unknown bird, specify unknown small, medium, or large bird, with size classes defined as follows:
    - *Small* = ≤100 grams (g); smaller than a mourning dove
    - *Medium* = 101–500 g; mourning dove/American kestrel up to American crow/northern harrier size
    - *Large* = >500 g; common raven/red-tailed hawk size or larger
10. Evidence for species identification; e.g., plumage, individual feathers, measurements, hair sample for bats, etc. If a recognized sensitive species, detailed notes, measurements, and extensive photos were recorded to substantiate ID

11. Age and sex, if known
12. Basis of age/sex determination; e.g., for birds—plumage, molt limits, fault bars, etc.
13. Carcass condition:
    - *Intact – fresh*
    - *Intact – partially decomposed*: stiff-flesh present; insects have begun to reduce carcass
    - *Intact – decomposed:* intact/mummified/rotten carcass or feathers/fur and bones only
    - *Scavenged – fresh*: fresh tissue and blood present; evidence of scavenging by vertebrates
    - *Scavenged – partially decomposed*: stiff-flesh present; insects have begun to reduce carcass in addition to vertebrate scavenging
    - *Scavenged – decomposed*: decomposed body parts/bones with or without flesh/feathers/fur; evidence of vertebrate scavenging
    - *Scavenged – feather spot*: record notes about whether feathers are fresh, bleached, or decomposed
    - *Injured*
    - *Other, see notes*

    Carcass condition notes: confirm intact or complete but severed carcass, or list parts found versus missing, with specific reference to left and right parts and the kinds of feathers found (especially primaries, secondaries, and rectrices), and describe evidence of blunt-force trauma (i.e., broken bones, lacerations, severed body parts, major contusions, etc.), internal bleeding, electrocution (i.e., singed feathers, other burn marks, clenched talons, etc.), other injuries, emaciation, disease, etc.
14. Likely cause of death:
    - *Blade Strike/Turbine Collision*

      A. Intact carcass with injuries consistent with a turbine blade strike or tower collision

      B. Intact or scavenged carcass of rarely depredated large raptors and vultures with no discernable signs of trauma, found within the search radius

      C. Intact carcass of other birds and bats (no evidence of vertebrate scavenging/predation) with no apparent injuries, found within the 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, and found outside of turbine search radius and within 10 m of power lines or guy wires

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

- *Other Collision*
  Intact carcass with injuries consistent with having collided with fence, building, other equipment/structure, or vehicle (i.e., blunt-force trauma, broken wings or neck, etc.), but no evidence of blade strike, electrocution, or line strike, and found outside of turbine search radius and beneath (within 10 m) power lines or guy wires (vertebrate scavenging/predation may obscure or mimic line-strike injuries)
- *Unknown*
  Lack of obvious trauma, carcass condition (state of scavenging or degradation), or location precludes confident assessment

15. Estimated time since death: fresh, <1 week, <1 month, or >1 month
16. Types of insects observed on/in carcass, if any, with brief description of kind and size
17. Scavenger/predator: type of predator or scavenger (bird, large mammal, small mammal, or invertebrate), if possible to determine, and the effects of scavenging/predation
18. Condition of flesh: fresh, gooey, dried, none
19. Condition of eyes: round and fluid-filled, sunken, dried, none
20. Condition of enamel, for birds: waxy covering on culmen and claws present or not
21. Color, for birds: leg scales and/or cere have begun to fade or not
22. 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
23. Unique image numbers for 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. Typically, 3–4 initial photos are taken before the carcass is disturbed to clearly document the initial carcass disposition and the focal-area and landscape setting, with additional photos taken as needed to document other salient features of the specimen.

Other data recorded each time an area was searched included wind and weather conditions, classification of the groundcover on the plot as a whole, and notes about relevant search-area access issues and constraints (e.g., related to livestock and facility/turbine maintenance activities).

After completing a given survey and recording data for each incident, the biologists placed all discovered carcasses or body parts in zip-locked plastic bags, and clearly labeled each bag with information about the collection circumstances, the species ID, and the relevant incident number. All carcasses were then transferred to the NextEra office facility in Livermore for further processing, specimen-labeling conforming to the requirements of relevant state and federal permits, and storage in the designated freezer located there. Variants of this standard procedure were implemented when either selected special-status species or injured/debilitated bats or birds were found. Relevant agency permits required special authorizations and communications to handle and manage carcasses (or injured animals) of species listed as state or federally endangered, threatened, or candidates for listing, and/or as a California fully protected (CA-FP) species. All such specimens typically were collected within 48 hours after confirming appropriate authorizations.

If a biologist discovered an injured/debilitated bat or bird, appropriate arrangements were made to secure the animal as quickly as possible and have a NextEra representative transport it to a nearby wildlife rehabilitation facility for care. Although injured/debilitated animals could have been harmed elsewhere (whether by another turbine or by unrelated factors outside of any survey plots) and wandered onto a survey plot while still mobile, we assigned all such animals found within a survey plot to that turbine and recorded them as fatalities for estimation purposes.

Our biologists also documented any bird or bat fatalities or injuries reported to us by others, or that they found in the Project area incidentally outside of the standard survey areas or times. They recorded each such carcass or injured animal as an *incidental* find. If such a carcass was found on a survey plot by a biologist not involved in surveying that plot, and the find did not involve a special-status species requiring immediate collection (e.g., golden eagle), the biologist recorded initial data and photos as for any fatality. Then they specially marked the carcass to distinguish it as previously found (similar to placed detectability-trial carcasses; see Section 2.3), and left it in place to allow for potential detection during a subsequent standard survey. If such a carcass was never found during a standard survey, we excluded it from estimating adjusted fatality rates. If the specimen was either a special-status species requiring collection prior to the next standard survey of that plot or an injured bird or bat that was immediately collected and taken to a rehabilitation facility, we conservatively assumed that a survey team would have discovered all such incidents during a subsequent survey and included them to produce adjusted fatality estimates (see Section 2.4).

Bird body parts severed by a turbine blade strike or dispersed by scavengers are often scattered across a survey plot, such that sometimes not all parts of a carcass are found during the same survey. When large birds such as red-tailed hawks and golden eagles are involved, it is often straightforward to match locations and parts to avoid duplicate fatality records. However, where comparatively abundant bat and smaller bird fatalities are concerned, post-mortality scavenging frequently produces feather spots that are readily dispersed by wind, and leaves behind other scattered, small bits and pieces of carcasses that mostly go unnoticed by human searchers, but are still readily detected by dogs over the course of multiple surveys. This scenario complicated efforts to match parts to minimize the potential for duplicate fatality reporting. Whenever the surveyors documented multiple incomplete carcasses of an individual species on a turbine plot, we compared the discovery locations, the carcass parts represented, and the relevant ages and degradation states of the different finds to support combining multiple records as single fatalities whenever justified by the available evidence. Nevertheless, the final dataset might have included some duplicate records due to complications caused by the dispersal of scavenged or degraded carcasses for which a definitive parts match was not possible.

2.3 Carcass Detectability Trials

Throughout the study, we conducted trials to estimate carcass detectability and incorporated relevant correction factors to calculate adjusted fatality estimates (see Section 2.4). During Year 1, we used the same trial carcasses to support deriving separate estimates of searcher efficiency (SE), carcass persistence (CP), and bleed-through (BT; i.e., the proportion of carcasses that persist undiscovered across multiple searches) by closely monitoring all carcasses after placement (Warren-Hicks et al. 2013). During Years 2 and 3, we documented and collected all placed carcasses discovered by surveyors, but we did not monitor carcasses for persistence. This approach resulted in single estimates of the probability of detection that integrated the influences of imperfect searcher efficiency, carcass removal by scavengers or abiotic factors, and bleed through (discussed further in Sections 2.3.2 and 2.4.3).

A designated biologist not involved in the fatality surveys periodically placed freshly dead (estimated to be no more than 1–2 days dead, then frozen and thawed) and specially marked bat and bird trial carcasses on the landscape in survey plots, without the fatality surveyors having knowledge of such placements. Placements occurred based on year-specific GRTS allocation plans and scheduling that ensured effective spatial and temporal representation across the facility, as well as effective randomization of placements relative to substrate variability. We sought to place a sufficient number of trial carcasses to enable effective annual estimation of bird and bat detection rates on a quarterly seasonal basis.

Our objective for each quarter of the 3-year study was to place at least 10 bat, 10 small bird, 10 medium bird, and 10 large bird trial carcasses spread out across the 7-day plots, and a similar array of carcasses on the 28-day plots. Seeking to achieve a minimum per-quarter sample size of 10 trial carcasses on 7-day plots and 10 trial carcasses on 28-day plots for each of the four taxon/size classes reflected that 10 samples per covariate class combination is considered the minimum for generating reliable SE and CP estimates (Huso et al. 2012). However, challenges finding sufficient numbers of fresh carcasses (constrained by relevant federal and state permits authorizing such acquisitions for the purpose of this Project) limited our ability to consistently achieve this objective. Limited availability of bat carcasses constrained the trial samples in Year 2 for several months, and limited availability of native medium and large birds required lumping the two classes for analysis in Years 1 and 2 to achieve acceptable covariate-class sample sizes (see Section 2.4).

We did not explicitly seek to achieve sufficient samples to support modeling the influence of substrate/visibility classes on detectability by stratifying placements to sufficiently represent relatively uncommon high-visibility substrates (i.e., gravel and bare dirt). Instead, we assumed that the spatially balanced, randomized placement of carcasses across the facility throughout each annual period would effectively represent the relevant influences of substrate/visibility on the ability of searchers to move through the survey plots and detect relevant carcasses. Similarly, we did not seek to model handler-dog teams or human searcher identities explicitly as covariates in the estimation models. Instead, throughout the study we ensured that all relevant surveyor combinations were presented with opportunities to detect diverse specimens of different types and sizes.

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 refined the classification to include small (≤100 grams [g]), medium (100–500 g), and large (>500 g) birds (see Section 2.2.2) and, to the degree practicable given the availability of suitable carcasses, we sought to balance representation of all three groups in our detectability-trial sampling. Bat trial carcasses included mostly medium-sized Mexican free-tailed bats, but also some larger adult hoary bats and big brown bats, as well as some smaller *Myotis* spp. To ensure that we collected sufficient trial-carcass data to support independent estimation of bat fatalities based on the supplemental fall pad/road surveys, we specifically augmented the bat placements during fall 2016 to ensure adequate sample-size representation for the pad/road survey areas.

Before placing a trial carcass on the landscape, the designated biologist marked each trial carcass with a small piece of green electrical tape wrapped around a leg or bat wing, which included a unique trial ID number for reference if the specimen tag was large enough for such a marker to be placed and remain reasonably inconspicuous. The biologist also clipped off the tips of primaries, secondaries, and rectrices on all bird trial carcasses to facilitate identification when only a feather spot remained following a scavenging event. This marking scheme ensured that surveyors were readily able to distinguish trial specimens from new fatalities, without rendering the specimens unnaturally conspicuous (Smallwood 2007, U.S. Fish and Wildlife Service 2012). Upon placing each carcass, the designated biologist mapped the placement location, recorded relevant placement data (including a substrate classification), and took digital photographs of the placement using a standard iPad-based data entry.

For practical reasons dictated by state permitting requirements, we used only largely intact specimens and carcasses that were freshly dead, frozen, and thawed, in the detectability trials. We acknowledge that scavenging rates of fresh/frozen and thawed carcasses may be lower than for fresh/never frozen specimens (Kerns et al. 2005, Strickland et al. 2011), and that dismembered or opened carcasses may attract scavengers more readily than intact carcasses (Smallwood 2007). Nevertheless, state permitting requirements for using outside bat and bird specimens for detectability trials dictated that all such specimens must have been frozen before deployment to help manage possible disease transmission, and managing the freezing, thawing, and placement of torn or dismembered carcasses was impractical. Moreover, the CP trials in Year 1 and the integrated CD trials in Years 2 and 3 both required placing only freshly dead (frozen and thawed) specimens to constitute trials that matched, to the degree practicable, the carcass persistence patterns of freshly deposited fatalities.

To reduce possible biases related to leaving scent traces or visual cues that may unnecessarily alert potential scavengers, the designated biologist handled all trial specimens only with nitrile 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 minimize the chance of artificially attracting scavengers. In addition, when placing carcasses, the biologist took a circuitous route to the randomly selected placement location, then randomly tossed the carcass 2–3 m away (recording the direction and distance to the deposited carcass from the predetermined placement coordinates), and then departed using a different circuitous direction. These protocols minimized the chance that the detection dogs (as well as potential scavengers) could follow human scent trails to the trial specimens (Reyes et al. 2016) or that human surveyors could follow visual cues to the trial carcasses.

Throughout the study, we used species known, or with the potential to occur, in the study area, including primarily native species, but also a few nonnative species that routinely occur in the study area, such as European starling, rock pigeon, and house sparrow (CEC and CDFG 2007, Smallwood 2007). We avoided using other surrogate animals because of evidence that scavenging rates for avian surrogates such as gamebirds and chickens, and for 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 detectability trials during this Project were (a) found as freshly dead fatalities during the study; (b) recovered freshly dead elsewhere as authorized by staff salvage permits (broad coverage for birds and bats); or (c) were gathered from regional animal rescue/rehabilitation centers, avian control operations at regional airports, and other approved and permitted sources (e.g., local falconers and raptor trapping operations). All of the latter specimens died naturally, were euthanized using only CO_2, or were shot with non-lead ammunition, showed no outward signs of disease, were never treated with medicines, and were frozen immediately after they died or were euthanized.

2.3.1 Year 1

2.3.1.1 Searcher Efficiency and Bleed Through

To maximize the probability of placed carcasses remaining long enough to serve as an effective SE trial, in Year 1 the designated biologist placed all trial carcasses the evening before or early in the morning on the same day when the next fatality survey on the relevant plot was scheduled. Dog handlers recorded when they discovered any of the specially marked and placed trial carcasses, and then left the carcasses in place to support continued monitoring for CP. Because trial carcasses were left on the landscape for up to 60 days to assess CP, the detection-dog teams often had multiple opportunities to detect a given trial carcass, which provided a means to estimate BT as originally defined by Warren-Hicks et al. (2013).

2.3.1.2 Carcass Persistence

In Year 1, we monitored the persistence of trial carcasses for up to 60 days or until the carcass was removed to the point of no longer qualifying as a detectable fatality. Once the dog teams completed a day's surveys, the handlers informed the designated biologist about any new trial carcasses they detected to ensure that a trail camera was installed as quickly as possible to begin monitoring the carcass for persistence.

The designated biologist monitored trial carcasses with infrared-triggered trail cameras during the first 2 weeks, and then through direct observation on a weekly basis thereafter. In select cases where camera monitoring was infeasible for part or all of the first 2-week period, the biologist sought to monitor such carcasses through direct observation on a daily basis during the first week and approximately every other day during the second week. Much of the CP monitoring that occurred after the initial two-week monitoring period involved the detection dogs re-verifying whether a given trial carcass was still present during the course of a standard fatality survey. In many cases, having the dogs verify the continued presence of known carcasses resulted in extended persistence times, as they were able to reliably verify the continued presence of especially partial bat carcasses well after they became undetectable for human searchers.

2.3.2 Years 2 and 3

In Years 2 and 3, we adopted the TAC-approved Big *D* approach to estimate carcass detectability (CD) (Brown et al. 2016, ICF International 2016, Smallwood and Neher 2016, Smallwood 2017). This alternative approach included the following elements:

- Trial carcasses were placed most weeks throughout the study period based on a randomized, spatially balanced placement design and irrespective of when surveys were scheduled.
- Detections were recorded whenever they occurred and carcasses were collected upon discovery (as with all actual fatalities).

- Carcasses were not monitored for persistence or to determine presence/absence before surveys.
- CD estimates generated for bats and birds of different size classes integrated the influences of imperfect searcher efficiency and removal of carcasses by scavengers and abiotic factors.

We sought representative variation in the ages of detectability trial carcasses by placing small numbers of trial carcasses on both 7-day and 28-day plots during most weeks irrespective of survey schedules, and by allowing detections to occur at any time after a trial carcass was placed. Regularly dispersing new trial carcasses across the landscape throughout the survey period also helped mimic natural fatality deposition patterns to the degree practicable. Achieving this objective was important to ensure the validity of the Big *D* "binomial" approach to conducting detectability trials (i.e., trial carcasses are either found or not, without regard to elapsed time between placement and discovery nor the reasons for failed detection) and using available estimator software to produce adjusted fatality estimates (discussed further in Section 2.4.2).

Unlike in Year 1, once a Year 2/3 surveyor discovered a trial carcass and recorded relevant data, they collected whatever remained of the carcass per standard practice for all documented fatalities. Otherwise, placed carcasses were not monitored further and no attempt was made to recover undiscovered trial carcasses. Here it is important to note that heavy scavenging before a surveyor or detection-dog team had a chance to search for a trial carcass could effectively remove the specimen tag and evidence of clipped feathers, and thereby preclude ready identification of the specimen as a trial carcass. We minimized errors of this nature by carefully crosschecking locations and other details when heavily scavenged, unmarked fatalities of species used as trial specimens were discovered on relevant plots. Nevertheless, it is possible that the scavenged, unmarked remains of some bat and small bird trial carcasses were recorded as fatalities, after scavengers dispersed the remains to other distant locations still on the relevant survey plot.

2.4 Fatality Estimates

2.4.1 Filtering Records Prior to Analysis

Before calculating fatality estimates, we excluded Year 1 carcasses that were (a) discovered during the first two weeks of surveys and appeared to be more than one week old; or (b) discovered during the second two weeks of surveys and appeared to be more than one month old. We eliminated these *aged-out carcasses* from the estimates, because they were likely deposited more than one search interval before the Project began, reflecting fatalities accumulated during the preceding 9 months of facility operation. In producing modeled fatality estimates, we also excluded (a) *off-plot incidental* finds (i.e., carcasses opportunistically found outside of standard survey plots), except two injured raptors (see Section 3.4.1); (b) *on-plot incidental* finds that a non-surveyor found and left in place on a standard survey plot, and the carcass was never found again during a standard survey (carcass detectability adjustments account for such misses); and (c) carcasses of non-volant juvenile birds.

2.4.2 Adjusted Fatality Estimates

We used *GenEst* 1.4.4 to produce adjusted fatality estimates (Dalthorp et al. 2018a, b; Simonis et al. 2018), conducting independent, year-specific analyses for bats and birds. *GenEst* was designed to support independent estimation of SE, CP, and BT, and our Year 1 SE/CP trial data supported that approach. For Years 2 and 3, the *GenEst* developers provided a work-around to support using the software to produce adjusted fatality estimates based on the Big *D* binomial approach to conducting detectability trials (see Appendix B).

The fundamental difference between the Year 1 conventional and the Years 2 and 3 modified approaches to fatality estimation reflected applying variants of the original Horvitz-Thompson (H-T) estimator (Horvitz and Thompson 1952, Thompson 1992):

Year 1 $$F_A = \frac{F_U}{SE \times CP \times DWP}$$

Years 2 and 3 $$F_A = \frac{F_U}{D \times DWP}$$

where F_A = adjusted fatality estimate, F_U = unadjusted count of fatalities over a given monitoring period, *SE* = estimated searcher efficiency; CP = estimated probability of carcass persistence; *DWP* = distance weighted proportion of carcasses falling within a survey plot (Huso and Dalthorp 2014); and *D* = Big *D* probability of carcass detection.

Given independent SE and CP data, as in Year 1, *GenEst* models underlying processes that influence SE and CP by developing nonlinear predictive models that capture both median tendencies and change through time (Simonis et al. 2018). The SE estimation model specifies a probability formula and a shape formula. The probability formula describes variation among covariate classes in *p*, the probability of detection during the first search interval after a carcass is placed, given that the carcass is present at the time of the search. The shape formula describes variation in *k*, which represents the fractional change in SE with each successive search as carcasses age. Similarly, the CP estimation model includes a location formula tracking median persistence across covariate groups (*l*), and a scale formula tracking change in persistence through time (*s*).

The work-around for Years 2 and 3 accommodated using the *GenEst* SE module to generate CD estimates based on simple binomial trial outcomes (carcass found or not). The modified approach included modeling the influences of potential covariates, but excluded explicit modeling of bleed-through and underlying processes reflecting the influence of time and carcass aging on detectability by searchers and removal by scavengers or abiotic factors (Dalthorp et al. 2018a). Rather than have the estimator model known influences on SE and CP in an attempt to produce less-biased estimates, applying the customized Big *D* approach assumed that the pattern of trial placements effectively mimicked the pattern of fatality depositions across the study landscape. This assumption was necessary to ensure that the resulting CD estimates effectively accounted for the influence of variation in elapsed times between placement and discovery on the degradation state of carcasses, and attendant interactive effects on the probability of removal by scavengers or abiotic factors and detection by searchers.

Limiting our assessment to year-specific analyses was further motivated by the analytical limits of operating *GenEst* from the standard graphical user interface (GUI). Operated from the GUI, *GenEst* is limited to evaluating, and producing reliable results concerning the influence on SE/CP of at most three covariates. Further, the GUI limits analysts to producing fatality estimates and corresponding confidence intervals (CIs) for at most two-way splits of the fatality observations. These limitations precluded developing multi-year models for birds that included *Year*, *Size Class*, *Survey Type*, and a season variable as predictors/covariates in the same models to estimate SE and CP in Year 1 or CD in Years 2 and 3. Instead, we limited our assessment to year-specific analyses tailored to each year's relevant bird size-class representations, survey specifics, and seasonal relationships. For bats, year-specific analyses were further motivated by inadequate representation of documented bat fatalities (n = 4) and discoveries of bat trial carcasses placed to quantify detectability (n = 0) on 28-day plots surveyed by humans in Year 2. These limitations translated to uniquely estimating Year 2 bat fatalities based only on data from the 7-day surveys and extrapolating to represent the entire facility (see Sections 3.3.3 and 3.5.2).

To develop the year-specific *GenEst* models, we evaluated the influence on SE, CP, and BT (Year 1) and on CD (Years 2 and 3) of the following covariates:

Size Class **(birds only)**: *small*, *medium*, and *large* (as defined in Section 2.2.2.3), with medium and large birds combined in Years 1 and 2 to overcome sample-size limitations

Survey Type: *7-day* and *28-day* search intervals (not relevant for bats in Year 2; based only on 7-day surveys)

Season (four possible variants considered independently): *Season*: fall = September – November; winter = December – February; spring = March – May; summer = June – August); *Season2A*: fall/winter and spring/summer; *Season2B*: winter/spring and summer/fall; and *Season2C*: fall/spring migration seasons and winter/summer nonmigration seasons

Within years and taxonomic groups, we compared Akaike Information Criterion scores corrected for small sample sizes (AICc) of all possible candidate models generated by *GenEst* to evaluate the merits of different additive and factorial predictor combinations. We considered an AICc score reduction (ΔAICc) of more than two points indicative of an improved model, reflecting a better balance of goodness-of-fit and parsimony (Burnham and Anderson 2002). For bats and each relevant size class of birds, we considered as potential final models only those models that were based on a minimum of 10 detectability trial cases per covariate-class combination (Huso et al. 2012). For the Year 2 and 3 analyses, the selected models included a season variable if any such model scored ΔAICc ≤2.00 compared to the top model. The latter approach reflected the following factors:

- Both the fatality and detectability data were expected to vary seasonally.
- The spatially and temporally randomized distribution of trial carcasses throughout each monitoring year was explicitly designed to support developing seasonal adjustments for carcass detectability, if warranted.
- It was recommended to bolster use of the customized *GenEst* routine for handling binomial detectability trials (D. Dalthorp, USGS, personal communication).

We represent adjusted fatality estimates and 95% confidence intervals (CIs) as: (a) average fatalities per turbine per year, (b) average fatalities per MW of installed capacity per year, and (c) total estimated fatalities per year. We produced annual, facility-level estimates for all individual bird and bat species. We focus on group estimates for bats, native nonraptors, and raptors, and species-specific estimates for species emphasized in the Programmatic Environmental Impact Report (PEIR) for the APWRA repowering effort (Alameda County Community Development Agency 2014: page 3.4-55). The latter include the four focal raptor species (golden eagle, red-tailed hawk, American kestrel, and burrowing owl) plus several other species of local conservation concern (Swainson's hawk, loggerhead shrike, prairie falcon, barn owl, and tricolored blackbird). Hereafter, we distinguish the first four raptor species as *focal raptor species* and the full suite of species emphasized in the PEIR as the *PEIR-emphasis species*. We also draw attention to a few other species documented as fatalities typically five or more times each year, which is considered a minimum sample size for generating meaningful adjusted fatality estimates (Huso et al. 2012).

To clarify pairwise differences in adjusted fatality estimates among groups for covariates reflected in a selected model, we evaluated overlap in 95% CIs for group medians to coarsely discern statistically significant differences. However, although non-overlapping CIs confirm a significant difference at or above the indicated confidence level (i.e., $P \leq 0.05$ in this case), overlapping CIs do not confirm a nonsignificant difference at that confidence level. Nevertheless, inclusion of a predictor variable based on a competitive AICc score for a relevant candidate model is indicative of a noteworthy contribution to explanatory power. Therefore, for discussion purposes we refer to no overlap of 95% CIs as indicative of a *strongly significant* difference between two group medians, approximately ≤33% overlap as indicative of at least a *marginally significant* difference, and broad overlap approximately >33% indicative of no statistical significance.

To provide context for discussing the precision of adjusted fatality estimates, we utilize a nonstandard but simple and informative coefficient of variation (CV) metric derived as the ratio of the width of the 95% CI divided by the median estimate. We equate *good* precision with $CV \leq 0.50$, *fair* precision with $0.50 < CV \leq 1.0$, and *poor* precision with $CV > 1.0$.

Blade-strike fatalities located outside of survey plots could bias unadjusted fatality counts low (Huso et al. 2016). This can occur if a bird or bat is flung outside of the survey plot before falling to the ground. It can also occur if the bird or bat is mortally wounded, but either continues flying for a bit before falling to its death outside the survey plot or falls down within the survey plot but hobbles off the plot before dying (Smallwood et al. 2010, H. T. Harvey & Associates 2013). We did not attempt to estimate the proportions of birds or bats that fell outside the survey plots. Instead, in using *GenEst* to produce adjusted fatality estimates, we used the *DWP* adjustment factors developed from data collected across other North American wind-energy facilities in grassland environments (including the Altamont) for survey plots of different radii (Huso and Dalthorp 2014). Specifically, we used 0.95 for large birds, 0.98 for medium birds, and 1.00 (i.e., no adjustment) for small birds and bats to adjust the raw fatality counts.

Factors that may contribute to overestimating wind-turbine-related mortality based on surveys such as this include unrelated background mortality resulting from predation, fence-wire strikes, and other causes of natural mortality (Smallwood 2007, ICF International 2016). Due to the high cost and logistical complexity involved in conducting rigorous studies, few researchers have attempted to quantify and adjust for background mortality in the context of energy development (Erickson et al. 2014), and we did not attempt to do so in this Project.

2.5 Spatial Distribution of Fatalities

To illustrate the spatial distributions of nonraptor and raptor fatalities accumulated across the 3-year monitoring period, we prepared maps that illustrated proportional variation across turbines based on adjusted annual fatality estimates for both species groups. To achieve this objective, we first summed the relevant Years 1–3 fatality totals at each turbine produced by *GenEst*. Then we used ArcGIS to bin turbines into standardized categories that reflected the degree to which each turbine-specific 3-year sum deviated from the average value for all turbines, and produced maps that reflected the degrees of deviation using color-coded circles of different sizes placed at each turbine location. Deviation was measured as the number of standard deviations (SDs) away from the mean. Negative values indicated deviation below the mean and positive values indicated deviation above the mean, with values binned in increments of one SD; i.e., <-1.5, -1.5 to -0.49, -0.5 to +0.49, +0.5 to +1.49, +1.5 to +2.49, and ≥+2.5. We also prepared species-specific "hotspot" maps for red-tailed hawk, American kestrel, and burrowing owl based on adjusted fatality estimates, and for golden eagle based on unadjusted fatality totals.

When interpreting the resulting maps, we adopt the following terminology in describing apparent fatality hotspots: *low hotspot* (medium-sized yellow circle on maps) = estimate 0.5–1.49 SDs above mean; *moderate hotspot* (large orange circle) = estimate 1.5–2.49 SDs above mean; and *strong hotspot* (extra-large red circle) = estimate ≥2.5 SDs above mean. It is important to note that this approach to classifying fatality hotspots is strictly relative within a given species- or group-specific dataset, and does not reflect how the magnitude of the fatality numbers might influence impressions about the relative importance of indicated hotspots. The latter may be of particular importance when comparing patterns among species. For example, a turbine classified as a strong hotspot for golden eagles might involve only a few actual fatalities, whereas a strong hotspot for bats as a group might involve 20–30 actual fatalities. However, further calibrating hotspot indicators in an objective manner based on ranking fatality totals across species is beyond the scope of this assessment.

For bats, because we were unable to develop useful adjusted fatality estimates for 28-day turbines in Year 2, we illustrated variation among turbines based on only year-specific estimates for each turbine derived from 7-day surveys with detection dogs. Although not as robust an assessment as for bird groups and species, the modified bat analysis nevertheless provided useful insight about bat fatality patterns across the facility.

Section 3.0 Results

3.1 Habitat and Climatic Conditions

As the surveys commenced in fall 2016, the accumulated dry, annual grasses and forbs on the study site were mostly grazed or trampled by cattle, especially on and around the turbine pads where livestock often congregated. The subsequent winter 2016/spring 2017 period was unusually wet, especially following on the heels of a severe 4–5-year drought (National Drought Mitigation Center 2019, National Oceanic and Atmospheric Association [NOAA] 2019). The vegetation responded accordingly, growing very dense and tall in many areas by May, to the point of substantially hindering the survey effort on many plots (e.g., see Figure 3). Ongoing cattle grazing moderated the spring vegetation growth in some areas, and the landscape immediately surrounding turbines sometimes remained relatively barren after grading during turbine installation and because of persistent cattle loafing. Thus, even during the height of spring vegetation growth, the substrate conditions across the survey landscape remained variable in Year 1.

Figure 3. Detection Dog Immersed in Unusually Dense, Tall Vegetation on a Survey Plot in Spring 2017

Winter 2017/spring 2018 was drier than average (NOAA 2019) and, although a few substantial storms brought some late rainfall relief in March/April 2018, overall below-average winter/spring rainfall produced abnormally dry conditions in the Project area by February that persisted through the summer (National Drought Mitigation

Center 2019). The low winter/spring rainfall resulted in comparatively moderate growth of annual vegetation in many areas compared to spring 2017. In addition dry, windy weather combined with residual fuel build-up since the wet winter of 2016/2017 led to a an extreme 2018 summer wildfire season in California, which frequently increased health and safety risks for our surveyors, especially for the detection-dog teams. Unlike human surveyors who can don respirators and thereby continue working as long as the smoke is not so thick as to preclude effective visibility and damage eyes, protective respirators are not an option for the dog teams, because the handler must be able to communicate verbally with the dogs and the dogs cannot wear respirators.

The 2019 water year beginning in October 2018 featured below-average rainfall through December and average rainfall in January, but then stormy, windy weather and heavy rainfall (twice the long-term average) prevailed in February, followed by additional windy and rainy (21% above average) weather in March, and a very wet May (250% of average). The complicated weather patterns (dry winter but wet spring), with spring flooding and strong winds in February and March, appeared to delay emergence of California ground squirrels (*Otospermophilus beecheyi*) and take a toll on golden eagle breeding performance in the region (e.g., see H. T. Harvey & Associates 2019). In addition, the delayed but then heavy spring rainfall moderated vegetation growth in most areas at a level similar to 2018.

3.2 Survey Effort and Search Intervals

During Year 1, we began with a 5-day per week survey schedule to accommodate 8 weeks of all-dog 7-day, 28-day, and fall road/pad surveys. After that, surveys continued 3 days per week through April 2017, and then transitioned to a Monday through Thursday schedule thereafter. The search intervals achieved at individual turbines varied from the ideal 7-day or 28-day interval for several reasons, including: (a) interannual rotations of the 7-day search-interval plots; (b) periodic schedule adjustments to accommodate changing survey and personnel needs; and (c) other occasional logistical, safety, and personnel constraints. Unanticipated and unavoidable minor variation in search intervals such as we experienced is effectively inconsequential when using *GenEst* to estimate fatalities. Appendixes C–E provide annual summaries of surveys and survey date ranges by turbine for each monitoring year.

3.3 Carcass Detectability

3.3.1 Composition and Placement of Trial Carcasses

The designated biologist placed new bird and/or bat carcasses on the 7-day and 28-day plots during 43 of 52 weeks in Year 1, 49 of 52 weeks in Year 2, and 51 of 52 weeks in Year 3. The study-wide placements consisted of 244 bats of at least 5 species, 267 small birds of 26 species, 108 medium birds of 9 species, and 160 large birds of 14 species (Table 1; Appendixes F–H). Most (73%) of the placed bats were Mexican free-tailed bats; the remainder comprised 15% hoary bats, 11% *Myotis* spp., and 1% big brown bats. For birds, 33% of the trial carcasses were nonnative house sparrows, European starlings, and rock pigeons; 12% were native red-tailed hawks; and 6% were native California Gulls. No other bird species composed more than 5% of the total bird placements. Across all years, 23% of the bats, 12% of the small birds, 4% of the medium birds, and 14% of the large birds originated as fatalities at the facility during the study.

Table 1. Placements of Carcass Detectability Trial Specimens by Year, Species Group, and Survey Type

			Number of Individuals	
Year	**Species Group**	**Number of Species**	**7-day Plots**	**28-day Plots**
Year 1	Bats	4	36	35
	Small birds	27	25	38
	Medium birds	9	15	12
	Large birds	10	13	24
Year 1 Subtotal	All Species	49	89	109
Year 2	Bats	3	37	31
	Small birds	25	47	48
	Medium birds	5	17	13
	Large birds	13	34	36
Year 2 Subtotal	All Species	46	135	128
Year 3	Bats	4–5[1]	53	52
	Small birds	16	53	55
	Medium birds	8	26	25
	Large birds	9	27	26
Year 3 Subtotal	All Species	37–38	159	158
All Years	Bats	5–7[1]	126	118
	Small birds	26	125	141
	Medium birds	9	58	50
	Large birds	14	74	86
Grand Total	All Species	52–54	383	395

[1] Included some *Myotis* spp. identified only as one of two possible species, which collectively might have represented multiple species.

Each year of the study, we placed 1–5 bat carcasses, 1–5 small bird carcasses, and 1–4 medium or large bird carcasses on every 7-day plot, and we placed 1–4 bat carcasses, 1–4 small bird carcasses, and 1–4 medium or large bird carcasses on most 28-day plots. Figures 4 and 5 illustrate the overall bat and bird placement arrays in Year 1; the placement patterns in Years 2 and 3 were similar.

In Year 2, a temporary shortage of suitable bat carcasses caused us to forego placing new bats on 7-day plots from late January through March and on 28-day plots from late January through May. The 7-day placement gap corresponded to the late winter/early spring period when bat fatalities are uncommon. The 28-day placement gap extended further into the onset of spring migration and the secondary activity peak for bat fatalities; however, we prioritized spring placements on the 7-day plots where the probability of bat fatality and trial-carcass detection was non-negligible.

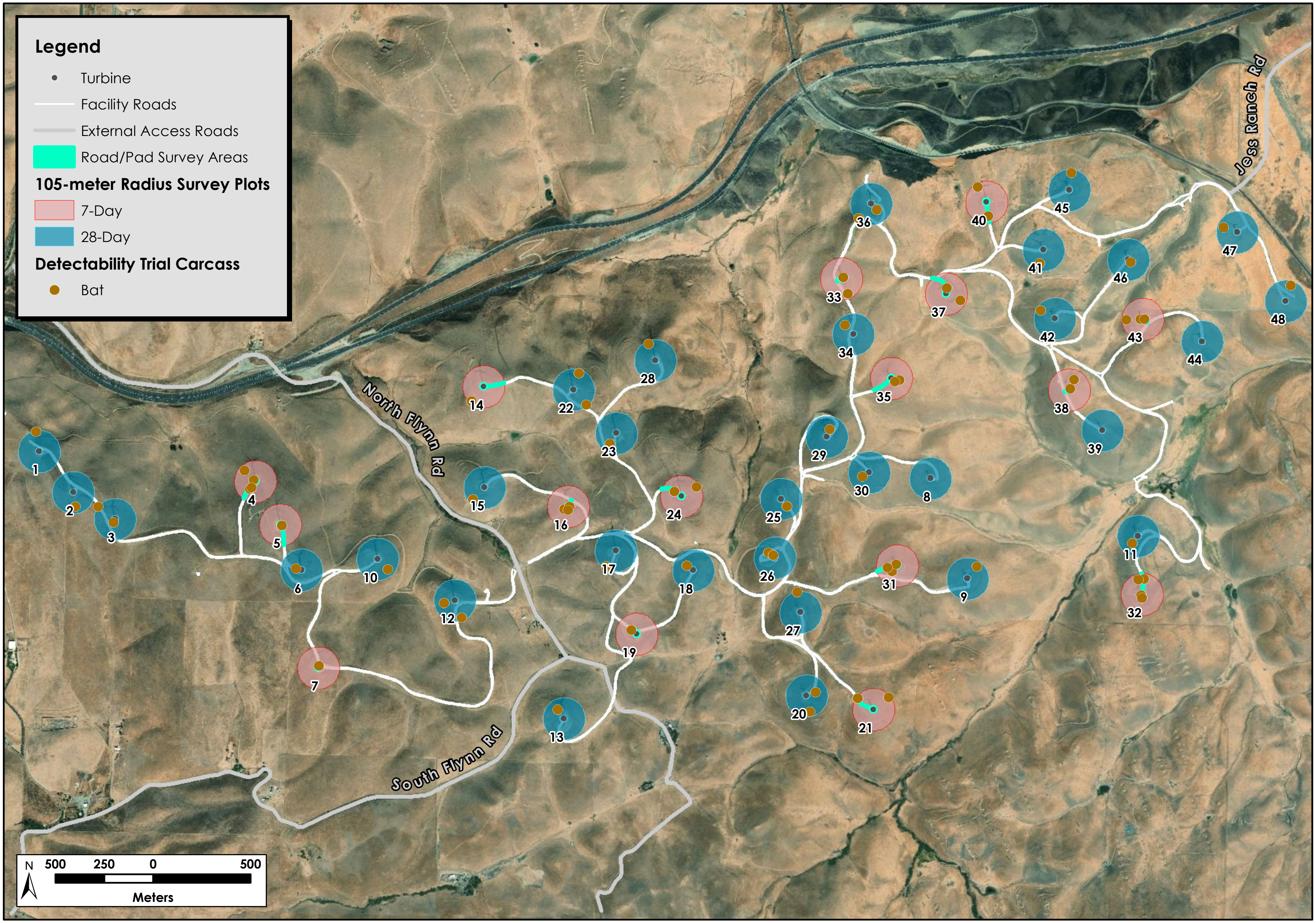

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Figure 4. Placement of Detectability Trial Bat Specimens in Year 1

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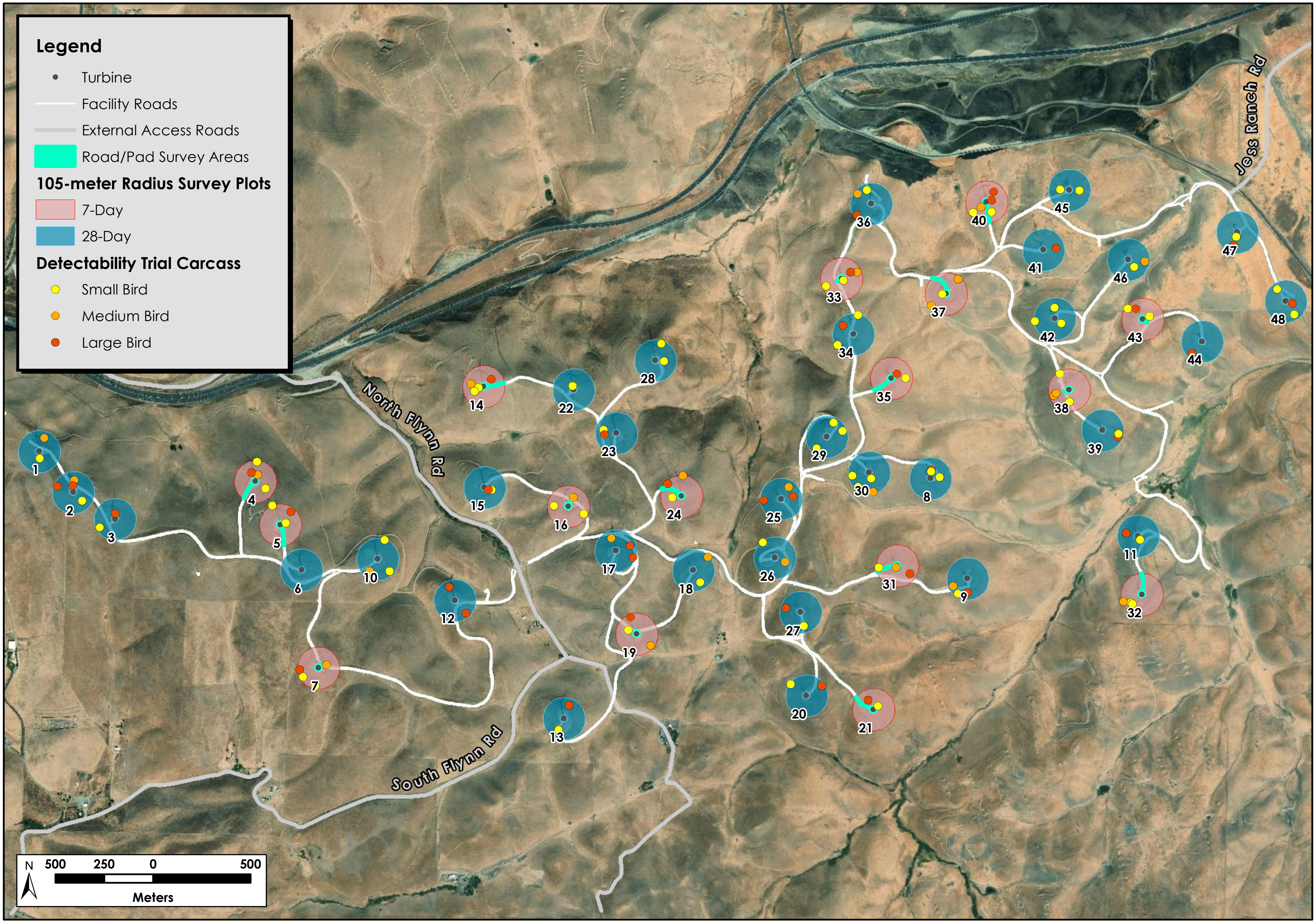
April 2021



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 5 Detectability Trial Birds.mxd

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Figure 5. Placement of Detectability Trial Bird Specimens in Year 1

3.3.2 Year 1

3.3.2.1 Searcher Efficiency

Of the 198 carcasses placed in Year 1, 6 bats, 5 small birds, 2 medium birds, and 1 large bird were likely removed before a detection-dog team had a chance to detect the carcass. Twelve of these 14 carcasses were confirmed missing within 1.3–7.8 hours; the remaining two carcasses were not confirmed missing until the next day. In no instance could we be sure that a carcass was removed before a survey happened, but we defaulted to removing all questionable cases to avoid biasing the SE estimates that did not account for the influence of carcass removal. Limited to first opportunities to detect placed carcasses that were available to be detected, the proportion of carcasses detected by dog teams in Year 1 ranged from 48–76% depending on the species group (Table 2). Given multiple opportunities to detect placed carcasses that remained available to be detected across multiple surveys, the nonmodeled SE ratings increased by 7–18 percentage points. Including all 198 placed carcasses—disregarding whether or not a given carcass was available for detection at the time of the first survey—and translating those data to estimates approximating Big *D* (CD), reduced the multiple-opportunity nonmodeled SE estimates by 2–6 percentage points (Table 2).

Table 2. Searcher Efficiency (SE) Field Trial Results for Detection-Dog Teams: Year 1

Species Group	Number Placed	Number Available For Detection[1]	SE First Opportunity To Detect		SE Multiple Opportunities to Detect		Big *D* Carcass Detectability	
			Found	%	Found	%	Found	%
Bats	71	65	37	57	44	68	44	62
Small Birds	61	56	27	48	32	55	32	51
Medium Birds	28	26	17	65	21	84	21	78
Large Birds	38	37	28	76	34	94	34	92
Total	**198**	**184**	**109**	**59**	**131**	**73**	**131**	**69**

[1] Items considered unavailable for detection during first survey after placement were confirmed missing within 1.3–7.8 hours after survey (n = 12) or the following morning (n =2), and were excluded from estimates of searcher efficiency (SE), but were included in estimates of Big *D* carcass detectability that accounted for carcass persistence (CP) (i.e., after placement, carcass was either found or not found, whether due to imperfect searcher detection or removal by scavengers or abiotic factors prior to a given search).

For bats in Year 1, the selected *GenEst* SE model was the top model with the lowest AICc score. That model included *Season2A* as a predictor of *p* and *k* (Appendix I). Estimated median SE for detection-dog teams was more than twice as high in fall/winter as it was in spring/summer, which non-overlapping 95% CIs confirmed was a significant difference (Table 3). Modeling the influence of *Season2A* on *k* suggested that the probability of detecting a bat carcass did not decline appreciably between successive search intervals on 7-day plots (k = 0.999), but declined by an estimated 53% (k = 0.469) between successive searches on 28-day plots.

The top, selected *GenEst* SE model for small birds in Year 1 was the null model (Appendix I). None of the candidate models with a ΔAICc <2 included a predictor of *p*, but three marginally competitive models included *Survey Type* and/or *Season2B* as predictors of *k*. Median SE for detection dogs in Year 1 was estimated to be 49% for small birds, with the probability of detection declining by 58% between successive searches (Table 3).

With data for medium and large birds combined to bolster covariate-group sample sizes, the top, selected *GenEst* SE model for medium/large birds in Year 1 included *Survey Type* as a predictor of *p* and *k* as a constant (Appendix I). The selected model was the only model that had a lower AICc than the null model, but a ΔAICc = 0.37 separating the two models indicated that the top model had only marginal explanatory value. Median SE for detection dogs in Year 1 was estimated to be 81% on 7-day plots and a marginally lower 64% on 28-day plots, with SE not declining appreciably between searches (Table 3).

Table 3. *GenEst* Searcher Efficiency (SE) Estimates and Model Parameters for Detection-Dog Teams: Year 1

Taxon / Size Class	Season or Survey Type	Number Placed	Number Found	Probability of Detection (SE) During First Search (*p*)[1]		Probability of SE Decline Between Searches (*k*)[1]	
				Median	95% CI[1]	Median	95% CI[1]
Bats	Fall/Winter	35	31	0.77	0.62–0.88	0.99	0.00-1.00
	Spring/Summer	30	13	0.32	0.18–0.50	0.47	0.20–0.76
Birds							
Small	All	56	32	0.49	0.36–0.61	0.42	0.21–0.67
Medium/ Large	7-day Surveys	28	26	0.81	0.64–0.91	0.97	0.00–1.00
	28-day Surveys	35	29	0.64	0.47–0.78	0.97	0.00–1.00

[1] *GenEst* estimation model for bats: *p* ~ Season2A, *k* ~ *Season2A*; for small birds: *p* ~ Constant, *k* ~ Constant; and for medium/large birds: *p* ~ Survey Type, *k* ~ Constant. See Appendix I for *GenEst* modeling results comparing potential candidate models and illustrating the basis for model selections.

3.3.2.2 Carcass Persistence

Documented, overall median CP times were 16 days for small birds, 32 days for bats, 57 days for medium birds, and 58 days for large birds (Table 4). Scavengers or abiotic factors removed, or rendered undetectable to detection dogs, 17% of the bats in <2 days, 20% in <7 days, and 49% in <28 days after placement. That left 51% of the placed bats as having persisted in detectable form for detection dogs for 28 days or more (noting that often involved dogs refinding small bits of scavenged/degraded bats in the original placement location). Small birds disappeared more quickly than bats; 43% of placed carcasses were removed or rendered undetectable within <7 days and 57% within <28 days. In contrast, 71% of medium birds and 95% of large birds persisted for 28 days or more. The distribution of CP times was highly bimodal for bats, small birds, and medium birds, but for large birds was strongly skewed toward long persistence times (Figure 6).

For bats in Year 1, the selected *GenEst* CP model was the top model, which incorporated a Weibull time-failure distribution, included *Survey Type* and *Season2A* as additive predictors of *l*, and considered *s* a constant (Appendix J). The probability of persistence through a 7-day or 28-day search interval (*r*) was estimated to be higher in spring/summer than in fall/winter on both 7-day and 28-day plots, and was estimated to be higher on 7-day plots than on 28-day plots during both seasonal periods. In most cases, broadly overlapping 95% CIs indicated no significant differences; however, CP on 28-day plots in fall/winter was marginally to strongly significantly lower than on 28-day plots in spring/summer and on 7-day plots in both seasons (Table 4).

Table 4. Carcass Persistence (CP) Estimates and *GenEst* Model Parameters Based on 60-Day Field Trials: Year 1

Taxon / Size Class	Survey Type and/or Season[1]	Number of Trial Carcasses	Documented CP Time Median (Range) (days)	Estimated CP Time (days)[2]		Probability of Persistence – 7-day Search Interval		Probability of Persistence – 28-day Search Interval	
				Median	95% CI[3]	r	95% CI[3]	r	95% CI
Bats	7-day, Fall/Winter	25	46 (0.3–60)	35	15.2–79.9	0.835	0.736–0.911	0.683	0.550–0.795
	28-day, Fall/Winter	15	11 (0.75–60)	9	3.1–23.0	0.679	0.514–0.820	0.449	0.270–0.626
	7-day, Spring/Summer	11	56 (8.5–60)	193	51.3–731.2	0.932	0.856–0.973	0.859	0.732–0.935
	28-day, Spring/Summer	20	57 (0.9–60)	7	18.1–119.7	0.857	0.760–0.929	0.721	0.580–0.833
	All	71	32 (0.3–60)	–	–	–	–		
Birds[2]									
Small	Fall/Winter	29	5 (0.2–60)	7	2.3–19.0	0.621	0.475–0.760	0.434	0.287–0.577
	Spring/Summer	32	41 (0.75–60)	37	12.5–108.3	0.818	0.704–0.909	0.665	0.525–0.785
	All	61	16 (0.2–60)	–	–	–	–		
Medium/ Large	All	66	58 (0.3–60)	Inf[4]	Inf	0.925	0.825–0.966	0.900	0.751–0.949

[1] See Section 2.4.2 for variable descriptions.
[2] *GenEst* estimation model for bats: Weibull time-failure distribution, *l* ~ *Survey Type* + *Season2A*, *s* ~ Constant; for small birds: lognormal time-failure distribution, *l* ~ *Season2A*, *s* ~ Constant; and for medium/large birds: lognormal time-failure distribution, *l* ~ Constant, *s* ~ Constant. See Appendix J for *GenEst* modeling results comparing potential candidate models and illustrating the basis for model selections.
[3] CI = confidence interval.
[4] Estimated value effectively infinite/inestimable; i.e., calculated as more than 1 year to many years.

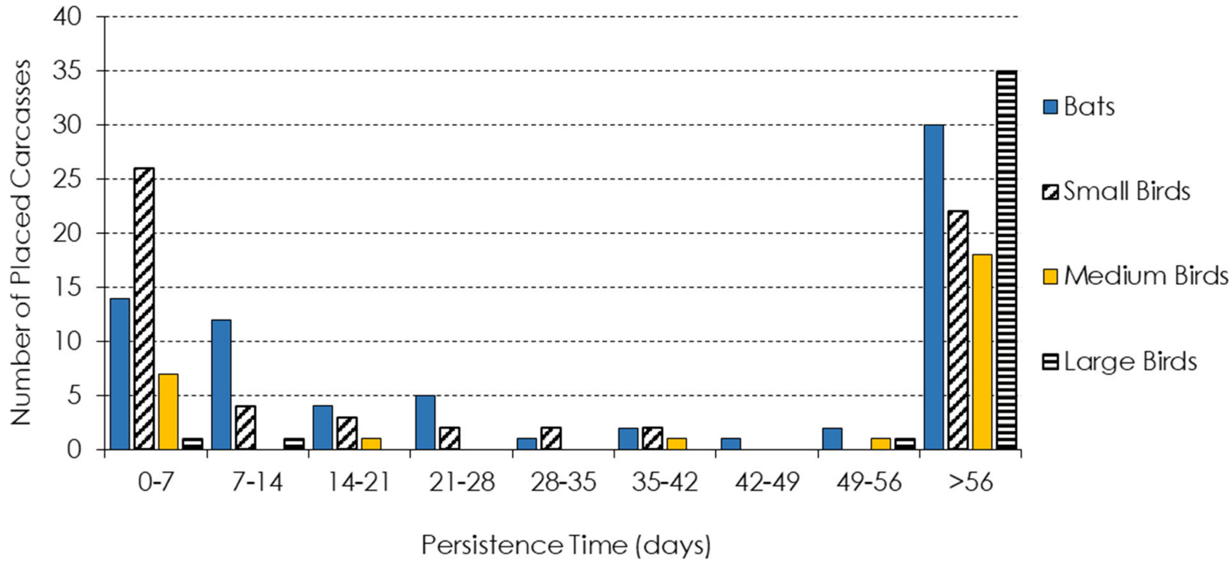


Figure 6. Persistence Times for Bats and Birds Placed During Carcass Persistence Trials: Year 1

For small birds in Year 1, the selected *GenEst* CP model was the top model, which incorporated a lognormal time-failure distribution, *Season2A* as a predictor of *l*, and *s* as a constant (Appendix J). CP for small birds was estimated to be at least marginally higher in fall/winter than in spring/summer (Table 4). For medium/large birds in Year 1, the selected *GenEst* CP model was the null model based on a lognormal time-failure distribution (Appendix J). All estimates of median CP time were effectively infinite/inestimable; however, the probability of a medium/large bird persisting between search intervals (*r*) was estimated with reasonable 95% CIs as 93% on 7-day plots and 90% on 28-day plots (Table 4).

3.3.3 Year 2

The detection-dog teams ultimately found 60% of the bat, 60% of the small bird, 84% of the medium bird, and 97% of the large bird trial carcasses placed on 7-day plots in Year 2. The only large bird the detection-dog teams did not find was one of two placed mallards, which a mammalian scavenger likely carried off intact. The human surveyors ultimately found 0% of the bats, 4% of the small birds, 46% of the medium birds, and 89% of the large birds placed on 28-day plots. The lack of trial detections and a very low fatality count (4) precluded developing a meaningful fatality estimate for bats on 28-day plots surveyed by humans in Year 2. The small-bird detection rate for human surveyors on 28-day plots also was very low (<15% in fall and winter and 0% in spring and summer) and limited the accuracy of estimates for that group based on combined 7-day/28-day data.

Including a season variable did not lower the AICc score below that of the null model describing CD for detection-dog teams searching for bats on 7-day plots; however, ΔAICc for a model including *Season2C* was 0.6. Therefore, we selected that model as the basis for calculating adjusted fatality estimates for bats in Year 2 (Appendix K). This model suggested that the probability of detection-dog teams finding bats on 7-day plots in Year 2 was nonsignificantly higher during migration seasons (fall and spring) than during nonmigration seasons (winter and summer) (Table 5). For small birds, the selected *GenEst* CD model was the top model (null model ΔAICc = 36.9) and included *Survey Type* and *Season2A* as additive predictors (Appendix K). That model indicated that CD for small birds was at least marginally higher in fall/winter than in spring/summer for detection-dog teams on 7-day plots, and was comparatively negligible for human surveyors on 28-day plots in both seasons. For medium/large birds, the selected *GenEst* CD model was the top model (null model ΔAICc = 4.2) and included *Survey Type* and *Season2C* as additive predictors (Appendix K). That model suggested that CD for medium/large birds was at least marginally lower on 28-day plots during migration seasons than on 7-day plots during migration seasons, or on either plot type during nonmigration seasons (Table 5).

Table 5. Carcass Detectability Trial Results and Adjustment Factors Used to Generate *GenEst* Adjusted Fatality Estimates: Year 2

Taxon/ Size Class[1]	Survey Type and/or Season	Number of Carcasses Placed	Species	Number of Carcasses Found	% Found	*GenEst* Estimated Probability of Detection[2]	
						Median	95% CI
Bats	7d Dog, Migration	15	3	11	73	0.733	0.467–0.896
	28d Human, Migration	9	2	0	0	–	–
	7d Dog, Nonmigration	22	2	11	50	0.524	0.318–0.722
	28d Human, Nonmigration	22	2	0	0	–	–
	Annual	68	3	22	32	–	–
Small Birds	7d Dog, Fall/Winter	22	13	15	68	0.710	0.503–0.856
	28d Human, Fall/Winter	23	11	2	9	0.060	0.015–0.216
	7d Dog, Spring/Summer	25	10	13	52	0.495	0.314–0.677
	28d Human, Spring/Summer	25	8	0	0	0.025	0.005–0.114
	Annual	95	25	30	32	–	–
Medium/ Large Birds	7d Dog, Migration	23	12	21	91	0.911	0.748–0.973
	28d Human, Migration	22	12	15	68	0.684	0.479–0.835
	7d Dog, Nonmigration	27	12	26	93	0.964	0.867–0.991
	28d Human, Nonmigration	27	10	23	85	0.850	0.680–0.938
	Annual	99	20	85	85	–	–
All Birds	Annual	97	45	137	52	–	–

[1] Small birds: average species mass 7–100 g (Wilson's warbler up to western meadowlarks); medium/large birds: average species mass 100–4200 g (California quail up to Canada goose)—sample-size limitations precluded analyzing medium and large birds separately.

[2] *GenEst* estimation model for bats (excluding 28-day survey data): *p* ~ *Season2C*, *k* ~ Fixed at 0; for small birds: *p* ~ *Survey Type* + *Season2A*, *k* ~ Fixed at 0; and for medium/large birds: *Survey Type* + *Season2C*, *k* ~ Fixed at 0. See Appendix K for modeling results comparing potential candidate models and illustrating the basis for model selections.

3.3.4 Year 3

The detection-dog teams found 55% of the bat, 57% of the small bird, 85% of the medium bird, and 89% of the large bird trial carcasses placed on 7-day plots in Year 3,. The human surveyors found 8% of the bat, 20%

of the small bird, 68% of the medium bird, and 96% of the large bird trial carcasses placed on 28-day plots. The selected *GenEst* CD models for bats, small birds, and medium birds included *Survey Type* and *Sesason2B* as predictors, whereas the selected model for large birds included only *Season2C* (Appendix L). For bats, small birds, and medium birds, estimated CD was always at least slightly higher on 7-day plots than on 28-day plots within seasons, but the differences were not significant for medium birds, and small birds showed a different seasonal pattern (Table 6). CD was nonsignificantly lower in winter/spring than in summer/fall for bats and medium birds on both 7-day and 28-day plots and for small birds on 28-day plots, but was marginally higher in winter/spring for small birds on 7-day plots. For large birds, the selected *GenEst* model indicated that CD was nonsignificantly lower during spring and fall migration seasons than during nonmigration seasons.

Table 6. Carcass Detectability Trial Results and Detectability Factors Used to Generate *GenEst* Adjusted Fatality Estimates: Year 3

Taxon/ Size Class[1]	Survey Type and/or Season	Number of Carcasses Placed	Species	Number of Carcasses Found	% Found	*GenEst* Estimated Probability of Detection[2]	
						Median	95% CI
Bats	7d Dog, Winter/Spring	27	5	13	48	0.481	0.304–0.664
	28d Human, Winter/Spring	28	5	0	0	0.018	0.003–0.116
	7d Dog, Summer/Fall	24	4	15	58	0.625	0.422–0.792
	28d Human, Summer/Fall	22	4	4	17	0.182	0.070–0.396
	Annual	101	5	32	32	–	–
Small Birds	7d Dog, Winter/Spring	28	8	20	71	0.714	0.524–0.850
	28d Human, Winter/Spring	26	8	5	19	0.192	0.082–0.387
	7d Dog, Summer/Fall	25	8	10	40	0.417	0.241–0.617
	28d Human, Summer/Fall	29	9	6	21	0.240	0.112–0.442
	Annual	108	16	41	38	–	–
Medium Birds	7d Dog, Winter/Spring	12	6	9	75	0.825	0.560–0.946
	28d Human, Winter/Spring	11	5	7	64	0.554	0.293–0.789
	7d Dog, Summer/Fall	14	3	13	93	0.931	0.738–0.985
	28d Human, Summer/Fall	14	4	10	71	0.779	0.526–0.918
	Annual	51	10	39	76	–	–
Large Birds	Migration	22	5	19	86	0.863	0.652–0.955
	Nonmigration	31	7	30	97	0.968	0.804–0.996
	Annual	53	8	49	92	–	–
All Birds	Annual	212	35	129	61	–	–

[1] Small birds: average species mass 6.5–100 g (ruby-crowned kinglet up to western meadowlarks); medium birds: average species mass 111–460 g (American kestrel up to barn owl); large birds: average species mass 610–4500 g (California gull up to Canada goose).

[2] *GenEst* estimation model for bats: *p ~ Season2C*, *k* ~ Fixed at 0; for small birds: *p ~ Survey Type + Season2A*, *k* ~ Fixed at 0; and for medium/large birds: *Survey Type + Season2C*, *k* ~ Fixed at 0. See Appendix L for modeling results comparing potential candidate models and illustrating the basis for model selections.

3.3.5 Interannual Comparisons

The Year 1 SE and CP trial data could not be translated to exact equivalents of the Years 2 and 3 CD estimates, because the strategy for placing trial carcasses differed in Year 1. Nevertheless, based on raw trial results and translating the Year 1 data to analogous CD metrics (see Section 3.3.2.1), estimated CD for bats on 7-day plots surveyed by detection-dog teams each year was higher in Year 1 (75%) than in Years 2 and 3 (53–59%), with the difference marginally significant for Year 1 versus Year 3 (Table 7). For birds on 7-day plots, the patterns of interannual variation differed slightly for small, medium, and large birds, but no significant variation was evident based on broadly overlapping 95% CIs (Table 7). On 28-day plots, the detection-dog teams surveying in Year 1 greatly outperformed the human surveyors in Years 2 and 3 in detecting bats and small birds, whereas the CD metrics for medium and large birds were similar for detection-dog teams in Year 1 compared to human searchers in Years 2 and 3.

Table 7. Interannual Comparisons of the Proportions of Detectability Trial Carcasses Found on Plots Surveyed at 7-Day and 28-Day Intervals

		7-Day Surveys		28-Day Surveys	
Taxon	Year	Proportion Detected	95% CI	Proportion Detected	95% CI
Bat	Year 1	0.75	0.622 – 0.905	0.49	0.334 – 0.514
	Year 2	0.59	0.450 – 0.766	0	–
	Year 3	0.53	0.403 – 0.672	0.08	0.014 – 0.096
Small Birds	Year 1	0.52	0.344 – 0.736	0.50	0.354 – 0.526
	Year 2	0.60	0.466 – 0.747	0.04	0.000 – 0.063
	Year 3	0.57	0.442 – 0.709	0.20	0.103 – 0.218
Medium Birds	Year 1	0.87	0.728 – 1.000	0.67	0.442 – 0.750
	Year 2	0.88	0.759 – 1.000	0.46	0.229 – 0.538
	Year 3	0.85	0.727 – 1.000	0.68	0.517 – 0.720
Large Birds	Year 1	1.00	–	0.88	0.764 – 0.917
	Year 2	0.94	0.877 – 1.000	0.89	0.800 – 0.917
	Year 3	0.89	0.789 – 1.000	0.96	0.907 – 1.000

3.3.6 Bleed-Through

In Year 1, estimated BT—quantified as originally described by Warren-Hicks et al. (2013)—for bats and small birds was 33–36% on 7-day plots and 22–23% on 28-day plots. Estimated BT for medium and large birds was 14% on 7-day plots and 20–21% on 28-day plots. Comparable, unbiased estimates of BT could not be generated from the Years 2/3 CD trial data, because some carcasses might have persisted in detectable form but remained undiscovered by a surveyor. Nevertheless, based only on detected carcasses, known BT rates in Years 2 and 3 were similar for surveys conducted by detection-dog teams on 7-day plots (21–50% for bats, 30–39% for small birds, and 7–27% for medium and large birds). In contrast, compared to Year 1, the estimated known BT rates for surveys conducted by humans on 28-day plots in Years 2 and 3 were low for bats (0%), small birds (0–9%), and medium/large birds in Year 2 (0–3%), but were comparable for medium/large birds in Year 3 (16–24%).

3.4 Composition of Fatality Incidents

3.4.1 Classification of Records Suited to Fatality Estimation

Across the 3-year study, we classified 40 individual finds as duplicates representing previously discovered fatalities (20 cases in Year 1, 14 cases in Year 2, and 6 cases in Year 3), and combined relevant records to eliminate duplications from the fatality tallies. We excluded 20 carcasses in Year 1 and four carcasses in Year 2 of nonvolant juvenile birds, most of which were horned larks and western meadowlarks—common grassland breeders in the Project area. We also excluded from further consideration 27 bats and 21 birds found during the first month of surveys in Year 1, for which carcass ageing suggested deposition occurred more than one search interval before the first relevant survey. In addition, we excluded one partial sternum of a possible golden eagle found on a survey plot in Year 1 that was old, weathered, and likely dropped on the relevant plot by a raven. We documented no other large raptor fatalities during the surveys from which this scrap of bone could have originated. After eliminating these inappropriate records, the Year 1 dataset contained fatalities of 202 bats and 311 volant birds, the Year 2 dataset contained 124 bats and 236 volant birds, and the Year 3 dataset contained 133 bats and 230 volant birds (Table 8, Appendixes M–O). Of these cases, 95–97% of the bats and 86–93% of the birds were found on survey plots each year.

We excluded from adjusted fatality estimates all off-plot incidentals found as carcasses, but included two raptors that were found off-plot alive but injured: a ferruginous hawk in Year 1 and a golden eagle in Year 2. Because both raptors had suffered apparent blade-strike injuries and were later euthanized, we included the incidents in all fatality estimates. For estimation purposes, we randomly assigned the hawk as a fatality to one of two nearby turbines (wind turbine generator [WTG]-22) and the eagle to one of four nearby turbines (WTG33). We also included as relevant fatality records four bats that were found on survey plots alive but injured/debilitated. Three injured Mexican free-tailed bats were found in Year 1 during the course of standard surveys; all three ultimately were euthanized at a rehabilitation center. An injured western mastiff bat was found in Year 3 on a survey plot, but not during a standard survey. The mastiff bat sustained non-lethal but permanently debilitating injuries to its shoulder and torso, and is currently a non-releasable resident on educational display at the Lindsay Wildlife Experience facility in Walnut Creek, California.

The dog teams discovered only three bats during the supplemental fall pad/road surveys that qualified for inclusion in fatality estimates (Table 8). Three other bats discovered during these surveys were excluded as having been deposited before the study began. Only one bat was found on a turbine pad during the supplemental surveys; the rest were relatively distant from the turbines on or near roads. Only four of the six bat fatalities found during the pad/road surveys were found within the formalized boundaries of those surveys. During the corresponding 7-day full-plot surveys, the dog teams found only two other bats within the designated pad/road survey areas. Thus, we documented only six bats total during the course of the 8-week surveys in the pad/road survey areas, whereas we found an additional 37 bats during that survey period elsewhere across the 7-day full plots. Given the low number of bats found during the supplemental surveys, we did not develop an adjusted fatality estimate for the pad/road surveys alone, but we did include all fatalities documented during the supplemental road-pad/surveys in our fatality estimates.

Table 8. Bat and Volant Bird Fatalities Qualified for Potential Inclusion in Fatality Estimates by Survey Year, Size Class, and Discovery Location

Survey Year	Taxon	Size Class	Off Plot Incidental	On Plot Survey Type				On Plot Subtotal	Total
				Pad/Road	7 Day	28 Day	Incidental		
Year 1	Bat	–	7	3	99	90	3	195	202
	Bird	Small	26	4	99	66	4	173	199
		Medium	2	0	5	7	4	16	18
		Large	15	1	28	43	7	79	94
		All Birds	43	5	132	116	15	268	311
Year 2	Bat	–	4	na	116	4	0	120	124
	Bird	Small	12	na	110	13	4	127	139
		Medium	4	na	24	13	2	39	43
		Large	2	na	16	33	3	52	54
		All Birds	18	na	150	59	9	218	236
Year 3	Bat	Small	7	na	104	22	0	126	133
	Bird	Small	10	na	116	31	3	150	160
		Medium	5	na	16	12	0	28	33
		Large	1	na	13	21	2	36	37
		All Birds	16	na	145	64	5	214	230
Grand Total Bats			18	18	3	319	116	3	441
Grand Total Birds			77	77	5	427	239	29	700

Of the on-plot incidental finds, we included in fatality estimates 4 bats and 16 birds in Year 1, 8 birds in Year 2, and 3 birds in Year 3 that either surveyors subsequently found or circumstances otherwise warranted their inclusion (e.g., golden eagles that were necessarily collected before the next survey occurred). Conversely, we excluded two small-bird on-plot incidental finds left in place in Year 3 that the surveyors never found. After excluding other off-plot incidentals (Table 8) and on-plot incidentals the surveyors never found, 195 bats and 268 birds remained as basis for estimating Year 1 fatalities, 120 bats and 218 birds remained as a basis for estimating Year 2 fatalities, and 126 bats and 212 birds remained as a basis for estimating Year 3 fatalities (Table 9, Appendixes M–O).

Table 9. Bat and Bird Fatalities Assigned to Survey Plots and Used to Calculate Adjusted Fatality Estimates by Year, Size Class, Survey Type, and Season

Survey Year	Taxon	Size Class[1]	Survey Type	Season[2] Fall	Winter	Spring	Summer	Total
Year 1	Bats	Small	7-day	52	2	11	39	104
			28-day	45	0	15	31	91
	Total Bats			97	2	26	70	195
	Birds	Small	7-day	16	11	36	41	104
			28-day	13	14	14	28	69
		Subtotal		29	25	50	69	173
		Medium	7-day	3	1	0	2	6
			28-day	1	3	1	5	10
		Subtotal		4	4	1	7	16
		Large	7-day	12	13	4	1	30
			28-day	19	13	12	5	49
		Subtotal		31	26	16	6	79
	Total Birds			64	55	67	82	268
Year 2	Bats	Small	7-day	76	2	16	22	116
			28-day	3	0	0	1	4
	Total Bats			79	2	16	23	120
	Birds	Small	7-day	32	24	28	26	110
			28-day	8	6	3	0	17
		Subtotal		40	30	31	26	127
		Medium	7-day	10	4	2	8	24
			28-day	5	5	4	1	15
		Subtotal		15	9	6	9	39
		Large	7-day	5	6	2	3	16
			28-day	13	5	9	9	36
		Subtotal		18	11	11	12	52
	Total Birds			73	50	48	47	218
Year 3	Bats	Small	7-day	55	0	11	38	104
			28-day	14	0	3	5	22
	Total Bats			69	0	14	43	126
	Birds	Small	7-day	44	17	25	31	117
			28-day	9	8	3	11	31
		Subtotal		53	25	28	42	148
		Medium	7-day	9	3	2	2	16
			28-day	10	0	1	1	12
		Subtotal		19	3	3	3	28
		Large	7-day	2	4	5	3	14
			28-day	8	3	3	8	22
		Subtotal		10	7	8	11	36
	Total Birds			82	35	39	56	212
Grand Total Bats				245	4	56	136	441
Grand Total Birds				219	140	154	185	698

[1] Average species mass used as basis for classifying bird sizes: small ≤100 g; medium 100–499 g, large ≥500 g.
[2] Fall = September – November (each year combines data from two successive seasons); winter = December – February; spring = March – May; summer = June – August.

3.4.2 Species Composition

Including all documented incidents, each year the bat fatalities included consistent proportions of Mexican free-tailed bats (53–58% of annual fatality total), hoary bats (37–38%), and western red bats (3%), plus inconsistent small numbers of a few other species (Table 10). The western red bats found in all 3 years, and the single western mastiff bat found alive but injured in Year 3, are CA-SSC.

Table 10. All Documented Bat and Volant Bird Fatalities by Year and Species

Group	Species	Year 1[1]	Year 2	Year 3	Total	Special Status[2]
Bats	Mexican free-tailed bat	133	71	70	274	–
	Hoary bat	84	46	50	180	–
	Western red bat	7	4	4	15	CA-SSC
	Big brown bat	2	0	0	2	–
	Silver-haired bat	1	0	1	2	–
	California myotis	0	1	1	2	–
	Western mastiff bat	0	0	1	1	CA-SSC
	Unknown bat	2	2	6	10	–
All Bats		**229**	**124**	**133**	**486**	**–**
Raptors	Red-tailed hawk	70	30	23	123	–
	Golden eagle	12	14	8	34	CA-FP
	American kestrel	4	11	7	22	–
	Burrowing owl	2	25	18	45	CA-SSC
	Turkey vulture	5	2	1	8	–
	Ferruginous hawk	5	3	0	8	–
	Rough-legged hawk	1	0	0	1	–
	Northern harrier	0	0	1	2	CA-SSC
	White-tailed kite	1	1	0	2	CA-FP
	Sharp-shinned hawk	1	1	0	2	–
	Peregrine falcon	0	0	1	1	CA-FP
	Prairie falcon	1	1	0	2	–
	Barn owl	3	3	0	6	–
	Short-eared owl	1	0	0	1	CA-SSC
	Unknown raptor	5	0	1	6	–
All Raptors		**111**	**91**	**61**	**263**	**–**
Nonraptors	Horned lark	44	34	23	101	–
	Western meadowlark	29	20	28	77	–
	White-throated swift	16	19	15	50	–
	Vaux's swift	3	3	3	9	CA-SSC
	House wren	27	2	7	36	–
	European starling	9	5	5	19	–
	Western grebe	1	0	0	1	–
	Unknown small grebe	1	0	1	2	–
	Mallard	1	2	1	4	–
	Unknown duck	0	0	1	1	–

Group	Species	Year 1[1]	Year 2	Year 3	Total	Special Status[2]
	Sora	0	0	1	1	–
	Virginia rail	1	0	0	1	–
	Killdeer	0	1	2	3	–
	Mourning dove	4	1	3	8	–
	Rock pigeon	1	0	1	2	–
	Eurasian collared-dove	1	0	0	1	–
	Common poorwill	1	0	0	1	–
	Rufus hummingbird	0	1	0	1	–
	Unknown hummingbird	1	0	0	1	–
	Western flycatcher	3	1	0	4	–
	Western kingbird	0	1	0	1	–
	Say’s phoebe	0	0	1	1	–
	Unknown flycatcher	5	3	5	13	–
	Loggerhead shrike	0	1	0	1	CA-SSC
	Warbling vireo	3	3	1	7	–
	Unknown vireo	1	2	0	3	–
	Common raven	1	2	1	4	–
	Cliff swallow	1	0	0	1	–
	Tree swallow	0	1	0	1	–
	Blue-gray gnatcatcher	0	0	1	1	–
	Ruby-crowned kinglet	0	4	3	7	–
	Mountain bluebird	0	1	1	2	–
	Swainson's thrush	1	0	1	2	–
	Hermit thrush	0	1	1	2	–
	American pipit	3	3	3	9	–
	House finch	1	1	1	3	–
	Grasshopper sparrow	1	0	0	1	CA-SSC
	Fox sparrow	1	0	1	2	–
	Savannah sparrow	3	1	0	4	–
	Lincoln’s sparrow	0	0	1	1	–
	Unknown sparrow	1	0	1	2	–
	Red-winged blackbird	1	0	0	1	–
	Tricolored blackbird	1	0	3	4	CA-T
	Brewer's blackbird	1	0	3	4	–
	Unknown blackbird	7	5	10	22	–
	Brown-headed cowbird	1	0	0	1	–
	Orange-crowned warbler	4	0	1	5	–
	Yellow warbler	1	1	2	4	CA-SSC
	Yellow-rumped warbler	0	0	1	1	–
	Black-throated gray warbler	1	0	2	3	–
	Townsend's warbler	4	1	1	6	–
	Hermit warbler	1	2	0	3	–
	Wilson's warbler	3	5	3	11	–
	Unknown warbler	8	4	3	15	–

Group	Species	Year 1[1]	Year 2	Year 3	Total	Special Status[2]
	Western tanager	2	1	0	3	–
	Black-headed grosbeak	4	0	0	4	–
	Unknown small bird	14	12	26	52	–
	Unknown medium bird	1	0	2	3	–
	Unknown large bird	2	0	0	2	–
All Nonraptors		221	144	170	535	–
All Birds		**332**	**235**	**231**	**798**	**–**

[1] Values include 26 bats, 11 raptors, and 20 other birds eliminated from further consideration because carcass ageing indicated the fatality occurred more than one search interval before the 3-year Project began.
[2] CA-FP = California fully protected; CA-SSC = California species of special concern; CA-T = California threatened species.

Across the 3 years of study, the bird fatalities included 37–44 native species and 1–3 nonnative species per year (Table 10). The nonnative species were rock pigeon, Eurasian collared-dove, and European starling. The native species included 14 species of raptors and vultures, six of which are afforded special-status protection in California: golden eagle (CA-FP and federally protected under the Bald and Golden Eagle Protection Act), peregrine falcon (CA-FP), white-tailed kite (CA-FP), northern harrier (CA-SSC), burrowing owl (CA-SSC), and short-eared owl (CA-SSC). The native nonraptor species (48 species total) included five special-status species: tricolored blackbird (California threatened [CA-T] species), loggerhead shrike (CA-SSC), Vaux's swift (CA-SSC), grasshopper sparrow (CA-SSC), and yellow warbler (CA-SSC). The number of nonraptor bird species confirmed as fatalities in Year 2 (27) was lower than in Year 1 (35), and only 19 species were represented in both years. The number of nonraptor bird species confirmed as fatalities in Year 3 (31) matched the average for the previous 2 years. Of the nine bird species focused on in the PEIR, only Swainson's hawk was not represented among the fatalities.

We documented 10 or more fatalities of red-tailed hawk, horned lark, western meadowlark, and white-throated swift each year of the study; 10 or more golden eagle fatalities in Years 1 and 2; 10 or more burrowing owl fatalities in Years 2 and 3; and 10 or more American kestrel fatalities only in Year 2 (Table 10). The only other species for which we documented 10 or more fatalities in a single year was house wren in Year 1, and only a few other identified species contributed more than five fatalities in a single year.

3.4.3 Condition of Fatality Incidents at Time of Discovery

Across the 3-year study, six bats and two large raptors were found alive and later died or were euthanized, amounting to 1% of recorded fatalities for both groups (Table 11). A majority (57%) of the documented bat fatalities were found as largely intact/complete carcasses in various states of decomposition, whereas 41% were found as incomplete scavenged carcasses or depredated remains in various states of decomposition. In contrast, high proportions of the small and medium-sized bird fatalities were found as only feather spots and, for both groups, more than 77–81% of the fatalities were found as incomplete, scavenged carcasses or depredated remains in various states of decomposition. Of the large bird fatalities, a relatively high 53% were found as largely intact/complete carcasses in various states of decomposition; a low 29% were found as incomplete carcasses; and a high 16% were dismembered by a turbine strike.

Table 11. Representation Across 3-Year Study of Bat and Bird Fatalities in Various Conditions at the Time of Discovery, Excluding Carcasses Deposited Before Study Began

	Bats		Small Birds		Medium Birds		Large Birds	
Carcass Condition	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Injured-died/euthanized	6	1.4	0	0.0	0	0.0	2	1.2
Intact/complete								
– fresh	80	18.1	30	6.7	8	9.4	32	19.2
– early decomposition	163	37.0	63	14.0	7	8.2	51	30.5
– decomposed	9	2.0	6	1.3	0	0.0	6	3.6
Dismembered	2	0.5	4	0.9	1	1.2	27	16.2
Depredated/scavenged								
– fresh	26	5.9	25	5.6	3	3.5	12	7.2
– early decomposition	139	31.5	143	31.8	22	25.9	15	9.0
– decomposed	16	3.6	9	2.0	4	7.1	10	6.0
– feather spot	0	0.0	170	37.8	38	44.7	12	7.2
Total	**441**	–	**450**	–	**83**	–	**167**	–

3.5 Fatality Estimates

3.5.1 Year 1

In Year 1 when detection-dog teams conducted all surveys, the adjusted annual per-turbine fatality estimates for the 7-day surveys were higher than those derived from the 28-day surveys for all species groups. The differences were marginally significant for all birds combined, small birds, and nonraptors, but were nonsignificant for bats, medium and large birds, and raptors (Table 12). The precision of the facility-level adjusted fatality estimates was good for all birds combined (CV = 0.47) and fair for all other primary groups (CV = 0.58–0.80). In reviewing estimates for all individual species documented during the survey year (see Appendix P), note that five or more fatalities are necessary to derive a meaningful annual fatality estimate and CI (Huso et al. 2012). Few species met this standard. Table 13 summarizes the Year 1 adjusted facility-wide fatality rates and estimated totals for the PEIR-emphasis species and other species for which the annual tally exceeded five fatalities in one or more survey years.

3.5.2 Year 2

The absence of detected bat trial carcasses precluded developing tailored fatality estimates for 28-day plots surveyed by humans in Year 2. Hence, we extrapolated facility-level estimates for bats in Year 2 based solely the findings of the 7-day surveys conducted by detection-dog teams. For birds, the per-turbine fatality rate estimates for the 28-day surveys were at least slightly lower than for the 7-day surveys for most groups, but the only significant difference was for medium birds and the differences for smaller birds and nonraptors as a group were negligible compared to Year 1 (Table 14). Moreover, unlike in Year 1, in Year 2 the estimated per-turbine fatality rate for large birds was nonsignificantly higher on the 28-day plots than on the 7-day plots.

Table 12. Adjusted Fatality Estimates for Bats and Selected Groups of Birds on 7-Day and 28-Day Survey Plots: Year 1

Survey Type	Group/Species	Contributing Fatalities[1]	Fatalities Per Turbine		Total Fatalities For Turbine Group	
			Estimate	95% CI[2]	Estimate	95% CI
7-Day Dog (16 turbines)	Bats	104	10.60	6.50 – 12.96	187	144 – 264
	Birds	139	15.30	8.69 – 18.06	265	212 – 339
	Small birds	104	12.60	6.50 – 15.28	222	171 – 296
	Medium birds	6	0.41	0.38 – 0.52	7	6 – 11
	Large birds	29	2.04	1.81 – 2.35	35	29 – 48
	Nonraptors	109	12.96	6.81 – 15.66	229	177 – 302
	Raptors	30	2.12	1.88 – 2.45	36	31 – 50
28-Day Dog (32 turbines)	Bats	91	7.83	2.84 – 10.29	285	201 – 434
	Birds	129	8.62	4.03 – 10.62	305	236 – 411
	Small birds	69	6.12	2.16 – 7.92	221	158 – 328
	Medium birds	10	0.38	0.31 – 0.50	14	10 – 23
	Large birds	50	1.85	1.56 – 2.33	63	54 – 103
	Nonraptors	74	6.33	2.31 – 8.15	228	166 – 335
	Raptors	55	2.07	1.72 – 2.60	71	60 – 115

1 Excludes (a) fatalities aged as having been deposited more than one search interval before the start of the monitoring Project; (b) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); and (c) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey.

2 CI = confidence interval.

Table 15 summarizes the estimated Year 2 adjusted fatality rates and facility-wide totals for the PEIR-emphasis species and other selected species (estimates for all detected species are provided in Appendix Q). Extrapolating solely from discoveries by detection-dog teams on 7-day plots produced facility-level estimates with fair precision for all bats combined and the two common bat species. The precision of fatality estimates derived from integrated 7-day/28-day data was good for medium birds, large birds, and raptors, but was poor for small birds and groups dominated by small birds (i.e., all birds and nonraptors).

3.5.3 Year 3

Higher detection rates of bats and small birds by human surveyors in Year 3 compared to Year 2 supported developing adjusted fatality estimates based on integrated 7-day/28-day data for both groups; however, the precision of the resulting 28-day estimates was poor (Table 16). Similar to Year 1, the adjusted annual per-turbine fatality rate estimates for the 7-day surveys were all higher than those derived from the 28-day surveys, with the differences least pronounced for large birds and raptors as a group. Unlike in prior years, however, all of the pairwise differences within bird groups were at least marginally if not strongly significant.

Table 13. Facility-Wide Adjusted Fatality Estimates for Selected Species Groups and Focal Species: Year 1

Taxon[1]	Contributing Fatalities[2]	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
		Median	95% CI[3]	Median	95% CI	Median	95% CI
All bats	195	9.89	7.45–13.82	5.52	4.16–7.72	475	358–663
Mexican free-tailed bat	113	5.65	4.22–7.84	3.16	2.36–4.38	271	203
Hoary bat	73	3.84	2.74–5.6	2.14	1.53–3.13	184	131
Western red bat	5	0.23	0.10–0.44	0.13	0.06–0.25	11	5
All birds	268	11.91	9.57–15.19	6.65	5.34–8.48	572	459–729
Small birds	173	9.26	7.13–12.69	5.17	3.98–7.09	444	342–609
Medium birds	16	0.45	0.33–0.69	0.25	0.19–0.38	21	16–33
Large birds	79	2.05	1.78–3.06	1.14	1.00–1.71	98	86–147
Nonraptors	183	9.54	7.40–12.97	5.33	4.13–7.24	458	355–622
Raptors	85	2.23	1.95–3.31	1.25	1.09–1.85	107	93–159
Golden eagle[4]	***6***	***0.18***	***0.13–0.32***	***0.10***	***0.07–0.18***	***9***	***6–15***
Red-tailed hawk	55	1.41	1.22–2.14	0.79	0.68–1.19	68	58–102
American kestrel	4	0.12	0.08–0.20	0.07	0.05–0.11	6	4–9
Prairie falcon	1	0.03	0.02–0.04	0.01	0.01–0.02	1	1–2
Burrowing owl	2	0.07	0.04–0.13	0.04	0.02–0.07	3	2–6
Barn owl	2	0.06	0.04–0.12	0.03	0.02–0.07	3	2–6
Loggerhead shrike	0	–	–	–	–	–	–
Tricolored blackbird	1	0.04	0.02–0.1	0.02	0.01–0.06	2	1–5
Horned lark	41	2.05	1.46–2.98	1.15	0.82–1.66	99	70–143
Western meadowlark	23	1.39	0.87–2.14	0.78	0.49–1.20	67	42–103
White-throated swift	16	0.92	0.54–1.57	0.52	0.30–0.88	44	26–76
House wren	23	1.13	0.73–1.69	0.63	0.41–0.95	54	35–81

1 Selected species represent PEIR-emphasis species and other native species for which more than five qualified fatalities were documented during two or more survey years. See Appendix P for comprehensive fatality estimates by species.
2 Excludes (a) fatalities aged as having been deposited more than one search interval before the start of the monitoring Project; (b) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); and (c) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey.
3 CI = confidence interval.
4 ***See Section 4.3.2 for discussion of the most appropriate mortality indices for this species.***

Table 14. *GenEst* Adjusted Fatality Estimates for Selected Groups of Birds on 7-Day and 28-Day Survey Plots: Year 2

Survey Type	Group/Species	Contributing Fatalities[1]	Fatalities Per Turbine		Total Fatalities For Turbine Group	
			Estimate	95% CI[2]	Estimate	95% CI
7-Day Dog (16 turbines)	Birds	150	14.63	12.01 – 19.67	234	192 – 315
	Small birds	110	11.94	9.39 – 17.05	191	150 – 273
	Medium birds	24	1.70	1.50 – 2.03	27	24 – 32
	Large birds	16	1.14	1.00 – 1.43	18	16 – 23
	Nonraptors	112	12.08	9.53 – 17.19	193	153 – 275
	Raptors	38	2.69	2.38 – 3.27	43	38 – 52
28-Day Human (32 turbines)	Birds	67	13.63	5.14 – 50.34	436	165 – 1611
	Small birds	17	11.49	2.95 – 42.11	368	94 – 1348
	Medium birds	14	0.65	0.46 – 1.00	21	15 – 32
	Large birds	36	1.61	1.31 – 2.36	52	42 – 76
	Nonraptors	20	11.63	3.04 – 42.27	372	97 – 1353
	Raptors	47	2.13	1.73 – 3.06	68	55 – 98

[1] Excludes (a) fatalities aged as deposited more than one search interval before the start of the monitoring Project; (b) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); and (c) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey.

[2] CI = confidence interval.

Table 15. Facility-Wide Adjusted Fatality Estimates for Selected Species and Species Groups: Year 2

Taxon[1]	Contributing Fatalities[2]	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
		Median	95% CI[3]	Median	95% CI	Median	95% CI
All bats	116	10.59	(8.19–15.42)	5.92	(4.58–8.61)	508	(393–740)
Mexican free-tailed bat	64	5.90	(4.40–8.87)	3.30	(2.46–4.95)	283	(211–426)
Hoary bat	44	4.17	(2.92–6.32)	2.33	(1.63–3.53)	200	(140–303)
Western red bat	2	0.17	(0.04–0.45)	0.09	(0.02–0.25)	8	(2–22)
All birds	217	14.34	(8.30–34.88)	8.01	(4.64–19.49)	688	(399–1674)
Small birds	127	11.79	(5.79–32.28)	6.59	(3.24–18.03)	566	(278–1549)
Medium birds	38	1.01	(0.84–1.28)	0.56	(0.47–0.71)	48	(41–61)
Large birds	52	1.46	(1.24–1.94)	0.81	(0.69–1.09)	70	(60–93)
Nonraptors	132	11.93	(5.93–32.4)	6.67	(3.31–18.10)	573	(285–1555)
Raptors	85	2.32	(2.01–3.01)	1.30	(1.13–1.68)	111	(97–144)
Golden eagle[4]	***14***	***0.39***	***(0.29–0.56)***	***0.22***	***(0.16–0.31)***	***19***	***(14–27)***
Red-tailed hawk	28	0.80	(0.63–1.11)	0.45	(0.35–0.62)	38	(30–53)
American kestrel	9	0.22	(0.19–0.30)	0.13	(0.10–0.17)	11	(9–14)
Prairie falcon	1	0.03	(0.02–0.04)	0.01	(0.01–0.02)	1	(1–2)
Burrowing owl	22	0.60	(0.48–0.81)	0.33	(0.27–0.45)	29	(23–39)
Barn owl	3	0.07	(0.06–0.09)	0.04	(0.03–0.05)	4	(3–4)
Loggerhead shrike	1	0.28	(0.02–2.11)	0.16	(0.01–1.18)	14	(1–101)
Tricolored blackbird	0	–	–	–	–	–	–
Horned lark	34	3.70	(1.49–14.38)	2.07	(0.83–8.04)	178	(72–690)
Western meadowlark	15	1.07	(0.39–4.00)	0.60	(0.22–2.24)	52	(19–192)
White-throated swift	19	1.23	(0.48–4.26)	0.69	(0.27–2.38)	59	(23–204)
House wren	1	0.04	(0.02–0.12)	0.02	(0.01–0.06)	2	(1–6)

[1] Selected species represent PEIR-emphasis species and other native species for which more than five qualified fatalities were documented during two or more survey years. See Appendix Q for comprehensive fatality estimates by species.
[2] Excludes (a) fatalities aged as having been deposited more than one search interval before the Project began; (b) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); and (c) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey.
[3] CI = confidence interval.
[4] ***See Section 4.3.2 for discussion of the most appropriate mortality indices for this species.***

Table 16. Adjusted Annual Fatality Estimates for Bats and Selected Groups of Birds Based on 7-Day and 28-Day Surveys: Year 3

Survey Type	Group/Species	Contributing Fatalities[1]	Fatalities Per Turbine		Total Fatalities For Turbine Group	
			Estimate	95% CI[2]	Estimate	95% CI
7-Day Dog (16 turbines)	Bats	103	10.74	8.49 – 15.54	172	136 – 249
	Birds	147	17.26	13.27 – 26.39	276	212 – 422
	Small birds	116	14.70	10.80 – 23.14	235	173 – 370
	Medium birds	16	1.15	1.00 – 1.62	18	16 – 26
	Large birds	14	1.06	0.88 – 1.38	17	14 – 22
	Nonraptors	122	15.14	11.38 – 24.08	242	182 – 385
	Raptors	25	1.88	1.57 – 2.39	30	25 – 38
28-Day Human (32 turbines)	Bats	22	8.28	2.43 – 50.22	265	78 – 1607
	Birds	65	5.83	3.85 – 10.34	187	123 – 331
	Small birds	31	4.57	2.50 – 8.96	146	80 – 287
	Medium birds	12	0.51	0.38 – 0.82	16	12 – 26
	Large birds	22	0.82	0.69 – 1.02	26	22 – 33
	Nonraptors	34	4.60	2.58 – 8.78	147	83 – 281
	Raptors	31	1.21	1.00 – 1.54	39	32 – 49

[1] Excludes (a) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); and (b) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey.

[2] CI = confidence interval.

Table 17 provides estimated Year 3 adjusted fatality rates and facility-wide totals for PEIR-emphasis species and other selected species based on integrated 7-day/28-day data (estimates for all detected species are provided in Appendix R). The precision of estimates was poor for all bats combined (CV = 3.41), but fair for Mexican free-tailed bats (CV = 0.83), the most numerous species. Among birds, the precision of estimates was good for large birds and raptors as groups and for golden eagles (CV = 0.35–0.45), and was fair for other groups (CV = 0.53–0.71).

Table 17. Facility-Wide Adjusted Fatality Estimates for Selected Species and Species Groups: Year 3

Taxon[1]	Contributing Fatalities[2]	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
		Median	95% CI[3]	Median	95% CI	Median	95% CI
All bats	126	9.32	5.06–36.81	5.21	2.82–20.56	447	243–1767
Mexican free-tailed bat	64	2.77	1.98–4.28	1.55	1.11–2.39	133	95–205
Hoary bat	49	5.62	2.05–32.63	3.14	1.15–18.23	270	99–1566
Western red bat	4	0.13	0.08–0.26	0.07	0.05–0.15	6	4–13
All birds	213	9.77	7.65–13.45	5.46	4.27–7.51	469	367–646
Small birds	147	8.08	6.01–11.73	4.52	3.36–6.55	388	289–563
Medium birds	28	0.73	0.59–0.98	0.41	0.33–0.55	35	28–47
Large birds	36	0.89	0.76–1.11	0.50	0.43–0.62	43	37–53
Nonraptors	156	8.32	6.26–11.96	4.65	3.50–6.68	399	301–574
Raptors	55	1.44	1.25–1.85	0.81	0.70–1.03	69	60–89
Golden eagle[4]	***8***	***0.20***	***0.17–0.25***	***0.11***	***0.09–0.14***	***9***	***8–12***
Red-tailed hawk	23	0.57	0.48–0.79	0.32	0.27–0.44	28	23–38
American kestrel	7	0.19	0.15–0.29	0.11	0.08–0.16	9	7–14
Prairie falcon	0	–	–	–	–	–	–
Burrowing owl	13	0.34	0.27–0.49	0.19	0.15–0.28	16	13–24
Barn owl	0	–	–	–	–	–	–
Loggerhead shrike	0	–	–	–	–	–	–
Tricolored blackbird	2	0.11	0.04–0.37	0.06	0.02–0.20	5	2–18
Horned lark	23	1.24	0.78–2.12	0.69	0.43–1.18	60	37–102
Western meadowlark	28	1.65	1.05–2.72	0.92	0.58–1.52	79	50–131
White-throated swift	14	0.83	0.46–1.54	0.46	0.25–0.86	40	22–74
House wren	7	0.40	0.16–0.90	0.22	0.09–0.50	19	8–43

[1] Selected species represent PEIR-emphasis species and other native species for which more than five qualified fatalities were documented during two or more survey years. See Appendix R for comprehensive fatality estimates by species.
[2] Excludes (a) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); and (b) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey.
[3] CI = confidence interval.
[4] ***See Section 4.3.2 for discussion of the most appropriate mortality indices for this species.***

3.5.4 Interannual Comparisons

For all bats combined, the Year 2 estimated facility-wide fatality total based on extrapolated 7-day data was nonsignificantly higher than the estimates for Years 1 and 3 based on integrated 7-day/28-day data (Table 18). A similar interannual pattern was evident for Mexican free-tailed bats alone, except that the Year 3 total was significantly lower than the Year 2 total. In contrast, the estimates for hoary bats increased slightly but nonsignificantly each year, and the estimates for the relatively uncommon, special-status western red bat decreased nonsignificantly each year.

Interannual variation in fatality estimates varied among groups and species of birds. Variation in facility-wide fatality totals for all birds, small birds, nonraptors, and raptors followed the same pattern as for all bats: highest in Year 2 and lowest in Year 3, with no significant differences apparent, except that raptor fatalities were significantly lower in Year 3 than in Years 1 and 2 (Table 18). At the species level among nonraptors, estimated fatalities of horned larks and white-throated swifts followed the same overarching pattern as for all birds and all nonraptors, whereas western meadowlarks and tricolored blackbirds followed the opposite pattern (highest in Year 3, lowest in Year 2). In addition, as noted in Sections 3.4.2, the overall species diversity and combined fatality rate for small, migratory birds such as warblers and house wrens was distinctly elevated in Year 1, lower in Year 2, and intermediate in Year 3.

Fatalities of large birds declined each year of study and the estimated total for Year 3 was significantly lower than in Years 2 and 3, whereas the interannual pattern for medium birds differed from that of both small and large birds. Combining data for medium and large raptors resulted in comparable estimates in Years 1 and 2 for all raptors combined, followed by a significant decline in fatalities in Year 3. At the species level, fatalities of red-tailed hawks were high in Year 1, but significantly lower in Years 2 and 3. In comparison, fatalities of golden eagles, American kestrels, and burrowing owls were lowest in Year 1, highest in Year 2, and moderate in Year 3, with golden eagle and burrowing owl fatalities marginally to significantly higher in Year 2 (Table 18).

3.5.4.1 Age-Specific Representation Among Fatalities of Red-tailed Hawks and Golden Eagles

The high Year 1 and moderate Year 2 fatality rates for red-tailed hawks mostly reflected elevated mortality in fall (and winter in Year 1), and the interannual pattern primarily reflected variation in the prevalence of juvenile birds as fatalities (Table 19). More specifically, the annual numbers of countable adult fatalities remained relatively steady (12–15 per year) and adult fatalities generally were distributed throughout the year. In contrast, the annual numbers of countable juvenile fatalities ranged from a high of 39 in Year 1 to a low of 6 in Year 3, and all Year 1 and 2 juvenile fatalities were recorded from fall through spring, whereas half of the Year 3 juvenile fatalities were recorded in summer.

For golden eagles, 19 of 26 (73%) fatalities that could be confidently aged were subadults, and the unadjusted countable total of subadult eagle fatalities increased each year from a low of five in Year 1 to a high of eight in Year 3 (Table 19). In contrast, the only confirmed juvenile fatalities (2) occurred in Year 2 and no confirmed adult or juvenile fatalities occurred in Year 3.

Table 18. Interannual Comparisons of Estimated Facility-Wide Adjusted Fatality Totals for Focal Groups and Species

	Year 1			Year 2			Year 3		
Taxon	Contributing Fatalities[1]	Median	95% CI[2]	Contributing Fatalities	Median	95% CI	Contributing Fatalities	Median	95% CI
All bats	195	477	360–680	116	508	393–740	126	447	243–1767
Mexican free-tailed bat	113	271	203–376	64	283	211–426	64	133	95–205
Hoary bat	73	184	131–269	44	200	140–303	49	270	99–1566
Western red bat	5	11	5–21	2	8	2–22	4	6	4–13
All birds	260	548	441–713	217	688	399–1674	213	469	367–646
Small birds	166	422	324–583	127	566	278–1549	147	388	289–563
Medium birds	19	25	19–37	38	48	41–61	28	35	28–47
Large birds	75	93	81–141	52	70	60–93	36	43	37–53
Nonraptors – all species	177	436	337–597	132	573	285–1555	156	399	301–574
Nonraptors – native only	173	427	326–607	127	534	240–1869	150	391	285–549
Raptors	83	104	90–155	85	111	97–144	55	69	60–89
Golden eagle[3]	***6***	***9***	***6–15***	***14***	***19***	***14–27***	***8***	***9***	***8–12***
Red-tailed hawk	55	68	58–102	28	38	30–53	23	28	23–38
American kestrel	4	6	4–9	9	11	9–14	7	9	7–14
Prairie falcon	1	1	1–2	1	1	1–2	0	0	–
Burrowing owl	2	3	2–6	22	29	23–39	13	16	13–24
Barn owl	2	3	2–6	3	4	3–4	0	0	–
Loggerhead shrike	0	0	0–0	1	14	1–101	0	0	–
Tricolored blackbird	1	2	1–5	0	0	–	2	5	2–18
Horned lark	41	99	70–143	34	178	72–690	23	60	37–102
Western meadowlark	23	67	42–103	15	52	19–192	28	79	50–131
White-throated swift	16	44	26–76	19	59	23–204	14	40	22–74
House wren	23	54	35–81	1	2	1–6	7	19	8–43

[1] Excludes (a) Year 1 fatalities deposited before the Project started; (b) off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots); (c) on-plot incidental finds that were found and left in place by a non-surveyor, and never found again during a standard survey; and (d) Year 2 bat fatalities found on 28-day survey plots.

[2] CI = confidence interval.

[3] ***See Section 4.3.2 for discussion of the most appropriate mortality indices for this species.***

Table 19. Documented Red-tailed Hawk and Golden Eagle Fatalities by Year, Season, and Age Class, Excluding Year 1 Carcasses Deposited Before Study Began

			Age Class				
Species	**Year**	**Season**	**Adult**	**Subadult**	**Juvenile**	**Unknown**	**Total**
Red-tailed Hawk	Year 1	Fall	7	0	19	2	28
		Winter	4	0	19	1	24
		Spring	4	1	6	0	11
		Summer	0	1	0	0	1
	Subtotal		15	2	44	3	64
	Year 2	Fall	4	0	8	1	13
		Winter	3	0	2	2	7
		Spring	3	0	2	1	6
		Summer	2	1	0	1	4
	Subtotal		12	1	12	5	30
	Year 3	Fall	3	0	0	2	5
		Winter	5	0	1	0	6
		Spring	5	0	2	0	7
		Summer	2	0	3	0	5
	Subtotal		15	0	6	2	23
Total			**42**	**3**	**62**	**10**	**117**
% of Species Total			**36**	**3**	**53**	**9**	**–**
Golden Eagle	Year 1	Fall	0	1	0	0	1
		Winter	0	0	0	1	1
		Spring	1	3	0	0	4
		Summer	1	1	0	0	2
	Subtotal		2	5	0	1	8
	Year 2	Fall	0	1	2	0	3
		Winter	0	1	0	1	2
		Spring	3	1	0	0	4
		Summer	0	3	0	2	5
	Subtotal		3	6	2	3	14
	Year 3	Fall	0	2	0	0	2
		Winter	0	1	0	0	1
		Spring	0	1	0	0	1
		Summer	0	4	0	0	4
	Subtotal		0	8	0	0	8
Total			**5**	**19**	**2**	**4**	**30**
% of Species Total			**17**	**63**	**7**	**13**	**–**

3.6 Temporal Distribution of Fatalities

Based solely on data derived from the 7-day surveys with detection dogs conducted each year, the adjusted fatality estimates for bats showed a 3-month peak during fall 2017, a briefer and less substantial peak in fall 2018, and moderate activity during the first half of the fall 2019 migration season (Figure 7). Bat fatalities also consistently occurred at low to moderate rates from April/May through July. Years 1 and 2 also showed modest secondary peaks in May/June during spring migration, whereas no real peak in activity occurred during spring 2019. The timing of species-specific fatalities also varied among years, especially in spring. Bat fatalities were comparatively scarce to nonexistent during winter, with only 11 total bat fatalities found from December through April in Year 1, none found during January and February in Year 2, and none found from December through March in Year 3.

Across the 3-year study, the detection-dog teams found one or more raptor fatalities on 7-day plots in all but 6 months, and the detection-dog teams in Year 1 and the human searchers in Years 2 and 3 found one or more raptor fatalities on 28-day plots in all but 3 months. In combination, we documented one or more raptor fatalities during each month of the study (Figure 8). Red-tailed hawks accounted for 49% of the estimated facility-wide total raptor fatalities, with one or more fatalities found in almost every month except during summer 2017. The adjusted fatality totals for this species were much higher during the first 8.5 months of the study than during any subsequent period, with a slight secondary peak in fall 2018 followed by consistently modest monthly numbers thereafter. Although we documented five golden eagle fatalities during the first 4 months of the project, none qualified to contribute to the adjusted fatality estimates, with the first qualified fatality found in April 2017. From then on, documented golden eagle fatalities were broadly distributed across the study, and were relatively common in spring and summer, especially in 2018. Fatalities of American kestrels and burrowing owls were scarce during Year 1, but increased beginning in fall 2017. Thereafter, American kestrel fatalities occurred primarily during fall/winter and were more common during fall/winter 2017 than during fall/winter 2018. In contrast, although we recorded no qualifying burrowing owl fatalities during the first 9.5 months of the study, we documented fatalities in all but one of the next 17 months, but then their occurrence became more sporadic again through the remainder of the study.

In Year 1, the detection-dog teams discovered one or more nonraptor bird fatalities on both the 7-day and 28-day plots in every month (Figure 9). In Year 2, the detection-dog teams again found one or more nonraptor bird fatalities on the 7-day plots each month, whereas the human searchers working the 28-day plots detected nonraptor birds in only 8 of 12 months. Nonraptor fatality activity was generally sustained at moderately high levels from winter 2016/2017 through spring 2018, but dropped off during summer 2018 and again during early spring 2019. Horned lark fatalities, in particular, appeared to drop off markedly after May 2018.

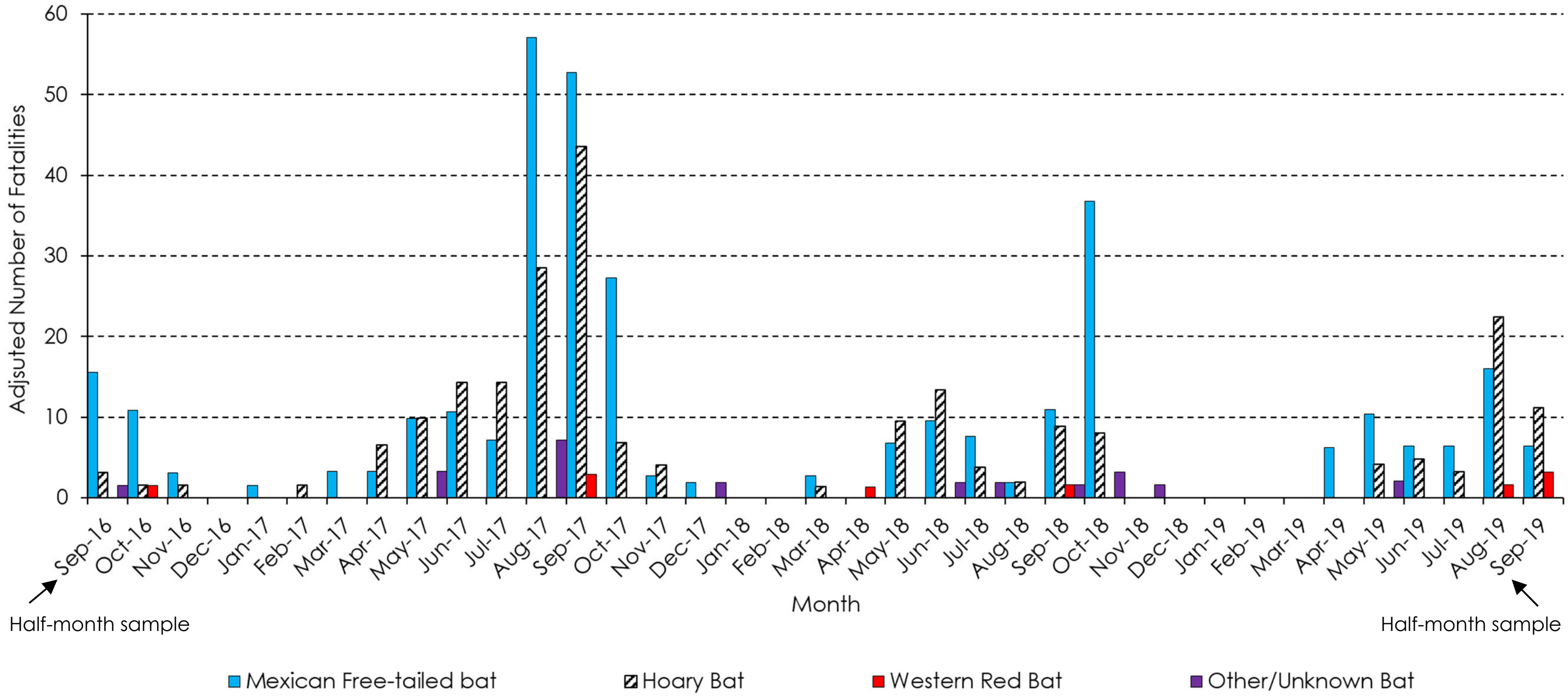


Figure 7. Temporal Variation Across 3-Year Study in Estimated Fatality Totals for Bats on Turbine Plots Surveyed at 7-Day Intervals by Detection-Dog Teams (16 Plots per Year)

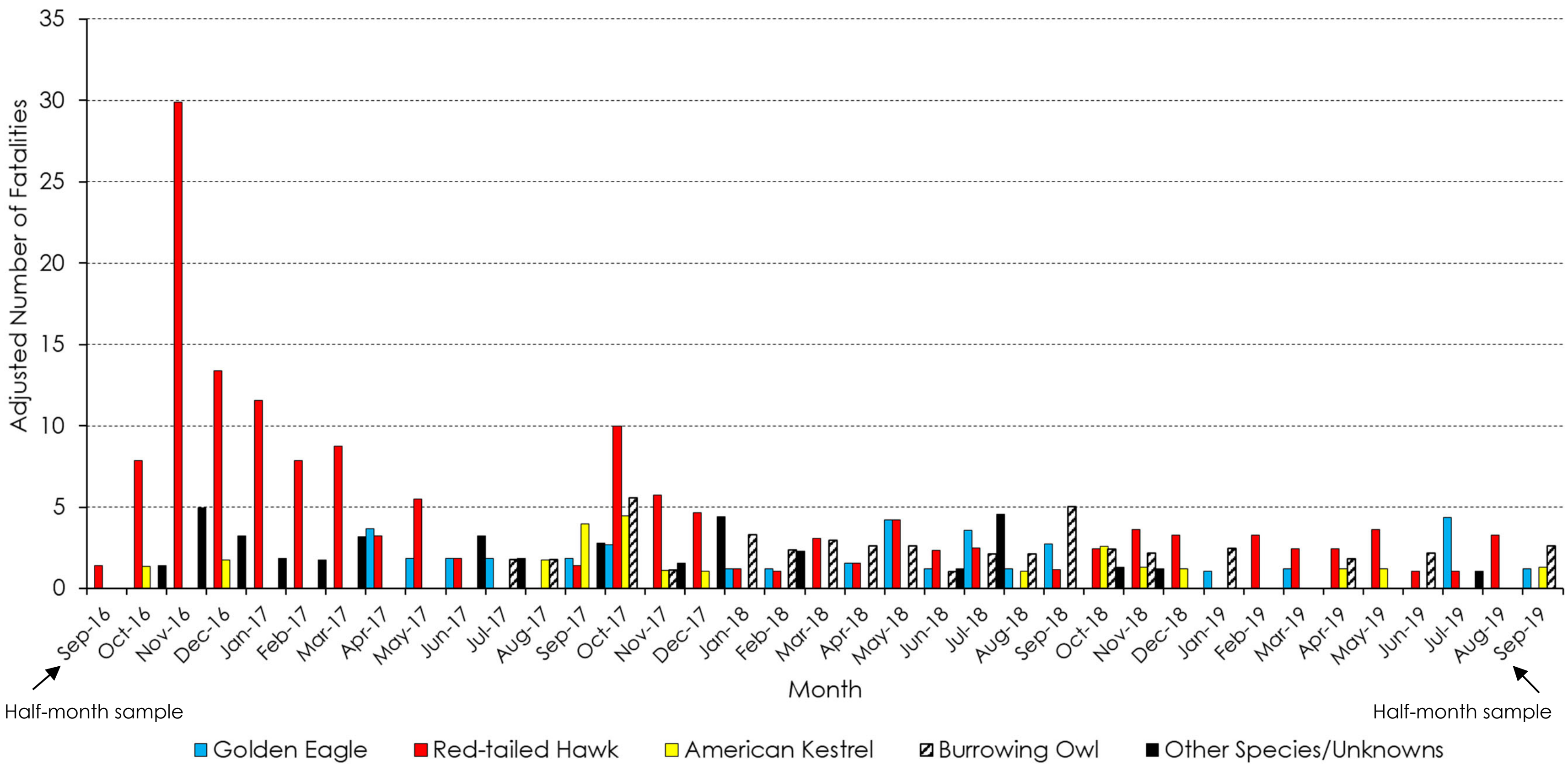


Figure 8. Temporal Variation Across 3-Year Study in Estimated Facility-Wide Fatality Totals for Raptors

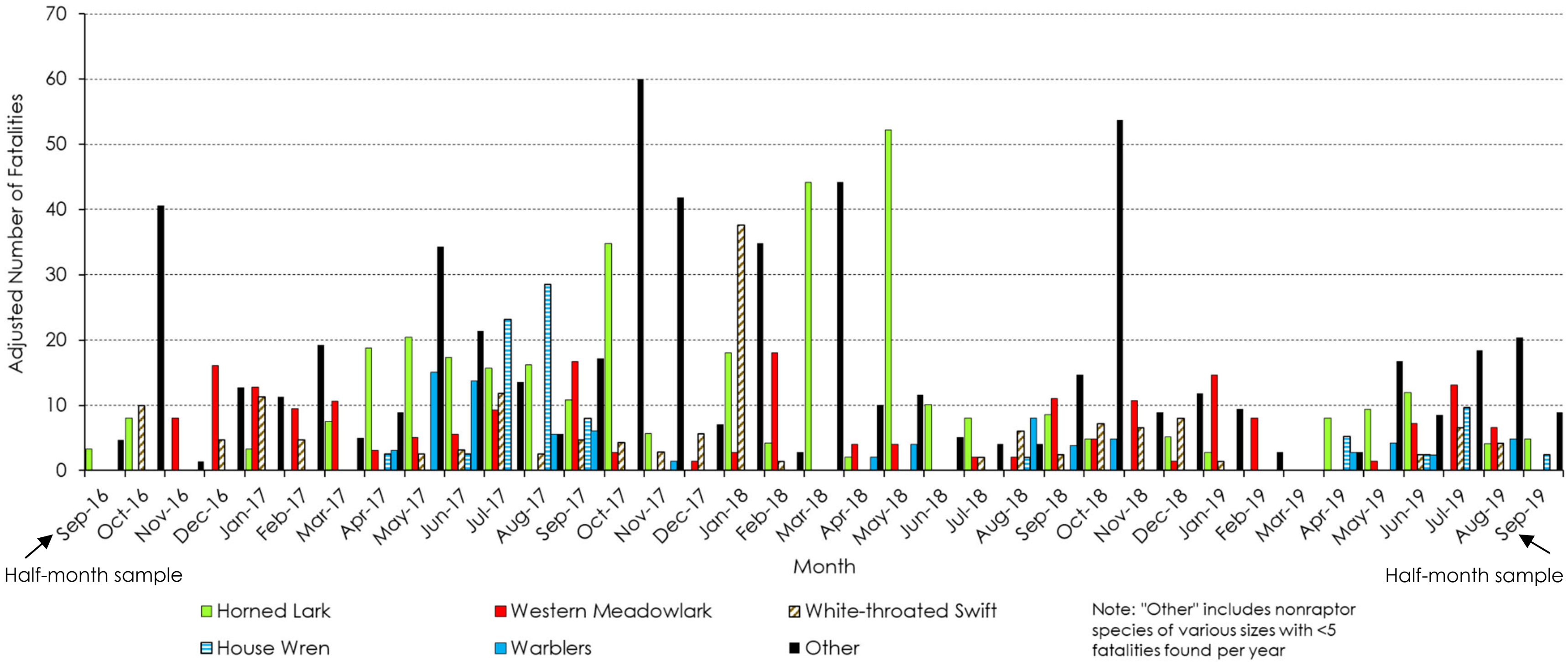


Figure 9. Temporal Variation Across 3-Year Study in Estimated Facility-Wide Fatality Totals for Small Birds

3.7 Spatial Distribution of Fatalities

The detection-dog teams found at least one bat on every 7-day plot they surveyed across the 3-year study, and in Year 1 they detected at least one bat fatality on all but one of the 28-day plots they surveyed (WTG 11) (Figure 10; WTG numbering from 1 through 48 generally runs from west to east, with a few exceptions—see Figure 2). In comparison, the human surveyors found only four bats on different 28-day plots in Year 2, and only 22 bats scattered across 50% of the 28-day plots surveyed in Year 3. The adjusted annual per turbine bat fatality rate on 7-day plots was elevated in Year 1 (16.2±4.05 [mean ± 95% CI] fatalities per turbine), but dropped marginally to the same lower level in Year 2 (10.7±2.78) and Year 3 (10.7±3.06).

Considering the year- and turbine-specific 7-day survey results for bats as if all turbines were surveyed the same way in the same year suggested that there were turbines with above average fatality levels scattered across the facility, but with greater overall concentrations in the western and east-central portions of the facility. The latter areas included four turbines that stood out as potential moderate (WTGs 8, 14, and 32) to strong (WTG 20) hotspots based on the year-specific data (Figures 10 and 11).

The detection-dog teams found at least one nonraptor fatality on all but one of the 7-day turbine plots they surveyed across the 3-year study, as well as on most of the 28-day plots they surveyed in Year 1. The human searchers found relatively few nonraptors overall, but the combined 3-year dataset revealed 20 turbine plots (42% of the total) with one or more countable nonraptor fatalities in all 3 years, 24 plots (50%) with one or more countable fatalities in 2 years, 3 plots (6%) with countable fatalities in only 1 year, and 1 plot (2%) with no fatalities during the study (WTG 7). Evaluated across all turbines, the per-turbine adjusted fatality rate for nonraptors averaged similar in Year 1 (11.69±4.63 fatalities per turbine) and Year 2 (11.4±5.80), then dropped marginally in Year 3 (8.1±4.13). With data aggregated across the 3-year study, nonraptor fatalities were broadly spread across the facility, with the only moderate hotspots shown in the northeast sector (WTGs 36, 37, and 42) (Figure 12).

For raptors as a group across the 3 years of monitoring, 15 turbines (31% of the total) had one or more countable raptor fatalities in all 3 years, 22 turbines (46%) had countable raptor fatalities in 2 years, 9 turbines (19%) had countable raptor fatalities in 1 year, and 2 (4%) turbines had no countable fatalities during the Project (Figure 10). The per-turbine raptor fatality rate averaged highest in Year 1 (3.0±1.22), dropped 23% in Year 2 (2.3±0.97), and dropped another 40% in Year 3 (1.4±0.94); however, the differences were not statistically significant. With data aggregated across the 3-year study, many low hotspots for raptor fatalities were scattered across the facility and five moderate hotspots were identified, three in the western sector and two in the eastern/southeastern sector (Figure 13).

Countable golden eagle fatalities never occurred during all 3 years at any individual turbine, occurred in 2 years at two turbines clustered in the west-central sector (WTGs 14 and 15) and at one turbine on the southeast fringe of the facility (WTG 11), occurred at 17 turbines in 1 year, and never occurred during the study at 58% (28) of the turbines. Whether based on adjusted or unadjusted fatality totals, golden eagle fatalities were most concentrated in the west-central sector of the facility along the North Flynn Road corridor, where three moderate to strong hotspots were located (WTGs 14, 15, and 16) (Figure 14). Along with another strong

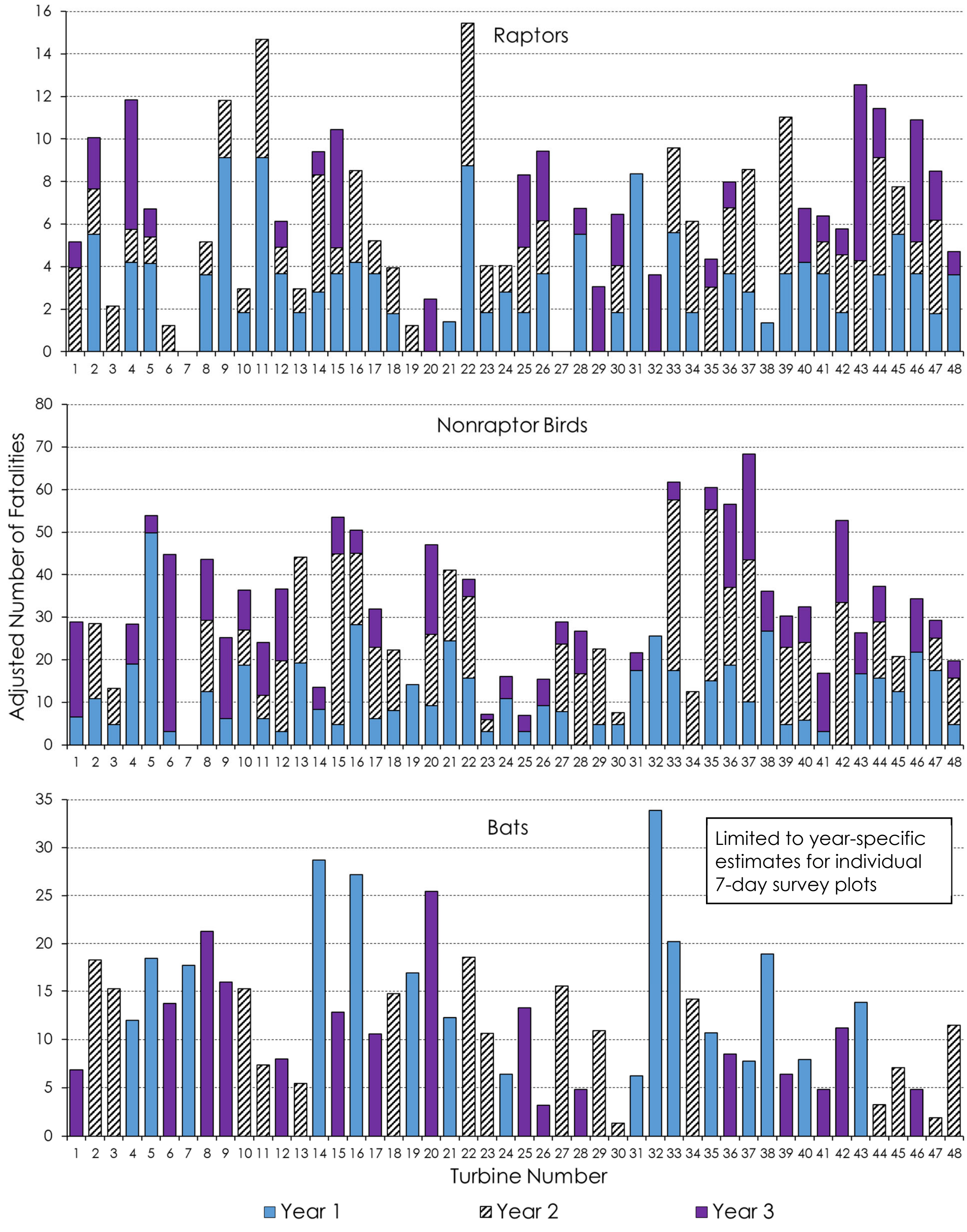
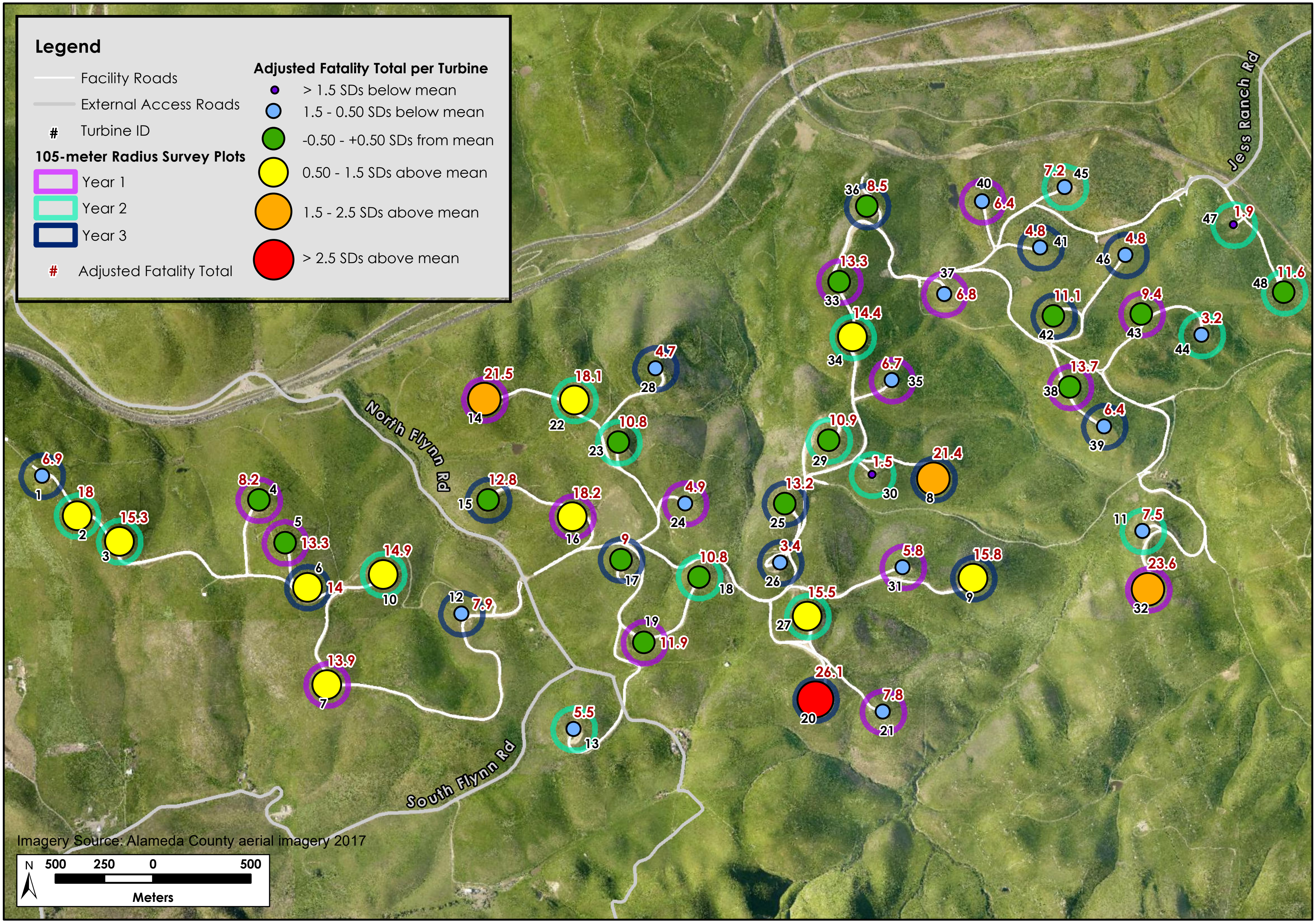


Figure 10. Adjusted Annual Estimates of Raptor, Nonraptor Bird, and Bat Fatalities by Turbine: Years 1–3



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 11 Proportional Representation of Adj Fatality_ Bats Oct2020.mxd

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Figure 11. Proportional Representation of Adjusted Bat Fatality Totals on 7-day Survey Plots, With a Different Set of 16 Turbines Surveyed in Each of Three Years

N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 12 Adj Fatality Totals Year 1 2 3 - Nonraptor.mxd

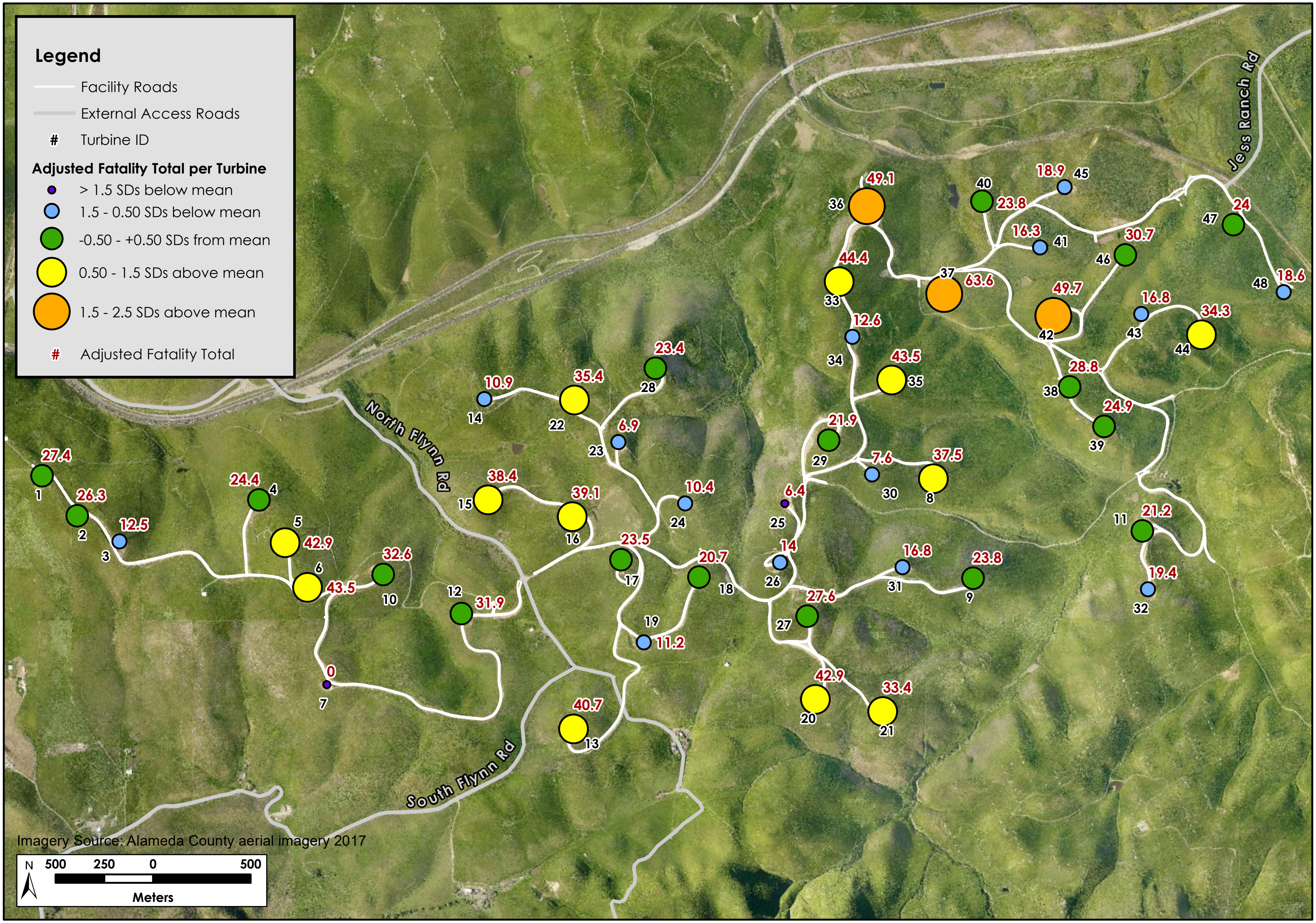

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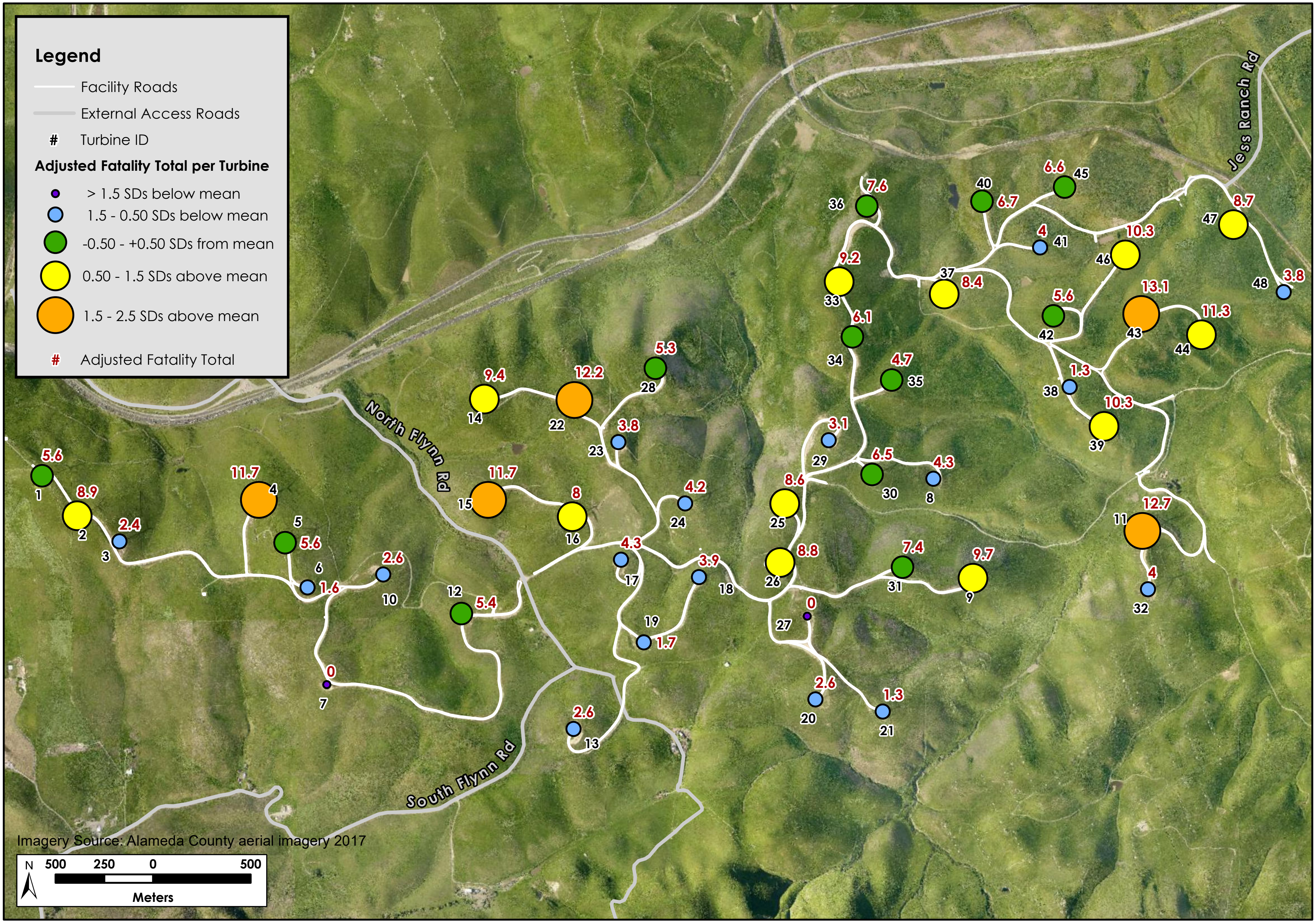
Figure 12. Proportional Representation of Adjusted Nonraptor Fatality Totals by Turbine Aggregated Across the 3-Year Study

Golden Hills Postconstruction Fatality Monitoring: Final 3-Year Report (3926-01)
April 2021



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 13 Adj Fatality Totals Year 1 2 3 - Raptor.mxd

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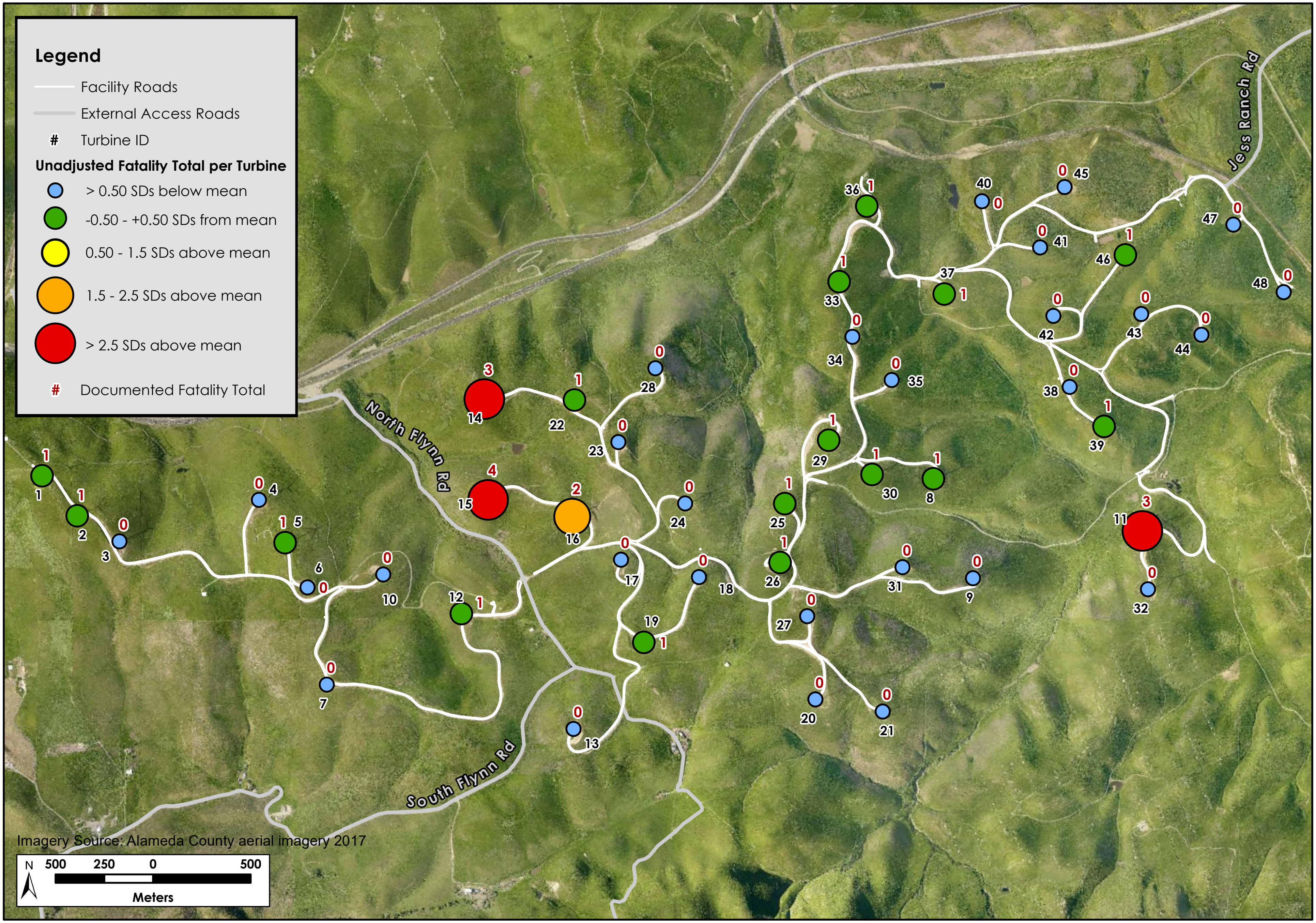
Figure 13. Proportional Representation of Adjusted Raptor Fatalities by Turbine Aggregated Across the 3-Year Study

Golden Hills Postconstruction Fatality Monitoring: Final 3-Year Report (3926-01)
April 2021



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 14 Proportional Representation of UnAdj Fatality_ Golden Eagle.mxd

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Figure 14. Proportional Representation of Unadjusted Golden Eagle Fatality Totals by Turbine Aggregated Across the 3-Year Study

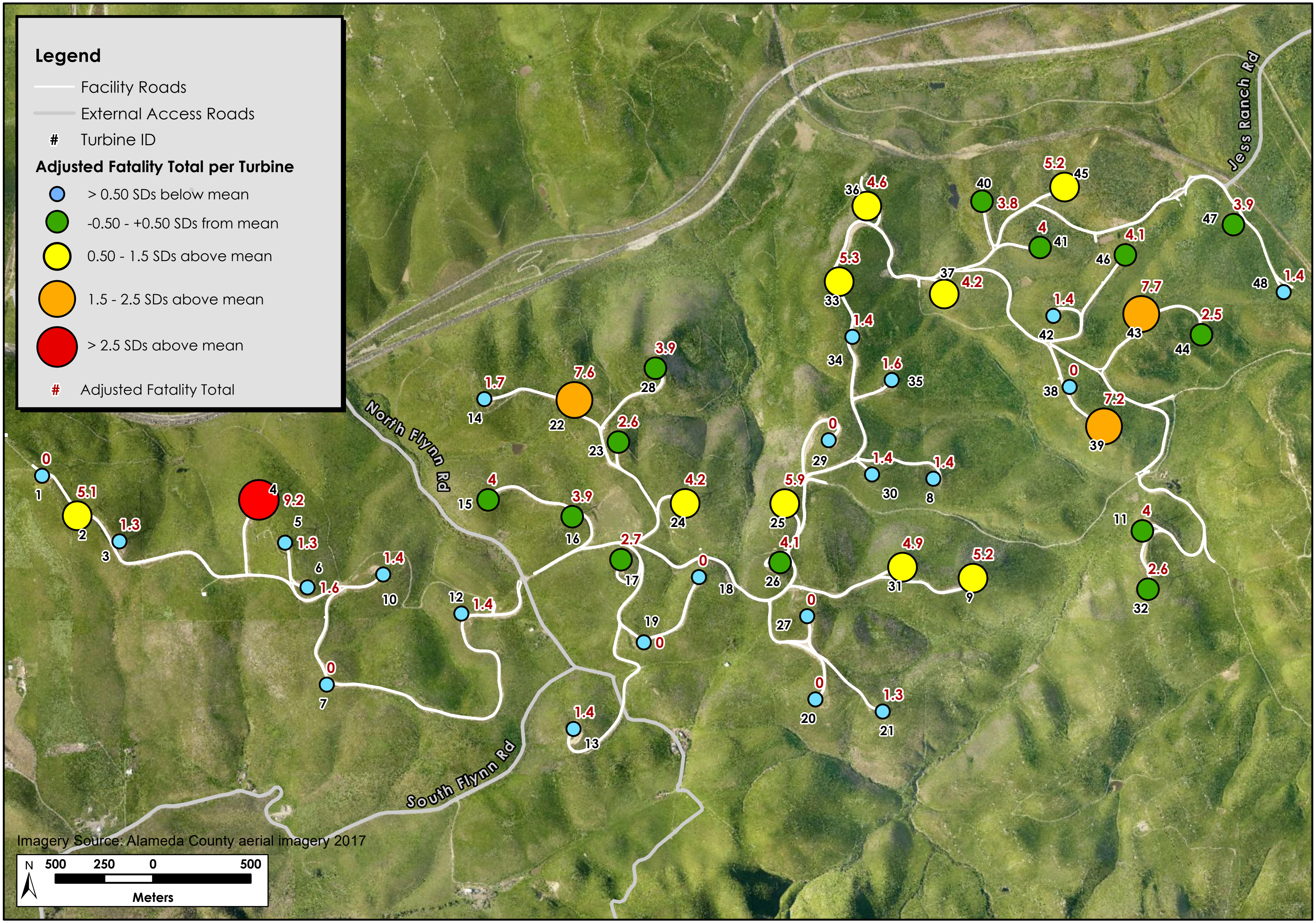
Golden Hills Postconstruction Fatality Monitoring: Final 3-Year Report (3926-01)
April 2021

hotspot at WTG 11 in the southeastern sector, WTGs 14 and 16 were the sites where we documented two golden eagle fatalities in a single monitoring year (all in Year 2). WTG 15 was the only turbine at which we documented more than two fatalities in a single monitoring year (three in Year 3; four total).

Countable red-tailed hawk fatalities occurred at one turbine in all 3 years (WTG 4 in the western sector), at 18 turbines (38% of the total number) in 2 years, at 21 turbines (44%) in 1 year, and never at 8 turbines (17%). Aggregated across the 3-year study, the adjusted data indicated low hotspots scattered across the facility and five moderate hotspots in various locations (Figure 15). We documented seven red-tailed hawk fatalities at WTG 4, which ranked as the only strong multi-year hotspot; however, we found relatively few fatalities of this species elsewhere in the western sector. Red-tailed hawk fatalities were overall more concentrated in the middle and eastern sectors, with three moderate hotspots in these areas where we documented 5–6 fatalities each (WTGs 22, 39, and 43). A majority (64%) of the red-tailed hawk fatalities were found as complete carcasses (including those dismembered by blade strikes).

Three years of monitoring yielded single, countable American kestrel fatalities at one turbine in 2 years (WTG 44 in the eastern sector) and at 18 other turbines in 1 year only, and revealed no fatalities at 60% (29) of the turbines. Aggregated across the 3-year study, WTG 44 emerged as a moderate hotspot for kestrel fatalities, although two actual fatalities expanded to an adjusted estimate of three fatalities does not constitute a red flag for this species (Figure 16). A high proportion (73%) of the kestrel fatalities were found as depredated/scavenged remains or feather spots.

Countable burrowing owl fatalities occurred during more than 1 year at only four turbines, with two of those turbines (WTGs 43 and 46) the only sites where we documented a total of four burrowing owl fatalities across the study. Otherwise, three fatalities occurred at WTG 44 but only in Year 2, and two fatalities occurred in a single year at six other turbines. Aggregated across the 3-year study, burrowing owl fatalities were largely absent from the western sector and were most concentrated in the northeastern sector (Figure 17). One moderate and two strong hotspots occurred clustered together in the northeastern sector at WTGs 43, 44, and 46, and a third moderate hotspot occurred a bit farther southwest at WTG 9. Most (91%) burrowing owl fatalities were found as depredated/scavenged remains or feather spots.



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 15 Adj Fatality Totals Year 1 2 3 - RTHA.mxd

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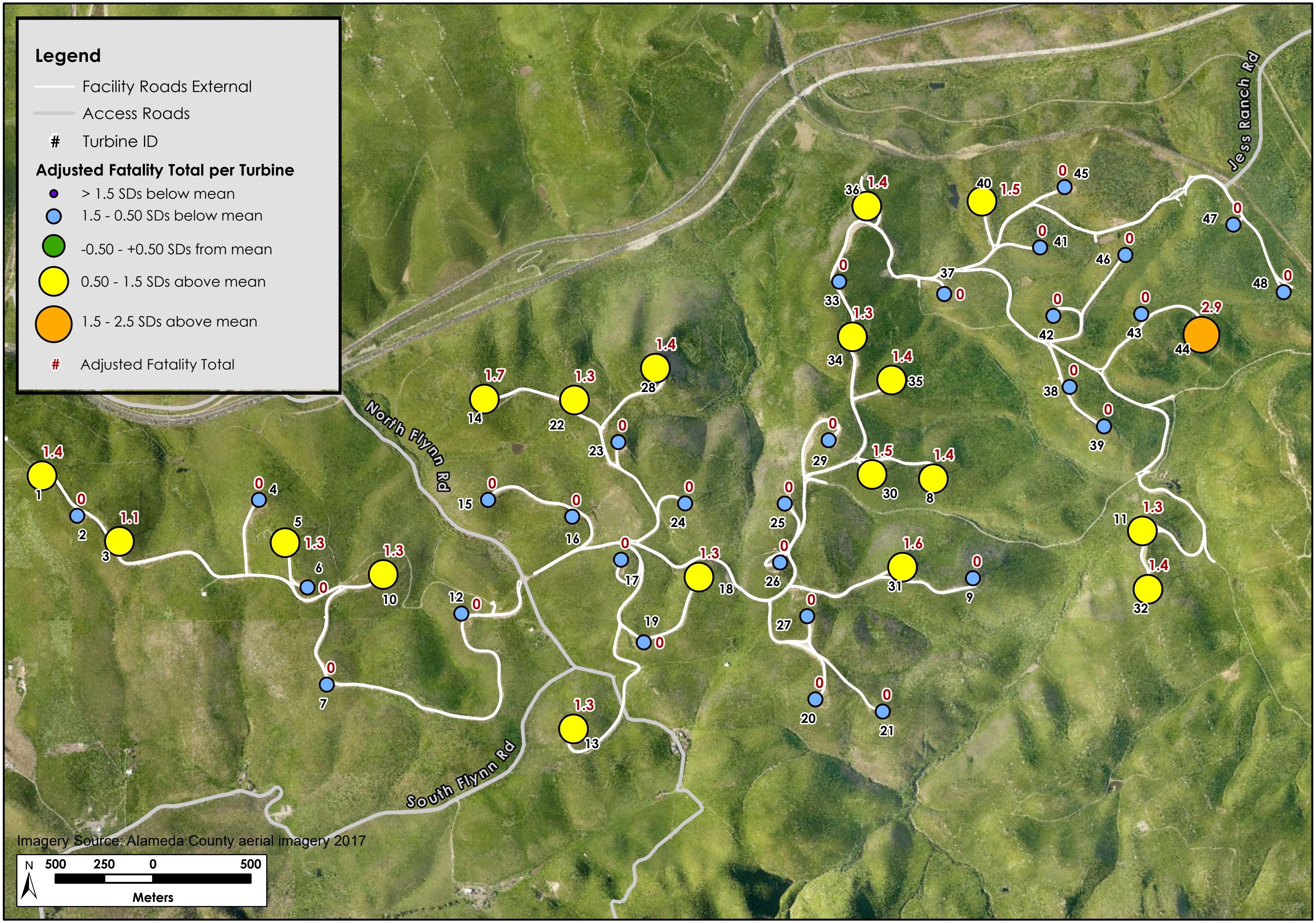
Figure 15. Proportional Representation of Adjusted Red-tailed Hawk Fatality Totals by Turbine Aggregated Across the 3-Year Study



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 16 Adj Fatality Totals Year 1 2 3 - Kestrel.mxd

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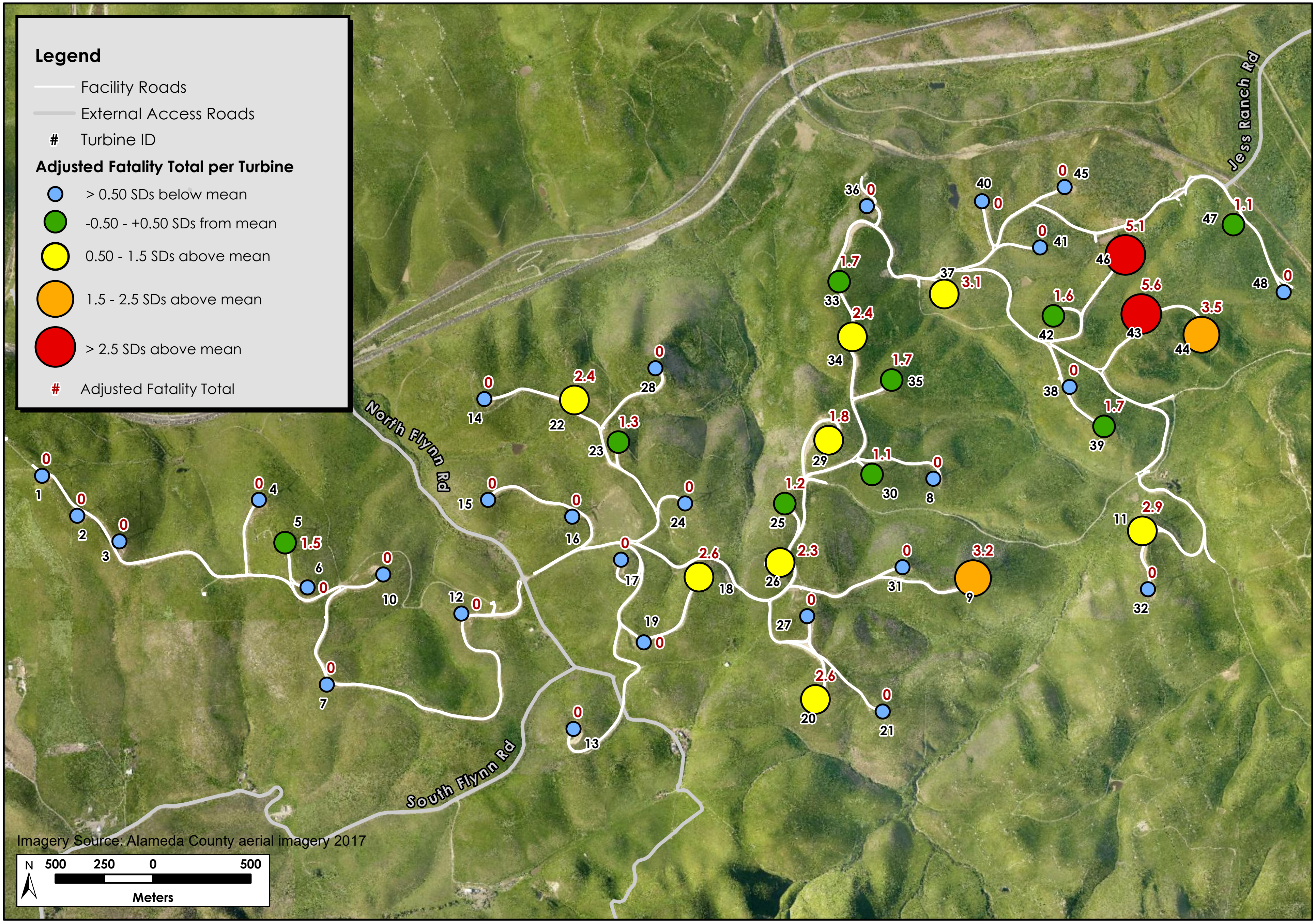
Figure 16. Proportional Representation of Adjusted American Kestrel Fatality Totals by Turbine Aggregated Across the 3-Year Study



N:\Projects3900\3926-01\Reports\PostConst_FatalityMonitoring_Year3\Fig 17 Proportional Representation of Adj Fatality_ BUOW.mxd

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Figure 17. Proportional Representation of Adjusted Burrowing Owl Fatality Totals by Turbine Aggregated Across the 3-Year Study

Section 4.0 Discussion

4.1 Carcass Detectability

The results of this Project emphasize the high value of using scent-detection dogs to survey for bats and small birds, with estimated annual carcass detectability on 7-day plots surveyed by detection dogs sustained between 53–63% for bats and 36–60% for small birds during the study. The apparent substantial reductions in carcass detectability for bats and small birds on 28-day plots surveyed by humans reflected the expected, lower efficiency of humans compared to dogs in searching for bats and small birds (Arnett 2006, Paula et al. 2011, Reyes et al. 2016). In contrast, estimated CD rates for detection-dog teams and human searchers were comparable for medium and large birds. Thus, whether or not absorbing the considerably greater expense and complexity of working with detection-dog teams compared to only human searchers would be cost-effective for other projects will depend on priorities.

Brown et al. (2016) provided comparative estimates of Big *D* carcass detectability for human searchers who conducted 28-day interval surveys during the Vasco Winds study. Across the 3-year study, carcass detectability for those surveys averaged 0% for bats, 10% for small birds (defined as <280 g), 56% for large birds (defined as ≥280 g and <2,048 g), and 80% for extra-large birds (≥2,048 g). The Years 2 and 3 CD estimates for humans surveying at 28-day intervals during our study were similar or higher than those from the Vasco Winds study: 0–10% for bats, 4–22% for small birds (defined as ≤100 g), 46–68% for medium birds (101–500 g), and 89–96% for large birds (>500 g). However, this comparison may be confounded by different carcass size classification standards and interannual and site-specific variation in scavenger activity.

During Year 1, our field biologists noted that partially consumed vole and gopher carcasses littered the survey plots during much of the year, suggesting that small mammals were abundant and predators/scavengers were well sated. Such a scenario was not apparent in Years 2 or 3, once the landscape had dried out again after the previous very wet winter/spring. This evidence, combined with the fact that reduced vegetative cover also likely increased the efficiency of scavenger activity (especially for visually-oriented avian scavengers), suggests that the carcass scavenging rate for smaller bats and birds might have been higher during Years 2 and 3 than during Year 1. However, the CD estimates for detection-dog teams on 7-day plots were generally similar from year to year, except for bats for which estimated CD in Year 1 was higher than in Years 2 and 3. This suggests that reduced vegetative cover might have contributed to both higher scavenging rates and higher SE in Years 2 and 3 for most taxa, and that those two influences might have balanced out to produce relatively stable overall CD rates compared to Year 1.

Reasons for the apparent decline in CD for bats in Years 2 and 3 are uncertain, but changes in the detection-dog teams as we transitioned between Years 1 and 2 might have contributed to the difference. Similarly, given that the seasonal vegetation conditions appeared similar in Years 2 and 3, the higher CD rates for humans searching for bats and small birds in Year 3 compared to Year 2 might have reflected a decline in the scavenging rate; however, personnel changes and the variable search efficiency of different individuals also may have contributed to this difference.

4.2 Composition of Fatality Incidents

Species documented as fatalities during this Project that were not represented as fatalities in previous reports for the Vasco Winds, Buena Vista, Diablo Winds, and APWRA-wide studies included three bat species (California myotis, silver-haired bat, and western mastiff bat) and 10 bird species (western grebe, rough-legged hawk, sharp-shinned hawk, rufous hummingbird, western kingbird, orange-crowned warbler, hermit warbler, fox sparrow, grasshopper sparrow, and black-headed grosbeak). Most of the small-bird species are not expected to occur routinely in the APWRA except as transient migrants/dispersers. These compositional differences likely reflect the influence of variable climatic and landscape conditions over the years, but also reflect both the noteworthy forensic bird and bat ID skills of our field coordinator and the exceptional ability of the detection dogs to locate small bat and bird carcasses.

4.2.1 Bats

The two species of bats that accounted for most of the bat fatalities, hoary bat and Mexican free-tailed bat, are both open aerial foragers that make fall migratory movements. Hoary bats are solitary and migrate long distances, possibly more than 2,000 kilometers (Cryan et al. 2004), whereas the Mexican free-tailed bats found in the APWRA typically make seasonal movements within California, such as between the Central Valley where they raise young in large colonies and the central coast where large numbers overwinter (Johnston 1998). Mexican free-tailed bats are abundant and not categorized as at risk. In contrast, the available evidence suggests that hoary bat populations are declining, possibly because of wind-energy mortality (Frick et al. 2017).

The western red bat's range in California is limited, with maternity areas generally restricted to lowland, old-growth riparian woodlands (Pierson and Rainey 1998). This species raises young in the Central Valley and, based on range maps of males and females, both sexes typically overwinter along the coast, suggesting this species makes seasonal movements within California (Johnston and Whitford 2009). Like the hoary bat, this species is a solitary foliage-roosting bat, but unlike hoary bats and Mexican free-tailed bats, western red bats forage primarily in open areas along streams and riverine habitats. This suggests that the regional population of western red bats is much smaller than relevant populations of the two predominant species represented as fatalities in the APWRA. Mostly because more than 90% of the old-growth riparian forests of the Central Valley have been lost or significantly degraded, this species is listed as a CA-SSC and California populations are considered at risk (Williams 1986, Pierson et al. 2000).

California myotis were previously detected acoustically in the APWRA (ICF International 2016), but never before as a fatality. Unlike the open aerial foraging hoary and Mexican free-tailed bats, California myotis typically forage close to foliage, are not known to migrate, and therefore are less likely to collide with turbines. The greater ability of detection dogs to find even small pieces of bats compared to humans also contributed to this novel discovery, as well as a few discoveries of other relatively small *Myotis* spp.

The single western mastiff bat found alive but debilitated in Year 3 also was a novel find for APWRA fatality monitoring. The natural history of this CA-SSC is not well known, but it is another open aerial forager and roosts colonially in high rocky cliffs and some tall buildings. This species goes into torpor during winter (Leitner 1966), suggesting these bats typically do not migrate. Western mastiff bats generally forage 30–60 m above ground level, but they are known to forage at altitudes as high as 600 m (Vaughan 1959). As they are the largest North American bat species outside of Mexico, this species likely forages long distances from its roost and, therefore, the documented individual could have been foraging rather than migrating. Western mastiff bat colonies are at risk because of limited roosting opportunities and susceptibility to human disturbance and pesticide loads (Williams 1986).

4.2.2 Raptors

The fatality results suggest that the recent extreme variation in climate and attendant landscape dynamics had different effects on the regional population dynamics—and attendant risk of exposure to turbine collisions—of red-tailed hawks compared to the other three focal raptor species. All four focal raptor species were represented as fatalities in all three monitoring years, but with variable patterns of interannual prevalence. Golden eagles, American kestrels, and burrowing owls exhibited a similar pattern with the highest fatality totals in Year 2 and lower totals in Years 1 and 3, whereas red-tailed hawk fatalities declined each year of the study.

Factors that might have contributed to the markedly elevated number of juvenile red-tailed hawk fatalities during fall/winter 2016/2017 include: (a) a pulse in migratory activity and winter residency of young birds from elsewhere; (b) a pulse in breeding productivity that bolstered the local/regional population of dispersed juveniles exposed to risk in the APWRA; and (c) wind/weather patterns, foraging conditions, and/or the average physical condition of individuals contributed to elevated collision risk. Regarding potential factor (a), the decline in red-tailed hawk annual fatality rates is the opposite of the pattern shown in annual raptor migration activity rates recorded at the long-term fall monitoring site in the Marin Headlands of California, located approximately 78 km west-northwest of the APWRA. The preliminary estimated activity rates for red-tailed hawks were 12.8 sightings per hour during fall 2016, 18.8 sightings per hour during fall 2017, and 22.6 sightings per hour during fall 2018 (Golden Gate Raptor Observatory 2017, 2018, 2019). These data suggest that an overall higher abundance of migrating/wintering raptors was not the root cause of the red-tailed hawk fatality trend. Nevertheless, it remains plausible that, although total regional abundance might have been lower, migrating/wintering juvenile red-tailed hawks might have concentrated in the APWRA during fall/winter 2016/2017 to a greater degree than in other years.

Regarding potential factor (b) above, local/regional breeding productivity data for red-tailed hawks are generally unavailable. However, extended annual monitoring of golden eagle breeding populations confirmed an initial rebound in breeding activity and productivity in 2016, after moderate rainfall in 2015 tempered the severe drought that plagued the region for the previous 4 years (H. T. Harvey & Associates 2016, 2019; Wiens et al. 2018). Prolonged, record-setting rainfall during winter/spring 2017 and attendant extreme growth of annual vegetation then resulted in very poor eagle breeding productivity that year. A good eagle breeding year then followed in 2018 after the landscape dried out again, annual vegetation growth moderated, and grazing further helped to maintain suitably open habitat for ground squirrels and foraging eagles. Another poor year then occurred in 2019 because of damage caused by very windy and wet spring weather (H. T. Harvey & Associates 2019, P. Kolar, USGS, personal communication). These data and patterns suggest that substantial variation in local/regional breeding productivity caused by extreme climatic variation, exacerbated by widespread wildfire after 2017, could have contributed to the declining trend in annual fatality totals for juvenile red-tailed hawks, with relatively high recruitment in 2016 contributing more juvenile birds during fall/winter 2016/2017, and poor productivity in 2017 contributing to the decline after that. It is also possible that the high fatality rate of juvenile birds in fall/winter 2016 contributed to low productivity in 2017 and 2018 by reducing recruitment into the local breeding population, in turn potentially limiting the number of local residents at risk of colliding with turbines.

As was originally demonstrated by radio-telemetry tracking research, golden eagle fatalities in the APWRA typically involve a high proportion of subadults (Hunt et al. 1995, 1999; Hunt 2002). The results of this Project reconfirmed this pattern, with subadults composing 73% of the documented fatalities. In contrast, the only confirmed juvenile fatalities (2) occurred in Year 2 when breeding productivity in the Diablo Range was relatively good, and no confirmed adult or juvenile fatalities occurred in Year 3 when breeding productivity declined substantially again. Hunt (2002) speculated that juveniles were less susceptible to turbine collisions, because they generally are not involved in high-distraction activities such as predatory behavior (they are mostly scavengers) and territorial/defensive skirmishes, whereas local breeding adults were less susceptible because their home ranges in the area only infrequently overlapped the APWRA.

It was also noteworthy during this Project that golden eagle fatalities were much more common in spring and summer (86% of all countable fatalities) than during fall and winter. This suggests that the documented fatalities might have involved primarily regional residents and a relative concentration of local subadult activity during the breeding season when local breeders were especially territorial. Otherwise, the elevated golden eagle fatality rate in Year 2, with fatalities most concentrated from April through September 2018, suggested the possible influence of a relatively good breeding year. Heightened local breeding activity could translate to territorial pairs forcing nonbreeding adult and subadult floaters to concentrate more within the APWRA away from nesting areas, but could also stimulate pairs including subadults to try nesting in areas of lesser habitat quality closer to turbines (Kolar and Wiens 2017). Lastly, increased local fledgling production in 2018 (e.g., see H. T. Harvey & Associates 2019) could have contributed to the two juvenile fatalities uniquely recorded that fall.

American kestrel fatalities occurred primarily in fall and winter. Why kestrel mortality followed a different interannual pattern than for red-tailed hawks is uncertain, but may reflect the differential effects of variation in primary productivity on the abundance and accessibility of relevant prey. More specifically, especially outside of the breeding season, insects are primary prey for American kestrels and insects both flourish and remain accessible to foraging kestrels during periods of high primary productivity and vegetation growth. In contrast, tall vegetation generally impedes foraging by larger raptors such as red-tailed hawks, which focus on small to medium-sized mammals, birds, and snakes as prey. Because of such foraging-niche differences, kestrels that subsequently wintered in the area might have benefited from the lush vegetation growth and increase in insect productivity that followed the high winter/spring rainfall in 2017. In contrast, such conditions may have deterred red-tailed hawks, because of the adverse consequences of flooding on burrowing mammals and the relative inaccessibility of preferred prey in dense, tall vegetation. It is also possible that the difference in the species-specific patterns reflected the greater susceptibility of kestrels to predation by other larger raptors.

Similar to the case for golden eagles, the heightened prevalence of burrowing owl fatalities from fall 2017 through winter 2018 appeared to track heightened breeding activity during 2018 after the landscape dried out again following the extreme 2017 rains. Our field crews noted anecdotally that burrowing owls appeared much more common on the project landscape during spring/summer 2018 than during spring/summer 2017.

4.2.3 Nonraptors

The 9-year APWRA-wide monitoring study revealed only two house wren and two white-throated swift fatalities (ICF International 2016). Our discovery of 16 white-throated swift and 27 house wren fatalities in Year 1 was unprecedented compared to the records in all previous APWRA fatality reports. The substantial 2017 summer wave of house wren fatalities did not occur again in Year 2, but a moderate number of summer fatalities did occur again in Year 3, suggesting highly variable population and/or movement dynamics for this species. In contrast, the unadjusted fatality totals for white-throated swifts were similar across all 3 years, with adjusted estimates highest in Year 2 and lowest in Year 1. It is also noteworthy that the long-term APWRA-wide study revealed no confirmed fatalities of Vaux's swift (CA-SSC), whereas we documented three fatalities of this species in each monitoring year.

As has been shown for bats (Barclay et al. 2007, Cryan and Barclay 2009), larger turbines that extend farther up into the airspace may represent a greater problem for high-flying, aerial-foraging swifts than the smaller, older generation turbines that were once prevalent in the APWRA. However, other relevant post-repower survey efforts (Western EcoSystems Technology 2006, Insignia Environmental 2012, Brown et al. 2016) revealed only one swift fatality (which happened to be the first Vaux's swift ever documented as a fatality in reports from the APWRA; Brown et al. 2016). This information suggests that other factors contributed to this outcome, such as the influence of other spatiotemporal or annual climatic factors, the high search efficiency of detection dogs, and the advanced forensic-ID skills of our field coordinator.

4.3 Fatality Estimates

Producing accurate fatality estimates at wind-energy facilities requires addressing three primary sources of error that can result in underestimating true fatality rates if ignored, or biased estimates if modeled improperly (Huso et al. 2016). These sources of error are imperfect searcher efficiency, carcasses being removed by scavengers or abiotic factors before searchers have a chance to discover the fatality, and the fact that some fatalities may fall outside of the area searched for carcasses. Each of these issues customarily has been dealt with explicitly using variable approaches to adjust unadjusted fatality counts to account for such factors.

The recent history of estimating bird and/or bat fatalities at wind-energy facilities involves use of primarily three estimators (Bernardino et al. 2013, Warren-Hicks et al. 2013, Huso et al. 2016). Erickson et al. (2000) and Johnson et al. (2000, 2003) used an estimator that assumed a Poisson process for the occurrence of bird deaths and scavenger removal (Shoenfeld 2004); however, this estimator proved to be severely biased low, after which Smallwood (2007) developed an estimator that incorporated an adjustment for periodic repetition of search events. In practice, however, periods between searches often are inconsistent, which violates a primary assumption motivating the logic behind Smallwood's estimator. Huso (2011, and Huso et al. 2012) conducted thorough simulations and conceptualized the logic behind development of a third estimator representing a tailored version of the Horvitz-Thompson estimator (Horvitz and Thompson 1952, Thompson 1992). Huso's estimator brought increased flexibility compared to the Shoenfeld and Smallwood estimators, because it allowed for unequal probability sampling and accounting for potential differences in searchability among plots and variation in detectability due to size of carcass or type of habitat. Based on simulations, Huso (2011) found that this estimator was also consistently less biased than were the other two estimators. Although the Schoenfeld (2004) estimator can perform similarly under certain conditions (e.g., when search intervals are relatively long [14–28 days] and mean carcass-persistence time is relatively short [<16 days]), Arnett et al. (2009) found that this estimator greatly underestimated fatality rates when SE was low for certain species (e.g., 13% for some bats). However, subsequent evaluations revealed that the Huso estimator may overestimate fatalities when the search interval is short and the aging of carcasses uncertain, because the method requires excluding from consideration any carcasses not deposited during the preceding search interval (i.e., no bleed-through is allowed; Wolpert 2015).

All of the above methods impose assumptions regarding carcass bleed-through; i.e., carcasses that are not discovered on one survey are either assumed to have a detection probability of zero (Huso 2011), one (Schoenfeld 2004), or a value determined by SE (Erickson et al. 2000) in subsequent surveys. Wolpert (2015; and see Warren-Hicks et al. 2013: Appendix A) demonstrated that imposing assumptions regarding bleed-through results in estimator bias and presented an alternative Avian and Chiropteran Mortality Estimator (ACME) that estimated a bleed-through parameter from CP trials. ACME also allowed SE to decrease as a function of time for a given carcass, building from previous insight reflecting that older degraded carcasses are more difficult for humans to find than fresh carcasses (Smallwood 2007, Korner-Nievergelt et al. 2011). However, carcass degradation may influence olfactory-driven detection dogs differently than it affects visually oriented human searchers, with one study suggesting that trained dogs detected decomposed bird carcasses more readily than fresh carcasses (Paula et al. 2011). Moreover, although olfactory-driven dogs are able to detect even small bits of carcasses relatively easily compared to humans, they cannot detect old feathers that no longer retain any flesh or body oils. Nevertheless, given similar taxa, degradation states, and substrate circumstances, large carcasses still present more odor overall than smaller carcasses and, therefore, developing tailored size-specific estimates of Big *D* remained a key objective for searches conducted by both detection dogs and humans.

Wolpert (2015) demonstrated that ACME produced less-biased fatality estimates compared to those generated by the estimators outlined by Erickson et al. (2000), Schoenfeld (2004), and Huso (2011) when search intervals were short (e.g., 7 days), and equivalent estimates otherwise. Therefore, we began this Project employing field methods compatible with using the ACME estimator to produce adjusted fatality estimates for the Project. Unfortunately, we subsequently discovered that the available *acme*R software did not function properly with our data. As a result, we initially diverted to using the well-established U.S. Geological Survey (USGS) Data Series 729 estimator (Huso 2011, Huso et al. 2012) as our primary tool to generate adjusted fatality estimates for Year 1.

We then explored developing the Year 2 fatality estimates based on the novel Big *D*-based approach outlined in Brown et al. (2016), Smallwood and Neher (2016), and Smallwood (2017), including generating carcass detectability estimates based on the average mass of relevant bird species. However, this method appeared to produce substantially inflated fatality estimates for certain key species (e.g., burrowing owls), probably due to sample limitations for developing robust models to predict carcass detectability from average species mass (Smallwood and Neher 2016).

In the meantime, the new USGS *GenEst* estimator was developed and made available for use in 2018, including methods to explicitly represent and account for BT in estimating SE. Hence, after completing the third year of this Project, we shifted to using *GenEst* to produce annual adjusted fatality estimates for all 3 years of the study, but utilizing variable approaches tailored to the unique characteristics of each study year. Ultimately using *GenEst* to produce all of the adjusted fatality estimates theoretically improved the comparability of estimates from the three survey years. However, unknown biases likely resulted from (a) the application of different detectability-trial field methods in Year 1 compared to Years 2 and 3, and (b) using a customized approach to adapt *GenEst* to produce CD estimates based on binomial field trials. In essence, the customized approach resulted in *GenEst* incorporating CD correction factors that matched the raw proportions of detected carcasses evident in the field data. The only exception was that, in order to produce relevant CIs, the *GenEst* algorithm substituted a small non-zero value for the detected proportion when documented CD for a given covariate combination was 0%, and a slightly lower value when documented CD was 100%.

4.3.1 7-Day Versus 28-Day Interval Surveys

Comparing the adjusted fatality estimates for 7-day and 28-day surveys provided additional evidence that, despite tailored SE/CP or CD adjustments, relying on a 28-day search interval often appears to underestimate fatality rates for bats and small birds (Brown et al. 2016, Smallwood and Neher 2016). This proved to be the case in Year 1 with dog teams searching all plots and especially in Years 2 and 3 with detection-dog teams searching the 7-day plots and humans searching the 28-day plots. Theoretically, the application of effective SE/CP or CD field trials combined with use of an effective estimator should overcome such limitations by incorporating appropriate adjustment factors. When CD is very low, however, such as during Years 2 and 3 of this Project for humans searching at 28-day intervals for bats and small birds, estimated adjustment factors may not be sufficient to overcome the resulting sampling bias and produce accurate estimates with good precision, especially if based on only modest trial sample sizes.

The annual CD metrics for medium and large birds suggested more-variable patterns in comparing human versus dog-teams as searchers and 7-day versus 28-day survey results. For example, the estimated CD for large birds was at least nonsignificantly higher for human searchers on 28-day plots (96%) than it was for detection-dog teams on 7-day plots (89%) in Year 3. These variable patterns suggested that, for larger birds, the independent 7-day and 28-day detectability adjustment factors often did a better job of adjusting for differences in detectability inherent to the two survey types (e.g., more time for scavenging to remove carcasses between 28-day searches). In turn, this result suggests that, if coupled with tailored SE/CP or CD field trials, the extended 28-day search interval can perform well for tracking fatalities of larger birds, but is not well suited to assessing fatality rates of bats and small birds.

4.3.2 Choice of Estimates to Represent Project Results

The lack of CD trial detections for bats in Year 2 on the 28-day plots forced fatality estimation based only on the 7-day-interval data collected at 16 turbines. This result limited our ability to conduct effective site-wide hotspot analyses for bats based on 3 years of data for all turbines, and reduced the precision of the resulting fatality estimates. Otherwise, however, drawing facility-level inferences based on sampling one-third of a facility's turbines is common practice in the wind industry (CEC and CDFG 2007, Strickland et al. 2011).

The *GenEst* estimated fatality totals for golden eagles translated to eight additional, undocumented eagle fatalities over the course of the study. This level of inflation in the estimated golden eagle fatality totals at a facility of this size situated in a grazed-grassland landscape cannot be justified. Our golden eagle fatality records, including off-plots, resulted from our team's extensive survey work and vigilance while traveling across the facility in looking for eagle and other large raptor carcasses, in particular, as well as the efforts of wind technicians and other eagle biologists and consultants that regularly traverse the site and report all carcasses they find. Therefore, although one or two dead eagles might have avoided notice over long periods in this open grassland landscape, missing as many as eight eagle fatalities is highly improbable given that eagle carcasses or obvious remnants tend to persist for long periods in readily detectable form.

The main reason why the adjusted fatality totals for golden eagles were inappropriately inflated is that the derived SE/CP and CD adjustment factors reflected grouped size classes (i.e., medium and large; sometimes combined to bolster detectability-trial samples sizes) that did not effectively represent extra-large raptors, especially eagles. For this reason, the incorporated adjustment factors underestimated carcass detectability and persistence for golden eagles, which resulted in unnecessarily large adjustments that overinflated the fatality estimates for that species, especially in Year 2.

As found during this study, eagles and other large raptors that are injured but not immediately killed by adverse interactions with turbines sometimes land or hobble off plot before dying or being discovered still alive. In addition, although expected to be rare, coyotes (*Canus latrans*) may occasionally carry or drag an entire eagle carcass off a survey plot without leaving detectable remnants that would still qualify as a fatality detection. Our experience suggests that detection of eagle carcasses that are deposited and remain on survey plots in the APWRA is invariably 100% when all turbines in a given facility are surveyed regularly across extended periods; however, detectability on survey plots of golden eagles debilitated by turbine interactions is sometimes <100% for the reasons stated above. Therefore, some adjustment of the documented on-plot incident totals is typically warranted to account for debilitated eagles that end up off plot and unavailable for on-plot discovery.

CD adjustments seek to account for the integrated influences of imperfect detection of carcasses that are available to be discovered on survey plots (SE) and imperfect persistence of carcasses (CP) that do not remain long enough for them to be discovered on survey plots. The *DWP* adjustment factor then seeks to account for turbine-related incidents that were never available for discovery on a survey plot, because the eagle initially fell to the ground beyond the bounds of the relevant survey plot. In this case, three golden eagle fatality/injury incidents were found off plot during this study, all with apparent blade-strike damage. One carcass was found by a detection-dog team 56 m outside of the closest survey plot in a decomposed and possibly scavenged state, with a missing head and partial right wing. A second carcass was found by a wind technician 12 m outside of the relevant survey plot, freshly dead and intact except for a severed wing. A third eagle was found by a wind technician alive but with an amputated wing off plot but near several turbines. Whether or not any of these eagles initially fell to the ground within a survey plot is unknown, but only the first of the three incidents could have involved removal by a scavenger. Further, over the course of a multi-year study such as this in the Golden

Hills facility landscape where grazed grassland predominates, there is a very high probability that any turbine-related eagle carcasses or injured birds that end up outside of all survey plots will ultimately be discovered and documented as off-plot incidental finds. This is especially likely given survey teams on site several days each week year-round covering all 48 turbines, facility staff tuned to opportunistically detecting dead or injured golden eagles, and the frequent presence of other observant biologists traversing the facility.

The three off-plot eagle discoveries represented 10% of the 30 qualified (not aged out) golden eagle incidents documented during this Project, or 25% (2) of eight Year 1 incidents, 7% (1) of 14 Year 2 incidents, and 0% of eight Year 3 incidents. For estimation purposes, we included the injured eagle but excluded the two off-plot carcasses from the tally of on-plot incidents used to produce the adjusted fatality estimates. The *DWP* adjustment factor (0.95) incorporated in the *GenEst* models translated to adding 1.5 eagle fatalities to the final adjusted fatality total, which was a reasonable match for the two carcasses found off plot, assuming they were initially deposited off-plot and were therefore never available for discovery on a survey plot. However, after already having included the injured eagle in the on-plot fatality tally, incorporating an additional CD adjustment factor for golden eagles was not warranted, because SE for eagles that are available for on-plot discovery is very high, if not routinely 100%, and the probability of whole-carcass removal by scavengers is very low, if not negligible.

Even if the detectability of golden eagle carcasses deposited on survey plots is occasionally less than perfect, given the current golden eagle fatality rate in the APWRA, CD would have to drop below 90% to have a meaningful, more than fractional, impact on the adjusted fatality estimate. In this case, basing the adjusted fatality estimates on CD factors developed for grouped medium and/or large birds, which fell below 70% during some periods, inflated the adjusted overall estimates for golden eagles to grossly unreasonable levels.

All prior estimates from previous projects and the PEIR threshold value represent some manner of adjusted estimate that did not accurately represent golden eagles due to the use of inaccurate SE/CP or CD adjustment factors. Accordingly, some might consider comparing the inflated adjusted estimates from this Project against those values to be a fair comparison. However, substantial variation in the field and analytical methods employed largely precludes confident comparisons among studies, and there are multiple reasons to believe that many of the pre-repowering project assessments yielded golden eagle fatality estimates that were biased low (e.g., because of factors such as small survey plots, extra-long search intervals, and sometimes use of inappropriate adjustment factors because no carcass detectability trials were conducted). Moreover, the established PEIR threshold values are not presented with precision estimates to support statistically meaningful comparisons, thereby effectively precluding valid assessments of whether a given project estimate is truly higher or lower than the relevant threshold.

For the reasons outlined above, and given the scale of the current Golden Hills investigations, it is our informed professional opinion that unadjusted fatality counts, including all fatalities and injured eagles documented on and off survey plots during a multi-year project by consultants, other biologists, and facility staff, currently provide the best available mortality indices for golden eagles in the APWRA where grazed grassland predominates. No better estimates will be possible for golden eagles unless and until the U.S. Fish & Wildlife Service is able to authorize conducting carcass detectability trials with actual golden eagles to accurately quantify carcass persistence and removal rates for that species.

4.3.3 Interannual Comparisons

Upon examining the temporal patterns in fatalities evident from this Project, it is important to note that the dividing line between monitoring years was mid-September. Hence, the annual monitoring-year estimates are less informative than examining the overall temporal patterns across the study (Figures 7–9 and 18). This comparison reflected that the overall fatality rate for the two most common bat species was considerably higher during the late-summer/fall 2017 migration season than it was during other previous and subsequent fall seasons represented during the study (albeit only in part for 2016 and 2019). The high abundance of bat fatalities during fall 2017 followed the very wet winter/spring in 2017, and we suspect reflected an increased concentration of activity in response to elevated insect abundance resulting from the high primary productivity that followed the heavy spring rainfall.

The adjusted annual fatality estimates for small birds and nonraptors varied nonsignificantly among survey years, but similar to bats, each estimate reflected a combination of two disparate fall seasons of activity, such that examining the overall annual-cycle patterns across the study was more informative. In this case, moderate Year 1 estimates reflected relatively low fatality activity between mid-fall 2016 and late-spring 2017, combined with sustained moderate activity during fall 2017 (Figure 18). Then in Year 2, the nonsignificantly higher estimated fatality totals reflected relatively high activity in late-fall/early winter 2017 and late-winter/spring 2018, but relatively low activity in summer/early fall 2018. Finally, the lower estimated fatality totals in Year 3 reflected lower than average fatality activity throughout that survey year. These patterns suggest that commonly encountered small birds and other nonraptors differed in their responses to changing regional and local climatic and landscape conditions (including major wildfires) compared to bats, and species-specific tracking further indicated markedly different response patterns among individual small bird species (Figure 9). Examining patterns in the raptor fatality data suggested additional unique patterns of variation through the study for the group as a whole and for the focal raptor species (Figures 10 and 18). Together these results suggest a complicated interplay between species-specific ecology and complex landscape dynamics caused by extreme climatological variation.

For example, in other nearby locations where burrowing owls are monitored annually (Santa Clara Valley), the number of breeding pairs has been declining, but the average productivity of active pairs increased in 2018 and markedly reversed a strong declining trend that occurred from 2012 through 2016 (Santa Clara Valley Habitat Authority 2018). However, the available evidence suggested that burrowing owl breeding productivity in the San Francisco Bay Area was again very low in 2019, as was true for other raptors such as golden eagles and Swainson's hawks (J. Estep, Estep Consulting, personal communication; Y. Wang, San Francisco Bay Bird Observatory, personal communication; H. T. Harvey & Associates 2019, unpublished data).

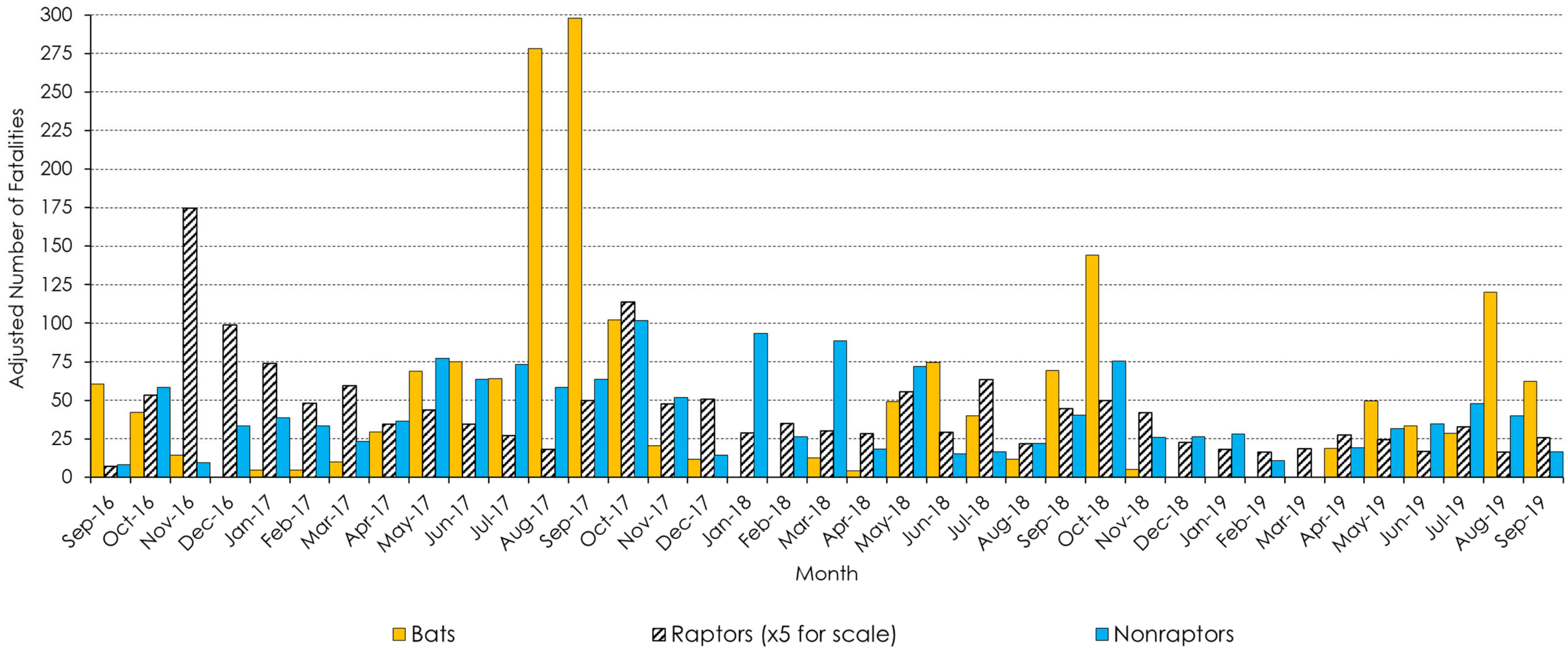

Figure 18. Temporal Variation in Adjusted Fatality Totals for Bats (Extrapolated 7-Day Survey Totals), Raptors, and Nonraptors

4.3.4 Comparisons with Previous APWRA Studies

Comparing adjusted fatality estimates from this study and previous APWRA studies to garner insight about the potential effects of repowering on bat and bird fatality rates is fraught with challenges and difficult to justify, because the field and analytical methods applied across relevant studies have varied considerably. With that important caveat stated, compared to fatality estimates generated by the other APWRA post-repower studies, the 3-year average annual per MW fatality estimates from this Project ranked marginally to significantly higher for bats, nonraptors, loggerhead shrikes, golden eagles, and red-tailed hawks; above-average for all raptors combined; and below average for American kestrels and burrowing owls (Table 20). For the other PEIR-emphasis species, the fatality numbers and estimates from this Project were similar or nominally higher than those from previous post-repower studies; however, project-specific fatality totals have been consistently too low for all such species during the post-repower period to produce meaningful fatality estimates.

Compared to the pre-repower estimates from the APWRA-wide avian study, the 3-year averages from this Project were slightly higher for all native nonraptors combined, significantly lower for all raptors combined, at least marginally higher for golden eagles, nonsignificantly higher for red-tailed hawks, and significantly lower for American kestrels and burrowing owls (Table 20). Among the other PEIR-emphasis species, meaningful pre- and post-repower comparisons were possible only for loggerhead shrikes and barn owls. Repowering in the APWRA appears to have had a positive outcome in reducing fatality rates for these species, though a statistically significant difference was clearly apparent only for barn owls (Table 20).

For nonraptors as a group, the 7-year average annual pre-repower fatality rate (4.5 fatalities per MW per year) established as the mortality threshold in the PEIR (Alameda County Community Development Agency 2014) differs markedly from the overall 9-year average (8.4 fatalities per MW per year) presented in the final APWRA-wide avian study report (ICF International 2016). However, this substantial difference reflects the inclusion of large numbers of nonnative rock pigeons and European starlings in the overall 9-year estimate. Those two species exhibited the highest average fatality rates during that study period, but are rarely found as fatalities at the repowered Golden Hills facilities. This outcome results from the repowered sites no longer providing old-generation turbine infrastructure that was well suited to roosting and nesting by these species. In comparison, the established PEIR threshold value reflected only native nonraptors. The relevant 3-year average from this Project appeared slightly higher than that value; however, the PEIR threshold values were not presented with confidence limits to support statistical comparisons (Table 20).

The marginally elevated fatality rate for native nonraptors derived from this Project compared to the other previous studies may largely reflect the enhanced ability of detection-dog teams to find fatalities of small bats and birds compared to human searchers, as well as the positive benefit of shorter search intervals compared to the pre-repower threshold estimate. For example, the 3-year Vasco Winds study, conducted with only human surveyors, documented only 10 horned lark and 14 western meadowlark fatalities (0.29–0.41 unadjusted fatalities per turbine), whereas our study, conducted using both detection dogs and humans, recorded 98 horned lark and 66 western meadowlark fatalities (1.5–2.1 unadjusted fatalities per turbine) that contributed to adjusted fatality estimates. However, extreme variation in the climatological and attendant habitat conditions that prevailed during different studies also likely contributed to the observed differences in detected fatalities. For

Table 20. Facility-Wide Estimates of Fatalities per MW per Year (95% CIs) for Bats, Nonraptors, Raptors, and PEIR-Emphasis Species from This Project and Other Monitoring Studies in the Altamont Pass Wind Resource Area

Study	All Bats	All Native Nonraptors	Loggerhead Shrike	Tricolored Blackbird	All Raptors	Golden Eagle[1]	Red-tailed Hawk	Swainson's Hawk	American Kestrel	Prairie Falcon	Burrowing Owl	Barn Owl
This Project: 3-year average	5.55 (5.15–5.95)	5.25 (4.26–6.23)	0.05 (0.00–0.16)	0.03 (0.00–0.06)	1.12 (0.81–1.43)	***0.14 (0.07–0.22)***	0.52 (0.25–0.79)	0	0.10 (0.07–0.14)	0.01 (0.00–0.01)	0.19 (0.02–0.35)	0.02 (0.00–0.05)
Vasco Winds: 3-year average[2]	3.21 (3.06–3.36)	1.94 (1.10–2.77)	0.02 (0.00–0.07)	0.02 (0.00–0.06)	0.64 (0.20–1.09)	0.04 (0.02–0.07)	0.21 (0.04–0.38)	0	0.28 (0.07–0.49)	0.01 (0.00–0.03)	0.06 (0.00–0.17)	0.02 (0.00–0.05)
Buena Vista: 3-year average[3]	0.67	1.01	0	0	0.36	0.07	0.17	0	0.09	nd[4]	0	nd
Diablo Winds: 5-year average[5]	0.78	2.51	nd	nd	1.21	0.02 (0.02–0.02)	0.28 (0.24–0.32)	nd	0.07 (0.05–0.09)	nd	0.58 (0.39–0.77)	nd
APWRA-wide Pre-repower: 2005–13 average[6]	0.12–0.26	nd	0.15 (0.06–0.24)	0.01 (0.01–0.02	2.01 (1.46–2.55)	0.09 (0.07–0.10)	0.40 (0.33–0.47)	0.001 (0.001–0.001)	0.56 (0.37–0.74)	0.02 (0.01–0.02)	0.67 (0.44–0.90)	0.18 (0.14–0.21)
Average estimates reflected in Programmatic EIR [7]												
Repowered Vasco Winds Year 1 [8]	nd	2.09	–	–	0.64	0.03	0.25	–	0.30	–	0.05	0.03
Repowered Buena Vista 3-year	0.48–1.08	1.01	–	–	0.31	0.04	0.10	–	0.15	0.00	0	0.00
Repowered Diablo Winds 5-year	0.78	2.51	0.00	–	1.21	0.01	0.20	–	0.09	–	0.84	0.02
Nonrepowered APWRA-wide, 7-year	0.26	4.50	0.19	–	2.43	0.08	0.44	0.00	0.59	0.02	0.78	0.24

1 ***The values presented here from this Project represent adjusted estimates derived using GenEst; however, we consider the unadjusted fatality counts with off-plot incidental finds (i.e., carcasses opportunistically found outside of standard survey plots) included to be the most accurate mortality indices for golden eagles during this Project: mean annual fatalities per MW = 0.12; 95% CI = 0.07–0.19 (see Section 4.3.2 for further discussion).***

2 Source: Brown et al. (2016). Values were derived from those presented in Table 27, which were based on overall detection (*D*) probabilities (comparative values based on independent estimation of searcher efficiency (SE) and carcass persistence (CP) were notably higher).

3 Source: Insignia Environmental (2012). Values represent those derived using "Estimator Two" with SE and carcass removal rates derived from the study (no CIs or year-specific fatality totals provided). Value for native nonraptors was taken from Alameda County Community Development Agency (2014: Table 3.4-10). One fatality each was documented for prairie falcon and barn owl, but no adjusted fatality estimates were available for comparison.

4 Indicates no suitable estimate was available for comparison.

5 The value for bats was based on data from 2005–2007 only as represented in Smallwood and Karas (2009). Value for all raptors was taken from Alameda County Community Development Agency (2014: Table 3.4-10). Values with CIs were taken from ICF International (2016: Table 3-18).

6 The value for bats was derived from Smallwood and Karas (2009) as summarized in Alameda County Community Development Agency (2014: page 3.4-48); range represents values pertaining to older and newer generations of pre-repower turbines. Values with CIs are taken from ICF International (2016: Tables 3–6 and 3-18); no comparable estimate was provided for only native nonraptors.

7 Source: Alameda County Community Development Agency (2014: Table 3.4-10). "–" generally indicates that no species-specific fatalities were found. Discrepancies between these values and comparative values above reflect either (a) post-reporting calculation adjustments made in consultation with NextEra and the Altamont TAC reflected in the PEIR values, or (b) updates reported in subsequent project reports reflecting the collection and analysis of additional years of monitoring data not reflected in the PEIR.

8 Value not provided for bats because Year 1-only estimate did not represent a valid metric. Value for golden eagles represents an updated average value for Years 1 and 2.

example, the Vasco Winds study occurred during the height of the recent drought, whereas this Project occurred after that 4-year drought had abated. This climatic shift likely triggered rapid responses and expanded populations of resident and seasonally resident smaller breeding birds and bats that are able to respond to improved breeding and foraging conditions quickly, and probably contributed to the high species diversity of small-bird fatalities in Year 1 and the unusual flurry of house wren fatalities in summer/fall 2017.

This climate factor also could have influenced the opposite difference evident in comparing fatality rates for all nonraptors combined from this Project and the full pre-repower APWRA-wide avian study; however, that difference primarily reflected a substantial post-repower reduction in the fatality rates of non-native rock pigeons and European starlings, rather than a notable overall reduction in fatalities of native nonraptors. During the pre-repowering era, fatality rates of those two species ranked among the highest across the APWRA (ICF International 2016), whereas this Project revealed few such fatalities. In comparison, the fatality rate from this Project for native nonraptors remained at least marginally elevated compared to the PEIR threshold value. In combination with the pre-repower threshold value being biased low due to use of long search intervals and only human searchers, this result suggests that repowering may be having an overall neutral effect on the fatality rates of native nonraptors as a group. This may be especially true for species that typically compose high proportions of the APWRA fatalities, such as horned larks and western meadowlarks. We suspect this result

derives from the fact that most fatalities of these species' reflect background rather than turbine-related mortality, and that repowering has not appreciably altered that reality.

Focused on the two small, nonraptor PEIR-emphasis species, comparative metrics suggest a reasonable probability that repowering has resulted in a reduction in loggerhead shrike fatalities, whereas the estimates for tricolored blackbirds suggest the opposite pattern. However, likely inconsistencies among studies in the probability of distinguishing the three species of blackbirds that occur as fatalities in the APWRA, combined with small fatality totals, precludes a confident comparison for the latter species.

The 3-year average annual per MW fatality estimate for all raptors combined from this Project was higher than for two of the three other post-repower studies, but was significantly lower than the pre-repower average from the APWRA-wide avian study (Table 20). The evident variation in estimated raptor fatality rates among post-repower studies may partly reflect the influence of variable field and estimation methods, as well as the consequences of evaluating project impacts based on short-term studies that may inadvertently represent atypical conditions (ICF International 2016). In addition, again such differences likely also reflect the influences of substantial interannual variation in local and regional climate and landscape conditions, and the attendant effects on wildlife populations.

For golden eagles, the primary conclusion from this Project is an above-average annual fatality rate compared to other post-repower APWRA studies, and a marginally above-average rate compared to the multi-year pre-repower average (Table 20). The same conclusion pertains whether the comparison is based on the overinflated *GenEst* adjusted estimate of 0.14 fatalities per MW per year or the more accurate unadjusted estimate with on- and off-plot incidents included of 0.12 fatalities per MW per year.

For red-tailed hawks, the primary conclusion from this Project is high interannual variability and a 3-year average per MW fatality rate that at least marginally exceeded the averages from prior pre- and post-repower

APWRA studies (Table 20). However, although the Year 1 fatality estimate was notably high, the Year 2 and 3 estimates were similar or lower than averages from the Vasco Winds post-repower and APWRA-wide pre-repower assessments.

In contrast to the case for golden eagles and red-tailed hawks, repowering with fewer, taller turbines has almost certainly contributed to substantially reduced average fatality rates for American kestrels and burrowing owls (Table 20), though considerable interannual variability in the fatality rates of these species also has been apparent. Similarly, although the relevant fatality data were often too sparse to support definitive conclusions for other PEIR-emphasis species, a definitive post-repower reduction in fatalities was also evident for barn owls.

The post-drought improvement in general landscape conditions undoubtedly bolstered populations of raptors compared to the drought period, and might have contributed to the elevated eagle and burrowing owl fatality rates in 2018 (Year 2). Population responses of species such as the larger raptors often lag behind those of prey species and smaller birds, which might have delayed the increase in golden eagle fatalities until Year 2 when local breeding productivity was good again. Annual monitoring across central California confirmed that golden eagle reproductive success and productivity dropped markedly during the 4-year drought, began to resurge in 2016, but then declined again during the very wet and "overgrown" 2017 breeding season. Productivity then surged strongly again in 2018 after the landscape dried out, but then declined substantially again in 2019 due to damaging spring winds and rain (Kolar and Wiens 2017; Wiens and Kolar 2016; Wiens et al. 2015, 2018; H. T. Harvey & Associates 2016, 2019; P. Kolar, USGS, personal communication). Increases in burrowing owl abundance and fatality rates also may have lagged until 2018, because excessive growth of ungrazed annual grasses and other vegetation generally precludes habitat suitability for both ground squirrels and burrowing owls (Smallwood et al. 2013).

4.3.5 Bat Fatalities and Repowering

Of the wind-energy areas in North America, the western states have had some of the lowest bat fatality rates (Arnett et al. 2008). Arnett and Baerwald (2013) suggested that the Great Basin and arid regions of the west might experience low bat fatality rates, because either foraging/roosting areas are scarce or no migratory pathways exist at these western sites. However, Arnett et al. (2008) pointed out that Midwestern wind-energy regions also have few potential roost trees, few obvious foraging opportunities, and no obvious migratory pathways, yet some Midwestern wind-energy regions have relatively high fatality rates. Thus, they suggested that the low fatality rates at some western sites may reflect biased reporting; i.e., absence of evidence rather than evidence of absence (Huso and Dalthorp 2014).

As larger, new-generation turbines have replaced smaller, older-generation turbines, concern has risen about the possibility that taller turbines will increase the probability of bat fatalities (Barclay et al. 2007). As a result, interest in documenting bat fatality rates in the APWRA has grown recently. However, a lack of credible, accurate information about pre-repower bat fatality rates in the APWRA precludes a confident assessment of the possible effects of repowering. From 2005–2013, only 23 bat fatalities were found in the APWRA during regular searches at monitored turbines (ICF International 2016); however, this dearth of fatalities may reflect primarily the use of long search intervals (e.g., 45 days). Bat fatalities were discovered at higher rates beginning in 2007 after shorter search intervals were used; however, that sampling also occurred primarily at larger, new-generation turbines and involved only human searchers (Smallwood and Karas 2009, Brown et al. 2016). The number of documented bat fatalities increased by an order of magnitude when we used scent-detection dogs during Year 1 of this Project (also see Arnett 2006, Paula et al. 2011).

Although most previous studies suggested that bat fatalities were rare in the APWRA, this Project represents the first time that scent-detection dogs have been used for an extended period to conduct fatality searches in the area. In addition, shorter 7-day search intervals were only recently implemented as a standard practice in the APWRA (Brown et al. 2016). This combination clearly resulted in our detecting far greater numbers of bat fatalities than previously reported in the APWRA; however, similar estimates of per MW fatality rates in this Project and the post-repower Vasco Winds study suggests that repowering with larger, taller turbines also may have contributed to a higher fatality rate for bats. Barclay et al. (2007) demonstrated that taller turbines kill bats at higher rates, and Cryan and Barclay (2009) predicted that, although taller turbines might reduce bird fatalities, they are likely to increase bat fatality rates.

Johnston et al. (2013) found that in the Montezuma Hills WRA, approximately 50% of the bat fatalities disappeared within the first 24 hours after placement (at least from the perspective of human searchers), and human searchers were unlikely to find these bat fatalities other than during the first search attempt. There is a higher probability that a scent-detection dog will eventually recover at least some evidence of each bat fatality before they fully blend into the soil (e.g., see Henrich and Dieter 2017). Especially during the first several weeks of surveys in 2016, when the fatality finds included many old carcasses deposited before the Project began, bat fatalities detected by the detection dogs often included small bits and pieces left behind after scavenging by insects and rodents. In many such cases, it was necessary for the dog to touch a carcass fragment with its nose before the handler could detect it. Additional research on the mechanisms by which bat carcasses are reduced to small pieces would help confirm our hypothesis that most bat fatalities go unnoticed by humans after the carcass has been degraded by insect and small mammal scavenging, even after repeated searches. In comparison, small-bird carcasses may remain visually noticeable as feather spots for longer after they have been reduced by insect and small mammal scavenging, but may not remain as detectable for dogs, which cannot smell degraded feathers that no longer retain tissue or body oils. It would also be helpful to have greater understanding about how the dogs' heightened ability to find small fragments influences the probability of duplicate fatality records.

These factors also confound assessing differences in pre- and post-repower fatality rates within the APWRA, which was already a challenging task due to a variety of factors (ICF International 2016). Adding to the mix the much higher SE of detection dogs for bats (as well as smaller birds) further confounds achieving meaningful comparisons. The first-opportunity detection-dog search efficiency for bats during Year 1 of the Project was more than four times higher than for the human searchers at the Vasco Winds project. However, even this level of difference in search efficiency cannot fully account for the fact that previously only 23 bats were discovered during 9 years of surveys across the APWRA (ICF International 2016), whereas we documented almost 500 bat fatalities during this 3-year study. Therefore, the use of detection dogs cannot fully explain the difference, but teasing apart the comparative influences of detection dogs, shorter search intervals, and taller turbines is a challenge that extends beyond the domain of this monitoring Project.

The APWRA PEIR (Alameda County Community Development Agency 2014) focuses on an annual rate of 1.68 bat fatalities per MW as a threshold value of interest for assessing the impact of the Project on bats, suggesting that the value represents the first-year of monitoring results from the Vasco Winds post-repower project. In fact, however, that value represents what was considered a national average for bat fatalities at the time, whereas the documented values from the Vasco Winds project and this Project were similar (Table 20). For these reasons, we do not think there is any solid basis for evaluating the Project's impact on bats compared to what might have been the case during the pre-repower years (i.e., when smaller, older turbines were in use). Moreover, additional years of data from additional projects will be necessary before a confident assessment can be made concerning post-repower bat fatality rates in the APWRA.

4.4 Spatial Patterns and Potential Fatality Hot Spots

The detection dogs found multiple bat fatalities at most turbines they searched throughout the study; however, the lack of effective comparative data for the 28-day plots in Year 2 precluded discerning overall multi-year spatial patterns across the facility. Nevertheless, having comparable annual estimates to compare across turbines, albeit from different monitoring years, provided useful insight about potential spatial patterns in bat fatalities. In general, the turbine-specific 7-day results suggested that bat fatalities were widespread with several potential fatality hotspots apparent (Figure 11). Without facility-wide, multi-year, 7-day-interval data from detection dogs and detailed modeling analyses, it is not possible to be certain about whether specific landscape features might have contributed to the fatality concentrations. That said, all four of the moderate and strong hotspots were situated at the ends of turbine strings or were otherwise relatively isolated on the edges of open areas. Moreover, three of the four indicated hotspots were located along a northwest-southeast line commencing with WTG 14 on a northwest edge of the facility and ending with WTG 32 on a southeast edge of the facility. This suggests a possible common flight corridor facilitated by prevailing westerly winds.

For nonraptors as a group, the 3-year integrated hotspot assessment again suggested primarily a broad distribution of fatalities across the facility; however, a notable line of low to strong hotspots was evident in the northeast sector, comprising WTGs 36, 37, 42, and 44 (Figure 12). The first three turbines were the only identified moderate or strong hotspots, and were all located along a northwest-southeast line similar to the possible hotspot line for bats mentioned above. The nonraptor fatality corridor began with a moderate hotspot at WTG 36, situated along a northern edge of the facility atop a north-south trending ridgeline at the apex of a wedge of turbine locations that expanded out to the south and southeast from there. The line continued through a strong hotspot at nearby WTG 37, then through another moderate hotspot at WTG 42, and finally through a low hotspot at WTG 44 along a southeastern edge of the facility (see Figure 2). Similar to bats, this pattern suggests that this concentration of nonraptor fatalities reflected the common northwest to southeast migration flight corridor through this region, which pertains because predominantly westerly winds and regional topography funnel bird migration on a northwest-southeast trajectory through this area of central California.

Similar to the case for bats and nonraptors, the combined 3-year dataset for raptors as a group confirmed a broad distribution of fatalities, with relative hotspots distributed across the facility (Figure 13). In this case, however, three of five moderate hotspots were clustered in the northwestern sector, while two others were located in the southeastern sector of the facility. This pattern reflected the combination of high fatality rates for red-tailed hawks and golden eagles in the northwestern sector, generally high raptor fatality rates along the southeastern edge of the facility near WTGs 39, 11, and 32, and an overall concentration of burrowing owl fatalities in the northeastern sector (Figures 14–17).

One commonality was that the southeastern edge of the facility featured various degrees of fatality hotspots for all primary species groups and most of the PEIR-emphasis species. One possible reason why this might have been the case for golden eagles, red-tailed hawks, American kestrels, and barn owls is the immediate proximity of many decommissioned but yet to be removed old-generation turbines. These structures provide attractive hunting, loafing, and roosting perches/substrates for these raptors, as well as potential nest substrates for species such as American kestrels, barn owls, red-tailed hawks, and some relevant prey species, which may increase the risk of adverse interactions with the nearby operational turbines.

We end by emphasizing that investigating fatality hotspots based on adjusted fatality totals makes sense for relatively common species and species groups for which the probability of detection is relatively low and fatalities are widely dispersed across the facility. However, doing so may produce misleading insight for uncommon species for which the probability of detection is relatively low and fatalities are found at only a few turbines. The latter outcome could arise because adjustments that are made to account for imperfect detection inflate the fatality totals only at turbines where fatalities were found, rather than represent the possibility of undiscovered fatalities at other turbines. For uncommon species, this could easily over-represent the importance of specific turbines as potential fatality hotspots. However, for common species/species groups with widespread documented fatalities, this potential bias is less likely to emerge because the relevant adjustments occur across most turbines. Similarly, for species with a high probability of detection (e.g., golden eagles), portraying spatial patterns based on unadjusted versus adjusted data will yield similar insight if the adjustment factors are properly tailored, because the effect of any such adjustments will be minimal.

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Appendix A. Common and Scientific Names of Bats and Birds Mentioned in This Report

Taxon	Common name	Scientific Name
Bats	Big brown bat	*Eptesicus fuscus*
	California myotis	*Myotis californicus*
	Hoary bat	*Aeorestes cinereus*
	Mexican free-tailed bat	*Tadarida brasiliensis*
	Silver-haired bat	*Lasionycteris noctivagans*
	Western mastiff bat	*Eumops perotis*
	Western red bat	*Lasiurus blossevillii*
	Yuma myotis	*Myotis yumanensis*
Birds	American crow	*Corvus brachyrhynchos*
	American kestrel	*Falco sparverius*
	American pipit	*Anthus rubescens*
	American robin	*Turdus migratorius*
	Band-tailed pigeon	*Patagioenas fasciata*
	Barn owl	*Tyto alba*
	Barn swallow	*Hirundo rustica*
	Black-bellied plover	*Pluvialis squatarola*
	Black-headed grosbeak	*Pheucticus melanocephalus*
	Black-throated gray warbler	*Setophaga nigrescens*
	Blue-gray gnatcatcher	*Polioptila caerulea*
	Brewer's blackbird	*Euphagus cyanocephalus*
	Brown creeper	*Certhia americana*
	Brown-headed cowbird	*Molothrus ater*
	Burrowing owl	*Athene cunicularia*
	California gull	*Larus californicus*
	California quail	*Callipepla californica*
	California scrub-jay	*Aphelocoma californica*
	California towhee	*Melozone crissalis*
	Canada goose	*Branta canadensis*
	Cedar waxwing	*Bombycilla cedrorum*
	Chestnut-backed chickadee	*Poecile rufescens*
	Cliff swallow	*Petrochelidon pyrrhonota*
	Common poorwill	*Phalaenoptilus nuttallii*
	Common raven	*Corvus corax*
	Cooper’s hawk	*Accipiter cooperii*
	Dark-eyed junco	*Junco hyemalis*
	Eurasian collared-dove	*Streptopelia decaocto*

Taxon	Common name	Scientific Name
	European starling	*Sturnus vulgaris*
	Ferruginous hawk	*Buteo regalis*
	Fox sparrow	*Passerella iliaca*
	Golden eagle	*Aquila chrysaetos*
	Golden-crowned sparrow	*Zonotrichia atricapilla*
	Grasshopper sparrow	*Ammodramus savannarum*
	Great blue heron	*Ardea herodias*
	Great egret	*Casmerodius alba*
	Great horned owl	*Bubo virginianus*
	Green-winged teal	*Anas carolinensis*
	Hermit thrush	*Catharus guttatus*
	Hermit warbler	*Setophaga occidentalis*
	Horned lark	*Eremophila alpestris*
	House finch	*Haemorhous mexicanus*
	House sparrow	*Passer domesticus*
	House wren	*Troglodytes aedon*
	Killdeer	*Charadrius vociferus*
	Least sandpiper	*Calidris minutilla*
	Lesser goldfinch	*Spinus psaltria*
	Lincoln's sparrow	*Melospiza lincolnii*
	Long-billed curlew	*Numenius americanus*
	Loggerhead shrike	*Lanius ludovicianus*
	Mallard	*Anas platyrhynchos*
	Mountain bluebird	*Sialia currucoides*
	Mourning dove	*Zenaida macroura*
	Northern mockingbird	*Mimus polyglottos*
	Northern harrier	*Circus cyaneus*
	Orange-crowned warbler	*Oreothlypis celata*
	Peregrine falcon	*Falco peregrinus*
	Prairie falcon	*Falco mexicanus*
	Red-breasted sapsucker	*Sphyrapicus ruber*
	Red-shouldered hawk	*Buteo lineatus*
	Red-tailed hawk	*Buteo jamaicensis*
	Red-winged blackbird	*Agelaius phoeniceus*
	Rock pigeon	*Columba livia*
	Rough-legged hawk	*Buteo lagopus*
	Ruby-crowned kinglet	*Regulus calendula*
	Rufous hummingbird	*Selasphorus rufus*
	Savannah sparrow	*Passerculus sandwichensis*
	Say's phoebe	*Sayornis saya*
	Sharp-shinned hawk	*Accipiter striatus*

Taxon	Common name	Scientific Name
	Short-billed dowitcher	*Limnodromus griseus*
	Short-eared owl	*Asio flammeus*
	Snow goose	*Chen caerulescens*
	Sora	*Porzana carolina*
	Spotted towhee	*Pipilo maculatus*
	Steller's jay	*Cyanocitta stelleri*
	Surf scoter	*Melanitta perspicillata*
	Swainson's thrush	*Catharus ustulatus*
	Townsend's warbler	*Setophaga townsendi*
	Tree swallow	*Tachycineta bicolor*
	Tricolored blackbird	*Agelaius tricolor*
	Turkey vulture	*Cathartes aura*
	Varied thrush	*Ixoreus naevius*
	Vaux's swift	*Chaetura vauxi*
	Virginia rail	*Rallus limicola*
	Warbling vireo	*Vireo gilvus*
	Western flycatcher	*Empidonax difficilis/occidentalis*
	Western grebe	*Aechmophorus occidentalis*
	Western gull	*Larus occidentalis*
	Western kingbird	*Tyrannus verticalis*
	Western meadowlark	*Sturnella neglecta*
	Western sandpiper	*Calidris mauri*
	Western screech-owl	*Megascops kennicottii*
	Western tanager	*Piranga ludoviciana*
	White-breasted nuthatch	*Sitta carolinensis*
	White-crowned sparrow	*Zonotrichia leucophrys*
	White-tailed kite	*Elanus leucurus*
	White-throated swift	*Aeronautes saxatalis*
	Wilson's warbler	*Cardellina pusilla*
	Yellow warbler	*Setophaga petechia*
	Yellow-rumped warbler	*Setophaga coronata*

Appendix B. Description of Customized Approach Used in *GenEst* to Accommodate Binomial Carcass Detectability Trials

Dan Dalthorp (U.S. Geological Survey, Corvallis, OR) provided the information below to Jeff Smith (H. T. Harvey & Associates) in the form of a PowerPoint slide deck on August 7, 2019. The provided information is copied verbatim below.

****

Binomial Trials

The Idea:

- g is the probability of detecting a carcass that arrives in searched areas during the span of the monitoring season
- Estimate g by placing trial carcasses in the field and using the fraction of them that searchers find as g
- The Advantage:
- Simplifies the field trials because carcasses do not need follow-up visits to determine carcass removal times (CP trials) or to verify that missed carcasses were still available to searchers (SE trials)

Disadvantages:

- Very sensitive to carcass placement times...MUST accurately reflect carcass arrival times (much more so than with regular CP trials)
- Sensitive to search covariates (visibility, season, size, etc.)

  [same way as standard SE trials are...but don't forget!]

Binomial Trials in GenEst

- GenEst can be used to analyze PCM data from binomial trials

The Idea:

- Carcasses are either found or not...doesn't matter whether missed carcasses were removed by scavengers or simply overlooked by searchers
- Enter the binomial trial data in an SE, recording simply whether each trial carcass was eventually found by searchers (1) or not (0)
- Model SE using covariates (just like with standard GenEst data) and $k = 0$.
- DO USE season as a covariate for SE because g will depend on season even if standard SE does not.
- Set up a dummy CP file that will give you $r = 1$

An Example

- wind_cleared data using bats only (and modified SE and CP files):

SE:

- File: include covariates but only one "search" column to indicate whether carcasses were eventually found (1) or not (0)
- Modeling: use covariates (as per usual) but with fixed $k = 0$

CP:

- File: Dummy file with 4 points:
- LastPresent = total span of monitoring period (2x) and span + 1 (2x)
- FirstAbsent = span + 1 (2x) and Inf (2x)
- Modeling: lognormal without covariates

CPID	Last Present	First Absent
cp1	200	201
cp2	200	201
cp3	201	Inf
cp4	201	Inf

DWP, SS, CO:

- Files: just as with standard analyses

Appendix C. Fatality Surveys Conducted in Year 1

	Number by Search Interval / Survey Type[1]				
Turbine	2–3 day Fall Road/Pad	7-day Full Plot	28-day Full Plot	Date of First Survey	Date of Last Survey
WTG-1			13	27-Sep-16	29-Aug-17
WTG-2			13	27-Sep-16	29-Aug-17
WTG-3			13	11-Oct-16	12-Sep-17
WTG-4	16	52		20-Sep-16	13-Sep-17
WTG-5	16	52		19-Sep-16	11-Sep-17
WTG-6			13	11-Oct-16	12-Sep-17
WTG-7	16	51		20-Sep-16	11-Sep-17
WTG-8			13	20-Sep-16	24-Aug-17
WTG-9			13	04-Oct-16	08-Sep-17
WTG-10			13	11-Oct-16	12-Sep-17
WTG-11			13	21-Sep-16	22-Aug-17
WTG-12			13	28-Sep-16	29-Aug-17
WTG-13			13	11-Oct-16	12-Sep-17
WTG-14	17	51		20-Sep-16	15-Sep-17
WTG-15			13	28-Sep-16	29-Aug-17
WTG-16	16	51		19-Sep-16	13-Sep-17
WTG-17			13	27-Sep-16	31-Aug-17
WTG-18			13	28-Sep-16	31-Aug-17
WTG-19	16	51		20-Sep-16	13-Sep-17
WTG-20			13	28-Sep-16	31-Aug-17
WTG-21	17	50		19-Sep-16	13-Sep-17
WTG-22			13	27-Sep-16	31-Aug-17
WTG-23			13	11-Oct-16	14-Sep-17
WTG-24	16	50		20-Sep-16	08-Sep-17
WTG-25			13	20-Sep-16	24-Aug-17
WTG-26			13	11-Oct-16	14-Sep-17
WTG-27			13	11-Oct-16	14-Sep-17
WTG-28			13	11-Oct-16	14-Sep-17
WTG-29			13	20-Sep-16	24-Aug-17
WTG-30			13	04-Oct-16	07-Sep-17
WTG-31	16	49		20-Sep-16	15-Sep-17
WTG-32	16	51		21-Sep-16	13-Sep-17
WTG-33	16	50		20-Sep-16	15-Sep-17
WTG-34			13	04-Oct-16	07-Sep-17
WTG-35	16	51		20-Sep-16	11-Sep-17
WTG-36			13	04-Oct-16	07-Sep-17
WTG-37	16	51		20-Sep-16	11-Sep-17
WTG-38	16	52		20-Sep-16	13-Sep-17
WTG-39			13	21-Sep-16	22-Aug-17
WTG-40	16	51		21-Sep-16	13-Sep-17
WTG-41			13	20-Sep-16	24-Aug-17
WTG-42			13	04-Oct-16	05-Sep-17
WTG-43	16	52		20-Sep-16	13-Sep-17
WTG-44			13	20-Sep-16	22-Aug-17
WTG-45			13	20-Sep-16	22-Aug-17
WTG-46			13	04-Oct-16	05-Sep-17
WTG-47			13	04-Oct-16	05-Sep-17
WTG-48			13	04-Oct-16	05-Sep-17

[1] Scent-detection dog teams conducted all surveys.

Appendix D. Fatality Surveys Conducted in Year 2

Turbine	Number by Search Interval / Survey Type[1] 7-day Full Plot	28-day Full Plot	Date of First Survey	Date of Last Survey
WTG-01	0	13	21-Sep-17	22-Aug-18
WTG-02	52	0	18-Sep-17	10-Sep-18
WTG-03	52	0	18-Sep-17	10-Sep-18
WTG-04	0	13	21-Sep-17	22-Aug-18
WTG-05	0	13	21-Sep-17	22-Aug-18
WTG-06	0	13	21-Sep-17	21-Aug-18
WTG-07	0	13	19-Sep-17	21-Aug-18
WTG-08	0	13	28-Sep-17	29-Aug-18
WTG-09	0	13	28-Sep-17	30-Aug-18
WTG-10	52	0	18-Sep-17	10-Sep-18
WTG-11	51	0	20-Sep-17	12-Sep-18
WTG-12	0	13	19-Sep-17	21-Aug-18
WTG-13	51	0	19-Sep-17	11-Sep-18
WTG-14	0	13	27-Sep-17	28-Aug-18
WTG-15	0	13	19-Sep-17	23-Aug-18
WTG-16	0	13	19-Sep-17	23-Aug-18
WTG-17	0	13	27-Sep-17	28-Aug-18
WTG-18	52	0	18-Sep-17	10-Sep-18
WTG-19	0	13	27-Sep-17	29-Aug-18
WTG-20	0	13	05-Oct-17	05-Sep-18
WTG-21	0	13	05-Oct-17	05-Sep-18
WTG-22	52	0	19-Sep-17	11-Sep-18
WTG-23	50	0	19-Sep-17	11-Sep-18
WTG-24	0	13	28-Sep-17	29-Aug-18
WTG-25	0	13	05-Oct-17	04-Sep-18
WTG-26	0	13	05-Oct-17	05-Sep-18
WTG-27	52	0	20-Sep-17	12-Sep-18
WTG-28	0	13	27-Sep-17	28-Aug-18
WTG-29	51	0	20-Sep-17	12-Sep-18
WTG-30	51	0	19-Sep-17	11-Sep-18
WTG-31	0	13	28-Sep-17	30-Aug-18
WTG-32	0	13	04-Oct-17	04-Sep-18
WTG-33	0	13	12-Oct-17	13-Sep-18
WTG-34	52	0	20-Sep-17	12-Sep-18
WTG-35	0	13	12-Oct-17	13-Sep-18
WTG-36	0	13	12-Oct-17	12-Sep-18
WTG-37	0	13	12-Oct-17	12-Sep-18
WTG-38	0	13	04-Oct-17	06-Sep-18
WTG-39	0	13	04-Oct-17	06-Sep-18
WTG-40	0	13	11-Oct-17	12-Sep-18
WTG-41	0	13	11-Oct-17	11-Sep-18
WTG-42	0	13	11-Oct-17	11-Sep-18
WTG-43	0	13	04-Oct-17	04-Sep-18
WTG-44	48	0	21-Sep-17[2]	13-Sep-18
WTG-45	48	0	12-Oct-17[2]	13-Sep-18
WTG-46	0	13	11-Oct-17	11-Sep-18
WTG-47	49	0	05-Oct-17[2]	13-Sep-18
WTG-48	49	0	05-Oct-17[2]	13-Sep-18

[1] Scent-detection dog teams conducted the 7-day surveys; human searchers conducted the 28-day surveys.
[9] Early surveys restricted by road construction activity.

Appendix E. Fatality Surveys Conducted in Year 3

Turbine	Number by Search Interval / Survey Type[1]		Date of First Survey	Date of Last Survey
	7-day Full Plot	28-day Full Plot		
WTG-01	50		17-Sep-18	09-Sep-19
WTG-02		13	09-Oct-18	10-Sep-19
WTG-03		13	09-Oct-18	10-Sep-19
WTG-04		13	19-Sep-18	21-Aug-19
WTG-05		13	19-Sep-18	21-Aug-19
WTG-06	50		17-Sep-18	09-Sep-19
WTG-07		13	19-Sep-18	21-Aug-19
WTG-08	51		18-Sep-18	10-Sep-19
WTG-09	51		18-Sep-18	10-Sep-19
WTG-10		13	09-Oct-18	10-Sep-19
WTG-11		13	04-Oct-18	12-Sep-19
WTG-12	50		17-Sep-18	09-Sep-19
WTG-13		13	25-Sep-18	27-Aug-19
WTG-14		13	25-Sep-18	27-Aug-19
WTG-15	50		19-Sep-18	11-Sep-19
WTG-16		13	02-Oct-18	03-Sep-19
WTG-17	50		17-Sep-18	02-Sep-19
WTG-18		13	25-Sep-18	27-Aug-19
WTG-19		13	10-Oct-18	11-Sep-19
WTG-20	51		18-Sep-18	10-Sep-19
WTG-21		13	27-Sep-18	11-Sep-19
WTG-22		12	25-Oct-18	29-Aug-19
WTG-23		13	03-Oct-18	04-Sep-19
WTG-24		13	10-Oct-18	11-Sep-19
WTG-25	51		18-Sep-18	10-Sep-19
WTG-26	50		19-Sep-18	11-Sep-19
WTG-27		13	20-Sep-18	22-Aug-19
WTG-28	49		19-Sep-18	28-Aug-19
WTG-29		13	20-Sep-18	22-Aug-19
WTG-30		13	03-Oct-18	04-Sep-19
WTG-31		13	27-Sep-18	29-Aug-19
WTG-32		13	04-Oct-18	05-Sep-19
WTG-33		13	11-Oct-18	12-Sep-19
WTG-34		13	03-Oct-18	04-Sep-19
WTG-35		13	11-Oct-18	12-Sep-19
WTG-36	50		19-Sep-18	11-Sep-19
WTG-37		13	18-Sep-18	20-Aug-19
WTG-38		13	18-Sep-18	20-Aug-19
WTG-39	50		20-Sep-18	12-Sep-19
WTG-40		13	18-Sep-18	20-Aug-19
WTG-41	52		20-Sep-18	12-Sep-19
WTG-42	49		20-Sep-18	12-Sep-19
WTG-43		13	02-Oct-18	03-Sep-19
WTG-44		13	02-Oct-18	03-Sep-19
WTG-45		13	26-Sep-18	28-Aug-19
WTG-46	49		20-Sep-18	12-Sep-19
WTG-47		13	26-Sep-18	28-Aug-19
WTG-48		13	26-Sep-18	28-Aug-19

[1] Scent-detection dog teams conducted the 7-day surveys; human searchers conducted the 28-day surveys.

Appendix F. Carcass Detectability Trial Specimens Placed in Year 1

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Removed Before SET?[1]	Detected?	Persist Time (days)
17-Oct-16	28d	8	38	340	Grazed/short grass	Common raven	Large	No	Yes	114
17-Oct-16	28d	11	44	200	Grazed/short grass	Hoary bat	Small	No	Yes	86
17-Oct-16	28d	29	80	20	Bare dirt/disturbed soil	European starling	Small	No	Yes	3
17-Oct-16	7d	31	3	360	Bare dirt/disturbed soil	Mexican free-tailed bat	Small	No	Yes	30
17-Oct-16	7d	37	13	250	Bare dirt/disturbed soil	House sparrow	Small	No	Yes	7
17-Oct-16	7d	40	30	30	Tall grass/forb	Red-tailed hawk	Large	No	Yes	63
17-Oct-16	28d	45	40	270	Tall grass/forb	Varied thrush	Small	No	No	63
18-Oct-16	7d	4	60	100	Tall grass/forb	California scrub jay	Small	No	No	2
18-Oct-16	7d	5	9	90	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	77
18-Oct-16	7d	19	27	280	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	64
18-Oct-16	7d	33	84	40	Tall grass/forb	Barn owl	Medium	No	Yes	64
19-Oct-16	7d	14	21	220	Bare dirt/disturbed soil	Cedar waxwing	Small	No	Yes	13
19-Oct-16	7d	24	100	360	Tall grass/forb	Band-tailed pigeon	Medium	No	Yes	63
24-Oct-16	28d	1	35	140	Grazed/short grass	House finch	Small	No	Yes	64
24-Oct-16	28d	2	57	360	Tall grass/forb	American crow	Medium	No	Yes	64
24-Oct-16	28d	17	90	190	Tall grass/forb	Hoary bat	Small	Yes?	No	2
24-Oct-16	28d	17	65	340	Tall grass/forb	Green-winged teal	Medium	No	Yes	71
25-Oct-16	7d	4	46	180	Grazed/short grass	Hoary bat	Small	No	Yes	8
25-Oct-16	7d	7	7	360	Turbine pad	Hoary bat	Small	No	Yes	63
25-Oct-16	28d	12	89	140	Tall grass/forb	Red-tailed hawk	Large	No	Yes	13
25-Oct-16	7d	16	10	240	Turbine pad	Hoary bat	Small	No	Yes	63
25-Oct-16	7d	24	45	240	Grazed/short grass	White-breasted nuthatch	Small	No	No	71
25-Oct-16	7d	31	36	240	Grazed/short grass	Hoary bat	Small	No	Yes	22
25-Oct-16	7d	32	74	360	Bare dirt/disturbed soil	Hoary bat	Small	No	Yes	63
26-Oct-16	7d	37	25	20	Bare dirt/disturbed soil	Hoary bat	Small	No	Yes	33
26-Oct-16	7d	43	5	130	Turbine pad	Mexican free-tailed bat	Small	No	Yes	84
01-Nov-16	7d	21	100	270	Road	Mexican free-tailed bat	Small	Yes	No	1
01-Nov-16	28d	30	101	170	Grazed/short grass	Cooper's hawk	Medium	No	Yes	84
01-Nov-16	28d	47	70	180	Grazed/short grass	Western grebe	Large	No	Yes	63
02-Nov-16	7d	30	15	128	Grazed/short grass	House sparrow	Small	No	Yes	2
07-Nov-16	7d	4	8	340	Turbine pad	Mexican free-tailed bat	Small	No	Yes	66
07-Nov-16	7d	31	47	240	Road	Mexican free-tailed bat	Small	Yes	No	0
07-Nov-16	7d	33	8	70	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	65

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Removed Before SET?[1]	Detected?	Persist Time (days)
07-Nov-16	7d	35	33	40	Tall grass/forb	Red-tailed hawk	Large	No	Yes	70
07-Nov-16	7d	38	7	70	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	3
08-Nov-16	7d	32	4	250	Turbine pad	Mexican free-tailed bat	Small	No	Yes	62
08-Nov-16	7d	40	73	180	Road	Mexican free-tailed bat	Small	No	Yes	6
08-Nov-16	7d	43	7	40	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	65
09-Nov-16	7d	14	58	270	Tall grass/forb	Band-tailed pigeon	Medium	No	Yes	64
09-Nov-16	7d	19	44	290	Grazed/short grass	House finch	Small	No	Yes	64
10-Nov-16	28d	26	35	310	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	6
27-Nov-16	7d	37	93	30	Tall grass/forb	American crow	Medium	No	Yes	57
28-Nov-16	7d	21	26	45	Grazed/short grass	Northern mockingbird	Small	Yes	No	0
28-Nov-16	28d	34	63	300	Grazed/short grass	Snow goose	Large	No	Yes	58
28-Nov-16	28d	36	41	130	Grazed/short grass	Mexican free-tailed bat	Small	Yes	No	1
28-Nov-16	28d	36	82	320	Grazed/short grass	Surf scoter	Medium	No	Yes	57
28-Nov-16	28d	42	98	240	Grazed/short grass	Western screech-owl	Medium	Yes	No	1
28-Nov-16	28d	48	79	180	Tall grass/forb	Mexican free-tailed bat	Small	No	No	21
29-Nov-16	28d	9	89	190	Grazed/short grass	Townsend's warbler	Small	No	No	8
30-Nov-16	7d	38	65	220	Grazed/short grass	Red-shouldered hawk	Medium	No	Yes	56
05-Dec-16	7d	5	100	330	Tall grass/forb	White-throated swift	Small	No	Yes	56
05-Dec-16	28d	6	26	270	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	30
05-Dec-16	28d	10	88	90	Grazed/short grass	European starling	Small	No	Yes	9
05-Dec-16	28d	23	56	240	Grazed/short grass	Red-tailed hawk	Large	No	Yes	57
05-Dec-16	28d	26	57	90	Grazed/short grass	American kestrel	Medium	No	No	7
06-Dec-16	28d	3	17	197	Grazed/short grass	Mexican free-tailed bat	Small	No	No	14
06-Dec-16	28d	28	87	360	Tall grass/forb	House sparrow	Small	No	No	7
19-Dec-16	7d	16	51	30	Tall grass/forb	American kestrel	Medium	No	No	0
19-Dec-16	28d	18	70	140	Tall grass/forb	Red-winged blackbird	Small	No	Yes	16
19-Dec-16	28d	20	91	40	Tall grass/forb	Red-tailed hawk	Large	No	Yes	57
19-Dec-16	7d	40	81	200	Tall grass/forb	American pipit	Small	No	No	7
20-Dec-16	28d	2	74	170	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	7
20-Dec-16	28d	22	99	120	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	7
27-Dec-16	28d	2	28	348	Grazed/short grass	Red-tailed hawk	Large	No	Yes	58
27-Dec-16	7d	7	90	242	Tall grass/forb	Western grebe	Large	No	Yes	56
27-Dec-16	28d	42	82	310	Grazed/short grass	Mexican free-tailed bat	Small	No	No	15
27-Dec-16	28d	46	86	100	Grazed/short grass	American crow	Medium	No	Yes	22
27-Dec-16	28d	48	71	314	Grazed/short grass	Ruby-crowned kinglet	Small	Yes?	No	7
29-Dec-16	7d	31	91	260	Grazed/short grass	Red-breasted sapsucker	Small	No	Yes	13
09-Jan-17	28d	25	71	30	Tall grass/forb	Surf scoter	Medium	No	Yes	57

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Removed Before SET?[1]	Detected?	Persist Time (days)
09-Jan-17	7d	40	56	130	Grazed/short grass	Yellow-rumped warbler	Small	No	No	7
09-Jan-17	28d	44	74	200	Grazed/short grass	Red-tailed hawk	Large	No	No	57
11-Jan-17	7d	4	73	320	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	49
11-Jan-17	28d	39	84	100	Tall grass/forb	European starling	Small	No	No	5
12-Jan-17	7d	24	87	50	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	13
16-Jan-17	28d	15	22	100	Grazed/short grass	Red-tailed hawk	Large	No	Yes	57
16-Jan-17	7d	16	25	210	Grazed/short grass	California myotis	Small	No	Yes	14
16-Jan-17	28d	18	97	30	Grazed/short grass	Band-tailed pigeon	Medium	No	Yes	57
17-Jan-17	7d	14	47	220	Grazed/short grass	House sparrow	Small	No	No	57
23-Jan-17	28d	9	79	250	Grazed/short grass	American crow	Medium	No	Yes	57
23-Jan-17	7d	32	67	230	Tall grass/forb	House finch	Small	No	Yes	0
23-Jan-17	28d	48	36	90	Grazed/short grass	Red-tailed hawk	Large	No	Yes	57
24-Jan-17	7d	32	65	220	Grazed/short grass	House sparrow	Small	na[2]	na[2]	6
25-Jan-17	7d	33	82	150	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	56
30-Jan-17	28d	27	99	340	Grazed/short grass	Big brown bat	Small	No	Yes	15
31-Jan-17	28d	3	86	210	Grazed/short grass	Dark-eyed junco	Small	No	Yes	6
13-Feb-17	28d	1	69	20	Grazed/short grass	Band-tailed pigeon	Medium	Yes	No	1
13-Feb-17	28d	22	14	350	Grazed/short grass	Lesser goldfinch	Small	No	No	57
13-Feb-17	7d	32	73	330	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	56
14-Feb-17	28d	12	51	230	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	8
14-Feb-17	7d	31	77	100	Grazed/short grass	Red-tailed hawk	Large	No	Yes	57
15-Feb-17	7d	38	91	340	Grazed/short grass	House sparrow	Small	No	No	6
21-Feb-17	28d	34	58	310	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	14
22-Feb-17	7d	4	43	320	Grazed/short grass	Red-tailed hawk	Large	No	Yes	56
22-Feb-17	28d	30	34	120	Grazed/short grass	European starling	Small	No	Yes	27
22-Feb-17	28d	42	42	100	Grazed/short grass	Red-winged blackbird	Small	No	Yes	35
22-Feb-17	7d	43	78	280	Grazed/short grass	American crow	Medium	No	Yes	56
27-Feb-17	28d	3	101	300	Bare dirt/disturbed soil	Mexican free-tailed bat	Small	No	Yes	57
27-Feb-17	28d	10	101	10	Grazed/short grass	Golden-crowned sparrow	Small	Yes	No	1
27-Feb-17	28d	23	61	190	Grazed/short grass	Mexican free-tailed bat	Small	Yes	No	1
28-Feb-17	7d	19	91	110	Grazed/short grass	Surf scoter	Medium	No	Yes	57
28-Feb-17	7d	24	89	290	Grazed/short grass	Red-tailed hawk	Large	No	Yes	57
06-Mar-17	7d	5	29	70	Grazed/short grass	House sparrow	Small	No	Yes	7
06-Mar-17	7d	16	67	250	Grazed/short grass	House sparrow	Small	No	Yes	56
06-Mar-17	28d	25	82	260	Grazed/short grass	Red-tailed hawk	Large	No	Yes	87
07-Mar-17	28d	41	70	180	Tall grass/forb	Mexican free-tailed bat	Small	No	No	14
13-Mar-17	28d	15	83	210	Tall grass/forb	Mexican free-tailed bat	Small	No	No	8

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Removed Before SET?[1]	Detected?	Persist Time (days)
13-Mar-17	28d	20	47	50	Grazed/short grass	Mexican free-tailed bat	Small	No	No	59
13-Mar-17	7d	35	71	70	Grazed/short grass	European starling	Small	No	Yes	58
13-Mar-17	7d	40	26	60	Grazed/short grass	Red-tailed hawk	Large	No	Yes	56
19-Mar-17	7d	37	94	220	Tall grass/forb	Surf scoter	Medium	No	Yes	58
20-Mar-17	7d	7	88	220	Tall grass/forb	Townsend's warbler	Small	No	No	2
20-Mar-17	28d	34	97	10	Grazed/short grass	White-throated swift	Small	No	No	87
21-Mar-17	28d	47	70	270	Tall grass/forb	Mexican free-tailed bat	Small	No	No	20
27-Mar-17	28d	13	69	180	Tall grass/forb	Red-tailed hawk	Large	No	Yes	58
28-Mar-17	28d	10	73	150	Tall grass/forb	Mexican free-tailed bat	Small	No	No	29
28-Mar-17	28d	28	43	90	Tall grass/forb	Brown creeper	Small	No	No	58
29-Mar-17	7d	43	79	210	Tall grass/forb	Mexican free-tailed bat	Small	No	No	36
04-Apr-17	28d	11	22	150	Grazed/short grass	House sparrow	Small	No	No	1
04-Apr-17	7d	33	84	60	Tall grass/forb	European starling	Small	No	Yes	
10-Apr-17	7d	7	43	60	Bare dirt/disturbed soil	Mourning dove	Medium	No	No	7
10-Apr-17	28d	17	73	60	Tall grass/forb	Red-tailed hawk	Large	No	Yes	60
10-Apr-17	28d	18	36	280	Grazed/short grass	Mexican free-tailed bat	Small	Yes	No	1
11-Apr-17	28d	12	95	160	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	56
17-Apr-17	28d	30	84	240	Tall grass/forb	Mourning dove	Small	No	No	60
17-Apr-17	28d	36	89	210	Tall grass/forb	Red-tailed hawk	Large	No	Yes	60
17-Apr-17	28d	42	51	360	Grazed/short grass	Mourning dove	Small	No	Yes	57
17-Apr-17	28d	46	18	110	Grazed/short grass	Mexican free-tailed bat	Small	No	No	58
24-Apr-17	7d	21	95	50	Tall grass/forb	Mexican free-tailed bat	Small	No	No	58
24-Apr-17	28d	23	61	270	Tall grass/forb	House sparrow	Small	No	No	59
24-Apr-17	28d	27	72	280	Tall grass/forb	Ferruginous hawk	Large	No	Yes	59
24-Apr-17	7d	35	23	110	Tall grass/forb	Mexican free-tailed bat	Small	No	Yes	56
08-May-17	28d	2	81	270	Tall grass/forb	Red-tailed hawk	Large	No	Yes	57
09-May-17	28d	15	37	110	Tall grass/forb	Cliff swallow	Small	No	Yes	8
10-May-17	7d	14	91	210	Tall grass/forb	Mexican free-tailed bat	Small	No	No	58
10-May-17	28d	22	85	10	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	57
15-May-17	7d	5	81	20	Tall grass/forb	Common raven	Large	No	Yes	56
16-May-17	7d	40	83	320	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	57
16-May-17	28d	48	81	150	Tall grass/forb	Brewer's blackbird	Small	No	Yes	44
17-May-17	28d	34	93	200	Tall grass/forb	House sparrow	Small	No	Yes	57
23-May-17	7d	37	80	100	Tall grass/forb	Mexican free-tailed bat	Small	No	Yes	10
24-May-17	28d	26	95	300	Tall grass/forb	Horned lark	Small	Yes	No	1
30-May-17	7d	7	95	170	Tall grass/forb	Chestnut-backed chickadee	Small	No	No	59
30-May-17	7d	43	58	320	Grazed/short grass	Common raven	Large	No	Yes	57

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Removed Before SET?[1]	Detected?	Persist Time (days)
30-May-17	28d	45	85	350	Grazed/short grass	Mexican free-tailed bat	Small	No	No	24
31-May-17	28d	25	47	150	Bare dirt/disturbed soil	Mexican free-tailed bat	Small	No	Yes	57
31-May-17	28d	29	84	50	Tall grass/forb	Western flycatcher	Small	No	Yes	57
06-Jun-17	7d	38	56	10	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	29
07-Jun-17	7d	16	88	100	Tall grass/forb	Horned lark	Small	No	No	70
07-Jun-17	28d	20	83	140	Tall grass/forb	Mexican free-tailed bat	Small	No	No	64
08-Jun-17	7d	33	54	210	Tall grass/forb	Rough-legged hawk	Large	No	Yes	75
12-Jun-17	28d	47	23	170	Bare dirt/disturbed soil	Brown-headed cowbird	Small	No	Yes	64
14-Jun-17	28d	9	75	20	Tall grass/forb	Mexican free-tailed bat	Small	No	No	62
14-Jun-17	7d	19	86	320	Tall grass/forb	California gull	Large	No	Yes	65
14-Jun-17	28d	36	67	320	Grazed/short grass	European starling	Small	No	Yes	33
20-Jun-17	28d	3	24	340	Tall grass/forb	California gull	Large	No	Yes	70
21-Jun-17	7d	4	97	350	Tall grass/forb	House sparrow	Small	No	Yes	21
21-Jun-17	28d	26	10	360	Grazed/short grass	Mexican free-tailed bat	Small	No	No	29
26-Jun-17	28d	39	87	80	Grazed/short grass	California gull	Large	No	Yes	66
28-Jun-17	28d	8	46	60	Tall grass/forb	Horned lark	Small	No	No	20
28-Jun-17	28d	41	65	80	Grazed/short grass	Red-tailed hawk	Large	No	Yes	70
05-Jul-17	28d	18	98	190	Tall grass/forb	European starling	Small	No	No	64
06-Jul-17	7d	31	7	180	Grazed/short grass	Rock pigeon	Medium	No	Yes	64
10-Jul-17	28d	46	48	120	Grazed/short grass	Ruby-crowned kinglet	Small	No	Yes	8
11-Jul-17	7d	21	49	320	Tall grass/forb	Turkey vulture	Large	No	Yes	65
12-Jul-17	28d	36	94	190	Tall grass/forb	Mexican free-tailed bat	Small	No	Yes	63
18-Jul-17	28d	13	51	310	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	1
18-Jul-17	7d	32	97	210	Tall grass/forb	Western screech-owl	Medium	No	Yes	65
19-Jul-17	28d	27	71	130	Grazed/short grass	Western flycatcher	Small	No	Yes	64
19-Jul-17	28d	28	87	320	Tall grass/forb	Mexican free-tailed bat	Small	No	No	64
20-Jul-17	7d	14	52	30	Tall grass/forb	Common raven	Large	No	Yes	69
24-Jul-17	28d	11	56	260	Tall grass/forb	Canada goose	Large	No	No	67
26-Jul-17	28d	8	30	340	Grazed/short grass	European starling	Small	No	Yes	64
26-Jul-17	28d	29	37	10	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	64
31-Jul-17	28d	1	97	340	Tall grass/forb	Mexican free-tailed bat	Small	No	Yes	66
31-Jul-17	28d	2	63	110	Tall grass/forb	House sparrow	Small	Yes	No	1
01-Aug-17	7d	16	18	170	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	43
02-Aug-17	28d	20	94	280	Tall grass/forb	Brown-headed cowbird	Small	No	No	29
08-Aug-17	7d	4	32	10	Grazed/short grass	Mourning dove	Medium	No	Yes	63
08-Aug-17	7d	38	58	160	Grazed/short grass	House sparrow	Small	No	Yes	64
09-Aug-17	28d	9	70	150	Tall grass/forb	Common raven	Large	Yes	No	1

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Removed Before SET?[1]	Detected?	Persist Time (days)
09-Aug-17	28d	30	37	30	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	63
14-Aug-17	7d	35	41	80	Tall grass/forb	Big brown bat	Small	No	No	64
15-Aug-17	28d	13	61	180	Bare dirt/disturbed soil	House wren	Small	No	No	7
15-Aug-17	7d	32	15	160	Grazed/short grass	Mexican free-tailed bat	Small	No	No	63
15-Aug-17	7d	43	89	280	Grazed/short grass	European starling	Small	No	No	7
22-Aug-17	7d	43	39	54	Grazed/short grass	White-throated swift	Small	No	Yes	15
22-Aug-17	28d	45	54	76	Grazed/short grass	Townsend's warbler	Small	No	Yes	44
23-Aug-17	7d	21	39	285	Grazed/short grass	Mexican free-tailed bat	Small	No	No	15
23-Aug-17	28d	25	63	69	Tall grass/forb	Turkey vulture	Large	No	Yes	63
23-Aug-17	28d	29	80	190	Tall grass/forb	California scrub jay	Small	No	No	5
28-Aug-17	28d	12	69	320	Grazed/short grass	Red-tailed hawk	Large	No	Yes	73
30-Aug-17	7d	40	33	200	Grazed/short grass	American kestrel	Medium	No	Yes	62
31-Aug-17	28d	17	92	100	Tall grass/forb	Long-billed curlew	Large	No	Yes	61
06-Sep-17	7d	38	79	220	Grazed/short grass	Mourning dove	Medium	No	Yes	85
07-Sep-17	28d	30	91	190	Tall grass/forb	Red-winged blackbird	Small	No	Yes	7
08-Sep-17	7d	24	37	280	Grazed/short grass	Mexican free-tailed bat	Small	No	Yes	41
12-Sep-17	7d	4	36	180	Grazed/short grass	Mexican free-tailed bat	Small	No	No	17
12-Sep-17	28d	10	71	200	Tall grass/forb	American kestrel	Medium	No	No	3

Appendix G. Carcass Detectability Trial Specimens Placed in Year 2

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
27-Sep-17	28d	17	86	190	Grazed/short grass	European starling	Small	No	–
27-Sep-17	28d	32	99	240	Tall grass/forb	Common raven	Large	Yes	7
27-Sep-17	7d	34	89	360	Tall grass/forb	Brown-headed cowbird	Small	Yes	1
27-Sep-17	28d	38	27	160	Grazed/short grass	Mexican free-tailed bat	Small	No	–
28-Sep-17	7d	22	101	190	Grazed/short grass	California gull	Large	Yes	5
29-Sep-17	7d	11	40	90	Grazed/short grass	Mexican free-tailed bat	Small	Yes	5
03-Oct-17	28d	20	84	30	Tall grass/forb	California scrub-jay	Small	No	–
03-Oct-17	7d	27	87	180	Tall grass/forb	Cedar waxwing	Small	Yes	29
03-Oct-17	7d	29	49	60	Tall grass/forb	American crow	Medium	Yes	1
03-Oct-17	7d	34	17	240	Grazed/short grass	Mexican free-tailed bat	Small	Yes	22
05-Oct-17	28d	4	51	220	Tall grass/forb	Mexican free-tailed bat	Small	No	–
05-Oct-17	28d	28	37	180	Tall grass/forb	Canada goose	Large	Yes	20
11-Oct-17	7d	22	39	120	Grazed/short grass	Mexican free-tailed bat	Small	Yes	6
11-Oct-17	7d	23	69	280	Grazed/short grass	Red-tailed hawk	Large	Yes	6
11-Oct-17	28d	31	73	270	Tall grass/forb	California gull	Large	Yes	15
12-Oct-17	7d	13	102	330	Grazed/short grass	European starling	Small	Yes	5
12-Oct-17	28d	26	39	70	Tall grass/forb	House sparrow	Small	No	–
12-Oct-17	28d	46	93	110	Grazed/short grass	Mexican free-tailed bat	Small	No	–
16-Oct-17	28d	4	91	180	Grazed/short grass	California gull	Large	Yes	2
16-Oct-17	28d	7	63	350	Tall grass/forb	White-crowned sparrow	Small	No	–
16-Oct-17	28d	8	95	90	Tall grass/forb	Mexican free-tailed bat	Small	No	–
17-Oct-17	7d	45	60	190	Tall grass/forb	Mallard	Large	No	–
17-Oct-17	7d	47	60	270	Grazed/short grass	Little brown bat	Small	Yes	9
19-Oct-17	7d	27	53	90	Grazed/short grass	Red-winged blackbird	Small	Yes	6
25-Oct-17	7d	10	30	240	Tall grass/forb	Long-billed curlew	Large	Yes	5
25-Oct-17	28d	14	57	230	Tall grass/forb	Mexican free-tailed bat	Small	No	–
25-Oct-17	7d	18	32	230	Tall grass/forb	American robin	Small	No	–
25-Oct-17	28d	24	68	260	Grazed/short grass	House finch	Small	No	–
25-Oct-17	28d	42	67	20	Grazed/short grass	California gull	Large	Yes	14
26-Oct-17	7d	23	97	140	Grazed/short grass	Mexican free-tailed bat	Small	Yes	26
31-Oct-17	7d	30	23	120	Tall grass/forb	Mexican free-tailed bat	Small	No	–
31-Oct-17	28d	43	48	220	Grazed/short grass	Cedar waxwing	Small	No	–
09-Nov-17	28d	1	69	210	Grazed/short grass	Red-tailed hawk	Large	Yes	7

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
09-Nov-17	7d	2	28	330	Grazed/short grass	Cedar waxwing	Small	Yes	4
09-Nov-17	28d	6	22	90	Gravel/dirt	Hoary bat	Small	No	–
09-Nov-17	7d	18	88	150	Tall grass/forb	California gull	Large	Yes	4
17-Nov-17	28d	17	40	240	Gravel/dirt	Mexican free-tailed bat	Small	No	–
17-Nov-17	28d	17	14	340	Grazed/short grass	Ferruginous hawk	Large	Yes	4
17-Nov-17	7d	27	91	60	Tall grass/forb	American kestrel	Medium	Yes	5
17-Nov-17	7d	29	90	210	Grazed/short grass	Hoary bat	Small	Yes	8
17-Nov-17	7d	30	99	240	Tall grass/forb	Golden-crowned sparrow	Small	Yes	4
17-Nov-17	28d	40	65	30	Grazed/short grass	European starling	Small	No	–
29-Nov-17	28d	26	88	220	Grazed/short grass	Band-tailed pigeon	Medium	Yes	1
29-Nov-17	7d	44	76	270	Grazed/short grass	Red-tailed hawk	Large	Yes	1
29-Nov-17	7d	45	17	270	Grazed/short grass	Mexican free-tailed bat	Small	No	–
29-Nov-17	7d	48	90	220	Grazed/short grass	Chestnut-backed chickadee	Small	Yes	15
01-Dec-17	28d	8	97	140	Grazed/short grass	Steller's jay	Medium	No	–
01-Dec-17	28d	31	102	320	Tall grass/forb	Mexican free-tailed bat	Small	No	–
06-Dec-17	28d	16	54	270	Grazed/short grass	Red-tailed hawk	Large	Yes	8
06-Dec-17	7d	44	85	70	Grazed/short grass	Orange-crowned warbler	Small	Yes	8
06-Dec-17	7d	48	71	280	Grazed/short grass	Canada goose	Large	Yes	1
07-Dec-17	28d	4	98	230	Tall grass/forb	Horned lark	Small	No	–
07-Dec-17	7d	10	82	300	Grazed/short grass	Mexican free-tailed bat	Small	Yes	4
07-Dec-17	28d	33	66	100	Grazed/short grass	Mexican free-tailed bat	Small	No	–
12-Dec-17	7d	2	95	80	Grazed/short grass	Mexican free-tailed bat	Small	Yes	14
12-Dec-17	28d	12	98	358	Grazed/short grass	Red-tailed hawk	Large	Yes	<1
12-Dec-17	28d	15	96	110	Grazed/short grass	Cedar waxwing	Small	No	–
12-Dec-17	7d	23	64	250	Grazed/short grass	Cedar waxwing	Small	Yes	<1
14-Dec-17	28d	42	47	350	Grazed/short grass	Mexican free-tailed bat	Small	No	–
14-Dec-17	7d	47	65	320	Grazed/short grass	Red-tailed hawk	Large	Yes	<1
18-Dec-17	28d	14	49	340	Grazed/short grass	Mexican free-tailed bat	Small	No	–
18-Dec-17	28d	28	98	260	Grazed/short grass	Dark-eyed junco	Small	No	–
18-Dec-17	28d	38	28	130	Grazed/short grass	Red-tailed hawk	Large	No	–
18-Dec-17	7d	45	88	40	Grazed/short grass	Mourning dove	Medium	Yes	3
18-Dec-17	7d	48	68	50	Grazed/short grass	Mexican free-tailed bat	Small	Yes	3
19-Dec-17	7d	11	82	290	Grazed/short grass	Great egret	Large	Yes	2
28-Dec-17	7d	3	93	190	Grazed/short grass	House sparrow	Small	No	–
28-Dec-17	7d	13	63	160	Gravel/dirt	Band-tailed pigeon	Medium	Yes	6
28-Dec-17	7d	18	62	360	Grazed/short grass	Mexican free-tailed bat	Small	No	–
29-Dec-17	28d	36	96	50	Grazed/short grass	Mexican free-tailed bat	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
29-Dec-17	28d	36	36	220	Grazed/short grass	Great egret	Large	Yes	5
29-Dec-17	28d	37	34	80	Grazed/short grass	House sparrow	Small	Yes	5
03-Jan-18	28d	6	78	310	Grazed/short grass	Cedar waxwing	Small	No	–
03-Jan-18	28d	25	34	280	Grazed/short grass	Red-tailed hawk	Large	Yes	20
03-Jan-18	7d	29	74	320	Tall grass/forb	Cedar waxwing	Small	No	–
03-Jan-18	7d	30	64	320	Tall grass/forb	Red-tailed hawk	Large	Yes	1
05-Jan-18	28d	16	35	210	Grazed/short grass	Mexican free-tailed bat	Small	No	–
05-Jan-18	7d	44	96	260	Grazed/short grass	Mexican free-tailed bat	Small	No	–
09-Jan-18	7d	22	65	330	Grazed/short grass	European starling	Small	Yes	1
09-Jan-18	28d	24	41	320	Grazed/short grass	Red-tailed hawk	Large	Yes	8
10-Jan-18	7d	2	83	40	Grazed/short grass	California gull	Large	Yes	5
10-Jan-18	7d	13	90	220	Grazed/short grass	Mexican free-tailed bat	Small	No	–
10-Jan-18	28d	41	87	300	Grazed/short grass	Mexican free-tailed bat	Small	No	–
10-Jan-18	28d	42	65	30	Grazed/short grass	European starling	Small	No	–
17-Jan-18	7d	10	60	40	Grazed/short grass	Western flycatcher	Small	No	–
17-Jan-18	28d	19	62	140	Grazed/short grass	California gull	Large	Yes	<1
17-Jan-18	28d	19	61	170	Grazed/short grass	Golden eagle[1]	Large	Yes	<1
17-Jan-18	7d	47	52	140	Grazed/short grass	Great blue heron	Large	Yes	1
18-Jan-18	28d	20	59	160	Grazed/short grass	Horned lark	Small	No	–
18-Jan-18	28d	26	37	220	Grazed/short grass	Mexican free-tailed bat	Small	No	–
18-Jan-18	7d	27	43	80	Grazed/short grass	Mexican free-tailed bat	Small	No	–
23-Jan-18	28d	15	71	270	Grazed/short grass	Mexican free-tailed bat	Small	No	–
23-Jan-18	28d	21	101	200	Grazed/short grass	California gull	Large	Yes	1
23-Jan-18	7d	23	62	100	Grazed/short grass	California gull	Large	Yes	<1
23-Jan-18	7d	34	92	250	Grazed/short grass	House sparrow	Small	Yes	15
23-Jan-18	28d	41	72	60	Grazed/short grass	House sparrow	Small	No	–
23-Jan-18	7d	47	61	260	Grazed/short grass	Mexican free-tailed bat	Small	Yes	2
31-Jan-18	28d	19	93	290	Grazed/short grass	Cedar waxwing	Small	No	–
31-Jan-18	7d	34	74	340	Grazed/short grass	Red-shouldered hawk	Large	Yes	<1
31-Jan-18	28d	35	33	90	Grazed/short grass	Great blue heron	Large	Yes	1
31-Jan-18	7d	44	99	140	Grazed/short grass	Cedar waxwing	Small	Yes	1
05-Feb-18	7d	13	51	120	Grazed/short grass	European starling	Small	Yes	1
05-Feb-18	28d	25	91	50	Grazed/short grass	European starling	Small	No	–
05-Feb-18	7d	29	95	230	Grazed/short grass	Rock pigeon	Medium	Yes	2
05-Feb-18	28d	40	81	30	Grazed/short grass	Rock pigeon	Medium	No	–
12-Feb-18	28d	8	48	320	Grazed/short grass	Red-shouldered hawk	Large	Yes	2
12-Feb-18	28d	9	58	70	Grazed/short grass	Cedar waxwing	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
12-Feb-18	7d	18	82	360	Grazed/short grass	Great horned owl	Large	Yes	<1
12-Feb-18	7d	30	99	200	Grazed/short grass	Cedar waxwing	Small	Yes	1
22-Feb-18	28d	1	25	320	Grazed/short grass	House sparrow	Small	No	–
22-Feb-18	7d	2	63	160	Grazed/short grass	California quail	Medium	No	–
22-Feb-18	28d	5	89	340	Grazed/short grass	Rock pigeon	Medium	Yes	13
22-Feb-18	7d	10	39	280	Grazed/short grass	Rock pigeon	Medium	Yes	4
26-Feb-18	28d	36	96	60	Grazed/short grass	House sparrow	Small	No	–
26-Feb-18	28d	43	101	240	Grazed/short grass	Great horned owl	Large	Yes	22
26-Feb-18	7d	44	69	260	Grazed/short grass	House sparrow	Small	No	–
26-Feb-18	7d	48	43	130	Grazed/short grass	Great blue heron	Large	Yes	3
07-Mar-18	28d	15	89	240	Grazed/short grass	Red-shouldered hawk	Large	Yes	1
07-Mar-18	7d	27	2	20	Gravel/dirt	Western meadowlark	Small	No	–
08-Mar-18	28d	14	63	230	Gravel/dirt	White-throated swift	Small	No	–
08-Mar-18	7d	45	99	360	Grazed/short grass	Sharp-shinned hawk	Medium	Yes	<1
12-Mar-18	7d	18	26	300	Gravel/dirt	Horned lark	Small	No	–
12-Mar-18	7d	22	59	230	Gravel/dirt	Sharp-shinned hawk	Medium	Yes	15
15-Mar-18	28d	38	72	300	Gravel/dirt	White-throated swift	Small	No	–
15-Mar-18	28d	39	89	10	Grazed/short grass	Canada goose	Large	Yes	7
19-Mar-18	28d	1	13	350	Gravel/dirt	Ferruginous hawk	Large	Yes	16
19-Mar-18	7d	11	75	80	Grazed/short grass	American pipit	Small	No	–
19-Mar-18	7d	13	45	200	Grazed/short grass	Red-tailed hawk	Large	Yes	8
22-Mar-18	28d	31	23	90	Grazed/short grass	House finch	Small	No	–
26-Mar-18	28d	38	51	80	Grazed/short grass	House sparrow	Small	No	–
26-Mar-18	28d	40	86	190	Grazed/short grass	American kestrel	Medium	No	–
26-Mar-18	7d	48	50	40	Tall grass/forb	House sparrow	Small	No	–
28-Mar-18	7d	44	23	140	Grazed/short grass	Great egret	Large	Yes	1
02-Apr-18	28d	26	79	90	Grazed/short grass	Rock pigeon	Medium	No	–
02-Apr-18	28d	33	98	300	Grazed/short grass	Cedar waxwing	Small	No	–
03-Apr-18	7d	23	7	8	Grazed/short grass	Cedar waxwing	Small	No	–
03-Apr-18	7d	34	94	312	Grazed/short grass	Hoary bat	Small	No	–
03-Apr-18	7d	34	41	184	Gravel/dirt	Rock pigeon	Medium	Yes	1
09-Apr-18	28d	35	56	130	Grazed/short grass	Western sandpiper	Small	No	–
09-Apr-18	28d	43	26	150	Gravel/dirt	Barn owl	Medium	No	–
10-Apr-18	7d	10	39	237	Grazed/short grass	Barn owl	Medium	Yes	6
10-Apr-18	7d	23	84	175	Grazed/short grass	Least sandpiper	Small	Yes	63
17-Apr-18	7d	3	7	182	Gravel/dirt	Mexican free-tailed bat	Small	No	–
17-Apr-18	7d	3	40	269	Grazed/short grass	House finch	Small	Yes	6

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
18-Apr-18	7d	18	55	227	Grazed/short grass	Red-tailed hawk	Large	Yes	5
19-Apr-18	28d	16	67	170	Tall grass/forb	Red-tailed hawk	Large	Yes	42
19-Apr-18	28d	42	9	80	Gravel/dirt	House finch	Small	No	–
27-Apr-18	28d	12	56	200	Tall grass/forb	European starling	Small	No	–
27-Apr-18	7d	22	59	290	Grazed/short grass	Mexican free-tailed bat	Small	Yes	40
27-Apr-18	28d	24	28	230	Tall grass/forb	Barn owl	Medium	Yes	12
27-Apr-18	7d	30	103	170	Tall grass/forb	California gull	Large	Yes	4
27-Apr-18	7d	45	51	90	Grazed/short grass	European starling	Small	No	–
01-May-18	7d	11	28	20	Grazed/short grass	Golden eagle[1]	Large	Yes	1
02-May-18	7d	2	102	80	Tall grass/forb	Horned lark	Small	Yes	19
03-May-18	28d	9	6	20	Gravel/dirt	Rock pigeon	Medium	No	–
03-May-18	28d	37	18	260	Tall grass/forb	Horned lark	Small	No	–
03-May-18	7d	45	100	280	Tall grass/forb	Red-tailed hawk	Large	Yes	36
09-May-18	28d	21	42	40	Tall grass/forb	House finch	Small	No	–
09-May-18	7d	29	5	80	Gravel/dirt	House finch	Small	Yes	42
11-May-18	7d	11	73	180	Tall grass/forb	Mexican free-tailed bat	Small	Yes	5
11-May-18	7d	23	27	30	Grazed/short grass	Rock pigeon	Medium	Yes	4
11-May-18	28d	37	74	160	Grazed/short grass	Red-tailed hawk	Large	Yes	12
16-May-18	7d	47	77	40	Grazed/short grass	Western sandpiper	Small	Yes	1
16-May-18	7d	48	100	140	Tall grass/forb	Hoary bat	Small	Yes	29
17-May-18	7d	27	87	60	Tall grass/forb	Turkey vulture	Large	Yes	5
17-May-18	28d	41	82	190	Grazed/short grass	Western sandpiper	Small	No	–
17-May-18	28d	46	29	150	Grazed/short grass	Great blue heron	Large	Yes	5
21-May-18	7d	2	43	360	Gravel/dirt	Red-tailed hawk	Large	Yes	<1
21-May-18	28d	5	54	90	Tall grass/forb	European starling	Small	No	–
21-May-18	28d	7	88	360	Tall grass/forb	Canada goose	Large	No	–
21-May-18	7d	10	59	290	Grazed/short grass	European starling	Small	Yes	<1
04-Jun-18	7d	13	47	140	Gravel/dirt	House sparrow	Small	No	–
04-Jun-18	28d	17	100	10	Gravel/dirt	House sparrow	Small	No	–
04-Jun-18	28d	20	31	190	Grazed/short grass	Red-tailed hawk	Large	Yes	9
04-Jun-18	7d	34	75	230	Tall grass/forb	Canada goose	Large	Yes	3
06-Jun-18	28d	38	2	360	Gravel/dirt	Mexican free-tailed bat	Small	No	–
06-Jun-18	7d	44	17	270	Grazed/short grass	Mexican free-tailed bat	Small	Yes	2
15-Jun-18	7d	11	8	280	Gravel/dirt	Cedar waxwing	Small	No	–
15-Jun-18	28d	14	56	160	Grazed/short grass	Hoary bat	Small	No	–
15-Jun-18	7d	23	63	170	Grazed/short grass	Hoary bat	Small	Yes	4
15-Jun-18	7d	23	78	230	Grazed/short grass	Red-tailed hawk	Large	Yes	4

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
15-Jun-18	28d	24	69	20	Tall grass/forb	Cedar waxwing	Small	No	–
15-Jun-18	28d	42	19	360	Gravel/dirt	Red-tailed hawk	Large	Yes	4
19-Jun-18	7d	3	62	180	Gravel/dirt	Barn owl	Medium	Yes	6
19-Jun-18	28d	12	91	200	Grazed/short grass	California gull	Large	No	–
20-Jun-18	28d	4	91	180	Tall grass/forb	Mexican free-tailed bat	Small	No	–
20-Jun-18	7d	18	92	220	Tall grass/forb	Western sandpiper	Small	Yes	6
20-Jun-18	28d	36	82	210	Tall grass/forb	Western sandpiper	Small	No	–
20-Jun-18	7d	47	99	340	Grazed/short grass	Mexican free-tailed bat	Small	Yes	1
25-Jun-18	28d	6	58	80	Tall grass/forb	Mexican free-tailed bat	Small	No	–
25-Jun-18	7d	22	67	340	Tall grass/forb	Rock pigeon	Medium	Yes	1
28-Jun-18	28d	8	65	60	Tall grass/forb	Rock pigeon	Medium	Yes	7
28-Jun-18	28d	31	46	20	Tall grass/forb	House sparrow	Small	No	–
28-Jun-18	7d	45	103	120	Grazed/short grass	Mexican free-tailed bat	Small	No	–
28-Jun-18	7d	48	62	310	Tall grass/forb	House sparrow	Small	Yes	7
05-Jul-18	28d	5	65	70	Tall grass/forb	Red-tailed hawk	Large	Yes	20
06-Jul-18	7d	11	94	40	Grazed/short grass	Red-tailed hawk	Large	Yes	12
06-Jul-18	7d	18	47	130	Tall grass/forb	Mexican free-tailed bat	Small	No	–
06-Jul-18	28d	20	51	70	Tall grass/forb	Mexican free-tailed bat	Small	No	–
06-Jul-18	7d	30	5	90	Gravel/dirt	European starling	Small	Yes	11
06-Jul-18	28d	38	13	230	Gravel/dirt	European starling	Small	No	–
11-Jul-18	28d	14	49	30	Grazed/short grass	Western sandpiper	Small	No	–
11-Jul-18	7d	22	41	230	Grazed/short grass	Western sandpiper	Small	Yes	6
11-Jul-18	28d	39	101	120	Grazed/short grass	Red-tailed hawk	Large	Yes	1
12-Jul-18	7d	10	65	110	Tall grass/forb	Mexican free-tailed bat	Small	No	–
12-Jul-18	7d	10	63	350	Tall grass/forb	Red-tailed hawk	Large	Yes	4
12-Jul-18	28d	19	102	50	Gravel/dirt	Mexican free-tailed bat	Small	No	–
17-Jul-18	28d	33	46	10	Grazed/short grass	Mexican free-tailed bat	Small	No	–
17-Jul-18	28d	36	58	50	Grazed/short grass	Mallard	Large	Yes	1
17-Jul-18	7d	47	80	120	Grazed/short grass	Cedar waxwing	Small	No	–
19-Jul-18	28d	1	15	220	Grazed/short grass	Cedar waxwing	Small	No	–
19-Jul-18	7d	2	36	120	Grazed/short grass	Mexican free-tailed bat	Small	Yes	4
19-Jul-18	7d	3	74	40	Tall grass/forb	Great blue heron	Large	Yes	4
26-Jul-18	28d	9	2	10	Gravel/dirt	Hoary bat	Small	No	–
26-Jul-18	28d	15	78	190	Grazed/short grass	House finch	Small	No	–
26-Jul-18	28d	17	15	180	Gravel/dirt	Rock pigeon	Medium	Yes	5
26-Jul-18	7d	27	52	330	Grazed/short grass	Rock pigeon	Medium	Yes	6
26-Jul-18	7d	29	100	280	Gravel/dirt	Hoary bat	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
26-Jul-18	7d	29	68	160	Grazed/short grass	House finch	Small	Yes	13
30-Jul-18	28d	21	57	290	Grazed/short grass	Mexican free-tailed bat	Small	No	–
30-Jul-18	28d	28	90	120	Tall grass/forb	California gull	Large	No	–
30-Jul-18	7d	34	73	150	Grazed/short grass	Mexican free-tailed bat	Small	Yes	2
31-Jul-18	28d	39	39	150	Grazed/short grass	Western sandpiper	Small	No	–
31-Jul-18	7d	47	58	100	Grazed/short grass	Wilson's warbler	Small	No	–
31-Jul-18	7d	48	72	50	Grazed/short grass	California gull	Large	Yes	2
09-Aug-18	7d	3	5	230	Gravel/dirt	Brown-headed cowbird	Small	Yes	18
09-Aug-18	28d	7	65	120	Tall grass/forb	Mallard	Large	Yes	12
10-Aug-18	7d	13	80	170	Grazed/short grass	Mexican free-tailed bat	Small	Yes	4
10-Aug-18	28d	16	92	110	Gravel/dirt	European starling	Small	No	–
10-Aug-18	28d	41	63	120	Grazed/short grass	Mexican free-tailed bat	Small	No	–
10-Aug-18	7d	44	89	130	Grazed/short grass	Mallard	Large	Yes	6
14-Aug-18	7d	27	76	210	Tall grass/forb	Mexican free-tailed bat	Small	Yes	1
14-Aug-18	7d	30	39	100	Grazed/short grass	Red-tailed hawk	Large	Yes	7
14-Aug-18	28d	36	86	330	Grazed/short grass	Mexican free-tailed bat	Small	No	–
14-Aug-18	7d	45	84	90	Grazed/short grass	House sparrow	Small	No	–
16-Aug-18	28d	4	36	350	Grazed/short grass	House sparrow	Small	No	–
16-Aug-18	28d	6	84	110	Tall grass/forb	Red-tailed hawk	Large	Yes	5
22-Aug-18	28d	14	55	230	Gravel/dirt	Barn owl	Medium	Yes	6
22-Aug-18	7d	22	22	40	Grazed/short grass	House finch	Small	No	–
24-Aug-18	7d	11	92	180	Grazed/short grass	Barn owl	Medium	Yes	5
24-Aug-18	7d	30	100	290	Gravel/dirt	Mexican free-tailed bat	Small	No	–
24-Aug-18	28d	31	94	130	Gravel/dirt	Mexican free-tailed bat	Small	No	–
24-Aug-18	28d	32	52	40	Grazed/short grass	Brown-headed cowbird	Small	No	–
29-Aug-18	7d	2	2	210	Gravel/dirt	Red-tailed hawk	Large	Yes	5
29-Aug-18	7d	3	96	160	Grazed/short grass	Mexican free-tailed bat	Small	No	–
29-Aug-18	7d	10	95	180	Grazed/short grass	European starling	Small	Yes	12
31-Aug-18	28d	25	78	110	Grazed/short grass	Mexican free-tailed bat	Small	No	–
31-Aug-18	28d	26	42	50	Grazed/short grass	Red-tailed hawk	Large	Yes	5
31-Aug-18	28d	46	16	80	Grazed/short grass	European starling	Small	No	–
05-Sep-18	28d	37	62	250	Grazed/short grass	American crow	Medium	No	–
05-Sep-18	28d	39	25	120	Grazed/short grass	Hoary bat	Small	No	–
05-Sep-18	7d	47	18	230	Grazed/short grass	Hoary bat	Small	Yes	1
07-Sep-18	7d	13	77	270	Tall grass/forb	House wren	Small	No	–
07-Sep-18	7d	29	93	60	Grazed/short grass	American kestrel	Medium	No	–
07-Sep-18	28d	35	55	150	Grazed/short grass	Hermit warbler	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
10-Sep-18	7d	13	11	320	Grazed/short grass	Barn owl	Medium	Yes	1
10-Sep-18	28d	33	88	180	Grazed/short grass	House finch	Small	Yes	3
10-Sep-18	7d	34	96	50	Grazed/short grass	House finch	Small	No	–
10-Sep-18	28d	35	29	340	Grazed/short grass	Hoary bat	Small	No	–
10-Sep-18	28d	41	36	270	Grazed/short grass	Barn owl	Medium	No	–
10-Sep-18	7d	48	70	320	Gravel/dirt	Hoary bat	Small	Yes	3

[1] Agency permits do not allow purposefully placing golden eagle carcasses for detectability trials. These cases represented situations where incidental discoveries of eagle carcasses on survey plots, shortly before the next survey of those plots was scheduled, allowed us to opportunistically evaluate discovery of eagle carcasses by surveyors while still conforming to agency requirements that all eagle carcasses be collected in short order.

Appendix H. Carcass Detectability Trial Specimens Placed in Year 3

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
24-Aug-18	28d	32	52	40	Grazed/short grass	Brown-headed cowbird	Small	No	–
24-Aug-18	28d	31	94	130	Road	Mexican free-tailed bat	Small	No	–
31-Aug-18	28d / 7d	46	16	80	Grazed/short grass	European starling	Small	No	–
31-Aug-18	28d / 7d	25	78	110	Grazed/short grass	Mexican free-tailed bat	Small	No	–
05-Sep-18	28d / 7d	39	25	120	Grazed/short grass	Hoary bat	Small	Yes	15
07-Sep-18	28d	35	55	150	Grazed/short grass	Hermit warbler	Small	No	–
07-Sep-18	7d / 28d	13	77	270	Tall grass/forb	House wren	Small	No	–
10-Sep-18	28d / 7d	41	36	270	Grazed/short grass	Barn owl	Medium	Yes	10
10-Sep-18	28d	35	29	340	Grazed/short grass	Hoary bat	Small	No	–
10-Sep-18	7d / 28d	34	96	50	Grazed/short grass	House finch	Small	No	–
24-Sep-18	7d	28	32	270	Grazed/short grass	Barn owl	Medium	Yes	2
24-Sep-18	7d	20	81	160	Tall grass/forb	European starling	Small	Yes	1
24-Sep-18	28d	22	45	50	Tall grass/forb	European starling	Small	No	–
25-Sep-18	28d	48	89	100	Grazed/short grass	Barn owl	Medium	Yes	1
25-Sep-18	28d	47	6	350	Turbine pad	Mexican free-tailed bat	Small	No	–
26-Sep-18	7d	46	23	130	Grazed/short grass	Mexican free-tailed bat	Small	Yes	15
01-Oct-18	28d	43	88	140	Grazed/short grass	Great blue heron	Large	Yes	1
01-Oct-18	7d	26	37	270	Grazed/short grass	House finch	Small	Yes	9
01-Oct-18	28d	16	42	160	Grazed/short grass	Mexican free-tailed bat	Small	Yes	1
01-Oct-18	28d	2	25	50	Road	Northern harrier	Medium	Yes	8
01-Oct-18	7d	9	96	270	Tall grass/forb	Mexican free-tailed bat	Small	No	–
04-Oct-18	28d	40	77	130	Grazed/short grass	House finch	Small	No	–
05-Oct-18	7d	1	53	40	Tall grass/forb	Great blue heron	Large	Yes	3
09-Oct-18	7d	28	45	220	Grazed/short grass	Mexican free-tailed bat	Small	Yes	1
09-Oct-18	28d	7	95	90	Tall grass/forb	Mexican free-tailed bat	Small	No	–
12-Oct-18	28d	29	99	200	Grazed/short grass	House sparrow	Small	No	–
12-Oct-18	28d	22	55	180	Road	Rock pigeon	Medium	No	–
12-Oct-18	7d	36	72	110	Road	Rock pigeon	Medium	Yes	5
12-Oct-18	7d	17	68	210	Tall grass/forb	House sparrow	Small	No	–
17-Oct-18	7d	46	78	210	Grazed/short grass	California gull	Large	Yes	1
17-Oct-18	28d	48	63	350	Grazed/short grass	Mexican free-tailed bat	Small	No	–
19-Oct-18	7d	12	89	280	Grazed/short grass	European starling	Small	No	–
19-Oct-18	28d	31	26	50	Grazed/short grass	European starling	Small	Yes	6
19-Oct-18	7d	15	83	180	Grazed/short grass	Mexican free-tailed bat	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
19-Oct-18	28d	21	89	20	Tall grass/forb	California gull	Large	Yes	19
25-Oct-18	28d	19	88	100	Tall grass/forb	House finch	Small	No	–
25-Oct-18	28d	35	85	260	Tall grass/forb	Mexican free-tailed bat	Small	No	–
26-Oct-18	28d	33	82	120	Grazed/short grass	Barn owl	Medium	Yes	13
26-Oct-18	7d	8	49	250	Tall grass/forb	Barn owl	Medium	Yes	4
26-Oct-18	7d	41	95	330	Tall grass/forb	House finch	Small	No	–
30-Oct-18	7d	15	97	320	Grazed/short grass	European starling	Small	Yes	1
30-Oct-18	28d	34	90	270	Grazed/short grass	Horned lark	Small	No	–
30-Oct-18	28d	24	61	260	Grazed/short grass	Mexican free-tailed bat	Small	No	–
30-Oct-18	7d	26	36	310	Grazed/short grass	Mexican free-tailed bat	Small	No	–
30-Oct-18	7d	41	31	160	Grazed/short grass	Mexican free-tailed bat	Small	Yes	9
30-Oct-18	28d	23	38	70	Grazed/short grass	Red-tailed hawk	Large	Yes	1
30-Oct-18	7d	26	98	90	Grazed/short grass	Red-tailed hawk	Large	No	–
06-Nov-18	28d	35	69	110	Grazed/short grass	European starling	Small	No	–
06-Nov-18	7d	36	70	160	Grazed/short grass	European starling	Small	Yes	1
07-Nov-18	28d	40	14	170	Grazed/short grass	American kestrel	Medium	Yes	7
09-Nov-18	28d	5	79	210	Grazed/short grass	Canada goose	Large	Yes	5
09-Nov-18	7d	12	63	270	Grazed/short grass	Canada goose	Large	Yes	17
09-Nov-18	7d	1	101	300	Grazed/short grass	Mexican free-tailed bat	Small	No	–
09-Nov-18	28d	4	55	110	Grazed/short grass	Mexican free-tailed bat	Small	No	–
19-Nov-18	7d	9	37	70	Grazed/short grass	House sparrow	Small	No	–
19-Nov-18	28d	47	78	280	Grazed/short grass	House sparrow	Small	No	–
19-Nov-18	7d	20	96	20	Grazed/short grass	Rock pigeon	Medium	Yes	1
19-Nov-18	28d	22	77	160	Road	Mexican free-tailed bat	Small	No	–
20-Nov-18	28d	16	71	170	Grazed/short grass	European starling	Small	No	–
20-Nov-18	7d	17	59	120	Grazed/short grass	Hoary bat	Small	Yes	–
20-Nov-18	28d	19	48	180	Grazed/short grass	Rock pigeon	Medium	No	–
26-Nov-18	7d	20	73	30	Road	Hoary bat	Small	Yes	1
28-Nov-18	28d	11	57	220	Grazed/short grass	European starling	Small	Yes	1
28-Nov-18	7d	46	61	220	Road	Ruby-crowned kinglet	Small	No	–
03-Dec-18	28d	10	65	40	Grazed/short grass	California gull	Large	Yes	1
03-Dec-18	7d	36	90	40	Grazed/short grass	California gull	Large	Yes	2
03-Dec-18	7d	28	32	210	Grazed/short grass	European starling	Small	Yes	2
03-Dec-18	7d	9	70	40	Grazed/short grass	Mallard	Large	Yes	8
03-Dec-18	7d	36	68	320	Grazed/short grass	Mexican free-tailed bat	Small	No	–
03-Dec-18	28d	38	86	330	Grazed/short grass	Mexican free-tailed bat	Small	No	–
04-Dec-18	7d	42	68	270	Grazed/short grass	Mexican free-tailed bat	Small	Yes	2
04-Dec-18	28d	33	73	300	Road	Mexican free-tailed bat	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
05-Dec-18	7d	39	98	360	Grazed/short grass	Great blue heron	Large	Yes	1
05-Dec-18	28d	29	54	40	Road	House finch	Small	No	–
05-Dec-18	28d	31	82	40	Tall grass/forb	Mexican free-tailed bat	Small	No	–
06-Dec-18	28d	11	27	210	Grazed/short grass	Great blue heron	Large	Yes	22
06-Dec-18	7d	6	76	240	Road	House finch	Small	No	–
10-Dec-18	7d	25	96	90	Road	Mexican free-tailed bat	Small	No	–
10-Dec-18	7d	8	59	270	Tall grass/forb	European starling	Small	Yes	8
12-Dec-18	28d	35	29	170	Grazed/short grass	Red-tailed hawk	Large	Yes	23
12-Dec-18	28d	48	34	320	Road	Mexican free-tailed bat	Small	No	–
13-Dec-18	28d	4	33	140	Grazed/short grass	European starling	Small	No	–
13-Dec-18	7d	1	56	100	Tall grass/forb	Red-tailed hawk	Large	Yes	4
18-Dec-18	28d	23	99	320	Grazed/short grass	Barn swallow	Small	No	–
18-Dec-18	7d	39	84	290	Grazed/short grass	Lesser goldfinch	Small	No	–
18-Dec-18	7d	36	36	110	Grazed/short grass	Mexican free-tailed bat	Small	No	–
18-Dec-18	7d	28	6	90	Turbine pad	Mourning dove	Medium	Yes	8
27-Dec-18	7d	1	28	220	Grazed/short grass	Mexican free-tailed bat	Small	No	–
27-Dec-18	28d	2	80	240	Grazed/short grass	Mexican free-tailed bat	Small	No	–
27-Dec-18	28d	10	10	190	Turbine pad	Mourning dove	Medium	Yes	6
28-Dec-18	28d	37	13	190	Grazed/short grass	Mexican free-tailed bat	Small	No	–
28-Dec-18	7d	25	94	120	Grazed/short grass	Rock pigeon	Medium	Yes	4
28-Dec-18	28d	37	61	130	Grazed/short grass	Rock pigeon	Medium	No	–
28-Dec-18	7d	17	89	350	Road	European starling	Small	Yes	3
28-Dec-18	28d	19	50	280	Road	European starling	Small	No	–
03-Jan-19	7d	6	47	40	Grazed/short grass	California towhee	Small	Yes	46
03-Jan-19	7d	42	103	170	Grazed/short grass	Red-tailed hawk	Large	Yes	0.5
03-Jan-19	28d	7	71	240	Tall grass/forb	House sparrow	Small	No	–
04-Jan-19	28d	18	29	310	Bare dirt/disturbed soil	Red-tailed hawk	Large	Yes	39
04-Jan-19	28d	13	98	80	Grazed/short grass	Mexican free-tailed bat	Small	No	–
04-Jan-19	7d	20	36	270	Grazed/short grass	Mexican free-tailed bat	Small	Yes	11
09-Jan-19	28d	19	100	310	Grazed/short grass	California myotis	Small	No	–
09-Jan-19	7d	46	42	240	Grazed/short grass	California myotis	Small	No	–
09-Jan-19	28d	44	95	170	Grazed/short grass	European starling	Small	No	–
09-Jan-19	28d	27	87	70	Tall grass/forb	California gull	Large	Yes	1
11-Jan-19	7d	28	96	250	Grazed/short grass	California gull	Large	Yes	5
11-Jan-19	7d	26	54	170	Grazed/short grass	European starling	Small	Yes	5
14-Jan-19	7d	8	51	280	Grazed/short grass	California myotis	Small	Yes	71
14-Jan-19	7d	39	36	280	Road	European starling	Small	Yes	3
14-Jan-19	28d	44	35	350	Road	White-throated swift	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
15-Jan-19	28d	11	83	20	Grazed/short grass	California myotis	Small	No	–
15-Jan-19	28d	22	21	290	Grazed/short grass	Red-tailed hawk	Large	Yes	2
15-Jan-19	7d	36	33	200	Grazed/short grass	Red-tailed hawk	Large	Yes	1
22-Jan-19	7d	42	50	50	Grazed/short grass	European starling	Small	Yes	23
22-Jan-19	7d	36	79	160	Road	Mexican free-tailed bat	Small	Yes	15
25-Jan-19	28d	27	65	210	Grazed/short grass	European starling	Small	No	–
25-Jan-19	28d	2	69	100	Grazed/short grass	Rock pigeon	Medium	Yes	4
25-Jan-19	28d	2	94	90	Road	Mexican free-tailed bat	Small	No	–
25-Jan-19	7d	9	90	310	Tall grass/forb	Rock pigeon	Medium	No	–
28-Jan-19	28d	24	79	220	Grazed/short grass	European starling	Small	No	–
28-Jan-19	7d	25	19	300	Grazed/short grass	European starling	Small	Yes	1
28-Jan-19	28d	33	74	350	Grazed/short grass	Mexican free-tailed bat	Small	No	–
28-Jan-19	28d	19	38	20	Road	California quail	Medium	No	–
31-Jan-19	7d	12	93	300	Grazed/short grass	Mexican free-tailed bat	Small	Yes	32
31-Jan-19	7d	1	35	40	Road	Cooper's hawk	Medium	Yes	4
04-Feb-19	28d	40	98	320	Grazed/short grass	Mexican free-tailed bat	Small	No	–
04-Feb-19	7d	15	92	30	Grazed/short grass	Red-tailed hawk	Large	Yes	16
04-Feb-19	28d	40	32	10	Grazed/short grass	Red-tailed hawk	Large	Yes	1
07-Feb-19	7d	1	102	210	Grazed/short grass	European starling	Small	Yes	4
07-Feb-19	28d	5	69	90	Grazed/short grass	European starling	Small	No	–
07-Feb-19	7d	6	69	20	Grazed/short grass	Mexican free-tailed bat	Small	Yes	11
11-Feb-19	7d	41	100	250	Grazed/short grass	California gull	Large	No	–
11-Feb-19	7d	17	26	150	Grazed/short grass	European starling	Small	Yes	0.5
11-Feb-19	28d	45	64	50	Grazed/short grass	European starling	Small	Yes	3
11-Feb-19	28d	14	47	180	Grazed/short grass	Mexican free-tailed bat	Small	No	–
11-Feb-19	7d	39	66	10	Grazed/short grass	Mexican free-tailed bat	Small	Yes	3
14-Feb-19	28d	21	102	230	Grazed/short grass	California gull	Large	Yes	13
19-Feb-19	7d	39	32	210	Grazed/short grass	California myotis	Small	No	–
19-Feb-19	7d	36	84	190	Road	European starling	Small	No	–
19-Feb-19	7d	26	82	100	Road	Rock pigeon	Medium	Yes	8
19-Feb-19	28d	30	81	330	Road	Rock pigeon	Medium	Yes	1
21-Feb-19	28d	10	51	270	Grazed/short grass	Mexican free-tailed bat	Small	No	–
21-Feb-19	28d	2	38	50	Road	European starling	Small	Yes	5
25-Feb-19	28d	21	56	320	Grazed/short grass	European starling	Small	No	–
25-Feb-19	7d	25	96	220	Grazed/short grass	European starling	Small	Yes	1
27-Feb-19	28d	37	86	200	Grazed/short grass	Great blue heron	Large	Yes	6
27-Feb-19	7d	6	90	330	Grazed/short grass	Red-tailed hawk	Large	Yes	5
27-Feb-19	28d	23	58	180	Road	Mexican free-tailed bat	Small	No	–

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
27-Feb-19	7d	12	6	290	Turbine pad	Mexican free-tailed bat	Small	Yes	5
04-Mar-19	7d	28	51	70	Grazed/short grass	Barn owl	Medium	Yes	2
04-Mar-19	28d	29	18	240	Grazed/short grass	Cooper's hawk	Medium	Yes	3
04-Mar-19	7d	25	96	250	Grazed/short grass	Mexican free-tailed bat	Small	Yes	36
04-Mar-19	28d	44	80	360	Grazed/short grass	Mexican free-tailed bat	Small	No	–
07-Mar-19	7d	12	81	230	Grazed/short grass	European starling	Small	Yes	18
07-Mar-19	28d	13	89	280	Grazed/short grass	European starling	Small	No	–
13-Mar-19	28d	16	76	340	Grazed/short grass	Black-bellied plover	Medium	No	–
13-Mar-19	7d	39	78	210	Grazed/short grass	Black-bellied plover	Medium	Yes	8
13-Mar-19	28d	32	89	140	Grazed/short grass	Western meadowlark	Small	No	–
13-Mar-19	7d	41	59	50	Grazed/short grass	Western meadowlark	Small	Yes	1
13-Mar-19	28d	31	99	220	Road	*Myotis* spp.	Small	No	–
15-Mar-19	7d	6	6	90	Turbine pad	*Myotis* spp.	Small	No	–
20-Mar-19	28d	44	99	250	Grazed/short grass	Canada goose	Large	Yes	27
20-Mar-19	28d	22	72	100	Grazed/short grass	Hoary bat	Small	No	–
20-Mar-19	28d	32	5	10	Turbine pad	European starling	Small	Yes	1
21-Mar-19	7d	1	97	330	Grazed/short grass	Canada goose	Large	Yes	4
21-Mar-19	7d	1	85	120	Grazed/short grass	Hoary bat	Small	No	–
21-Mar-19	7d	6	104	90	Road	European starling	Small	Yes	4
25-Mar-19	7d	15	92	340	Grazed/short grass	Western sandpiper	Small	Yes	16
25-Mar-19	28d	33	97	40	Grazed/short grass	Western sandpiper	Small	No	–
25-Mar-19	7d	17	81	10	Road	Red-tailed hawk	Large	Yes	0.5
28-Mar-19	28d	31	100	170	Grazed/short grass	Mexican free-tailed bat	Small	No	–
28-Mar-19	7d	36	71	50	Grazed/short grass	Mexican free-tailed bat	Small	No	–
28-Mar-19	28d	32	74	350	Road	Red-tailed hawk	Large	Yes	21
29-Mar-19	7d	46	23	360	Grazed/short grass	House finch	Small	No	–
01-Apr-19	7d	26	82	180	Grazed/short grass	*Myotis* spp.	Small	No	–
01-Apr-19	28d	38	92	260	Grazed/short grass	*Myotis* spp.	Small	No	–
01-Apr-19	28d	37	80	120	Grazed/short grass	Western meadowlark	Small	No	–
01-Apr-19	7d	9	103	110	Tall grass/forb	European starling	Small	Yes	8
05-Apr-19	7d	25	53	40	Grazed/short grass	California gull	Large	Yes	4
05-Apr-19	28d	3	77	130	Grazed/short grass	Great egret	Large	Yes	18
08-Apr-19	28d	14	38	350	Grazed/short grass	European starling	Small	Yes	1
08-Apr-19	7d	20	52	40	Grazed/short grass	Western sandpiper	Small	Yes	1
08-Apr-19	28d	47	98	80	Road	Hoary bat	Small	No	–
08-Apr-19	7d	9	85	200	Tall grass/forb	Red-tailed hawk	Large	Yes	8
10-Apr-19	28d	19	101	320	Grazed/short grass	Red-tailed hawk	Large	Yes	70
10-Apr-19	7d	41	59	230	Road	Hoary bat	Small	Yes	1

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
14-Apr-19	7d	46	36	340	Grazed/short grass	Rock pigeon	Medium	No	–
14-Apr-19	7d	41	16	330	Tall grass/forb	Mexican free-tailed bat	Small	Yes	11
14-Apr-19	7d	26	16	250	Turbine pad	European starling	Small	No	–
19-Apr-19	28d	3	30	280	Grazed/short grass	Mexican free-tailed bat	Small	No	–
19-Apr-19	28d	7	99	80	Road	European starling	Small	No	–
19-Apr-19	28d	7	54	190	Tall grass/forb	Rock pigeon	Medium	No	–
22-Apr-19	28d	27	30	350	Grazed/short grass	*Myotis* spp.	Small	No	–
22-Apr-19	7d	20	37	190	Grazed/short grass	Short-billed dowitcher	Medium	No	–
22-Apr-19	7d	46	55	80	Grazed/short grass	Western sandpiper	Small	Yes	3
22-Apr-19	7d	28	75	250	Tall grass/forb	*Myotis* spp.	Small	No	–
26-Apr-19	28d	5	80	180	Grazed/short grass	Western sandpiper	Small	No	–
26-Apr-19	28d	14	100	50	Tall grass/forb	California gull	Large	No	–
29-Apr-19	7d	8	11	270	Bare dirt/disturbed soil	House wren	Small	No	–
29-Apr-19	7d	25	101	50	Road	Rock pigeon	Medium	Yes	1
29-Apr-19	28d	40	60	160	Road	Rock pigeon	Medium	Yes	1
29-Apr-19	7d	17	45	300	Tall grass/forb	Mexican free-tailed bat	Small	Yes	7
02-May-19	28d	48	30	150	Grazed/short grass	Horned lark	Small	No	–
02-May-19	28d	18	36	80	Tall grass/forb	Mexican free-tailed bat	Small	No	–
08-May-19	7d	42	101	190	Grazed/short grass	*Myotis* spp.	Small	Yes	1
08-May-19	28d	22	90	230	Tall grass/forb	European starling	Small	No	–
08-May-19	28d	21	96	50	Tall grass/forb	*Myotis* spp.	Small	No	–
10-May-19	7d	15	36	150	Grazed/short grass	California gull	Large	Yes	5
10-May-19	7d	9	56	310	Grazed/short grass	European starling	Small	No	–
13-May-19	7d	36	29	170	Bare dirt/disturbed soil	Mexican free-tailed bat	Small	No	–
13-May-19	28d	23	103	190	Road	European starling	Small	No	–
13-May-19	28d	34	84	90	Tall grass/forb	Mexican free-tailed bat	Small	No	–
13-May-19	28d	30	64	350	Tall grass/forb	Rock pigeon	Medium	Yes	30
14-May-19	7d	15	60	20	Road	Horned lark	Small	No	–
14-May-19	7d	26	53	250	Road	Rock pigeon	Medium	Yes	1
14-May-19	28d	31	63	180	Tall grass/forb	California gull	Large	Yes	50
20-May-19	28d	2	102	180	Tall grass/forb	California gull	Large	Yes	29
20-May-19	7d	6	103	60	Tall grass/forb	European starling	Small	Yes	0.5
20-May-19	28d	5	5	360	Turbine pad	Hoary bat	Small	No	–
21-May-19	7d	42	72	60	Grazed/short grass	California gull	Large	No	–
21-May-19	28d	38	38	130	Grazed/short grass	European starling	Small	No	–
21-May-19	7d	26	71	270	Road	Hoary bat	Small	No	–
30-May-19	28d	3	74	280	Road	Rock pigeon	Medium	Yes	19
30-May-19	7d	12	24	80	Road	Rock pigeon	Medium	Yes	4

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
30-May-19	28d	10	99	40	Tall grass/forb	European starling	Small	Yes	19
31-May-19	7d	20	76	270	Grazed/short grass	European starling	Small	Yes	4
31-May-19	28d	45	93	340	Grazed/short grass	*Myotis* spp.	Small	No	–
31-May-19	7d	46	47	140	Grazed/short grass	*Myotis* spp.	Small	No	–
04-Jun-19	28d	45	33	220	Grazed/short grass	European starling	Small	No	–
04-Jun-19	7d	41	33	240	Road	European starling	Small	No	–
04-Jun-19	7d	28	100	120	Tall grass/forb	Mexican free-tailed bat	Small	Yes	15
07-Jun-19	7d	8	74	170	Grazed/short grass	California gull	Large	Yes	3
07-Jun-19	28d	32	32	240	Grazed/short grass	California gull	Large	Yes	6
07-Jun-19	28d	29	62	110	Tall grass/forb	Mexican free-tailed bat	Small	No	–
09-Jun-19	7d	25	102	100	Grazed/short grass	*Myotis* spp.	Small	Yes	37
09-Jun-19	7d	25	6	120	Road	Horned lark	Small	No	–
09-Jun-19	7d	9	42	130	Tall grass/forb	Rock pigeon	Medium	Yes	16
10-Jun-19	28d	44	55	340	Grazed/short grass	Golden-crowned sparrow	Small	No	–
10-Jun-19	28d	11	75	170	Road	*Myotis* spp.	Small	No	–
10-Jun-19	28d	33	98	280	Tall grass/forb	Great horned owl	Large	Yes	10
20-Jun-19	28d	4	79	350	Tall grass/forb	Mexican free-tailed bat	Small	No	–
20-Jun-19	7d	12	99	270	Tall grass/forb	Rock pigeon	Medium	Yes	4
21-Jun-19	28d	13	100	200	Grazed/short grass	Rock pigeon	Medium	Yes	10
21-Jun-19	7d	17	92	170	Road	Mexican free-tailed bat	Small	No	–
21-Jun-19	28d	27	102	140	Tall grass/forb	European starling	Small	No	–
21-Jun-19	7d	42	80	350	Tall grass/forb	European starling	Small	No	–
27-Jun-19	7d	12	31	140	Grazed/short grass	*Myotis* spp.	Small	No	–
27-Jun-19	7d	1	97	40	Tall grass/forb	European starling	Small	Yes	3
28-Jun-19	28d	18	91	250	Grazed/short grass	European starling	Small	No	–
28-Jun-19	28d	32	42	250	Grazed/short grass	*Myotis* spp.	Small	No	–
28-Jun-19	7d	46	73	210	Road	Rock pigeon	Medium	Yes	5
28-Jun-19	28d	31	6	60	Turbine pad	Rock pigeon	Medium	No	–
02-Jul-19	7d	17	16	40	Grazed/short grass	California gull	Large	Yes	6
02-Jul-19	28d	22	104	120	Tall grass/forb	Western gull	Large	Yes	1
05-Jul-19	7d	9	97	220	Grazed/short grass	Mexican free-tailed bat	Small	Yes	4
05-Jul-19	28d	23	98	180	Grazed/short grass	Mexican free-tailed bat	Small	No	–
05-Jul-19	28d	16	68	70	Road	European starling	Small	No	–
05-Jul-19	7d	36	56	90	Road	European starling	Small	No	–
08-Jul-19	28d	43	45	190	Grazed/short grass	Hoary bat	Small	Yes	1
08-Jul-19	28d	40	104	160	Grazed/short grass	Rock pigeon	Medium	Yes	43
08-Jul-19	7d	42	95	230	Grazed/short grass	Rock pigeon	Medium	Yes	3
08-Jul-19	7d	28	93	180	Tall grass/forb	House wren	Small	Yes	2

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
11-Jul-19	7d	6	78	300	Grazed/short grass	Hoary bat	Small	Yes	11
11-Jul-19	28d	2	65	140	Tall grass/forb	European starling	Small	Yes	61
16-Jul-19	7d	41	97	260	Grazed/short grass	*Myotis* spp.	Small	Yes	9
16-Jul-19	28d	33	26	220	Road	Rock pigeon	Medium	No	–
16-Jul-19	7d	36	45	220	Tall grass/forb	European starling	Small	No	–
18-Jul-19	28d	16	99	40	Grazed/short grass	European starling	Small	No	–
18-Jul-19	28d	5	46	240	Grazed/short grass	*Myotis* spp.	Small	No	–
18-Jul-19	7d	6	66	170	Road	Rock pigeon	Medium	Yes	4
22-Jul-19	7d	15	103	350	Grazed/short grass	European starling	Small	Yes	9
22-Jul-19	7d	20	102	190	Tall grass/forb	Mexican free-tailed bat	Small	Yes	1
22-Jul-19	7d	26	49	100	Tall grass/forb	Red-tailed hawk	Large	Yes	9
22-Jul-19	28d	29	89	170	Tall grass/forb	Red-tailed hawk	Large	Yes	3
26-Jul-19	28d	45	89	80	Grazed/short grass	European starling	Small	No	–
26-Jul-19	28d	47	50	130	Grazed/short grass	Mexican free-tailed bat	Small	Yes	5
29-Jul-19	28d	13	85	120	Grazed/short grass	European starling	Small	No	–
29-Jul-19	7d	20	25	270	Grazed/short grass	Rock pigeon	Medium	Yes	8
29-Jul-19	7d	9	9	130	Road	*Myotis* spp.	Small	Yes	1
30-Jul-19	7d	46	77	300	Grazed/short grass	European starling	Small	No	–
30-Jul-19	7d	15	26	360	Grazed/short grass	Golden eagle	Large	Yes	1
30-Jul-19	28d	48	86	320	Grazed/short grass	Rock pigeon	Medium	Yes	29
30-Jul-19	28d	16	49	340	Road	*Myotis* spp.	Small	Yes	7
05-Aug-19	7d	25	19	350	Grazed/short grass	Mexican free-tailed bat	Small	Yes	1
05-Aug-19	28d	34	60	170	Grazed/short grass	Mexican free-tailed bat	Small	No	–
05-Aug-19	7d	8	66	40	Tall grass/forb	White-throated swift	Small	Yes	22
06-Aug-19	28d	23	96	300	Grazed/short grass	Barn owl	Medium	Yes	29
06-Aug-19	7d	39	50	50	Grazed/short grass	California gull	Large	Yes	2
06-Aug-19	28d	32	65	170	Grazed/short grass	White-throated swift	Small	Yes	2
12-Aug-19	7d	2	97	70	Grazed/short grass	Mexican free-tailed bat	Small	No	–
12-Aug-19	7d	1	28	320	Road	European starling	Small	No	–
12-Aug-19	28d	10	40	200	Tall grass/forb	Rock pigeon	Medium	Yes	1
12-Aug-19	7d	17	45	20	Tall grass/forb	Rock pigeon	Medium	Yes	14
13-Aug-19	7d	15	65	120	Grazed/short grass	Mexican free-tailed bat	Small	No	–
13-Aug-19	28d	35	24	210	Road	European starling	Small	Yes	4
19-Aug-19	28d	37	83	330	Grazed/short grass	*Myotis* spp.	Small	No	–
19-Aug-19	28d	38	42	180	Road	Great egret	Large	Yes	1
19-Aug-19	7d	8	31	80	Road	Red-tailed hawk	Large	Yes	1
21-Aug-19	7d	42	95	120	Grazed/short grass	*Myotis* spp.	Small	No	–
21-Aug-19	28d	29	89	120	Tall grass/forb	European starling	Small	Yes	1

Date Placed	Survey Type	Turbine ID	Distance From Turbine (m)	Bearing From Turbine (°)	Placement Substrate	Species	Size Class	Detected?	Carcass Age at Discovery (days)
21-Aug-19	7d	39	71	190	Tall grass/forb	House wren	Small	No	–
26-Aug-19	7d	20	93	90	Grazed/short grass	European starling	Small	Yes	1
26-Aug-19	28d	18	59	120	Grazed/short grass	Mexican free-tailed bat	Small	No	–
26-Aug-19	7d	25	84	50	Tall grass/forb	Great egret	Large	Yes	1
27-Aug-19	28d	44	73	110	Grazed/short grass	European starling	Small	No	–
27-Aug-19	7d	26	98	100	Grazed/short grass	Mexican free-tailed bat	Small	No	–
27-Aug-19	7d	47	18	120	Grazed/short grass	Red-tailed hawk	Large	No	–
04-Sep-19	7d	42	83	110	Grazed/short grass	American crow	Medium	Yes	1
04-Sep-19	28d	30	23	90	Grazed/short grass	European starling	Small	No	–
04-Sep-19	28d	11	104	170	Grazed/short grass	Hoary bat	Small	No	–
04-Sep-19	28d	34	52	20	Grazed/short grass	Rock pigeon	Medium	Yes	0.5
06-Sep-19	7d	12	79	180	Grazed/short grass	Spotted towhee	Small	No	–
06-Sep-19	7d	6	89	270	Road	Hoary bat	Small	Yes	3
09-Sep-19	7d	8	87	30	Grazed/short grass	Hoary bat	Small	Yes	1
09-Sep-19	28d	24	99	10	Tall grass/forb	Western gull	Large	Yes	2
09-Sep-19	28d	19	2	190	Turbine pad	Hoary bat	Small	No	–
10-Sep-19	7d	26	87	290	Grazed/short grass	European starling	Small	Yes	1
10-Sep-19	7d	41	19	360	Grazed/short grass	Rock pigeon	Medium	Yes	2
10-Sep-19	28d	35	95	350	Tall grass/forb	European starling	Small	No	–

Appendix I. *GenEst* Searcher Efficiency (SE) Candidate Models and Selections to Estimate Adjusted Fatalities: Year 1

The tables below represent the top 20 *GenEst* candidate models (based on AICc scores) describing SE for bats and birds in Year 1. The candidate models for bats included all possible, estimable combinations of *Survey Type* (7-day or 28-day interval) and a season variable. The latter consisted of four alternative forms considered independently: *Season*: fall = September – November; winter = December – February; spring = March – May; summer = June – August; *Season2A*: fall/winter and spring/summer; *Season2B*: winter/spring and summer/fall; and *Season2C*: fall/spring migration seasons and winter/summer nonmigration seasons. *Size Class* was included as an additional predictor in the bird models, classified as *Small* (≤100 g) or *Medium/Large* (120–4,500 g; lumped due to trial sample-size limitations). The models selected to produce adjusted fatality estimates are highlighted in ***bold italics***, and the null model is gray-shaded for reference when shown. Selected models had the lowest AICc score among relevant candidates that were based on a minimum of 10 detectability trial cases per covariate-class combination. The *GenEst* SE multivariate models specify a "*p* formula" describing variation in the median probability of detection (SE) among covariate classes, and a "*k* formula" describing how the probability of detecting a previously overlooked carcass declines with each successive survey attempt as carcasses age.

Bats

***p* Formula**	***k* Formula**	**AICc**	**ΔAICc**
p ~ Season2A	***k ~ Season2A***	***110.32***	***0***
p ~ Season2A	*k* ~ constant	110.96	0.64
p ~ Season2A	*k* ~ Survey Type + Season2A	112.11	1.79
p ~ Season2A	*k* ~ Survey Type	112.12	1.80
p ~ Survey Type + Season2A	*k* ~ Season2A	112.66	2.34
p ~ Survey Type + Season2A	*k* ~ constant	113.22	2.90
p ~ Survey Type + Season2A	*k* ~ Survey Type	114.24	3.92
p ~ Survey Type + Season2A	*k* ~ Survey Type + Season2A	114.45	4.13
p ~ Season2A	*k* ~ Survey Type * Season2A	114.54	4.22
p ~ Survey Type * Season2A	*k* ~ Season2A	114.95	4.63
p ~ Survey Type * Season2A	*k* ~ constant	115.18	4.86
p ~ Season	*k* ~ constant	115.40	5.08
p ~ Survey Type * Season2A	*k* ~ Survey Type	115.74	5.42
p ~ Survey Type * Season2A	*k* ~ Survey Type + Season2A	116.59	6.27
p ~ Season	*k* ~ Survey Type	116.63	6.31
p ~ Survey Type + Season2A	*k* ~ Survey Type * Season2A	116.97	6.65
p ~ Survey Type + Season	*k* ~ constant	117.82	7.50
p ~ Survey Type + Season	*k* ~ Survey Type	118.94	8.62
p ~ Season	*k* ~ Season	119.16	8.84
p ~ Survey Type * Season2A	*k* ~ Survey Type * Season2A	119.19	8.87

Small Birds

p Formula	*k* Formula	AICc	ΔAICc
***p* ~ constant**	***k* ~ constant**	***107.47***	***0***
p ~ constant	*k* ~ Season2B	107.80	0.33
p ~ constant	*k* ~ Survey Type	108.36	0.89
p ~ constant	*k* ~ Survey Type + Season2B	109.11	1.64
p ~ Survey Type	*k* ~ constant	109.55	2.08
p ~ constant	*k* ~ Season2A	109.60	2.13
p ~ Season2A	*k* ~ constant	109.65	2.18
p ~ Season2C	*k* ~ constant	109.68	2.21
p ~ Season2B	*k* ~ constant	109.69	2.22
p ~ constant	*k* ~ Season2C	109.70	2.23
p ~ Season2B	*k* ~ Season2B	109.93	2.46
p ~ Survey Type	*k* ~ Season2B	109.95	2.48
p ~ Survey Type	*k* ~ Survey Type	110.21	2.74
p ~ constant	*k* ~ Survey Type + Season2A	110.44	2.97
p ~ Season2C	*k* ~ Survey Type	110.65	3.18
p ~ Season2A	*k* ~ Survey Type	110.66	3.19
p ~ Season2B	*k* ~ Survey Type	110.67	3.20
p ~ constant	*k* ~ Survey Type + Season2C	110.68	3.21
p ~ constant	*k* ~ Survey Type * Season2B	110.96	3.49
p ~ Survey Type	*k* ~ Survey Type + Season2B	111.07	3.60

Medium/Large Birds

p Formula	*k* Formula	AICc	∆AICc
p ~ Survey Type	***k ~ constant***	***97.87***	***0***
p ~ constant	*k* ~ constant	98.24	0.37
p ~ constant	*k* ~ Season2B	98.46	0.59
p ~ *Survey Type* + Season2B	*k* ~ constant	98.85	0.98
p ~ Season2B	*k* ~ constant	98.85	0.98
p ~ *Survey Type*	*k* ~ Season2B	98.92	1.05
p ~ constant	*k* ~ *Survey Type*	99.04	1.17
p ~ *Survey Type* + Season2A	*k* ~ constant	99.07	1.20
p ~ *Survey Type*	*k* ~ *Survey Type*	99.36	1.49
p ~ Season2A	*k* ~ constant	99.41	1.54
p ~ Season2B	*k* ~ Season2B	99.82	1.95
p ~ constant	*k* ~ *Survey Type* + Season2B	100.03	2.16
p ~ *Survey Type* + Season2C	*k* ~ constant	100.08	2.21
p ~ *Survey Type*	*k* ~ Season2A	100.11	2.24
p ~ *Survey Type*	*k* ~ Season2C	100.14	2.27
p ~ Season2B	*k* ~ *Survey Type*	100.28	2.41
p ~ Season2A	*k* ~ *Survey Type*	100.35	2.48
p ~ constant	*k* ~ Season2A	100.42	2.55
p ~ Season2C	*k* ~ constant	100.42	2.55
p ~ constant	*k* ~ Season2C	100.43	2.56

Appendix J. *GenEst* Carcass Persistence (CP) Candidate Models and Selections to Estimate Adjusted Fatalities: Year 1

The tables below represent the top 20 *GenEst* candidate models (based on AICc scores) describing CP for bats and birds in Year 1. The candidate models for bats included all possible, estimable combinations of *Survey Type* (7-day or 28-day interval) and a season variable. The latter consisted of four alternative forms considered independently: *Season*: fall = September – November; winter = December – February; spring = March – May; summer = June – August; *Season2A*: fall/winter and spring/summer; *Season2B*: winter/spring and summer/fall; and *Season2C*: fall/spring migration seasons and winter/summer nonmigration seasons. *Size Class* was included as an additional predictor in the bird models, classified as *Small* (≤100 g) or *Medium/Large* (120–4,500 g; lumped due to trial sample-size limitations). The models selected to produce adjusted fatality estimates are highlighted in ***bold italics***, and the null model is gray-shaded for reference when shown. Selected models had the lowest AICc score among relevant candidates that were based on a minimum of 10 persistence trial cases per covariate-class combination. The *GenEst* specifies three elements composing the multivariate CP estimation model: a time-failure distribution model (log-logistic, lognormal, Weibull, or exponential); a "location formula" describing variation among covariate classes in *l*, the median probability of persisting; and a "scale formula" describing *s*, which represents how the probability of persistence changes through time as carcasses age.

Bats

Time-Failure Distribution	Location Formula (*l*)	Scale Formula (*s*)	AICc	ΔAICc
Weibull	***l ~ Survey Type + Season2A***	***s ~ constant***	***308.10***	***0***
loglogistic	l ~ Survey Type + Season2A	s ~ constant	308.41	0.31
Weibull	l ~ Survey Type * Season2A	s ~ constant	308.77	0.67
lognormal	l ~ Survey Type + Season2A	s ~ constant	309.21	1.11
loglogistic	l ~ Survey Type * Season2A	s ~ constant	309.22	1.12
Weibull	l ~ Survey Type + Season2A	s ~ Season2A	310.37	2.27
Weibull	l ~ Survey Type + Season2A	s ~ Survey Type	310.42	2.32
lognormal	l ~ Survey Type * Season2A	s ~ constant	310.69	2.59
loglogistic	l ~ Survey Type + Season2A	s ~ Survey Type	310.71	2.61
loglogistic	l ~ Survey Type + Season2A	s ~ Season2A	310.72	2.62
Weibull	l ~ Survey Type * Season2A	s ~ Season2A	310.76	2.66
loglogistic	l ~ Season2A	s ~ constant	310.83	2.73
Weibull	l ~ Survey Type * Season2A	s ~ Survey Type	310.99	2.89
Weibull	l ~ Season2A	s ~ constant	311.26	3.16
lognormal	l ~ Survey Type + Season2A	s ~ Survey Type	311.51	3.41
lognormal	l ~ Survey Type + Season2A	s ~ Season2A	311.51	3.41
loglogistic	l ~ Survey Type * Season2A	s ~ Season2A	311.56	3.46
loglogistic	l ~ Survey Type * Season2A	s ~ Survey Type	311.60	3.50
lognormal	l ~ Season2A	s ~ constant	311.97	3.87
Weibull	l ~ Survey Type + Season	s ~ constant	312.55	4.45

Small Birds

Time-Failure Distribution	Location Formula (*l*)	Scale Formula (*s*)	AICc	ΔAICc
lognormal	***l ~ Season2A***	***s ~ constant***	***266.92***	***0***
lognormal	l ~ constant	s ~ Season2C	267.01	0.09
loglogistic	l ~ Season2A	s ~ constant	267.34	0.42
lognormal	l ~ Season2C	s ~ Season2C	268.03	1.11
loglogistic	l ~ constant	s ~ Season2C	268.03	1.11
lognormal	l ~ Survey Type + Season2A	s ~ constant	268.84	1.92
lognormal	l ~ Survey Type	s ~ Season2C	268.94	2.02
lognormal	l ~ Season2A	s ~ Survey Type	269.15	2.23
loglogistic	l ~ Season2C	s ~ Season2C	269.19	2.27
lognormal	l ~ Season2A	s ~ Season2A	269.20	2.28
lognormal	l ~ constant	s ~ Survey Type + Season2C	269.28	2.36
loglogistic	l ~ Survey Type + Season2A	s ~ constant	269.35	2.43
loglogistic	l ~ Season2A	s ~ Survey Type	269.57	2.65
loglogistic	l ~ Season2A	s ~ Season2A	269.61	2.69
lognormal	l ~ constant	s ~ constant	269.74	2.82
lognormal	l ~ Survey Type + Season2C	s ~ Season2C	270.13	3.21
loglogistic	l ~ Survey Type	s ~ Season2C	270.19	3.27
loglogistic	l ~ constant	s ~ Survey Type + Season2C	270.30	3.38
lognormal	l ~ Season2C	s ~ Survey Type + Season2C	270.41	3.49
loglogistic	l ~ constant	s ~ constant	270.53	3.61

Medium/Large Birds

Time-Failure Distribution	Location Formula	Scale Formula	AICc	ΔAICc
lognormal	l ~ constant	s ~ constant	92.75	0
lognormal	***l ~ Season2A***	***s ~ constant***	**92.96**	0.21
lognormal	l ~ Survey Type	s ~ constant	93.27	0.52
loglogistic	l ~ constant	s ~ constant	93.45	0.70
loglogistic	l ~ Season2A	s ~ constant	93.53	0.78
Weibull	l ~ constant	s ~ constant	93.62	0.87
lognormal	l ~ constant	s ~ Season2A	93.63	0.88
Weibull	l ~ Season2A	s ~ constant	93.70	0.95
loglogistic	l ~ Survey Type	s ~ constant	93.75	1.00
lognormal	l ~ Survey Type + Season2A	s ~ constant	93.89	1.14
Weibull	l ~ Survey Type	s ~ constant	93.90	1.15
lognormal	l ~ constant	s ~ Survey Type	94.08	1.33
loglogistic	l ~ Survey Type + Season2A	s ~ constant	94.13	1.38
loglogistic	l ~ constant	s ~ Season2A	94.15	1.40
Weibull	l ~ Survey Type + Season2A	s ~ constant	94.18	1.43
Weibull	l ~ constant	s ~ Season2A	94.19	1.44
loglogistic	l ~ constant	s ~ Survey Type	94.54	1.79
Weibull	l ~ constant	s ~ Survey Type	94.56	1.81
lognormal	l ~ Season2B	s ~ constant	94.75	2.00
lognormal	l ~ Survey Type	s ~ Season2A	94.76	2.01

Appendix K. *GenEst* Carcass Detectability (CD) Candidate Models and Selections to Estimate Adjusted Fatalities: Year 2

The tables below represent all or the top 20 *GenEst* candidate models (based on AICc scores) describing CD for bats and birds in Year 2. The modeling analysis for bats was limited to data collected on 7-day survey plots, and the predictor variables analyzed were four alternative forms of a season variable considered independently: *Season*: fall = September – November; winter = December – February; spring = March – May; summer = June – August; *Season2A*: fall/winter and spring/summer; *Season2B*: winter/spring and summer/fall; and *Season2C*: fall/spring migration seasons and winter/summer nonmigration seasons. The analysis for birds was based on data from both 7-day and 28-day surveys. *Size Class* was included as a predictor variable in all bird models, classified as *Small* (≤100 g) or *Medium*/*Large* (120–4,500 g; lumped due to trial sample-size limitations). Other potential predictors in the bird models were *Survey Type* (7-day or 28-day search interval) and a season variable as described above for bats. The models selected to produce adjusted fatality estimates are highlighted in ***bold italics***, and the null model is gray-shaded for reference when shown. Selected models had the lowest AICc score among relevant candidates that were based on a minimum of 10 detectability trial cases per covariate combination. The *GenEst* searcher efficiency module used to predict CD specifies a "*p* formula" describing variation in the median probability of detection (CD) among covariate classes, and a "*k* formula" describing how the probability of detection declines with successive survey attempts. For this analysis, *k* was set to zero (0) as part of a customized approach to using *GenEst* to estimate CD based on binomial field trials (i.e., carcass is discovered or not with no monitoring for persistence and no limit on time to discovery) (Appendix B).

Bats

Formula *p*	Formula *k*	AICc	∆AICc
p ~ constant	*k* fixed at 0	50.23	0
p ~ Season2C	***k fixed at 0***	***50.83***	***0.60***
p ~ Season2A	*k* fixed at 0	52.01	1.78
p ~ Season2B	*k* fixed at 0	52.03	1.80
p ~ Season	*k* fixed at 0	55.06	4.83

Small Birds

Formula *p*	Formula *k*	AICc	∆AICc
p ~ Survey Type + Season2A	***k fixed at 0***	***83.66***	***0***
p ~ Survey Type	*k* fixed at 0	84.18	0.52
p ~ Survey Type * Season2A	*k* fixed at 0	85.18	1.52
p ~ Survey Type + Season2B	*k* fixed at 0	86.27	2.61
p ~ Survey Type + Season2C	*k* fixed at 0	86.31	2.65
p ~ Survey Type + Season	*k* fixed at 0	87.95	4.29
p ~ Survey Type * Season2B	*k* fixed at 0	88.45	4.79
p ~ Survey Type * Season2C	*k* fixed at 0	88.46	4.80
p ~ Survey Type * Season	*k* fixed at 0	95.27	11.61
p ~ Constant	*k* fixed at 0	120.54	36.88
p ~ Season2A	*k* fixed at 0	121.10	37.44
p ~ Season2B	*k* fixed at 0	122.50	38.84
p ~ Season2C	*k* fixed at 0	122.59	38.93
p ~ Season	*k* fixed at 0	125.13	41.47

Medium/Large Birds

Formula *p*	Formula *k*	AICc	∆AICc
p ~ Survey Type + Season2C	***k fixed at 0***	***78.57***	***0***
p ~ Survey Type * Season2A	*k* fixed at 0	78.79	0.22
p ~ Survey Type	*k* fixed at 0	79.01	0.44
p ~ Survey Type * Season2C	*k* fixed at 0	80.74	2.17
p ~ Survey Type + Season2B	*k* fixed at 0	81.03	2.46
p ~ Survey Type + Season2A	*k* fixed at 0	81.13	2.56
p ~ Survey Type * Season2B	*k* fixed at 0	82.11	3.54
p ~ Season2C	*k* fixed at 0	82.48	3.91
p ~ constant	*k* fixed at 0	82.73	4.16
p ~ Survey Type + Season	*k* fixed at 0	82.81	4.24
p ~ Season2B	*k* fixed at 0	84.73	6.16
p ~ Season2A	*k* fixed at 0	84.80	6.23
p ~ Survey Type * Season	*k* fixed at 0	85.81	7.24
p ~ Season	*k* fixed at 0	86.63	8.06

Appendix L. *GenEst* Carcass Detectability (CD) Candidate Models and Selections to Estimate Adjusted Fatalities: Year 3

The tables below represent all or the top 20 *GenEst* candidate models (based on AICc scores) describing CD for bats and birds in Year 3. Predictor variables considered for bats and birds were *Survey Type* (7-day or 28-day interval) and a season variable. The latter consisted of four alternative forms considered independently: *Season*: fall = September – November; winter = December – February; spring = March – May; summer = June – August; *Season2A*: fall/winter and spring/summer; *Season2B*: winter/spring and summer/fall; and *Season2C*: fall/spring migration seasons and winter/summer nonmigration seasons. *Size Class* was included as an additional predictor in the bird models, classified as *Small* (average species mass ≤100 g), *Medium* (101–500 g), and *Large* (>500 g). The models selected to produce adjusted fatality estimates are highlighted in ***bold italics***, and the null model is gray-shaded for reference when shown. Selected models had the lowest AICc score among relevant candidates that were based on a minimum of 10 detectability trial cases per covariate-class combination. The *GenEst* searcher efficiency module used to predict CD specifies a "*p* formula" describing variation in the median probability of detection (CD) among covariate classes, and a "*k* formula" describing how the probability of detection declines with successive survey attempts. For this analysis, *k* was set to zero (0) as part of a customized approach to using *GenEst* to estimate CD based on binomial field trials (i.e., carcass is discovered or not with no monitoring for persistence and no limit on time to discovery) (Appendix B).

Bats

Formula *p*	Formula *k*	AICc	∆AICc
p ~ Survey Type * Season2B	***k fixed at 0***	***99.44***	***0***
p ~ Survey Type + Season2B	*k* fixed at 0	100.22	0.78
p ~ Survey Type	*k* fixed at 0	102.21	2.77
p ~ Survey Type + Season2C	*k* fixed at 0	103.33	3.89
p ~ Survey Type + Season	*k* fixed at 0	103.56	4.12
p ~ Survey Type + Season2A	*k* fixed at 0	104.32	4.88
p ~ Survey Type * Season2A	*k* fixed at 0	104.85	5.41
p ~ Survey Type * Season2C	*k* fixed at 0	105.25	5.81
p ~ Survey Type * Season	*k* fixed at 0	107.79	8.35
p ~ Season2B	*k* fixed at 0	126.65	27.21
p ~ constant	*k* fixed at 0	128.18	28.74
p ~ Season2C	*k* fixed at 0	129.60	30.16
p ~ Season	*k* fixed at 0	130.24	30.80
p ~ Season2A	*k* fixed at 0	130.26	30.82

Small Birds

Formula *p*	Formula *k*	AICc	∆AICc
p ~ Survey Type * Season2B	***k fixed at 0***	***127.52***	***0***
p ~ Survey Type	*k* fixed at 0	128.15	0.63
p ~ Survey Type + Season2B	*k* fixed at 0	128.29	0.77
p ~ Survey Type + Season2C	*k* fixed at 0	130.15	2.63
p ~ Survey Type + Season2A	*k* fixed at 0	130.27	2.75
p ~ Survey Type * Season2A	*k* fixed at 0	130.75	3.23
p ~ Survey Type * Season2C	*k* fixed at 0	132.31	4.79
p ~ Survey Type + Season	*k* fixed at 0	132.50	4.98
p ~ Survey Type * Season	*k* fixed at 0	134.88	7.36
p ~ constant	*k* fixed at 0	140.52	13.00
p ~ Season2B	*k* fixed at 0	140.59	13.07
p ~ Season2C	*k* fixed at 0	142.46	14.94
p ~ Season2A	*k* fixed at 0	142.60	15.08
p ~ Season	*k* fixed at 0	144.71	17.19

Medium Birds

Formula *p*	Formula *k*	AICc	∆AICc
p ~ Survey Type	*k* fixed at 0	53.95	0
p ~ Survey Type + Season2B	***k fixed at 0***	***54.12***	***0.17***
p ~ Survey Type * Season2B	*k* fixed at 0	54.58	0.63
p ~ constant	*k* fixed at 0	54.77	0.82
p ~ Season2B	*k* fixed at 0	55.17	1.22
p ~ Survey Type + Season2C	*k* fixed at 0	56.17	2.22
p ~ Survey Type + Season2A	*k* fixed at 0	56.20	2.25
p ~ Season2C	*k* fixed at 0	56.91	2.96
p ~ Season2A	*k* fixed at 0	56.94	2.99
p ~ Survey Type * Season2C	*k* fixed at 0	58.26	4.31
p ~ Survey Type * Season2A	*k* fixed at 0	58.40	4.45
p ~ Survey Type + Season	*k* fixed at 0	58.95	5.00
p ~ Season	*k* fixed at 0	59.80	5.85
p ~ Survey Type * Season	*k* fixed at 0	66.09	12.14

Large Birds

Formula *p*	Formula *k*	AICc	∆AICc
p ~ constant	*k* fixed at 0	30.44	0
***p* ~ Season2C**	***k* fixed at 0**	**30.60**	**0.16**
p ~ Survey Type + Season2C	*k* fixed at 0	31.46	1.02
p ~ Survey Type	*k* fixed at 0	31.55	1.11
p ~ Season2B	*k* fixed at 0	32.19	1.75
p ~ Season2A	*k* fixed at 0	32.59	2.15
p ~ Survey Type + Season2B	*k* fixed at 0	33.36	2.92
p ~ Survey Type + Season2A	*k* fixed at 0	33.79	3.35
p ~ Survey Type * Season2C	*k* fixed at 0	34.35	3.91
p ~ Season	*k* fixed at 0	35.13	4.69
p ~ Survey Type * Season2A	*k* fixed at 0	35.27	4.83
p ~ Survey Type * Season2B	*k* fixed at 0	36.10	5.66
p ~ Survey Type * Season	*k* fixed at 0	45.60	15.16

Appendix M. Fatality and Injury Incidents in Year 1

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
	Bats								
02-Aug-17	Big brown bat	S	23	19	7d	101	35	Scavenged-partial decomposed	Included
02-Aug-17	Big brown bat	S	23	38	7d	52	60	Scavenged-partial decomposed	Included
20-Sep-16	Hoary bat	S	30	29	28d	64	48	Intact-decomposed	Excluded: predates survey
20-Sep-16	Hoary bat	S	30	37	7d	12	100	Intact-decomposed	Excluded: predates survey
21-Sep-16	Hoary bat	S	30	33	7d	79	70	Intact-decomposed	Excluded: predates survey
23-Sep-16	Hoary bat	S	30	32	7d	88	5	Scavenged-partial decomposed	Excluded: predates survey
23-Sep-16	Hoary bat	S	30	43	7d	49	62	Scavenged-fresh	Included
26-Sep-16	Hoary bat	S	30	32	7d	17	50	Intact-fresh	Included
28-Sep-16	Hoary bat	S	30	15	28d	85	32	Scavenged-partial decomposed	Excluded: predates survey
28-Sep-16	Hoary bat	S	30	19	7d	19	29	Scavenged-decomposed	Excluded: predates survey
03-Oct-16	Hoary bat	S	30	32	7d	72	32	Scavenged-decomposed	Excluded: predates survey
11-Oct-16	Hoary bat	S	30	6	Incidental	125	27	Scavenged-decomposed	Excluded: off plot
11-Oct-16	Hoary bat	S	30	28	28d	52	74	Scavenged-fresh	Included
18-Oct-16	Hoary bat	S	30	44	28d	87	24	Scavenged-decomposed	Included
19-Oct-16	Hoary bat	S	30	33	7d	71	43	Scavenged-decomposed	Included
08-Nov-16	Hoary bat	S	30	6	28d	7	65	Scavenged-fresh	Included
10-Nov-16	Hoary bat	S	30	27	28d	35	330	Scavenged-fresh	Included
14-Nov-16	Hoary bat	S	30	40	7d	16	270	Intact-partial decomposed	Included
15-Nov-16	Hoary bat	S	30	39	28d	33	340	Intact-decomposed	Included
16-Nov-16	Hoary bat	S	30	19	Incidental	107	90	Intact-partial decomposed	Excluded: off plot
22-Nov-16	Hoary bat	S	30	2	28d	27	260	Scavenged-decomposed	Included
23-Feb-17	Hoary bat	S	30	38	7d	21	360	Scavenged-partial decomposed	Included
03-Apr-17	Hoary bat	S	30	16	7d	31	110	Intact-partial decomposed	Included
03-Apr-17	Hoary bat	S	30	32	7d	70	60	Scavenged-fresh	Included
25-Apr-17	Hoary bat	S	30	27	28d	86	80	Intact-partial decomposed	Included
09-May-17	Hoary bat	S	30	15	28d	92	40	Intact-partial decomposed	Included
17-May-17	Hoary bat	S	30	33	Incidental	115	50	Scavenged-partial decomposed	Excluded: off plot
18-May-17	Hoary bat	S	30	30	28d	96	20	Intact-partial decomposed	Included
23-May-17	Hoary bat	S	30	3	28d	42	340	Scavenged-partial decomposed	Included
23-May-17	Hoary bat	S	30	16	7d	20	350	Intact-fresh	Included
25-May-17	Hoary bat	S	30	23	28d	15	360	Scavenged-partial decomposed	Included
29-May-17	Hoary bat	S	30	40	7d	58	20	Scavenged-partial decomposed	Included
31-May-17	Hoary bat	S	30	4	7d	92	20	Intact-partial decomposed	Included
01-Jun-17	Hoary bat	S	30	29	28d	93	60	Intact-decomposed	Included
02-Jun-17	Hoary bat	S	30	14	7d	40	60	Intact-partial decomposed	Included
02-Jun-17	Hoary bat	S	30	33	7d	59	50	Scavenged-partial decomposed	Included
13-Jun-17	Hoary bat	S	30	46	28d	81	260	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
13-Jun-17	Hoary bat	S	30	47	28d	57	20	Scavenged-partial decomposed	Included
14-Jun-17	Hoary bat	S	30	19	7d	37	120	Intact-partial decomposed	Included
20-Jun-17	Hoary bat	S	30	10	28d	76	360	Intact-partial decomposed	Included
27-Jun-17	Hoary bat	S	30	45	28d	97	65	Scavenged-partial decomposed	Included
28-Jun-17	Hoary bat	S	30	16	7d	65	355	Scavenged-partial decomposed	Included
29-Jun-17	Hoary bat	S	30	25	28d	95	55	Scavenged-partial decomposed	Included
03-Jul-17	Hoary bat	S	30	7	7d	56	355	Intact-partial decomposed	Included
03-Jul-17	Hoary bat	S	30	35	7d	95	60	Scavenged-partial decomposed	Included
06-Jul-17	Hoary bat	S	30	22	28d	67	350	Intact-partial decomposed	Included
06-Jul-17	Hoary bat	S	30	43	7d	15	350	Intact-partial decomposed	Included
19-Jul-17	Hoary bat	S	30	40	Incidental	110	20	Intact-partial decomposed	Excluded: off plot
26-Jul-17	Hoary bat	S	30	32	7d	84	60	Scavenged-partial decomposed	Included
03-Aug-17	Hoary bat	S	30	22	28d	103	45	Intact-partial decomposed	Included
21-Aug-17	Hoary bat	S	30	5	7d	95	145	Intact-fresh	Included
21-Aug-17	Hoary bat	S	30	35	7d	90	20	Intact-partial decomposed	Included
22-Aug-17	Hoary bat	S	30	44	28d	60	75	Intact-fresh	Included
22-Aug-17	Hoary bat	S	30	44	28d	95	80	Intact-fresh	Included
24-Aug-17	Hoary bat	S	30	29	28d	64	342	Intact-decomposed	Included
29-Aug-17	Hoary bat	S	30	1	28d	95	60	Other, see notes	Included
29-Aug-17	Hoary bat	S	30	1	28d	85	190	Scavenged-partial decomposed	Included
30-Aug-17	Hoary bat	S	30	19	7d	40	15	Intact-partial decomposed	Included
30-Aug-17	Hoary bat	S	30	32	7d	48	340	Scavenged-fresh	Included
30-Aug-17	Hoary bat	S	30	32	7d	88	80	Intact-partial decomposed	Included
30-Aug-17	Hoary bat	S	30	38	7d	45	80	Intact-partial decomposed	Included
30-Aug-17	Hoary bat	S	30	38	7d	5	60	Intact-partial decomposed	Included
30-Aug-17	Hoary bat	S	30	43	7d	61	60	Intact-partial decomposed	Included
31-Aug-17	Hoary bat	S	30	18	28d	52	25	Scavenged-fresh	Included
31-Aug-17	Hoary bat	S	30	22	28d	65	5	Intact-partial decomposed	Included
31-Aug-17	Hoary bat	S	30	22	28d	32	340	Scavenged-partial decomposed	Included
01-Sep-17	Hoary bat	S	30	14	7d	30	25	Intact-partial decomposed	Included
01-Sep-17	Hoary bat	S	30	14	7d	80	85	Intact-fresh	Included
01-Sep-17	Hoary bat	S	30	14	7d	70	70	Scavenged-partial decomposed	Included
04-Sep-17	Hoary bat	S	30	7	7d	30	105	Intact-fresh	Included
05-Sep-17	Hoary bat	S	30	48	28d	95	20	Intact-partial decomposed	Included
06-Sep-17	Hoary bat	S	30	32	7d	35	350	Scavenged-decomposed	Included
06-Sep-17	Hoary bat	S	30	40	7d	82	10	Intact-fresh	Included
06-Sep-17	Hoary bat	S	30	40	7d	52	20	Intact-partial decomposed	Included
07-Sep-17	Hoary bat	S	30	36	28d	30	350	Scavenged-partial decomposed	Included
07-Sep-17	Hoary bat	S	30	36	28d	50	120	Intact-partial decomposed	Included
07-Sep-17	Hoary bat	S	30	36	28d	60	50	Scavenged-partial decomposed	Included
08-Sep-17	Hoary bat	S	30	14	7d	60	355	Scavenged-partial decomposed	Included
08-Sep-17	Hoary bat	S	30	14	7d	95	30	Intact-fresh	Included
11-Sep-17	Hoary bat	S	30	37	7d	40	105	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
12-Sep-17	Hoary bat	S	30	10	28d	10	300	Intact-fresh	Included
12-Sep-17	Hoary bat	S	30	13	28d	30	90	Intact-partial decomposed	Included
15-Sep-17	Hoary bat	S	30	14	7d	57	40	Scavenged-partial decomposed	Included
15-Sep-17	Hoary bat	S	30	33	7d	68	90	Intact-partial decomposed	Included
15-Sep-17	Hoary bat	S	30	33	7d	51	360	Scavenged-partial decomposed	Included
15-Sep-17	Hoary bat	S	30	33	7d	77	80	Scavenged-partial decomposed	Included
20-Sep-16	Mexican free-tailed bat	S	9.5	44	28d	84	60	Scavenged-decomposed	Excluded: predates survey
20-Sep-16	Mexican free-tailed bat	S	9.5	41	28d	27	74	Intact-fresh	Included
20-Sep-16	Mexican free-tailed bat	S	9.5	44	28d	16	324	Scavenged-partial decomposed	Included
21-Sep-16	Mexican free-tailed bat	S	9.5	32	7d	35	30	Intact-partial decomposed	Excluded: predates survey
22-Sep-16	Mexican free-tailed bat	S	9.5	7	7d	100	78	Intact-partial decomposed	Excluded: predates survey
22-Sep-16	Mexican free-tailed bat	S	9.5	24	7d	29	255	Scavenged-partial decomposed	Excluded: predates survey
22-Sep-16	Mexican free-tailed bat	S	9.5	19	7d	100	36	Scavenged-partial decomposed	Included
23-Sep-16	Mexican free-tailed bat	S	9.5	7	7d	30	330	Intact-fresh	Included
26-Sep-16	Mexican free-tailed bat	S	9.5	5	7d	78	358	Intact-partial decomposed	Excluded: predates survey
26-Sep-16	Mexican free-tailed bat	S	9.5	5	7d	58	60	Intact-partial decomposed	Excluded: predates survey
26-Sep-16	Mexican free-tailed bat	S	9.5	16	7d	84	104	Scavenged-decomposed	Excluded: predates survey
26-Sep-16	Mexican free-tailed bat	S	9.5	5	7d	20	22	Intact-partial decomposed	Included
26-Sep-16	Mexican free-tailed bat	S	9.5	5	7d	86	5	Scavenged-fresh	Included
26-Sep-16	Mexican free-tailed bat	S	9.5	16	7d	15	350	Scavenged-fresh	Included
27-Sep-16	Mexican free-tailed bat	S	9.5	2	28d	63	105	Scavenged-partial decomposed	Excluded: predates survey
27-Sep-16	Mexican free-tailed bat	S	9.5	17	28d	31	360	Scavenged-fresh	Included
27-Sep-16	Mexican free-tailed bat	S	9.5	17	28d	23	112	Scavenged-fresh	Included
27-Sep-16	Mexican free-tailed bat	S	9.5	7	7d	47	52	Intact-partial decomposed	Included
28-Sep-16	Mexican free-tailed bat	S	9.5	15	28d	2.5	10	Scavenged-decomposed	Excluded: predates survey
28-Sep-16	Mexican free-tailed bat	S	9.5	19	7d	26	350	Scavenged-decomposed	Excluded: predates survey
28-Sep-16	Mexican free-tailed bat	S	9.5	12	28d	26	350	Intact-partial decomposed	Included
28-Sep-16	Mexican free-tailed bat	S	9.5	19	7d	50	5	Scavenged-decomposed	Included
28-Sep-16	Mexican free-tailed bat	S	9.5	21	7d	6	360	Scavenged-partial decomposed	Included
28-Sep-16	Mexican free-tailed bat	S	9.5	24	7d	66	352	Scavenged-partial decomposed	Included
28-Sep-16	Mexican free-tailed bat	S	9.5	43	7d	42	10	Scavenged-partial decomposed	Included
29-Sep-16	Mexican free-tailed bat	S	9.5	33	7d	99	64	Scavenged-decomposed	Excluded: predates survey
29-Sep-16	Mexican free-tailed bat	S	9.5	38	7d	47	37	Intact-partial decomposed	Excluded: predates survey
03-Oct-16	Mexican free-tailed bat	S	9.5	32	7d	33	50	Scavenged-partial decomposed	Excluded: predates survey
03-Oct-16	Mexican free-tailed bat	S	9.5	37	7d	79	48	Scavenged-fresh	Included
04-Oct-16	Mexican free-tailed bat	S	9.5	34	28d	3	154	Intact-fresh	Included
04-Oct-16	Mexican free-tailed bat	S	9.5	36	28d	22	24	Scavenged-partial decomposed	Included
04-Oct-16	Mexican free-tailed bat	S	9.5	48	28d	24	45	Scavenged-decomposed	Included
05-Oct-16	Mexican free-tailed bat	S	9.5	38	7d	12	152	Scavenged-decomposed	Excluded: predates survey
07-Oct-16	Mexican free-tailed bat	S	9.5	19	7d	20	45	Scavenged-partial decomposed	Included
10-Oct-16	Mexican free-tailed bat	S	9.5	37	7d	34	42	Scavenged-partial decomposed	Included
10-Oct-16	Mexican free-tailed bat	S	9.5	7	7d	44	319	Scavenged-partial decomposed	Included
11-Oct-16	Mexican free-tailed bat	S	9.5	27	28d	65	5	Scavenged-decomposed	Excluded: predates survey

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
11-Oct-16	Mexican free-tailed bat	S	9.5	27	28d	7	231	Scavenged-decomposed	Excluded: predates survey
12-Oct-16	Mexican free-tailed bat	S	9.5	19	7d	91	15	Scavenged-fresh	Included
18-Oct-16	Mexican free-tailed bat	S	9.5	39	28d	33	128	Intact-partial decomposed	Included
18-Oct-16	Mexican free-tailed bat	S	9.5	44	28d	3	122	Intact-fresh	Included
18-Oct-16	Mexican free-tailed bat	S	9.5	44	28d	65	34	Scavenged-decomposed	Included
25-Oct-16	Mexican free-tailed bat	S	9.5	1	28d	88	35	Scavenged-fresh	Included
25-Oct-16	Mexican free-tailed bat	S	9.5	2	28d	11	53	Intact-fresh	Included
25-Oct-16	Mexican free-tailed bat	S	9.5	12	28d	22	120	Scavenged-fresh	Included
25-Oct-16	Mexican free-tailed bat	S	9.5	20	28d	78	68	Scavenged-partial decomposed	Included
31-Oct-16	Mexican free-tailed bat	S	9.5	37	7d	54	225	Scavenged-partial decomposed	Included
31-Oct-16	Mexican free-tailed bat	S	9.5	32	7d	54	357	Injured-died/euthanized	Included
01-Nov-16	Mexican free-tailed bat	S	9.5	42	28d	47	24	Scavenged-partial decomposed	Included
14-Nov-16	Mexican free-tailed bat	S	9.5	5	7d	41	270	Intact-partial decomposed	Included
21-Nov-16	Mexican free-tailed bat	S	9.5	5	7d	27	140	Intact-fresh	Included
25-Jan-17	Mexican free-tailed bat	S	9.5	31	7d	39	110	Intact-fresh	Included
07-Mar-17	Mexican free-tailed bat	S	9.5	29	28d	29	50	Intact-fresh	Included
13-Mar-17	Mexican free-tailed bat	S	9.5	16	7d	21	345	Injured-died/euthanized	Included
28-Mar-17	Mexican free-tailed bat	S	9.5	13	28d	15	115	Intact-partial decomposed	Included
04-Apr-17	Mexican free-tailed bat	S	9.5	8	28d	41	50	Intact-partial decomposed	Included
04-Apr-17	Mexican free-tailed bat	S	9.5	39	28d	90	125	Intact-partial decomposed	Included
26-Apr-17	Mexican free-tailed bat	S	9.5	24	7d	47	95	Intact-partial decomposed	Included
02-May-17	Mexican free-tailed bat	S	9.5	44	28d	32	5	Intact-fresh	Included
04-May-17	Mexican free-tailed bat	S	9.5	7	7d	18	80	Intact-partial decomposed	Included
11-May-17	Mexican free-tailed bat	S	9.5	22	28d	79	210	Intact-partial decomposed	Included
11-May-17	Mexican free-tailed bat	S	9.5	22	28d	87	20	Intact-partial decomposed	Included
17-May-17	Mexican free-tailed bat	S	9.5	32	7d	74	60	Scavenged-partial decomposed	Included
18-May-17	Mexican free-tailed bat	S	9.5	36	28d	75	45	Intact-partial decomposed	Included
22-May-17	Mexican free-tailed bat	S	9.5	32	7d	69	360	Scavenged-partial decomposed	Included
23-May-17	Mexican free-tailed bat	S	9.5	10	28d	63	40	Scavenged-partial decomposed	Included
02-Jun-17	Mexican free-tailed bat	S	9.5	24	Incidental	110	45	Intact-partial decomposed	Excluded: off plot
02-Jun-17	Mexican free-tailed bat	S	9.5	14	7d	95	45	Intact-partial decomposed	Included
05-Jun-17	Mexican free-tailed bat	S	9.5	35	7d	95	85	Intact-partial decomposed	Included
13-Jun-17	Mexican free-tailed bat	S	9.5	46	28d	81	270	Scavenged-partial decomposed	Included
15-Jun-17	Mexican free-tailed bat	S	9.5	36	28d	35	100	Scavenged-partial decomposed	Included
20-Jun-17	Mexican free-tailed bat	S	9.5	6	28d	49	190	Scavenged-partial decomposed	Included
20-Jun-17	Mexican free-tailed bat	S	9.5	6	28d	99	50	Scavenged-partial decomposed	Included
23-Jun-17	Mexican free-tailed bat	S	9.5	33	Incidental	110	45	Intact-partial decomposed	Excluded: off plot
23-Jun-17	Mexican free-tailed bat	S	9.5	33	7d	90	55	Scavenged-partial decomposed	Included
06-Jul-17	Mexican free-tailed bat	S	9.5	22	28d	78	5	Intact-partial decomposed	Included
10-Jul-17	Mexican free-tailed bat	S	9.5	29	28d	81	50	Scavenged-partial decomposed	Included
12-Jul-17	Mexican free-tailed bat	S	9.5	16	7d	96	30	Intact-partial decomposed	Included
24-Jul-17	Mexican free-tailed bat	S	9.5	5	7d	78	115	Intact-fresh	Included
27-Jul-17	Mexican free-tailed bat	S	9.5	29	28d	99	20	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
09-Aug-17	Mexican free-tailed bat	S	9.5	21	7d	85	40	Scavenged-partial decomposed	Included
10-Aug-17	Mexican free-tailed bat	S	9.5	36	Incidental	108	80	Scavenged-partial decomposed	Excluded: off plot
10-Aug-17	Mexican free-tailed bat	S	9.5	9	28d	70	75	Scavenged-partial decomposed	Included
14-Aug-17	Mexican free-tailed bat	S	9.5	5	7d	79	40	Injured-died/euthanized	Included
23-Aug-17	Mexican free-tailed bat	S	9.5	21	7d	83	51	Intact-decomposed	Included
23-Aug-17	Mexican free-tailed bat	S	9.5	21	7d	74	37	Intact-decomposed	Included
23-Aug-17	Mexican free-tailed bat	S	9.5	4	7d	65	35	Intact-fresh	Included
23-Aug-17	Mexican free-tailed bat	S	9.5	16	7d	95	35	Intact-fresh	Included
23-Aug-17	Mexican free-tailed bat	S	9.5	38	7d	103	50	Intact-fresh	Included
24-Aug-17	Mexican free-tailed bat	S	9.5	25	28d	95	60	Intact-partial decomposed	Included
25-Aug-17	Mexican free-tailed bat	S	9.5	14	7d	80	350	Intact-partial decomposed	Included
25-Aug-17	Mexican free-tailed bat	S	9.5	14	7d	60	65	Intact-fresh	Included
25-Aug-17	Mexican free-tailed bat	S	9.5	14	7d	55	25	Intact-fresh	Included
25-Aug-17	Mexican free-tailed bat	S	9.5	33	7d	95	75	Intact-fresh	Included
29-Aug-17	Mexican free-tailed bat	S	9.5	1	28d	4	120	Intact-partial decomposed	Included
29-Aug-17	Mexican free-tailed bat	S	9.5	1	28d	5	340	Other, see notes	Included
29-Aug-17	Mexican free-tailed bat	S	9.5	12	28d	60	65	Intact-partial decomposed	Included
30-Aug-17	Mexican free-tailed bat	S	9.5	16	7d	69	360	Scavenged-partial decomposed	Included
30-Aug-17	Mexican free-tailed bat	S	9.5	32	7d	69	90	Scavenged-partial decomposed	Included
30-Aug-17	Mexican free-tailed bat	S	9.5	4	7d	67	20	Scavenged-partial decomposed	Included
30-Aug-17	Mexican free-tailed bat	S	9.5	32	7d	51	30	Scavenged-fresh	Included
30-Aug-17	Mexican free-tailed bat	S	9.5	43	7d	49	360	Scavenged-partial decomposed	Included
31-Aug-17	Mexican free-tailed bat	S	9.5	18	28d	13	5	Intact-fresh	Included
31-Aug-17	Mexican free-tailed bat	S	9.5	18	28d	5	5	Intact-partial decomposed	Included
31-Aug-17	Mexican free-tailed bat	S	9.5	20	28d	82	60	Scavenged-partial decomposed	Included
01-Sep-17	Mexican free-tailed bat	S	9.5	31	7d	90	65	Scavenged-partial decomposed	Included
01-Sep-17	Mexican free-tailed bat	S	9.5	31	7d	70	75	Scavenged-partial decomposed	Included
04-Sep-17	Mexican free-tailed bat	S	9.5	7	7d	25	95	Scavenged-partial decomposed	Included
04-Sep-17	Mexican free-tailed bat	S	9.5	7	7d	70	20	Intact-partial decomposed	Included
04-Sep-17	Mexican free-tailed bat	S	9.5	7	7d	15	335	Intact-fresh	Included
05-Sep-17	Mexican free-tailed bat	S	9.5	42	28d	15	285	Intact-fresh	Included
05-Sep-17	Mexican free-tailed bat	S	9.5	46	28d	80	85	Intact-fresh	Included
06-Sep-17	Mexican free-tailed bat	S	9.5	4	7d	60	50	Intact-partial decomposed	Included
06-Sep-17	Mexican free-tailed bat	S	9.5	16	7d	43	40	Intact-partial decomposed	Included
07-Sep-17	Mexican free-tailed bat	S	9.5	34	28d	50	45	Intact-fresh	Included
07-Sep-17	Mexican free-tailed bat	S	9.5	34	28d	60	65	Intact-fresh	Included
08-Sep-17	Mexican free-tailed bat	S	9.5	9	28d	100	40	Scavenged-fresh	Included
11-Sep-17	Mexican free-tailed bat	S	9.5	5	7d	90	300	Scavenged-partial decomposed	Included
12-Sep-17	Mexican free-tailed bat	S	9.5	3	28d	60	60	Scavenged-partial decomposed	Included
12-Sep-17	Mexican free-tailed bat	S	9.5	3	28d	80	80	Intact-partial decomposed	Included
12-Sep-17	Mexican free-tailed bat	S	9.5	6	28d	80	105	Intact-decomposed	Included
12-Sep-17	Mexican free-tailed bat	S	9.5	13	28d	100	20	Intact-partial decomposed	Included
13-Sep-17	Mexican free-tailed bat	S	9.5	21	Incidental	110	70	Intact-fresh	Excluded: off plot

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
13-Sep-17	Mexican free-tailed bat	S	9.5	38	7d	20	80	Intact-fresh	Included
13-Sep-17	Mexican free-tailed bat	S	9.5	38	7d	25	80	Intact-fresh	Included
14-Sep-17	Mexican free-tailed bat	S	9.5	27	28d	100	60	Scavenged-partial decomposed	Included
14-Sep-17	Mexican free-tailed bat	S	9.5	23	28d	13	250	Scavenged-partial decomposed	Included
14-Sep-17	Mexican free-tailed bat	S	9.5	23	28d	101	40	Scavenged-partial decomposed	Included
14-Sep-17	Mexican free-tailed bat	S	9.5	26	28d	19	140	Intact-partial decomposed	Included
14-Sep-17	Mexican free-tailed bat	S	9.5	27	28d	47	50	Intact-fresh	Included
14-Sep-17	Mexican free-tailed bat	S	9.5	28	28d	77	5	Scavenged-partial decomposed	Included
15-Sep-17	Mexican free-tailed bat	S	9.5	14	7d	93	360	Scavenged-partial decomposed	Included
15-Sep-17	Mexican free-tailed bat	S	9.5	31	7d	68	15	Intact-partial decomposed	Included
27-Sep-16	Silver-haired bat	S	10.5	24	7d	21	20	Scavenged-fresh	Included
28-Sep-16	Unknown bat	S	14	12	28d	38	36	Scavenged-decomposed	Excluded: predates survey
05-May-17	Unknown bat	S	14	33	7d	49	20	Intact-decomposed	Included
26-Sep-16	Western red bat	S	8	32	7d	66	30	Scavenged-decomposed	Excluded: predates survey
27-Sep-16	Western red bat	S	8	17	28d	71	348	Scavenged-fresh	Included
03-Oct-16	Western red bat	S	8	37	7d	101	51	Scavenged-fresh	Included
04-Oct-16	Western red bat	S	8	9	28d	92	26	Scavenged-partial decomposed	Excluded: predates survey
25-May-17	Western red bat	S	8	27	28d	55	10	Intact-decomposed	Included
07-Sep-17	Western red bat	S	8	34	28d	25	80	Intact-partial decomposed	Included
13-Sep-17	Western red bat	S	8	32	7d	56	50	Intact-partial decomposed	Included
	Birds								
10-Oct-16	American Kestrel	M	119	5	7d	58	271	Other, see notes	Included
13-Dec-16	American Kestrel	M	119	8	28d	85	280	Scavenged-feather spot	Included
22-Aug-17	American Kestrel	M	119	44	28d	20	116	Scavenged-partial decomposed	Included
08-Sep-17	American Kestrel	M	119	31	7d	6	120	Intact-partial decomposed	Included
30-Jan-17	American Pipit	S	21	32	7d	56	180	Scavenged-feather spot	Included
13-Mar-17	American Pipit	S	21	32	7d	82	280	Scavenged-partial decomposed	Included
11-Apr-17	American Pipit	S	21	15	Incidental	107	21	Intact-decomposed	Excluded: off plot
01-Nov-16	Barn Owl	M	460	48	28d	54	101	Scavenged-partial decomposed	Included
04-Jan-17	Barn Owl	M	460	6	Incidental	113	300	Scavenged-decomposed	Excluded: off plot
22-Feb-17	Barn Owl	M	460	9	28d	45	200	Intact-partial decomposed	Included
18-May-17	Black-headed Grosbeak	S	45	4	7d	38	90	Scavenged-partial decomposed	Included
31-May-17	Black-headed Grosbeak	S	45	37	7d	74	30	Intact-partial decomposed	Included
29-Jun-17	Black-headed Grosbeak	S	45	29	Incidental	110	80	Scavenged-partial decomposed	Excluded: off plot
01-Sep-17	Black-headed Grosbeak	S	45	33	7d	19	30	Scavenged-feather spot	Included
25-Apr-17	Black-throated Gray Warbler	S	8.4	13	28d	100	70	Scavenged-partial decomposed	Included
10-Apr-17	Brewer's Blackbird	S	63	32	7d	60	190	Scavenged-feather spot	Included
25-May-17	Brown-headed Cowbird	S	45	26	28d	7	290	Intact-partial decomposed	Included
06-Jul-17	Burrowing Owl	M	151	18	28d	85	330	Scavenged-partial decomposed	Included
03-Aug-17	Burrowing Owl	M	151	11	28d	31	40	Scavenged-partial decomposed	Included
10-Apr-17	Cliff Swallow	S	21	35	7d	26	170	Intact-fresh	Included
26-Jul-17	Common Poorwill	S	50	32	7d	50	10	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
05-Apr-17	Common Raven	L	1200	4	7d	10	230	Intact-partial decomposed	Included
13-Feb-17	Eurasian Collared-Dove	M	200	1	28d	65	360	Scavenged-feather spot	Included
20-Dec-16	European Starling	S	82	22	28d	63	340	Scavenged-decomposed	Included
11-Jan-17	European Starling	S	82	45	28d	44	80	Scavenged-fresh	Included
16-Jan-17	European Starling	S	82	32	7d	86	340	Scavenged-fresh	Included
07-Feb-17	European Starling	S	82	39	28d	52	220	Scavenged-feather spot	Included
15-Feb-17	European Starling	S	82	33	7d	95	320	Scavenged-feather spot	Included
15-Feb-17	European Starling	S	82	33	7d	41	180	Scavenged-fresh	Included
20-Mar-17	European Starling	S	82	37	7d	78	120	Scavenged-feather spot	Included
24-May-17	European Starling	S	82	13	Incidental	113	140	Scavenged-feather spot	Excluded: off plot
31-May-17	European Starling	S	82	11	28d	5	100	Intact-partial decomposed	Included
29-Nov-16	Ferruginous Hawk	L	1600	42	28d	7	320	Other, see notes	Included
07-Dec-16	Ferruginous Hawk	L	1600	12	Incidental	116	30	Scavenged-partial decomposed	Excluded: off plot
28-Dec-16	Ferruginous Hawk	L	1600	30	28d	54	213	Scavenged-decomposed	Included
29-Dec-16	Ferruginous Hawk	L	1600	14	7d	0	101	Intact-fresh	Included
01-Mar-17	Ferruginous Hawk	L	1600	22	7d	149	131	Injured-died/euthanized	Included
03-Oct-16	Fox Sparrow	S	32	40	7d	87	70	Scavenged-feather spot	Included
20-Sep-16	Golden Eagle	L (VL)	4200	14	7d	26	28	Intact-decomposed	Excluded: predates survey[4]
20-Sep-16	Golden Eagle	L (VL)	4200	24	7d	6	222	Other, see notes	Excluded: predates survey[4]
27-Sep-16	Golden Eagle	L (VL)	4200	17	28d	24	166	Intact-partial decomposed	Excluded: predates survey[4]
11-Oct-16	Golden Eagle	L (VL)	4200	3	28d	62	81	Scavenged-decomposed	Excluded: predates survey[4]
13-Dec-16	Golden Eagle	L (VL)	4200	39	Incidental	161	80	Scavenged-decomposed	Excluded: off plot
11-Apr-17	Golden Eagle	L (VL)	4200	22	28d	52	105	Intact-decomposed	Included
11-Apr-17	Golden Eagle	L (VL)	4200	12	28d	55	290	Other, see notes	Included
09-May-17	Golden Eagle	L (VL)	4200	15	28d	51	70	Scavenged-partial decomposed	Included
23-May-17	Golden Eagle	L (VL)	4200	12	Incidental	117	168	Intact-fresh	Excluded: off plot
27-Jun-17	Golden Eagle	L (VL)	4200	11	28d	60	85	Intact-partial decomposed	Included
27-Jul-17	Golden Eagle	L (VL)	4200	25	28d	33	60	Intact-partial decomposed	Included
07-Sep-17	Golden Eagle	L (VL)	4200	36	28d	19	250	Intact-fresh	Included
08-May-17	Grasshopper Sparrow	S	17	32	7d	61	90	Scavenged-partial decomposed	Included
17-May-17	Hermit Warbler	S	10	21	7d	16	90	Scavenged-partial decomposed	Included
19-Sep-16	Horned Lark	S	32	16	7d	30	148	Scavenged-decomposed	Excluded: predates survey
26-Sep-16	Horned Lark	S	32	32	7d	22	90	Scavenged-feather spot	Excluded: predates survey
26-Sep-16	Horned Lark	S	32	16	7d	61	44	Scavenged-feather spot	Included
07-Oct-16	Horned Lark	S	32	31	7d	7	117	Scavenged-fresh	Included
18-Oct-16	Horned Lark	S	32	44	28d	13	306	Scavenged-feather spot	Included
16-Jan-17	Horned Lark	S	32	5	7d	39	180	Scavenged-feather spot	Included
15-Mar-17	Horned Lark	S	32	24	7d	80	360	Scavenged-feather spot	Included
22-Mar-17	Horned Lark	S	32	14	7d	31	180	Intact-partial decomposed	Included
29-Mar-17	Horned Lark	S	32	38	7d	37	210	Intact-partial decomposed	Included
05-Apr-17	Horned Lark	S	32	31	7d	41	30	Scavenged-partial decomposed	Included
10-Apr-17	Horned Lark	S	32	21	7d	16	250	Scavenged-fresh	Included
17-Apr-17	Horned Lark	S	32	5	7d	56	70	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
18-Apr-17	Horned Lark	S	32	46	28d	24	180	Intact-decomposed	Included
19-Apr-17	Horned Lark	S	32	38	7d	32	280	Intact-decomposed	Included
25-Apr-17	Horned Lark	S	32	13	28d	22	360	Scavenged-partial decomposed	Included
26-Apr-17	Horned Lark	S	32	38	7d	33	290	Scavenged-feather spot	Included
09-May-17	Horned Lark	S	32	2	28d	36	260	Scavenged-decomposed	Included
11-May-17	Horned Lark	S	32	14	Incidental	107	80	Scavenged-fresh	Excluded: off plot
11-May-17	Horned Lark	S	32	14	7d	71	280	Scavenged-partial decomposed	Included
16-May-17	Horned Lark	S	32	47	28d	51	40	Scavenged-feather spot	Included
23-May-17	Horned Lark	S	32	10	28d	23	100	Scavenged-partial decomposed	Included
25-May-17	Horned Lark	S	32	26	28d	7	250	Intact-partial decomposed	Included
25-May-17	Horned Lark	S	32	23	28d	15	300	Scavenged-partial decomposed	Included
29-May-17	Horned Lark	S	32	16	7d	86	80	Scavenged-partial decomposed	Included
08-Jun-17	Horned Lark	S	32	18	28d	2	10	Intact-partial decomposed	Included
09-Jun-17	Horned Lark	S	32	20	28d	28	70	Scavenged-partial decomposed	Included
14-Jun-17	Horned Lark	S	32	19	7d	80	10	Scavenged-fresh	Included
15-Jun-17	Horned Lark	S	32	9	28d	46	180	Intact-partial decomposed	Included
21-Jun-17	Horned Lark	S	32	16	7d	80	30	Scavenged-feather spot	Included
27-Jun-17	Horned Lark	S	32	44	28d	45	120	Scavenged-partial decomposed	Included
05-Jul-17	Horned Lark	S	32	21	7d	30	285	Scavenged-fresh	Included
14-Jul-17	Horned Lark	S	32	31	7d	17	110	Scavenged-feather spot	Included
18-Jul-17	Horned Lark	S	32	10	28d	9	20	Scavenged-partial decomposed	Included
26-Jul-17	Horned Lark	S	32	43	7d	65	60	Scavenged-partial decomposed	Included
26-Jul-17	Horned Lark	S	32	43	7d	68	60	Scavenged-partial decomposed	Included
28-Jul-17	Horned Lark	S	32	31	7d	10	120	Scavenged-fresh	Included
09-Aug-17	Horned Lark	S	32	38	7d	26	90	Scavenged-partial decomposed	Included
10-Aug-17	Horned Lark	S	32	36	28d	62	350	Scavenged-partial decomposed	Included
21-Aug-17	Horned Lark	S	32	5	7d	70	105	Scavenged-partial decomposed	Included
22-Aug-17	Horned Lark	S	32	45	28d	30	220	Scavenged-decomposed	Included
23-Aug-17	Horned Lark	S	32	16	7d	52	74	Scavenged-feather spot	Included
23-Aug-17	Horned Lark	S	32	38	7d	33	324	Intact-fresh	Included
12-Sep-17	Horned Lark	S	32	10	28d	76	240	Scavenged-partial decomposed	Included
12-Sep-17	Horned Lark	S	32	13	28d	35	100	Intact-partial decomposed	Included
13-Dec-16	House Finch	S	21	8	28d	85	280	Scavenged-fresh	Included
03-Apr-17	House Wren	S	11	32	7d	79	60	Scavenged-partial decomposed	Included
23-Jun-17	House Wren	S	11	33	7d	70	60	Intact-partial decomposed	Included
10-Jul-17	House Wren	S	11	35	7d	89	10	Scavenged-partial decomposed	Included
10-Jul-17	House Wren	S	11	35	7d	100	20	Scavenged-partial decomposed	Included
12-Jul-17	House Wren	S	11	16	7d	35	10	Intact-partial decomposed	Included
12-Jul-17	House Wren	S	11	43	7d	70	30	Scavenged-partial decomposed	Included
13-Jul-17	House Wren	S	11	36	28d	74	50	Scavenged-partial decomposed	Included
14-Jul-17	House Wren	S	11	24	7d	68	30	Scavenged-partial decomposed	Included
17-Jul-17	House Wren	S	11	5	7d	56	40	Intact-partial decomposed	Included
19-Jul-17	House Wren	S	11	16	7d	70	60	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
20-Jul-17	House Wren	S	11	25	Incidental	134	40	Intact-fresh	Excluded: off plot
27-Jul-17	House Wren	S	11	29	Incidental	110	80	Scavenged-partial decomposed	Excluded: off plot
31-Jul-17	House Wren	S	11	35	7d	30	60	Scavenged-partial decomposed	Included
03-Aug-17	House Wren	S	11	17	28d	80	210	Scavenged-partial decomposed	Included
03-Aug-17	House Wren	S	11	18	28d	80	40	Scavenged-decomposed	Included
03-Aug-17	House Wren	S	11	17	28d	80	70	Intact-partial decomposed	Included
03-Aug-17	House Wren	S	11	22	28d	100	40	Scavenged-partial decomposed	Included
09-Aug-17	House Wren	S	11	4	7d	60	55	Scavenged-partial decomposed	Included
10-Aug-17	House Wren	S	11	36	28d	79	30	Scavenged-partial decomposed	Included
11-Aug-17	House Wren	S	11	24	7d	90	60	Scavenged-partial decomposed	Included
14-Aug-17	House Wren	S	11	37	7d	40	80	Intact-partial decomposed	Included
17-Aug-17	House Wren	S	11	27	28d	30	80	Scavenged-partial decomposed	Included
21-Aug-17	House Wren	S	11	35	7d	95	95	Scavenged-partial decomposed	Included
31-Aug-17	House Wren	S	11	20	Incidental	107	60	Scavenged-partial decomposed	Excluded: off plot
08-Sep-17	House Wren	S	11	14	Incidental	110	70	Scavenged-partial decomposed	Excluded: off plot
11-Sep-17	House Wren	S	11	5	7d	40	40	Scavenged-partial decomposed	Included
14-Sep-17	House Wren	S	11	27	28d	87	35	Scavenged-partial decomposed	Included
16-May-17	Mallard	L	1225	47	28d	129	100	Intact-decomposed	Included
21-Sep-16	Mourning Dove	M	120	11	28d	80	80	Scavenged-decomposed	Excluded: predates survey
06-Feb-17	Mourning Dove	M	120	21	7d	98	176	Scavenged-feather spot	Included
18-Jul-17	Mourning Dove	M	120	13	28d	62	100	Intact-fresh	Included
18-Jul-17	Mourning Dove	M	120	13	28d	80	100	Scavenged-fresh	Included
15-May-17	Orange-crowned Warbler	S	10	5	7d	87	85	Scavenged-partial decomposed	Included
15-May-17	Orange-crowned Warbler	S	10	35	7d	90	50	Scavenged-partial decomposed	Included
06-Jun-17	Orange-crowned Warbler	S	10	2	28d	70	80	Intact-decomposed	Included
31-Aug-17	Orange-crowned Warbler	S	10	20	28d	43	60	Intact-fresh	Included
17-Oct-16	Prairie Falcon	L	709	5	7d	92	53	Scavenged-decomposed	Included
20-Sep-16	Red-tailed Hawk	L	1080	31	7d	35	250	Scavenged-decomposed	Excluded: predates survey
21-Sep-16	Red-tailed Hawk	L	1080	38	7d	87	70	Other, see notes	Excluded: predates survey
21-Sep-16	Red-tailed Hawk	L	1080	43	7d	20	182	Scavenged-decomposed	Excluded: predates survey
26-Sep-16	Red-tailed Hawk	L	1080	40	7d	24	12	Intact-fresh	Included
03-Oct-16	Red-tailed Hawk	L	1080	3	Incidental	342	280	Intact-fresh	Excluded: off plot
04-Oct-16	Red-tailed Hawk	L	1080	34	28d	47	72	Scavenged-partial decomposed	Excluded: predates survey
04-Oct-16	Red-tailed Hawk	L	1080	46	28d	25	118	Intact-fresh	Included
05-Oct-16	Red-tailed Hawk	L	1080	43	7d	59	331	Scavenged-decomposed	Excluded: predates survey
05-Oct-16	Red-tailed Hawk	L	1080	4	7d	25	95	Intact-fresh	Included
10-Oct-16	Red-tailed Hawk	L	1080	40	7d	24	170	Intact-fresh	Included
11-Oct-16	Red-tailed Hawk	L	1080	3	28d	83	27	Scavenged-decomposed	Excluded: predates survey
17-Oct-16	Red-tailed Hawk	L	1080	16	7d	30	103	Intact-fresh	Included
24-Oct-16	Red-tailed Hawk	L	1080	5	Incidental	112	39	Scavenged-feather spot	Excluded: off plot
25-Oct-16	Red-tailed Hawk	L	1080	2	28d	85	118	Scavenged-partial decomposed	Included
31-Oct-16	Red-tailed Hawk	L	1080	31	Incidental	116	300	Scavenged-partial decomposed	Excluded: off plot
01-Nov-16	Red-tailed Hawk	L	1080	34	28d	50	326	Scavenged-decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
02-Nov-16	Red-tailed Hawk	L	1080	33	7d	45	340	Intact-fresh	Included
08-Nov-16	Red-tailed Hawk	L	1080	6	Incidental	126	344	Scavenged-decomposed	Excluded: off plot
08-Nov-16	Red-tailed Hawk	L	1080	13	28d	19	232	Scavenged-partial decomposed	Included
08-Nov-16	Red-tailed Hawk	L	1080	10	28d	96	333	Scavenged-fresh	Included
10-Nov-16	Red-tailed Hawk	L	1080	23	28d	79	33	Scavenged-decomposed	Included
10-Nov-16	Red-tailed Hawk	L	1080	28	28d	49	153	Other, see notes	Included
10-Nov-16	Red-tailed Hawk	L	1080	26	28d	19	310	Intact-partial decomposed	Included
15-Nov-16	Red-tailed Hawk	L	1080	39	28d	7	90	Intact-decomposed	Included
22-Nov-16	Red-tailed Hawk	L	1080	22	28d	84	10	Scavenged-decomposed	Included
22-Nov-16	Red-tailed Hawk	L	1080	2	28d	37	160	Intact-partial decomposed	Included
22-Nov-16	Red-tailed Hawk	L	1080	15	28d	67	360	Intact-fresh	Included
22-Nov-16	Red-tailed Hawk	L	1080	17	28d	37	200	Intact-partial decomposed	Included
22-Nov-16	Red-tailed Hawk	L	1080	22	28d	2	340	Intact-partial decomposed	Included
23-Nov-16	Red-tailed Hawk	L	1080	24	7d	33	90	Scavenged-fresh	Included
28-Nov-16	Red-tailed Hawk	L	1080	16	7d	20	180	Scavenged-fresh	Included
29-Nov-16	Red-tailed Hawk	L	1080	36	28d	67	120	Scavenged-decomposed	Included
29-Nov-16	Red-tailed Hawk	L	1080	48	28d	33	20	Intact-partial decomposed	Included
05-Dec-16	Red-tailed Hawk	L	1080	37	7d	64	142	Scavenged-partial decomposed	Included
06-Dec-16	Red-tailed Hawk	L	1080	28	28d	16	240	Scavenged-fresh	Included
07-Dec-16	Red-tailed Hawk	L	1080	4	Incidental	145	190	Intact-fresh	Excluded: off plot
07-Dec-16	Red-tailed Hawk	L	1080	31	7d	62	60	Intact-fresh	Included
12-Dec-16	Red-tailed Hawk	L	1080	11	28d	69	80	Intact-partial decomposed	Included
13-Dec-16	Red-tailed Hawk	L	1080	41	28d	33	140	Scavenged-partial decomposed	Included
14-Dec-16	Red-tailed Hawk	L	1080	31	7d	1	360	Intact-fresh	Included
27-Dec-16	Red-tailed Hawk	L	1080	2	28d	28	348	Intact-fresh	Included
28-Dec-16	Red-tailed Hawk	L	1080	9	28d	57	15	Intact-fresh	Included
29-Dec-16	Red-tailed Hawk	L	1080	34	Incidental	228	360	Intact-partial decomposed	Excluded: off plot
04-Jan-17	Red-tailed Hawk	L	1080	28	28d	39	320	Scavenged-partial decomposed	Included
11-Jan-17	Red-tailed Hawk	L	1080	11	Incidental	147	240	Scavenged-fresh	Excluded: off plot
18-Jan-17	Red-tailed Hawk	L	1080	31	7d	15	10	Scavenged-fresh	Included
23-Jan-17	Red-tailed Hawk	L	1080	37	7d	33	110	Scavenged-fresh	Included
24-Jan-17	Red-tailed Hawk	L	1080	9	28d	45	170	Scavenged-partial decomposed	Included
24-Jan-17	Red-tailed Hawk	L	1080	9	28d	59	170	Scavenged-fresh	Included
24-Jan-17	Red-tailed Hawk	L	1080	9	28d	52	90	Intact-fresh	Included
25-Jan-17	Red-tailed Hawk	L	1080	31	7d	38	30	Intact-fresh	Included
06-Feb-17	Red-tailed Hawk	L	1080	21	7d	63	244	Other, see notes	Included
07-Feb-17	Red-tailed Hawk	L	1080	41	28d	42	132	Intact-partial decomposed	Included
14-Feb-17	Red-tailed Hawk	L	1080	17	28d	52	300	Intact-partial decomposed	Included
15-Feb-17	Red-tailed Hawk	L	1080	33	7d	59	330	Scavenged-fresh	Included
21-Feb-17	Red-tailed Hawk	L	1080	5	7d	82	20	Intact-fresh	Included
01-Mar-17	Red-tailed Hawk	L	1080	4	7d	7	116	Intact-fresh	Included
07-Mar-17	Red-tailed Hawk	L	1080	45	28d	27	230	Intact-partial decomposed	Included
07-Mar-17	Red-tailed Hawk	L	1080	39	28d	26	40	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
14-Mar-17	Red-tailed Hawk	L	1080	22	28d	47	5	Scavenged-partial decomposed	Included
15-Mar-17	Red-tailed Hawk	L	1080	26	28d	84	20	Intact-fresh	Included
04-Apr-17	Red-tailed Hawk	L	1080	29	Incidental	123	280	Scavenged-decomposed	Excluded: off plot
04-Apr-17	Red-tailed Hawk	L	1080	45	28d	25	100	Intact-partial decomposed	Included
19-Apr-17	Red-tailed Hawk	L	1080	33	7d	20	80	Intact-partial decomposed	Included
02-May-17	Red-tailed Hawk	L	1080	11	28d	30	160	Intact-partial decomposed	Included
04-May-17	Red-tailed Hawk	L	1080	8	28d	20	70	Intact-decomposed	Included
10-May-17	Red-tailed Hawk	L	1080	4	Incidental	108	160	Other, see notes	Excluded: off plot
30-May-17	Red-tailed Hawk	L	1080	11	28d	52	20	Intact-partial decomposed	Included
13-Jun-17	Red-tailed Hawk	L	1080	46	28d	42	340	Intact-partial decomposed	Included
01-Sep-17	Red-tailed Hawk	L	1080	24	7d	70	130	Intact-fresh	Included
22-Feb-17	Red-winged Blackbird	S	52	47	28d	22	270	Intact-partial decomposed	Included
28-Jun-17	Rock Pigeon	M	270	32	7d	30	75	Intact-fresh	Included
16-Jan-17	Rough-legged Hawk	L	990	44	28d	68	190	Intact-fresh	Included
11-Oct-16	Savannah Sparrow	S	19	13	28d	64	87	Scavenged-fresh	Included
24-Jan-17	Savannah Sparrow	S	19	42	Incidental	118	110	Scavenged-feather spot	Excluded: off plot
13-Feb-17	Savannah Sparrow	S	19	32	Incidental	108	210	Scavenged-feather spot	Excluded: off plot
20-Sep-16	Sharp-shinned Hawk	M	141	44	28d	23	54	Scavenged-decomposed	Excluded: predates survey
21-Mar-17	Short-eared Owl	M	350	47	28d	90	360	Scavenged-decomposed	Included
05-Jun-17	Swainson's Thrush	S	31	5	7d	70	80	Scavenged-partial decomposed	Included
03-Oct-16	Townsend's Warbler	S	8.8	32	7d	85	64	Scavenged-feather spot	Excluded: predates survey
05-Jun-17	Townsend's Warbler	S	8.8	5	7d	95	65	Scavenged-partial decomposed	Included
05-Jun-17	Townsend's Warbler	S	8.8	5	7d	80	80	Scavenged-partial decomposed	Included
13-Jul-17	Townsend's Warbler	S	8.8	9	Incidental	108	30	Scavenged-partial decomposed	Excluded: off plot
12-Jul-17	Tricolored Blackbird	S	59	40	7d	97	310	Intact-partial decomposed	Included
04-Jun-17	Turkey Vulture	L (VL)	1830	12	28d	7	240	Intact-fresh	Included
07-Jun-17	Turkey Vulture	L (VL)	1830	16	7d	71	10	Intact-decomposed	Included
25-Jul-17	Turkey Vulture	L (VL)	1830	45	28d	30	5	Intact-partial decomposed	Included
13-Sep-17	Turkey Vulture	L (VL)	1830	40	7d	34	50	Other, see notes	Included
15-Sep-17	Turkey Vulture	L (VL)	1830	14	7d	73	10	Other, see notes	Included
17-Oct-16	Unknown blackbird	S	52	32	Incidental	109	58	Scavenged-partial decomposed	Excluded: off plot
04-May-17	Unknown blackbird	S	52	38	7d	85	20	Scavenged-feather spot	Included
17-May-17	Unknown blackbird	S	52	32	7d	68	210	Scavenged-partial decomposed	Included
08-Jun-17	Unknown blackbird	S	52	22	28d	65	270	Scavenged-feather spot	Included
13-Jun-17	Unknown blackbird	S	52	47	28d	25	300	Intact-partial decomposed	Included
14-Jun-17	Unknown blackbird	S	52	19	7d	28	130	Intact-partial decomposed	Included
30-Jun-17	Unknown blackbird	S	52	14	Incidental	125	80	Scavenged-feather spot	Excluded: off plot
07-Feb-17	Unknown buteo	L	1075	29	Incidental	125	68	Scavenged-feather spot	Excluded: off plot
10-May-17	Unknown flycatcher	S	11	4	7d	49	70	Scavenged-partial decomposed	Included
05-Jun-17	Unknown flycatcher	S	11	5	7d	65	55	Scavenged-partial decomposed	Included
28-Jun-17	Unknown flycatcher	S	11	4	7d	71	40	Scavenged-partial decomposed	Included
31-Jul-17	Unknown flycatcher	S	11	5	7d	97	30	Scavenged-partial decomposed	Included
07-Sep-17	Unknown flycatcher	S	11	30	28d	100	50	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
01-Sep-17	Unknown hummingbird	S	3.5	31	7d	40	190	Scavenged-feather spot	Included
25-Oct-16	Unknown large bird	L	1708	18	28d	58	42	Scavenged-decomposed	Included
04-Nov-16	Unknown large bird	L	1708	5	7d	15	53	Scavenged-fresh	Included
13-Dec-16	Unknown large raptor	L	1075	25	Incidental	111	190	Scavenged-feather spot	Excluded: off plot
14-Jun-17	Unknown medium bird	M	276	21	7d	5	10	Scavenged-partial decomposed	Included
19-Jul-17	Unknown passerine	S	38	19	Incidental	119	10	Scavenged-partial decomposed	Excluded: off plot
05-Jun-17	Unknown passerine	S	38	5	Incidental	110	15	Scavenged-feather spot	Excluded: off plot
28-Feb-17	Unknown passerine or swift	S	38	10	Incidental	114	250	Scavenged-fresh	Excluded: off plot
29-Dec-16	Unknown raptor	L	1075	33	7d	90	60	Scavenged-decomposed	Included
05-Jan-17	Unknown raptor	L	1075	31	7d	59	320	Scavenged-decomposed	Included
03-May-17	Unknown raptor	L	1075	4	7d	1	190	Scavenged-feather spot	Included
07-Oct-16	Unknown small bird	S	38	43	7d	20	175	Scavenged-feather spot	Excluded: predates survey
14-Oct-16	Unknown small bird	S	38	19	7d	9	220	Scavenged-decomposed	Excluded: predates survey
18-Oct-16	Unknown small bird	S	38	45	28d	87	68	Scavenged-feather spot	Included
19-Oct-16	Unknown small bird	S	38	16	7d	10	293	Scavenged-decomposed	Included
25-Oct-16	Unknown small bird	S	38	1	28d	90	1	Scavenged-feather spot	Included
26-Oct-16	Unknown small bird	S	38	43	7d	73	80	Scavenged-feather spot	Included
26-Oct-16	Unknown small bird	S	38	43	7d	43	121	Scavenged-feather spot	Included
28-Oct-16	Unknown small bird	S	38	14	7d	14	47	Scavenged-fresh	Included
16-May-17	Unknown small bird	S	38	46	28d	20	195	Scavenged-feather spot	Included
05-Jun-17	Unknown small bird	S	38	5	7d	70	80	Scavenged-partial decomposed	Included
21-Aug-17	Unknown small bird	S	38	5	7d	100	40	Scavenged-feather spot	Included
31-May-17	Unknown small grebe	M	450	5	Incidental	124	160	Scavenged-partial decomposed	Excluded: off plot
12-Dec-16	Unknown sparrow	S	25	21	7d	34	180	Scavenged-feather spot	Included
15-Jun-17	Unknown vireo	S	38	34	Incidental	109	60	Scavenged-partial decomposed	Excluded: off plot
15-May-17	Unknown warbler	S	9.3	5	7d	90	50	Scavenged-partial decomposed	Included
21-Jun-17	Unknown warbler	S	9.3	21	7d	46	30	Scavenged-partial decomposed	Included
13-Jul-17	Unknown warbler	S	9.3	9	Incidental	109	50	Scavenged-feather spot	Excluded: off plot
14-Aug-17	Unknown warbler	S	9.3	5	Incidental	120	15	Scavenged-partial decomposed	Excluded: off plot
16-Aug-17	Unknown warbler	S	9.3	43	Incidental	108	60	Scavenged-partial decomposed	Excluded: off plot
23-Aug-17	Unknown warbler	S	9.3	21	7d	17	70	Scavenged-feather spot	Included
31-Aug-17	Unknown warbler	S	9.3	20	Incidental	134	60	Scavenged-feather spot	Excluded: off plot
04-Sep-17	Unknown warbler	S	9.3	5	7d	60	60	Scavenged-feather spot	Included
27-Sep-16	Vaux's Swift	S	18	22	28d	39	260	Scavenged-feather spot	Included
10-Oct-16	Vaux's Swift	S	18	5	7d	71	44	Scavenged-feather spot	Included
25-May-17	Vaux's Swift	S	18	26	28d	55	50	Scavenged-partial decomposed	Included
25-Oct-16	Virginia Rail	S	85	15	28d	98	28	Scavenged-feather spot	Included
31-May-17	Warbling Vireo	S	12	5	Incidental	112	60	Scavenged-partial decomposed	Excluded: off plot
19-Jul-17	Warbling Vireo	S	12	4	7d	83	40	Scavenged-partial decomposed	Included
10-Aug-17	Warbling Vireo	S	12	9	28d	70	355	Scavenged-partial decomposed	Included
03-May-17	Western Flycatcher	S	11	4	7d	64	20	Intact-fresh	Included
08-May-17	Western Flycatcher	S	11	5	7d	98	10	Intact-fresh	Included
31-May-17	Western Flycatcher	S	11	25	Incidental	107	20	Intact-fresh	Excluded: off plot

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
04-Nov-16	Western Grebe	L	1500	38	Incidental	117	299	Scavenged-fresh	Excluded: off plot
21-Sep-16	Western Meadowlark	S	100	43	7d	95	90	Scavenged-feather spot	Excluded: predates survey
22-Sep-16	Western Meadowlark	S	100	24	Incidental	111	103	Scavenged-feather spot	Excluded: off plot
27-Sep-16	Western Meadowlark	S	100	22	28d	94	254	Scavenged-feather spot	Excluded: predates survey
28-Sep-16	Western Meadowlark	S	100	43	7d	40	220	Scavenged-feather spot	Excluded: predates survey
01-Nov-16	Western Meadowlark	S	100	47	28d	34	346	Scavenged-feather spot	Included
09-Nov-16	Western Meadowlark	S	100	31	7d	70	316	Scavenged-feather spot	Included
05-Dec-16	Western Meadowlark	S	100	16	7d	73	270	Scavenged-feather spot	Included
20-Dec-16	Western Meadowlark	S	100	2	28d	63	100	Scavenged-fresh	Included
27-Dec-16	Western Meadowlark	S	100	40	Incidental	111	303	Scavenged-feather spot	Excluded: off plot
27-Dec-16	Western Meadowlark	S	100	16	7d	98	272	Scavenged-feather spot	Included
28-Dec-16	Western Meadowlark	S	100	36	28d	104	188	Scavenged-feather spot	Included
04-Jan-17	Western Meadowlark	S	100	3	28d	94	20	Scavenged-feather spot	Included
11-Jan-17	Western Meadowlark	S	100	29	28d	55	270	Scavenged-fresh	Included
23-Jan-17	Western Meadowlark	S	100	21	7d	84	200	Scavenged-fresh	Included
08-Feb-17	Western Meadowlark	S	100	44	28d	40	207	Scavenged-feather spot	Included
22-Feb-17	Western Meadowlark	S	100	36	Incidental	109	170	Scavenged-fresh	Excluded: off plot
22-Feb-17	Western Meadowlark	S	100	48	28d	56	180	Scavenged-partial decomposed	Included
14-Mar-17	Western Meadowlark	S	100	20	28d	56	110	Scavenged-feather spot	Included
15-Mar-17	Western Meadowlark	S	100	33	7d	1	140	Intact-partial decomposed	Included
15-Mar-17	Western Meadowlark	S	100	38	7d	72	285	Scavenged-feather spot	Included
22-Mar-17	Western Meadowlark	S	100	38	7d	75	315	Scavenged-partial decomposed	Included
04-Apr-17	Western Meadowlark	S	100	8	28d	43	185	Intact-partial decomposed	Included
08-May-17	Western Meadowlark	S	100	5	7d	94	60	Scavenged-feather spot	Included
25-May-17	Western Meadowlark	S	100	33	7d	64	140	Intact-partial decomposed	Included
06-Jun-17	Western Meadowlark	S	100	12	28d	37	110	Intact-partial decomposed	Included
07-Jun-17	Western Meadowlark	S	100	4	7d	85	180	Scavenged-partial decomposed	Included
18-Jul-17	Western Meadowlark	S	100	6	28d	97	140	Scavenged-feather spot	Included
18-Jul-17	Western Meadowlark	S	100	10	28d	96	200	Intact-partial decomposed	Included
25-Jul-17	Western Meadowlark	S	100	44	28d	95	45	Scavenged-feather spot	Included
24-Apr-17	Western Tanager	S	30	32	7d	86	100	Intact-partial decomposed	Included
07-Sep-17	Western Tanager	S	30	36	28d	82	180	Scavenged-feather spot	Included
30-Nov-16	White-tailed Kite	M	335	38	7d	97	40	Scavenged-partial decomposed	Included
19-Oct-16	White-throated Swift	S	32	24	7d	28	26	Scavenged-decomposed	Included
19-Oct-16	White-throated Swift	S	32	38	7d	46	118	Scavenged-fresh	Included
24-Oct-16	White-throated Swift	S	32	38	7d	27	24	Scavenged-fresh	Included
13-Dec-16	White-throated Swift	S	32	8	28d	38	160	Scavenged-feather spot	Included
12-Jan-17	White-throated Swift	S	32	19	7d	8	110	Intact-fresh	Included
24-Jan-17	White-throated Swift	S	32	46	28d	30	10	Scavenged-fresh	Included
25-Jan-17	White-throated Swift	S	32	19	7d	90	130	Scavenged-partial decomposed	Included
28-Feb-17	White-throated Swift	S	32	10	28d	36	350	Scavenged-feather spot	Included
31-May-17	White-throated Swift	S	32	19	7d	40	150	Scavenged-partial decomposed	Included
27-Jun-17	White-throated Swift	S	32	11	28d	65	30	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
11-Jul-17	White-throated Swift	S	32	46	28d	37	110	Scavenged-partial decomposed	Included
11-Jul-17	White-throated Swift	S	32	46	28d	27	70	Scavenged-partial decomposed	Included
27-Jul-17	White-throated Swift	S	32	41	28d	50	340	Scavenged-feather spot	Included
31-Jul-17	White-throated Swift	S	32	37	7d	35	50	Intact-partial decomposed	Included
23-Aug-17	White-throated Swift	S	32	43	7d	39	52	Intact-fresh	Included
05-Sep-17	White-throated Swift	S	32	46	28d	20	130	Scavenged-feather spot	Included
17-May-17	Wilson's Warbler	S	7	21	7d	91	90	Scavenged-partial decomposed	Included
22-May-17	Wilson's Warbler	S	7	16	7d	60	50	Scavenged-partial decomposed	Included
01-Jun-17	Wilson's Warbler	S	7	25	28d	66	50	Scavenged-partial decomposed	Included
17-May-17	Yellow Warbler	S	9.8	14	Incidental	110	30	Intact-fresh	Excluded: off plot

[1] S = small (average species mass ≤100 g); M = medium (101–500 g); L = large (501–1799 g); VL = very large (≥1800 g) – generally grouped with large birds.

[2] Sources: Sibley (2016) for birds and University of Michigan (2019) for bats.

[3] Included = included in all fatality estimates. Excluded: predates survey = carcass excluded from all fatality estimates because aging suggested it was deposited more than one search interval before the study began. Excluded: off plot = carcass excluded from adjusted fatality estimates because found outside all survey plots. Included = excluded from Huso DS729 and simplified Horvitz-Thompson estimates that exclude bleed-through detections.

[4] See Appendix S for details.

Appendix N. Fatality and Injury Incidents in Year 2

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
	Bats								
04-Dec-17	California myotis	S	4.4	10	7d	100	160	Scavenged-fresh	Included
18-Sep-17	Hoary bat	S	30	18	7d	20	50	Intact-partial decomposed	Included
19-Sep-17	Hoary bat	S	30	23	7d	60	10	Scavenged-partial decomposed	Included
19-Sep-17	Hoary bat	S	30	23	7d	95	20	Intact-partial decomposed	Included
19-Sep-17	Hoary bat	S	30	23	7d	90	50	Intact-partial decomposed	Included
20-Sep-17	Hoary bat	S	30	29	7d	100	95	Intact-partial decomposed	Included
20-Sep-17	Hoary bat	S	30	34	7d	51	80	Scavenged-partial decomposed	Included
20-Sep-17	Hoary bat	S	30	34	7d	101	50	Intact-partial decomposed	Included
20-Sep-17	Hoary bat	S	30	34	7d	92	50	Scavenged-partial decomposed	Included
20-Sep-17	Hoary bat	S	30	34	7d	79	90	Intact-partial decomposed	Included
25-Sep-17	Hoary bat	S	30	3	7d	10	40	Intact-partial decomposed	Included
25-Sep-17	Hoary bat	S	30	18	7d	10	100	Intact-partial decomposed	Included
26-Sep-17	Hoary bat	S	30	13	7d	10	90	Intact-partial decomposed	Included
26-Sep-17	Hoary bat	S	30	22	7d	10	60	Scavenged-partial decomposed	Included
27-Sep-17	Hoary bat	S	30	27	7d	10	95	Intact-partial decomposed	Included
27-Sep-17	Hoary bat	S	30	27	7d	10	45	Intact-partial decomposed	Included
27-Sep-17	Hoary bat	S	30	29	7d	10	30	Intact-partial decomposed	Included
02-Oct-17	Hoary bat	S	30	2	7d	80	240	Scavenged-partial decomposed	Included
05-Oct-17	Hoary bat	S	30	48	7d	100	60	Scavenged-partial decomposed	Included
16-Oct-17	Hoary bat	S	30	3	7d	12	260	Intact-partial decomposed	Included
18-Oct-17	Hoary bat	S	30	11	7d	76	10	Scavenged-partial decomposed	Included
25-Oct-17	Hoary bat	S	30	22	7d	50	100	Intact-partial decomposed	Included
13-Nov-17	Hoary bat	S	30	18	7d	80	30	Scavenged-partial decomposed	Included
15-Nov-17	Hoary bat	S	30	29	7d	80	100	Scavenged-partial decomposed	Included
27-Nov-17	Hoary bat	S	30	10	7d	60	280	Scavenged-partial decomposed	Included
12-Mar-18	Hoary bat	S	30	10	7d	20	230	Intact-fresh	Included
01-May-18	Hoary bat	S	30	13	7d	26	356	Intact-partial decomposed	Included
02-May-18	Hoary bat	S	30	27	7d	15	20	Scavenged-partial decomposed	Included
14-May-18	Hoary bat	S	30	2	7d	80	60	Intact-partial decomposed	Included
21-May-18	Hoary bat	S	30	2	7d	80	30	Intact-partial decomposed	Included
22-May-18	Hoary bat	S	30	13	7d	45	20	Intact-partial decomposed	Included
29-May-18	Hoary bat	S	30	2	7d	95	40	Intact-partial decomposed	Included
31-May-18	Hoary bat	S	30	27	7d	70	70	Intact-fresh	Included
07-Jun-18	Hoary bat	S	30	11	7d	51	90	Scavenged-decomposed	Included
08-Jun-18	Hoary bat	S	30	48	7d	98	94	Scavenged-partial decomposed	Included
11-Jun-18	Hoary bat	S	30	3	7d	70	90	Scavenged-partial decomposed	Included
18-Jun-18	Hoary bat	S	30	3	7d	79	100	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
21-Jun-18	Hoary bat	S	30	33	28d	95	30	Scavenged-partial decomposed	Included
26-Jun-18	Hoary bat	S	30	22	7d	90	35	Intact-fresh	Included
29-Jun-18	Hoary bat	S	30	45	7d	45	60	Intact-partial decomposed	Included
29-Jun-18	Hoary bat	S	30	45	7d	80	55	Intact-fresh	Included
02-Jul-18	Hoary bat	S	30	18	7d	80	45	Intact-partial decomposed	Included
23-Jul-18	Hoary bat	S	30	18	7d	75	40	Intact-partial decomposed	Included
30-Aug-18	Hoary bat	S	30	47	7d	95	90	Scavenged-partial decomposed	Included
06-Sep-18	Hoary bat	S	30	44	7d	60	226	Scavenged-fresh	Included
06-Sep-18	Hoary bat	S	30	48	7d	100	80	Scavenged-partial decomposed	Included
12-Sep-18	Hoary bat	S	30	27	7d	10	20	Scavenged-partial decomposed	Included
18-Sep-17	Mexican free-tailed bat	S	9.5	18	7d	100	80	Intact-partial decomposed	Included
18-Sep-17	Mexican free-tailed bat	S	9.5	18	7d	16	350	Intact-partial decomposed	Included
19-Sep-17	Mexican free-tailed bat	S	9.5	13	7d	60	65	Intact-partial decomposed	Included
19-Sep-17	Mexican free-tailed bat	S	9.5	22	7d	15	80	Scavenged-partial decomposed	Included
19-Sep-17	Mexican free-tailed bat	S	9.5	22	7d	90	70	Intact-partial decomposed	Included
19-Sep-17	Mexican free-tailed bat	S	9.5	23	7d	70	190	Scavenged-partial decomposed	Included
20-Sep-17	Mexican free-tailed bat	S	9.5	27	7d	20	35	Scavenged-decomposed	Included
20-Sep-17	Mexican free-tailed bat	S	9.5	34	7d	52	25	Scavenged-fresh	Included
20-Sep-17	Mexican free-tailed bat	S	9.5	34	7d	25	80	Scavenged-partial decomposed	Included
20-Sep-17	Mexican free-tailed bat	S	9.5	34	7d	88	20	Scavenged-fresh	Included
25-Sep-17	Mexican free-tailed bat	S	9.5	2	7d	30	75	Intact-partial decomposed	Included
25-Sep-17	Mexican free-tailed bat	S	9.5	2	7d	10	60	Intact-partial decomposed	Included
25-Sep-17	Mexican free-tailed bat	S	9.5	3	7d	10	40	Intact-fresh	Included
25-Sep-17	Mexican free-tailed bat	S	9.5	10	7d	10	30	Intact-partial decomposed	Included
26-Sep-17	Mexican free-tailed bat	S	9.5	22	7d	10	45	Intact-fresh	Included
26-Sep-17	Mexican free-tailed bat	S	9.5	22	7d	10	345	Intact-partial decomposed	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	28	28d	10	130	Intact-fresh	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	11	7d	10	160	Intact-fresh	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	11	7d	10	115	Intact-fresh	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	27	7d	10	65	Scavenged-partial decomposed	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	27	7d	10	180	Scavenged-partial decomposed	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	29	7d	10	60	Scavenged-partial decomposed	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	29	7d	10	50	Intact-fresh	Included
27-Sep-17	Mexican free-tailed bat	S	9.5	29	7d	10	290	Intact-fresh	Included
28-Sep-17	Mexican free-tailed bat	S	9.5	34	7d	10	30	Intact-partial decomposed	Included
28-Sep-17	Mexican free-tailed bat	S	9.5	34	7d	10	195	Intact-fresh	Included
02-Oct-17	Mexican free-tailed bat	S	9.5	2	7d	40	10	Scavenged-partial decomposed	Included
02-Oct-17	Mexican free-tailed bat	S	9.5	2	7d	100	90	Intact-partial decomposed	Included
02-Oct-17	Mexican free-tailed bat	S	9.5	3	7d	60	70	Scavenged-partial decomposed	Included
02-Oct-17	Mexican free-tailed bat	S	9.5	10	7d	50	60	Intact-partial decomposed	Included
03-Oct-17	Mexican free-tailed bat	S	9.5	22	Incidental	110	65	Intact-fresh	Excluded: off plot
03-Oct-17	Mexican free-tailed bat	S	9.5	22	7d	80	130	Intact-fresh	Included
04-Oct-17	Mexican free-tailed bat	S	9.5	11	7d	90	30	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
05-Oct-17	Mexican free-tailed bat	S	9.5	27	7d	55	80	Intact-fresh	Included
05-Oct-17	Mexican free-tailed bat	S	9.5	48	7d	20	340	Intact-partial decomposed	Included
05-Oct-17	Mexican free-tailed bat	S	9.5	48	7d	15	85	Intact-partial decomposed	Included
05-Oct-17	Mexican free-tailed bat	S	9.5	48	7d	22	330	Intact-partial decomposed	Included
09-Oct-17	Mexican free-tailed bat	S	9.5	2	7d	8	50	Intact-partial decomposed	Included
09-Oct-17	Mexican free-tailed bat	S	9.5	18	7d	30	190	Intact-partial decomposed	Included
13-Oct-17	Mexican free-tailed bat	S	9.5	10	7d	40	90	Intact-fresh	Included
16-Oct-17	Mexican free-tailed bat	S	9.5	10	7d	80	80	Scavenged-decomposed	Included
16-Oct-17	Mexican free-tailed bat	S	9.5	10	7d	100	105	Intact-partial decomposed	Included
16-Oct-17	Mexican free-tailed bat	S	9.5	18	7d	2	340	Intact-partial decomposed	Included
17-Oct-17	Mexican free-tailed bat	S	9.5	23	7d	40	160	Scavenged-decomposed	Included
18-Oct-17	Mexican free-tailed bat	S	9.5	29	7d	30	180	Intact-partial decomposed	Included
23-Oct-17	Mexican free-tailed bat	S	9.5	18	7d	2	270	Intact-fresh	Included
26-Oct-17	Mexican free-tailed bat	S	9.5	45	7d	25	170	Scavenged-partial decomposed	Included
20-Nov-17	Mexican free-tailed bat	S	9.5	3	7d	15	180	Scavenged-partial decomposed	Included
23-Nov-17	Mexican free-tailed bat	S	9.5	48	7d	60	130	Intact-partial decomposed	Included
30-Nov-17	Mexican free-tailed bat	S	9.5	45	Incidental	135	50	Scavenged-partial decomposed	Excluded: off plot
05-Dec-17	Mexican free-tailed bat	S	9.5	22	7d	70	160	Scavenged-partial decomposed	Included
26-Mar-18	Mexican free-tailed bat	S	9.5	2	7d	72	42	Intact-fresh	Included
27-Mar-18	Mexican free-tailed bat	S	9.5	22	7d	8	339	Intact-partial decomposed	Included
14-May-18	Mexican free-tailed bat	S	9.5	2	7d	20	20	Intact-partial decomposed	Included
14-May-18	Mexican free-tailed bat	S	9.5	2	7d	100	60	Intact-partial decomposed	Included
17-May-18	Mexican free-tailed bat	S	9.5	48	7d	90	30	Intact-partial decomposed	Included
21-May-18	Mexican free-tailed bat	S	9.5	3	7d	95	200	Intact-partial decomposed	Included
21-May-18	Mexican free-tailed bat	S	9.5	3	7d	20	90	Intact-partial decomposed	Included
06-Jun-18	Mexican free-tailed bat	S	9.5	10	7d	60	46	Scavenged-partial decomposed	Included
11-Jun-18	Mexican free-tailed bat	S	9.5	3	7d	80	60	Intact-partial decomposed	Included
12-Jun-18	Mexican free-tailed bat	S	9.5	22	7d	78	92	Intact-partial decomposed	Included
12-Jun-18	Mexican free-tailed bat	S	9.5	22	7d	100	78	Scavenged-partial decomposed	Included
29-Jun-18	Mexican free-tailed bat	S	9.5	45	7d	100	140	Intact-fresh	Included
12-Jul-18	Mexican free-tailed bat	S	9.5	44	7d	47	68	Scavenged-partial decomposed	Included
16-Jul-18	Mexican free-tailed bat	S	9.5	10	7d	65	120	Scavenged-partial decomposed	Included
24-Jul-18	Mexican free-tailed bat	S	9.5	23	7d	60	95	Intact-partial decomposed	Included
25-Jul-18	Mexican free-tailed bat	S	9.5	34	7d	95	75	Scavenged-partial decomposed	Included
31-Jul-18	Mexican free-tailed bat	S	9.5	30	Incidental	115	60	Scavenged-partial decomposed	Excluded: off plot
20-Aug-18	Mexican free-tailed bat	S	9.5	2	7d	102	10	Intact-partial decomposed	Included
11-Sep-18	Mexican free-tailed bat	S	9.5	41	28d	46	50	Scavenged-partial decomposed	Included
12-Sep-18	Mexican free-tailed bat	S	9.5	29	7d	30	55	Intact-fresh	Included
12-Jun-18	Unknown bat	S	14	23	7d	44	72	Scavenged-partial decomposed	Included
04-Jul-18	Unknown bat	S	14	27	7d	100	80	Intact-partial decomposed	Included
27-Sep-17	Western red bat	S	8	27	7d	10	60	Intact-partial decomposed	Included
21-Nov-17	Western red bat	S	8	17	28d	5	260	Intact-fresh	Included
24-Apr-18	Western red bat	S	8	30	7d	70	5	Intact-fresh	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
12-Sep-18	Western red bat	S	8	11	Incidental	130	80	Intact-partial decomposed	Excluded: off plot
	Birds								
26-Sep-17	American Kestrel	M	125	13	7d	10	170	Intact-partial decomposed	Included
27-Sep-17	American Kestrel	M	125	14	28d	10	324	Scavenged-feather spot	Included
02-Oct-17	American Kestrel	M	125	10	7d	37	170	Intact-partial decomposed	Included
09-Oct-17	American Kestrel	M	125	18	7d	15	280	Scavenged-partial decomposed	Included
18-Oct-17	American Kestrel	M	125	11	7d	87	70	Scavenged-feather spot	Included
26-Oct-17	American Kestrel	M	125	44	7d	80	60	Scavenged-feather spot	Included
08-Nov-17	American Kestrel	M	125	34	7d	20	110	Intact-fresh	Included
29-Nov-17	American Kestrel	M	125	11	Incidental	135	20	Scavenged-partial decomposed	Excluded: off plot
27-Dec-17	American Kestrel	M	125	22	7d	45	315	Scavenged-feather spot	Included
04-Jun-18	American Kestrel	M	125	13	Incidental	282	64	Scavenged-feather spot	Excluded: off plot
20-Aug-18	American Kestrel	M	125	3	7d	40	350	Intact-fresh	Included
03-Jan-18	American Pipit	S	21	40	28d	8	344	Intact-fresh	Included
27-Mar-18	American Pipit	S	21	22	7d	13	310	Scavenged-feather spot	Included
29-Mar-18	American Pipit	S	21	33	28d	13	230	Scavenged-partial decomposed	Included
25-Jul-18	Barn Owl	M	460	11	7d	100	320	Scavenged-feather spot	Included
25-Jul-18	Barn Owl	M	460	34	7d	105	355	Scavenged-feather spot	Included
25-Jul-18	Barn Owl	M	460	1	28d	96	290	Intact-partial decomposed	Included
04-Oct-17	Burrowing Owl	M	151	39	28d	94	110	Intact-partial decomposed	Included
10-Oct-17	Burrowing Owl	M	151	22	7d	100	340	Scavenged-feather spot	Included
11-Oct-17	Burrowing Owl	M	151	42	28d	40	50	Scavenged-feather spot	Included
12-Oct-17	Burrowing Owl	M	151	37	28d	43	210	Intact-fresh	Included
14-Nov-17	Burrowing Owl	M	151	23	7d	80	200	Scavenged-feather spot	Included
04-Jan-18	Burrowing Owl	M	151	34	7d	86	280	Scavenged-fresh	Included
05-Jan-18	Burrowing Owl	M	151	33	28d	37	80	Scavenged-partial decomposed	Included
11-Jan-18	Burrowing Owl	M	151	34	7d	90	152	Scavenged-feather spot	Included
15-Feb-18	Burrowing Owl	M	151	9	28d	98	252	Scavenged-feather spot	Included
20-Feb-18	Burrowing Owl	M	151	43	28d	34	265	Intact-fresh	Included
01-Mar-18	Burrowing Owl	M	151	35	28d	100	300	Scavenged-feather spot	Included
15-Mar-18	Burrowing Owl	M	151	9	28d	60	330	Scavenged-fresh	Included
12-Apr-18	Burrowing Owl	M	151	44	7d	50	120	Scavenged-decomposed	Included
25-Apr-18	Burrowing Owl	M	151	37	28d	63	178	Scavenged-feather spot	Included
16-May-18	Burrowing Owl	M	151	11	7d	95	20	Scavenged-partial decomposed	Included
17-May-18	Burrowing Owl	M	151	41	28d	37	180	Scavenged-feather spot	Included
01-Jun-18	Burrowing Owl	M	151	44	7d	60	340	Scavenged-feather spot	Included
19-Jun-18	Burrowing Owl	M	151	23	Incidental	124	130	Scavenged-feather spot	Excluded: off plot
16-Jul-18	Burrowing Owl	M	151	18	7d	60	158	Scavenged-feather spot	Included
19-Jul-18	Burrowing Owl	M	151	48	Incidental	115	135	Intact-partial decomposed	Excluded: off plot
31-Jul-18	Burrowing Owl	M	151	30	7d	40	260	Scavenged-feather spot	Included
16-Aug-18	Burrowing Owl	M	151	47	7d	90	190	Scavenged-feather spot	Included
28-Aug-18	Burrowing Owl	M	151	22	7d	80	85	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
11-Sep-18	Burrowing Owl	M	151	46	28d	53	60	Scavenged-partial decomposed	Included
13-Sep-18	Burrowing Owl	M	151	44	7d	100	45	Scavenged-feather spot	Included
23-May-18	Common Raven	L	1200	36	28d	21	165	Intact-partial decomposed	Included
05-Jun-18	Common Raven	L	1200	3	7d	29	308	Scavenged-partial decomposed	Included
07-Nov-17	European Starling	S	82	22	7d	40	300	Scavenged-feather spot	Included
30-Nov-17	European Starling	S	82	20	28d	28	50	Scavenged-decomposed	Included
21-Dec-17	European Starling	S	82	45	7d	25	30	Scavenged-feather spot	Included
15-Feb-18	European Starling	S	82	45	7d	100	160	Scavenged-feather spot	Included
19-Jun-18	European Starling	S	82	13	7d	88	330	Scavenged-feather spot	Included
21-Nov-17	Ferruginous Hawk	L	1600	17	28d	14	350	Intact-partial decomposed	Included
21-Dec-17	Ferruginous Hawk	L	1600	47	7d	25	170	Other, see notes	Included
23-Feb-18	Ferruginous Hawk	L	1600	44	7d	30	170	Other, see notes	Included
17-Oct-17	Golden Eagle	L (VL)	4200	30	7d	23	230	Intact-partial decomposed	Included
18-Oct-17	Golden Eagle	L (VL)	4200	1	28d	44	260	Intact-partial decomposed	Included
17-Jan-18	Golden Eagle	L (VL)	4200	19	28d	55	182	Other, see notes	Included
07-Feb-18	Golden Eagle	L (VL)	4200	5	28d	70	119	Other, see notes	Included
11-Apr-18	Golden Eagle	L (VL)	4200	8	28d	72	315	Other, see notes	Included
02-May-18	Golden Eagle	L (VL)	4200	11	7d	28	20	Other, see notes	Included
31-May-18	Golden Eagle	L (VL)	4200	16	28d	66	60	Other, see notes	Included
31-May-18	Golden Eagle	L (VL)	4200	16	28d	37	10	Intact-partial decomposed	Included
22-Jun-18	Golden Eagle	L (VL)	4200	37	28d	26	5	Intact-partial decomposed	Included
06-Jul-18	Golden Eagle	L (VL)	4200	33	28d	–	–	Injured-died/euthanized	Included
11-Jul-18	Golden Eagle	L (VL)	4200	14	28d	19	40	Other, see notes	Included
25-Jul-18	Golden Eagle	L (VL)	4200	11	7d	35	170	Other, see notes	Included
22-Aug-18	Golden Eagle	L (VL)	4200	14	28d	79	100	Other, see notes	Included
06-Sep-18	Golden Eagle	L (VL)	4200	39	28d	78	80	Other, see notes	Included
02-Nov-17	Hermit Thrush	S	31	44	7d	20	160	Scavenged-feather spot	Included
22-Aug-18	Hermit Warbler	S	10	11	7d	95	45	Intact-fresh	Included
27-Aug-18	Hermit Warbler	S	10	2	7d	60	50	Intact-partial decomposed	Included
27-Sep-17	Horned Lark	S	32	27	7d	10	230	Intact-decomposed	Included
04-Oct-17	Horned Lark	S	32	39	28d	45	100	Intact-partial decomposed	Included
05-Oct-17	Horned Lark	S	32	47	7d	70	180	Scavenged-partial decomposed	Included
11-Oct-17	Horned Lark	S	32	42	28d	89	100	Scavenged-feather spot	Included
08-Nov-17	Horned Lark	S	32	27	7d	70	40	Scavenged-feather spot	Included
20-Nov-17	Horned Lark	S	32	10	7d	10	245	Intact-fresh	Included
29-Nov-17	Horned Lark	S	32	29	7d	20	100	Intact-partial decomposed	Included
30-Nov-17	Horned Lark	S	32	44	7d	8	100	Scavenged-feather spot	Included
03-Jan-18	Horned Lark	S	32	36	28d	50	166	Intact-fresh	Included
16-Jan-18	Horned Lark	S	32	30	7d	30	120	Scavenged-feather spot	Included
06-Feb-18	Horned Lark	S	32	22	7d	80	100	Scavenged-feather spot	Included
08-Feb-18	Horned Lark	S	32	44	7d	30	355	Scavenged-feather spot	Included
19-Feb-18	Horned Lark	S	32	18	7d	100	170	Scavenged-feather spot	Included
15-Mar-18	Horned Lark	S	32	48	7d	105	120	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
26-Mar-18	Horned Lark	S	32	10	7d	42	70	Intact-fresh	Included
29-Mar-18	Horned Lark	S	32	35	28d	35	160	Intact-fresh	Included
18-Apr-18	Horned Lark	S	32	34	7d	65	354	Scavenged-partial decomposed	Included
01-May-18	Horned Lark	S	32	13	7d	17	52	Intact-partial decomposed	Included
03-May-18	Horned Lark	S	32	45	7d	35	90	Scavenged-partial decomposed	Included
09-May-18	Horned Lark	S	32	29	7d	95	50	Scavenged-partial decomposed	Included
23-May-18	Horned Lark	S	32	27	7d	100	40	Scavenged-partial decomposed	Included
23-May-18	Horned Lark	S	32	29	7d	80	95	Scavenged-feather spot	Included
29-May-18	Horned Lark	S	32	2	7d	40	90	Scavenged-fresh	Included
31-May-18	Horned Lark	S	32	15	28d	20	60	Intact-partial decomposed	Included
06-Jun-18	Horned Lark	S	32	10	7d	78	340	Scavenged-feather spot	Included
07-Jun-18	Horned Lark	S	32	29	7d	68	126	Scavenged-partial decomposed	Included
13-Jun-18	Horned Lark	S	32	27	7d	96	56	Scavenged-partial decomposed	Included
21-Jun-18	Horned Lark	S	32	47	7d	15	308	Scavenged-partial decomposed	Included
27-Jun-18	Horned Lark	S	32	29	7d	70	85	Scavenged-partial decomposed	Included
03-Jul-18	Horned Lark	S	32	13	7d	40	320	Scavenged-feather spot	Included
03-Jul-18	Horned Lark	S	32	22	7d	30	25	Scavenged-feather spot	Included
16-Jul-18	Horned Lark	S	32	3	7d	42	176	Scavenged-fresh	Included
24-Jul-18	Horned Lark	S	32	22	7d	25	340	Scavenged-partial decomposed	Included
11-Sep-18	Horned Lark	S	32	22	7d	10	320	Scavenged-feather spot	Included
18-Dec-17	House Finch	S	21	10	7d	30	250	Scavenged-feather spot	Included
28-Jun-18	House Wren	S	11	27	Incidental	110	6	Scavenged-partial decomposed	Excluded: off plot
01-Aug-18	House Wren	S	11	29	7d	100	60	Intact-fresh	Included
23-Aug-18	Killdeer	S	88	45	7d	95	95	Scavenged-feather spot	Included
24-Jan-18	Loggerhead Shrike	S	47	21	28d	85	208	Scavenged-feather spot	Included
04-Oct-17	Mallard	L	1250	39	28d	55	70	Scavenged-partial decomposed	Included
12-Sep-18	Mallard	L	1225	40	28d	90	205	Scavenged-feather spot	Included
30-Jan-18	Mountain Bluebird	S	30	22	7d	95	240	Scavenged-feather spot	Included
19-Sep-17	Mourning Dove	M	120	13	7d	30	320	Scavenged-feather spot	Included
04-Dec-17	Northern Harrier	M	425	2	7d	5	200	Intact-fresh	Included
21-Dec-17	Prairie Falcon	L	709	47	7d	95	10	Scavenged-partial decomposed	Included
04-Oct-17	Red-tailed Hawk	L	1080	38	Incidental	125	96	Intact-partial decomposed	Excluded: off plot
04-Oct-17	Red-tailed Hawk	L	1080	39	28d	48	110	Intact-fresh	Included
05-Oct-17	Red-tailed Hawk	L	1080	47	7d	55	230	Other, see notes	Included
10-Oct-17	Red-tailed Hawk	L	1080	22	7d	60	200	Other, see notes	Included
12-Oct-17	Red-tailed Hawk	L	1080	33	28d	90	102	Intact-partial decomposed	Included
12-Oct-17	Red-tailed Hawk	L	1080	36	28d	73	360	Other, see notes	Included
12-Oct-17	Red-tailed Hawk	L	1080	37	28d	89	100	Other, see notes	Included
25-Oct-17	Red-tailed Hawk	L	1080	14	28d	59	280	Scavenged-partial decomposed	Included
01-Nov-17	Red-tailed Hawk	L	1080	43	28d	29	100	Intact-partial decomposed	Included
01-Nov-17	Red-tailed Hawk	L	1080	43	28d	77	40	Scavenged-feather spot	Included
07-Nov-17	Red-tailed Hawk	L	1080	22	7d	10	300	Intact-fresh	Included
29-Nov-17	Red-tailed Hawk	L	1080	39	28d	25	144	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
07-Dec-17	Red-tailed Hawk	L	1080	45	7d	95	280	Scavenged-feather spot	Included
12-Dec-17	Red-tailed Hawk	L	1080	6	28d	43	180	Scavenged-feather spot	Included
20-Dec-17	Red-tailed Hawk	L	1080	23	7d	50	90	Scavenged-feather spot	Included
28-Dec-17	Red-tailed Hawk	L	1080	39	28d	32	328	Intact-partial decomposed	Included
17-Jan-18	Red-tailed Hawk	L	1080	24	28d	35	356	Intact-partial decomposed	Included
13-Feb-18	Red-tailed Hawk	L	1080	14	Incidental	114	254	Scavenged-partial decomposed	Excluded: off plot
19-Feb-18	Red-tailed Hawk	L	1080	3	7d	10	80	Intact-fresh	Included
01-Mar-18	Red-tailed Hawk	L	1080	35	28d	36	210	Intact-fresh	Included
20-Mar-18	Red-tailed Hawk	L	1080	25	28d	27	332	Scavenged-partial decomposed	Included
25-Apr-18	Red-tailed Hawk	L	1080	36	28d	52	77	Other, see notes	Included
01-May-18	Red-tailed Hawk	L	1080	22	7d	25	130	Intact-fresh	Included
02-May-18	Red-tailed Hawk	L	1080	4	28d	23	250	Intact-partial decomposed	Included
15-May-18	Red-tailed Hawk	L	1080	25	28d	46	333	Other, see notes	Included
19-Jun-18	Red-tailed Hawk	L	1080	42	28d	52	105	Intact-partial decomposed	Included
25-Jun-18	Red-tailed Hawk	L	1080	2	7d	41	84	Intact-fresh	Included
11-Jul-18	Red-tailed Hawk	L	1080	26	28d	89	29	Other, see notes	Included
26-Jul-18	Red-tailed Hawk	L	1080	16	28d	73	260	Intact-partial decomposed	Included
13-Sep-18	Red-tailed Hawk	L	1080	45	7d	80	270	Other, see notes	Included
12-Oct-17	Ruby-crowned Kinglet	S	6.5	37	28d	103	140	Scavenged-fresh	Included
18-Oct-17	Ruby-crowned Kinglet	S	6.5	34	7d	25	180	Other, see notes	Included
23-Oct-17	Ruby-crowned Kinglet	S	6.5	18	7d	30	290	Intact-partial decomposed	Included
10-Apr-18	Ruby-crowned Kinglet	S	6.5	13	7d	23	240	Intact-partial decomposed	Included
08-May-18	Rufous Hummingbird	S	3.3	13	7d	15	110	Intact-partial decomposed	Included
08-Nov-17	Savannah Sparrow	S	19	42	28d	45	326	Scavenged-feather spot	Included
08-Feb-18	Sharp-shinned Hawk	M	185	15	28d	31	330	Intact-fresh	Included
13-Sep-18	Townsend's Warbler	S	8.8	47	7d	103	50	Intact-partial decomposed	Included
04-Apr-18	Tree Swallow	S	20	34	7d	17	74	Scavenged-partial decomposed	Included
26-Jun-18	Turkey Vulture	L (VL)	1830	12	28d	26	140	Intact-partial decomposed	Included
11-Jul-18	Turkey Vulture	L (VL)	1830	26	28d	94	44	Intact-decomposed	Included
14-Dec-17	Unknown blackbird	S	52	44	7d	40	280	Scavenged-feather spot	Included
14-Dec-17	Unknown blackbird	S	52	44	7d	40	280	Scavenged-feather spot	Included
14-Dec-17	Unknown blackbird	S	52	44	7d	50	320	Scavenged-feather spot	Included
06-Mar-18	Unknown blackbird	S	52	22	7d	90	340	Scavenged-feather spot	Included
10-May-18	Unknown blackbird	S	52	45	Incidental	120	200	Scavenged-feather spot	Excluded: off plot
17-Oct-17	Unknown flycatcher	S	11	12	28d	43	20	Scavenged-partial decomposed	Included
30-May-18	Unknown flycatcher	S	11	18	7d	60	40	Intact-partial decomposed	Included
15-Aug-18	Unknown flycatcher	S	11	27	Incidental	130	50	Scavenged-partial decomposed	Excluded: off plot
01-Oct-17	Unknown small bird	S	38	8	28d	18	344	Scavenged-feather spot	Included
17-Oct-17	Unknown small bird	S	38	23	7d	100	220	Scavenged-partial decomposed	Included
01-Nov-17	Unknown small bird	S	38	27	7d	102	40	Scavenged-partial decomposed	Included
14-Nov-17	Unknown small bird	S	38	30	7d	70	50	Scavenged-feather spot	Included
22-Nov-17	Unknown small bird	S	38	27	7d	95	80	Scavenged-decomposed	Included
14-Feb-18	Unknown small bird	S	38	11	7d	70	260	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
03-Apr-18	Unknown small bird	S	38	22	7d	88	341	Scavenged-feather spot	Included
17-Apr-18	Unknown small bird	S	38	13	7d	50	330	Scavenged-feather spot	Included
19-Apr-18	Unknown small bird	S	38	44	Incidental	109	182	Scavenged-decomposed	Excluded: off plot
21-May-18	Unknown small bird	S	38	18	7d	80	140	Scavenged-feather spot	Included
24-May-18	Unknown small bird	S	38	48	7d	70	95	Scavenged-fresh	Included
06-Jun-18	Unknown small bird	S	38	18	7d	80	20	Scavenged-feather spot	Included
21-May-18	Unknown vireo	S	38	3	7d	95	140	Scavenged-partial decomposed	Included
13-Jun-18	Unknown vireo	S	38	34	Incidental	155	50	Scavenged-partial decomposed	Excluded: off plot
23-Nov-17	Unknown warbler	S	9.3	47	7d	90	185	Scavenged-feather spot	Included
24-Apr-18	Unknown warbler	S	9.3	13	7d	45	35	Scavenged-partial decomposed	Included
01-May-18	Unknown warbler	S	9.3	13	7d	64	8	Scavenged-partial decomposed	Included
22-Aug-18	Unknown warbler	S	9.3	11	7d	100	55	Scavenged-feather spot	Included
04-Oct-17	Vaux's Swift	S	18	29	7d	31	335	Scavenged-partial decomposed	Included
05-Oct-17	Vaux's Swift	S	18	47	7d	25	110	Scavenged-feather spot	Included
15-Nov-17	Vaux's Swift	S	18	27	7d	80	110	Scavenged-feather spot	Included
19-Apr-18	Warbling Vireo	S	12	44	7d	40	89	Intact-decomposed	Included
06-Aug-18	Warbling Vireo	S	12	3	7d	30	20	Scavenged-partial decomposed	Included
04-Sep-18	Warbling Vireo	S	12	23	7d	50	90	Scavenged-partial decomposed	Included
03-Oct-17	Western Flycatcher	S	11	22	7d	30	190	Intact-fresh	Included
02-Jul-18	Western Kingbird	S	38	2	7d	35	100	Scavenged-feather spot	Included
27-Sep-17	Western Meadowlark	S	100	17	28d	10	12	Intact-decomposed	Included
04-Oct-17	Western Meadowlark	S	100	34	7d	83	270	Scavenged-feather spot	Included
13-Oct-17	Western Meadowlark	S	100	27	7d	100	30	Other, see notes	Included
16-Nov-17	Western Meadowlark	S	100	6	Incidental	110	180	Scavenged-partial decomposed	Excluded: off plot
12-Dec-17	Western Meadowlark	S	100	22	Incidental	115	170	Scavenged-feather spot	Excluded: off plot
14-Dec-17	Western Meadowlark	S	100	48	7d	84	110	Scavenged-feather spot	Included
05-Jan-18	Western Meadowlark	S	100	45	7d	35	90	Scavenged-feather spot	Included
18-Jan-18	Western Meadowlark	S	100	48	7d	90	120	Scavenged-feather spot	Included
08-Feb-18	Western Meadowlark	S	100	44	7d	25	95	Scavenged-feather spot	Included
28-Feb-18	Western Meadowlark	S	100	37	28d	4	175	Intact-fresh	Included
09-Apr-18	Western Meadowlark	S	100	2	7d	57	210	Scavenged-partial decomposed	Included
19-Apr-18	Western Meadowlark	S	100	48	7d	54	211	Scavenged-feather spot	Included
03-May-18	Western Meadowlark	S	100	48	7d	0	30	Intact-partial decomposed	Included
23-May-18	Western Meadowlark	S	100	27	7d	45	80	Scavenged-feather spot	Included
08-Jun-18	Western Meadowlark	S	100	48	Incidental	117	156	Scavenged-feather spot	Excluded: off plot
20-Jun-18	Western Meadowlark	S	100	29	Incidental	133	60	Scavenged-partial decomposed	Excluded: off plot
02-Jul-18	Western Meadowlark	S	100	2	7d	45	340	Scavenged-feather spot	Included
23-Jul-18	Western Meadowlark	S	100	2	Incidental	125	330	Scavenged-partial decomposed	Excluded: off plot
27-Aug-18	Western Meadowlark	S	100	2	7d	60	10	Scavenged-feather spot	Included
12-Sep-18	Western Meadowlark	S	100	29	7d	60	50	Scavenged-feather spot	Included
03-Jul-18	Western Tanager	S	30	22	7d	80	30	Scavenged-partial decomposed	Included
13-Dec-17	White-tailed Kite	M	335	1	28d	59	270	Scavenged-feather spot	Included
12-Oct-17	White-throated Swift	S	32	27	7d	20	20	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
23-Oct-17	White-throated Swift	S	32	2	7d	30	20	Intact-fresh	Included
23-Oct-17	White-throated Swift	S	32	3	7d	80	130	Scavenged-feather spot	Included
29-Nov-17	White-throated Swift	S	32	34	7d	30	330	Scavenged-feather spot	Included
29-Nov-17	White-throated Swift	S	32	34	7d	30	260	Scavenged-feather spot	Included
05-Dec-17	White-throated Swift	S	32	13	7d	30	350	Intact-partial decomposed	Included
05-Dec-17	White-throated Swift	S	32	13	7d	20	270	Scavenged-feather spot	Included
05-Dec-17	White-throated Swift	S	32	13	7d	50	10	Scavenged-feather spot	Included
06-Dec-17	White-throated Swift	S	32	34	7d	30	240	Scavenged-partial decomposed	Included
11-Jan-18	White-throated Swift	S	32	16	28d	58	136	Intact-partial decomposed	Included
11-Jan-18	White-throated Swift	S	32	34	7d	30	170	Scavenged-feather spot	Included
15-Jan-18	White-throated Swift	S	32	10	7d	35	20	Scavenged-feather spot	Included
16-Jan-18	White-throated Swift	S	32	28	28d	28	340	Intact-partial decomposed	Included
16-Jan-18	White-throated Swift	S	32	13	7d	30	230	Scavenged-feather spot	Included
01-Feb-18	White-throated Swift	S	32	44	7d	55	235	Intact-fresh	Included
16-Jul-18	White-throated Swift	S	32	2	7d	55	40	Intact-partial decomposed	Included
06-Aug-18	White-throated Swift	S	32	2	7d	7	40	Scavenged-partial decomposed	Included
13-Aug-18	White-throated Swift	S	32	18	7d	60	60	Intact-partial decomposed	Included
14-Aug-18	White-throated Swift	S	32	13	7d	30	289	Scavenged-partial decomposed	Included
20-Sep-17	Wilson's Warbler	S	7	29	7d	65	60	Scavenged-partial decomposed	Included
25-Sep-17	Wilson's Warbler	S	7	18	7d	49	60	Other, see notes	Included
27-Aug-18	Wilson's Warbler	S	7	18	Incidental	120	45	Scavenged-fresh	Excluded: off plot
27-Aug-18	Wilson's Warbler	S	7	18	7d	100	40	Scavenged-partial decomposed	Included
12-Sep-18	Wilson's Warbler	S	7	11	Incidental	115	50	Intact-partial decomposed	Excluded: off plot
09-May-18	Yellow Warbler	S	9.8	29	7d	100	40	Intact-partial decomposed	Included

1 S = small (average species mass ≤100 g); M = medium (101–500 g); L = large (501–1799 g); VL = very large (≥1800 g) – generally grouped with large birds.
2 Sources: Sibley (2016) for birds and University of Michigan (2019) for bats.
3 Included = included in adjusted fatality estimates. Excluded: off plot = carcass excluded from adjusted fatality estimates because found outside all survey plots. Excluded: not from survey area = possible golden eagle old/bleached sternum fragment excluded from all fatality estimates because likely carried by raven, dropped on plot, and clearly not a match for any large raptor carcasses found in the survey area.

Appendix O. Fatality and Injury Incidents in Year 3

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
	Bats								
11-Oct-18	California myotis	S	4.4	33	28d	44	44	Intact-partial decomposed	Included
18-Sep-18	Hoary bat	S	30	8	7d	104	50	Intact-partial decomposed	Included
18-Sep-18	Hoary bat	S	30	8	7d	92	350	Scavenged-partial decomposed	Included
25-Sep-18	Hoary bat	S	30	25	7d	50	80	Intact-partial decomposed	Included
04-Oct-18	Hoary bat	S	30	11	28d	37	15	Intact-fresh	Included
08-Oct-18	Hoary bat	S	30	17	7d	45	10	Intact-partial decomposed	Included
09-Oct-18	Hoary bat	S	30	9	7d	21	60	Scavenged-partial decomposed	Included
18-Oct-18	Hoary bat	S	30	42	7d	103	40	Scavenged-partial decomposed	Included
24-Oct-18	Hoary bat	S	30	15	7d	103	60	Scavenged-partial decomposed	Included
30-Oct-18	Hoary bat	S	30	8	7d	80	30	Scavenged-partial decomposed	Included
01-Nov-18	Hoary bat	S	30	42	Incidental	150	80	Scavenged-partial decomposed	Excluded: off plot
14-Nov-18	Hoary bat	S	30	5	28d	51	174	Scavenged-partial decomposed	Included
19-Mar-19	Hoary bat	S	30	44	28d	33	308	Intact-fresh	Included
01-May-19	Hoary bat	S	30	4	28d	23	335	Intact-partial decomposed	Included
01-May-19	Hoary bat	S	30	4	28d	45	348	Intact-partial decomposed	Included
21-May-19	Hoary bat	S	30	20	7d	95	70	Intact-partial decomposed	Included
22-May-19	Hoary bat	S	30	36	7d	100	20	Scavenged-partial decomposed	Included
10-Jun-19	Hoary bat	S	30	25	7d	60	60	Intact-partial decomposed	Included
26-Jun-19	Hoary bat	S	30	15	7d	60	90	Scavenged-partial decomposed	Included
27-Jun-19	Hoary bat	S	30	46	7d	102	10	Intact-partial decomposed	Included
03-Jul-19	Hoary bat	S	30	22	28d	67	42	Scavenged-partial decomposed	Included
11-Jul-19	Hoary bat	S	30	46	7d	15	240	Scavenged-partial decomposed	Included
17-Jul-19	Hoary bat	S	30	36	7d	100	40	Intact-partial decomposed	Included
05-Aug-19	Hoary bat	S	30	12	7d	40	25	Intact-partial decomposed	Included
13-Aug-19	Hoary bat	S	30	3	28d	21	20	Intact-fresh	Included
13-Aug-19	Hoary bat	S	30	6	7d	75	80	Scavenged-partial decomposed	Included
19-Aug-19	Hoary bat	S	30	12	7d	103	70	Intact-fresh	Included
20-Aug-19	Hoary bat	S	30	38	28d	99	80	Intact-fresh	Included
20-Aug-19	Hoary bat	S	30	40	28d	78	34	Intact-fresh	Included
20-Aug-19	Hoary bat	S	30	9	7d	90	70	Intact-fresh	Included
20-Aug-19	Hoary bat	S	30	20	7d	30	20	Intact-partial decomposed	Included
20-Aug-19	Hoary bat	S	30	25	7d	40	350	Intact-partial decomposed	Included
23-Aug-19	Hoary bat	S	30	42	7d	20	100	Intact-fresh	Included
26-Aug-19	Hoary bat	S	30	12	7d	90	100	Scavenged-partial decomposed	Included
26-Aug-19	Hoary bat	S	30	17	7d	95	60	Intact-partial decomposed	Included
27-Aug-19	Hoary bat	S	30	8	7d	90	55	Scavenged-partial decomposed	Included
27-Aug-19	Hoary bat	S	30	9	7d	70	20	Scavenged-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
27-Aug-19	Hoary bat	S	30	25	7d	30	5	Intact-partial decomposed	Included
28-Aug-19	Hoary bat	S	30	36	7d	50	30	Scavenged-partial decomposed	Included
29-Aug-19	Hoary bat	S	30	39	7d	103	40	Intact-partial decomposed	Included
03-Sep-19	Hoary bat	S	30	43	28d	60	40	Intact-partial decomposed	Included
03-Sep-19	Hoary bat	S	30	44	28d	83	20	Intact-partial decomposed	Included
03-Sep-19	Hoary bat	S	30	8	7d	30	350	Intact-fresh	Included
03-Sep-19	Hoary bat	S	30	8	7d	30	120	Scavenged-partial decomposed	Included
03-Sep-19	Hoary bat	S	30	8	7d	80	40	Intact-partial decomposed	Included
03-Sep-19	Hoary bat	S	30	20	7d	104	90	Intact-partial decomposed	Included
04-Sep-19	Hoary bat	S	30	23	28d	45	10	Scavenged-partial decomposed	Included
10-Sep-19	Hoary bat	S	30	10	28d	44	90	Scavenged-partial decomposed	Included
10-Sep-19	Hoary bat	S	30	9	7d	104	10	Intact-partial decomposed	Included
12-Sep-19	Hoary bat	S	30	39	7d	80	70	Intact-partial decomposed	Included
12-Sep-19	Hoary bat	S	30	42	7d	70	355	Scavenged-partial decomposed	Included
17-Sep-18	Mexican free-tailed bat	S	9.5	17	7d	70	35	Scavenged-decomposed	Included
18-Sep-18	Mexican free-tailed bat	S	9.5	20	7d	100	70	Scavenged-partial decomposed	Included
20-Sep-18	Mexican free-tailed bat	S	9.5	42	7d	50	65	Scavenged-decomposed	Included
24-Sep-18	Mexican free-tailed bat	S	9.5	1	7d	15	300	Intact-partial decomposed	Included
26-Sep-18	Mexican free-tailed bat	S	9.5	15	7d	15	80	Intact-partial decomposed	Included
26-Sep-18	Mexican free-tailed bat	S	9.5	28	7d	10	320	Intact-partial decomposed	Included
01-Oct-18	Mexican free-tailed bat	S	9.5	1	7d	30	15	Intact-partial decomposed	Included
01-Oct-18	Mexican free-tailed bat	S	9.5	6	7d	102	50	Intact-partial decomposed	Included
01-Oct-18	Mexican free-tailed bat	S	9.5	6	7d	80	45	Intact-partial decomposed	Included
02-Oct-18	Mexican free-tailed bat	S	9.5	8	7d	20	40	Intact-fresh	Included
02-Oct-18	Mexican free-tailed bat	S	9.5	8	7d	12	150	Intact-fresh	Included
02-Oct-18	Mexican free-tailed bat	S	9.5	9	7d	15	20	Intact-fresh	Included
02-Oct-18	Mexican free-tailed bat	S	9.5	20	7d	95	50	Scavenged-decomposed	Included
02-Oct-18	Mexican free-tailed bat	S	9.5	20	7d	70	80	Scavenged-partial decomposed	Included
02-Oct-18	Mexican free-tailed bat	S	9.5	20	7d	20	10	Intact-fresh	Included
03-Oct-18	Mexican free-tailed bat	S	9.5	26	7d	10	340	Intact-fresh	Included
03-Oct-18	Mexican free-tailed bat	S	9.5	28	7d	102	150	Intact-decomposed	Included
04-Oct-18	Mexican free-tailed bat	S	9.5	39	Incidental	120	300	Intact-fresh	Excluded: off plot
04-Oct-18	Mexican free-tailed bat	S	9.5	11	28d	0	2	Injured-died/euthanized	Included
04-Oct-18	Mexican free-tailed bat	S	9.5	39	7d	102	20	Intact-fresh	Included
04-Oct-18	Mexican free-tailed bat	S	9.5	41	7d	21	140	Intact-partial decomposed	Included
07-Oct-18	Mexican free-tailed bat	S	9.5	42	7d	5	70	Scavenged-fresh	Included
08-Oct-18	Mexican free-tailed bat	S	9.5	6	7d	80	195	Intact-fresh	Included
08-Oct-18	Mexican free-tailed bat	S	9.5	12	7d	51	40	Intact-partial decomposed	Included
09-Oct-18	Mexican free-tailed bat	S	9.5	9	Incidental	107	50	Intact-partial decomposed	Excluded: off plot
09-Oct-18	Mexican free-tailed bat	S	9.5	3	28d	35	344	Intact-partial decomposed	Included
09-Oct-18	Mexican free-tailed bat	S	9.5	8	7d	89	40	Intact-partial decomposed	Included
09-Oct-18	Mexican free-tailed bat	S	9.5	20	7d	85	50	Scavenged-partial decomposed	Included
15-Oct-18	Mexican free-tailed bat	S	9.5	12	7d	100	5	Intact-fresh	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
16-Oct-18	Mexican free-tailed bat	S	9.5	9	7d	95	70	Intact-fresh	Included
16-Oct-18	Mexican free-tailed bat	S	9.5	25	7d	90	40	Intact-partial decomposed	Included
18-Oct-18	Mexican free-tailed bat	S	9.5	46	7d	30	110	Intact-fresh	Included
29-Oct-18	Mexican free-tailed bat	S	9.5	1	7d	100	60	Intact-partial decomposed	Included
06-Nov-18	Mexican free-tailed bat	S	9.5	3	28d	50	336	Intact-partial decomposed	Included
06-Nov-18	Mexican free-tailed bat	S	9.5	3	28d	33	310	Intact-partial decomposed	Included
29-Nov-18	Mexican free-tailed bat	S	9.5	32	28d	2	348	Injured-died/euthanized	Included
22-Apr-19	Mexican free-tailed bat	S	9.5	6	7d	25	20	Intact-fresh	Included
23-Apr-19	Mexican free-tailed bat	S	9.5	20	7d	20	85	Scavenged-partial decomposed	Included
30-Apr-19	Mexican free-tailed bat	S	9.5	17	7d	95	75	Intact-partial decomposed	Included
06-May-19	Mexican free-tailed bat	S	9.5	17	7d	90	20	Intact-partial decomposed	Included
14-May-19	Mexican free-tailed bat	S	9.5	20	7d	104	100	Scavenged-partial decomposed	Included
21-May-19	Mexican free-tailed bat	S	9.5	25	7d	60	30	Scavenged-partial decomposed	Included
27-May-19	Mexican free-tailed bat	S	9.5	1	7d	90	40	Intact-partial decomposed	Included
27-May-19	Mexican free-tailed bat	S	9.5	6	7d	104	72	Scavenged-partial decomposed	Included
04-Jun-19	Mexican free-tailed bat	S	9.5	25	7d	30	60	Scavenged-partial decomposed	Included
05-Jun-19	Mexican free-tailed bat	S	9.5	36	7d	60	70	Intact-partial decomposed	Included
10-Jun-19	Mexican free-tailed bat	S	9.5	9	7d	70	100	Intact-partial decomposed	Included
18-Jun-19	Mexican free-tailed bat	S	9.5	20	7d	90	48	Scavenged-partial decomposed	Included
02-Jul-19	Mexican free-tailed bat	S	9.5	15	7d	70	20	Intact-partial decomposed	Included
08-Jul-19	Mexican free-tailed bat	S	9.5	6	Incidental	115	80	Intact-partial decomposed	Excluded: off plot
09-Jul-19	Mexican free-tailed bat	S	9.5	8	7d	70	40	Scavenged-partial decomposed	Included
16-Jul-19	Mexican free-tailed bat	S	9.5	20	7d	103	50	Intact-partial decomposed	Included
17-Jul-19	Mexican free-tailed bat	S	9.5	36	Incidental	115	60	Intact-partial decomposed	Excluded: off plot
25-Jul-19	Mexican free-tailed bat	S	9.5	29	28d	52	30	Intact-fresh	Included
31-Jul-19	Mexican free-tailed bat	S	9.5	28	7d	80	5	Intact-partial decomposed	Included
01-Aug-19	Mexican free-tailed bat	S	9.5	41	7d	90	40	Intact-fresh	Included
05-Aug-19	Mexican free-tailed bat	S	9.5	6	7d	80	50	Scavenged-partial decomposed	Included
14-Aug-19	Mexican free-tailed bat	S	9.5	20	7d	35	60	Scavenged-partial decomposed	Included
20-Aug-19	Mexican free-tailed bat	S	9.5	8	7d	90	50	Scavenged-partial decomposed	Included
20-Aug-19	Mexican free-tailed bat	S	9.5	9	7d	80	60	Intact-fresh	Included
20-Aug-19	Mexican free-tailed bat	S	9.5	25	7d	90	60	Scavenged-partial decomposed	Included
22-Aug-19	Mexican free-tailed bat	S	9.5	26	7d	80	40	Intact-partial decomposed	Included
27-Aug-19	Mexican free-tailed bat	S	9.5	9	7d	103	90	Scavenged-fresh	Included
27-Aug-19	Mexican free-tailed bat	S	9.5	20	7d	105	70	Intact-partial decomposed	Included
28-Aug-19	Mexican free-tailed bat	S	9.5	36	7d	80	30	Scavenged-partial decomposed	Included
29-Aug-19	Mexican free-tailed bat	S	9.5	22	Incidental	108	80	Intact-partial decomposed	Excluded: off plot
03-Sep-19	Mexican free-tailed bat	S	9.5	20	7d	80	60	Intact-fresh	Included
09-Sep-19	Mexican free-tailed bat	S	9.5	17	7d	90	50	Intact-partial decomposed	Included
11-Sep-19	Mexican free-tailed bat	S	9.5	15	7d	100	35	Intact-partial decomposed	Included
11-Sep-19	Mexican free-tailed bat	S	9.5	15	7d	70	30	Scavenged-decomposed	Included
28-Aug-19	Myotis spp.	S	7.5	15	Incidental	125	60	Intact-fresh	Excluded: off plot
01-May-19	Silver-haired bat	S	10.5	8	7d	50	45	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
19-Sep-18	Unknown bat	S	14	15	7d	80	350	Scavenged-partial decomposed	Included
01-Oct-18	Unknown bat	S	14	6	7d	80	60	Scavenged-partial decomposed	Included
17-Oct-18	Unknown bat	S	14	7	28d	12	250	Scavenged-decomposed	Included
23-Oct-18	Unknown bat	S	14	18	28d	25	68	Scavenged-partial decomposed	Included
25-Oct-18	Unknown bat	S	14	42	7d	60	5	Scavenged-partial decomposed	Included
22-Nov-18	Western mastiff bat	S	65	39	7d	1	10	Injured-non-releasable/in captivity	Included
27-Sep-18	Western red bat	S	8	42	7d	40	20	Scavenged-partial decomposed	Included
16-Aug-19	Western red bat	S	8	41	7d	90	80	Scavenged-partial decomposed	Included
10-Sep-19	Western red bat	S	8	9	7d	100	50	Intact-partial decomposed	Included
11-Sep-19	Western red bat	S	8	15	7d	90	30	Intact-partial decomposed	Included
	Birds								
03-Oct-18	American Kestrel	M	125	30	28d	38	6	Scavenged-partial decomposed	Included
11-Oct-18	American Kestrel	M	125	35	28d	37	330	Scavenged-partial decomposed	Included
13-Nov-18	American Kestrel	M	125	40	28d	93	108	Scavenged-partial decomposed	Included
24-Dec-18	American Kestrel	M	125	1	7d	104	270	Scavenged-feather spot	Included
24-Apr-19	American Kestrel	M	125	28	7d	20	40	Scavenged-partial decomposed	Included
17-May-19	American Kestrel	M	125	36	7d	40	80	Scavenged-feather spot	Included
05-Sep-19	American Kestrel	M	125	32	28d	67	300	Scavenged-partial decomposed	Included
11-Dec-18	American Pipit	S	21	37	28d	81	208	Scavenged-feather spot	Included
04-Feb-19	American Pipit	S	21	6	7d	95	130	Scavenged-partial decomposed	Included
23-Jul-19	American Pipit	S	21	38	28d	76	48	Scavenged-partial decomposed	Included
17-Sep-18	Black-throated Gray Warbler	S	8.4	17	7d	90	25	Intact-partial decomposed	Included
08-Oct-18	Black-throated Gray Warbler	S	8.4	6	7d	100	185	Intact-partial decomposed	Included
24-Sep-18	Blue-gray Gnatcatcher	S	6.0	6	7d	70	60	Intact-partial decomposed	Included
22-Oct-18	Brewer's Blackbird	S	63	17	Incidental	107	120	Scavenged-feather spot	Excluded: off plot
30-Oct-18	Brewer's Blackbird	S	63	44	28d	37	200	Scavenged-fresh	Included
08-Nov-18	Brewer's Blackbird	S	63	46	Incidental	115	250	Scavenged-fresh	Excluded: off plot
19-Sep-18	Burrowing Owl	M	151	5	28d	64	285	Scavenged-feather spot	Included
19-Sep-18	Burrowing Owl	M	151	26	7d	40	150	Scavenged-feather spot	Included
02-Oct-18	Burrowing Owl	M	151	43	28d	82	75	Scavenged-feather spot	Included
29-Oct-18	Burrowing Owl	M	151	17	Incidental	130	300	Scavenged-fresh	Excluded: off plot
30-Oct-18	Burrowing Owl	M	151	25	Incidental	110	100	Scavenged-feather spot	Excluded: off plot
31-Oct-18	Burrowing Owl	M	151	26	7d	80	20	Scavenged-feather spot	Included
01-Nov-18	Burrowing Owl	M	151	46	7d	30	90	Scavenged-partial decomposed	Included
20-Nov-18	Burrowing Owl	M	151	25	7d	100	230	Scavenged-feather spot	Included
18-Dec-18	Burrowing Owl	M	151	20	Incidental	110	10	Scavenged-feather spot	Excluded: off plot
15-Jan-19	Burrowing Owl	M	151	20	7d	100	90	Scavenged-partial decomposed	Included
22-Jan-19	Burrowing Owl	M	151	20	7d	74	80	Scavenged-feather spot	Included
21-Feb-19	Burrowing Owl	M	151	41	Incidental	115	290	Scavenged-decomposed	Excluded: off plot
04-Apr-19	Burrowing Owl	M	151	29	28d	40	150	Scavenged-decomposed	Included
20-Jun-19	Burrowing Owl	M	151	46	7d	80	290	Scavenged-feather spot	Included
27-Jun-19	Burrowing Owl	M	151	46	7d	100	320	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
11-Jul-19	Burrowing Owl	M	151	46	Incidental	110	110	Scavenged-partial decomposed	Excluded: off plot
03-Sep-19	Burrowing Owl	M	151	43	28d	100	200	Scavenged-feather spot	Included
03-Sep-19	Burrowing Owl	M	151	43	28d	59	300	Scavenged-partial decomposed	Included
25-Jul-19	Common Raven	L	1200	41	7d	102	270	Scavenged-feather spot	Included
01-Nov-18	European Starling	S	82	11	28d	19	358	Scavenged-feather spot	Included
01-Nov-18	European Starling	S	82	42	7d	70	20	Scavenged-feather spot	Included
17-Jan-19	European Starling	S	82	42	7d	15	100	Scavenged-feather spot	Included
21-May-19	European Starling	S	82	9	7d	103	280	Scavenged-feather spot	Included
17-Jun-19	European Starling	S	82	12	7d	100	320	Scavenged-partial decomposed	Included
16-Oct-18	Fox Sparrow	S	32	8	7d	101	260	Scavenged-feather spot	Included
20-Sep-18	Golden Eagle	L (VL)	4200	29	28d	40	40	Intact-partial decomposed	Included
30-Jan-19	Golden Eagle	L (VL)	4200	15	7d	50	220	Intact-partial decomposed	Included
14-Mar-19	Golden Eagle	L (VL)	4200	46	7d	15	210	Intact-fresh	Included
01-Jul-19	Golden Eagle	L (VL)	4200	14	28d	76	134	Intact-partial decomposed	Included
16-Jul-19	Golden Eagle	L (VL)	4200	2	28d	81	360	Other, see notes	Included
25-Jul-19	Golden Eagle	L (VL)	4200	26	7d	32	10	Intact-fresh	Included
31-Jul-19	Golden Eagle	L (VL)	4200	15	7d	18	20	Other, see notes	Included
04-Sep-19	Golden Eagle	L (VL)	4200	15	7d	50	115	Intact-partial decomposed	Included
18-Oct-18	Hermit Thrush	S	31	42	7d	87	170	Scavenged-feather spot	Included
20-Sep-18	Horned Lark	S	32	42	7d	45	100	Intact-fresh	Included
24-Sep-18	Horned Lark	S	32	6	7d	50	340	Scavenged-partial decomposed	Included
25-Sep-18	Horned Lark	S	32	8	7d	15	170	Scavenged-partial decomposed	Included
09-Oct-18	Horned Lark	S	32	20	7d	103	50	Scavenged-partial decomposed	Included
10-Oct-18	Horned Lark	S	32	15	7d	39	360	Scavenged-feather spot	Included
11-Dec-18	Horned Lark	S	32	37	28d	92	132	Scavenged-feather spot	Included
24-Jan-19	Horned Lark	S	32	41	7d	80	290	Scavenged-partial decomposed	Included
24-Jan-19	Horned Lark	S	32	41	7d	80	290	Scavenged-partial decomposed	Included
09-Apr-19	Horned Lark	S	32	25	7d	25	120	Scavenged-partial decomposed	Included
18-Apr-19	Horned Lark	S	32	42	7d	10	90	Intact-partial decomposed	Included
23-Apr-19	Horned Lark	S	32	10	28d	51	20	Intact-fresh	Included
02-May-19	Horned Lark	S	32	26	7d	90	130	Intact-partial decomposed	Included
08-May-19	Horned Lark	S	32	36	7d	10	10	Intact-partial decomposed	Included
22-May-19	Horned Lark	S	32	36	7d	100	300	Scavenged-feather spot	Included
30-May-19	Horned Lark	S	32	27	28d	60	360	Intact-fresh	Included
04-Jun-19	Horned Lark	S	32	9	7d	80	60	Scavenged-partial decomposed	Included
19-Jun-19	Horned Lark	S	32	28	7d	30	100	Scavenged-partial decomposed	Included
20-Jun-19	Horned Lark	S	32	46	7d	95	320	Scavenged-partial decomposed	Included
27-Jun-19	Horned Lark	S	32	39	7d	103	310	Scavenged-feather spot	Included
30-Jun-19	Horned Lark	S	32	6	7d	40	160	Scavenged-partial decomposed	Included
06-Aug-19	Horned Lark	S	32	43	28d	38	120	Scavenged-partial decomposed	Included
02-Sep-19	Horned Lark	S	32	17	7d	100	1	Scavenged-partial decomposed	Included
12-Sep-19	Horned Lark	S	32	42	7d	70	350	Scavenged-partial decomposed	Included
29-Mar-19	House Finch	S	21	46	Incidental	26	360	Intact-fresh	Excluded: on plot not discovered

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
03-Apr-19	House Wren	S	11	4	28d	36	10	Intact-fresh	Included
30-Jun-19	House Wren	S	11	1	7d	100	30	Intact-fresh	Included
16-Jul-19	House Wren	S	11	25	7d	103	70	Intact-partial decomposed	Included
31-Jul-19	House Wren	S	11	36	7d	70	40	Intact-fresh	Included
31-Jul-19	House Wren	S	11	36	7d	100	40	Scavenged-partial decomposed	Included
31-Jul-19	House Wren	S	11	36	7d	100	70	Scavenged-partial decomposed	Included
05-Sep-19	House Wren	S	11	41	7d	104	70	Scavenged-partial decomposed	Included
30-Oct-18	Killdeer	S	88	43	28d	66	88	Scavenged-feather spot	Included
22-Nov-18	Killdeer	S	88	39	Incidental	115	50	Scavenged-feather spot	Excluded: off plot
09-May-19	Lincoln's Sparrow	S	17	42	7d	40	85	Intact-partial decomposed	Included
28-Nov-18	Mallard	L	1225	23	28d	48	48	Scavenged-feather spot	Included
10-Jan-19	Mountain Bluebird	S	30	42	7d	70	260	Scavenged-feather spot	Included
20-Sep-18	Mourning Dove	M	120	41	7d	30	260	Scavenged-feather spot	Included
02-Oct-18	Mourning Dove	M	120	20	7d	103	150	Scavenged-feather spot	Included
29-Nov-18	Mourning Dove	M	120	46	7d	20	110	Scavenged-partial decomposed	Included
09-Oct-18	Northern Harrier	M	425	2	28d	24	20	Intact-partial decomposed	Included
03-May-19	Orange-crowned Warbler	S	10	41	7d	100	50	Intact-partial decomposed	Included
01-Nov-18	Peregrine Falcon	L	975	42	7d	90	50	Scavenged-fresh	Included
02-Oct-18	Red-tailed Hawk	L	1080	44	28d	35	220	Intact-partial decomposed	Included
17-Oct-18	Red-tailed Hawk	L	1080	4	28d	99	270	Scavenged-feather spot	Included
14-Nov-18	Red-tailed Hawk	L	1080	4	28d	17	280	Intact-partial decomposed	Included
14-Nov-18	Red-tailed Hawk	L	1080	4	28d	71	160	Scavenged-feather spot	Included
21-Nov-18	Red-tailed Hawk	L	1080	47	28d	87	298	Scavenged-feather spot	Included
04-Dec-18	Red-tailed Hawk	L	1080	25	7d	60	120	Scavenged-fresh	Included
05-Dec-18	Red-tailed Hawk	L	1080	15	7d	102	80	Scavenged-fresh	Included
26-Dec-18	Red-tailed Hawk	L	1080	15	7d	45	5	Intact-fresh	Included
13-Feb-19	Red-tailed Hawk	L	1080	47	28d	47	310	Scavenged-partial decomposed	Included
20-Feb-19	Red-tailed Hawk	L	1080	30	28d	4	260	Intact-partial decomposed	Included
21-Feb-19	Red-tailed Hawk	L	1080	32	28d	19	208	Intact-fresh	Included
05-Mar-19	Red-tailed Hawk	L	1080	40	28d	32	210	Intact-partial decomposed	Included
14-Mar-19	Red-tailed Hawk	L	1080	41	7d	40	220	Intact-fresh	Included
03-Apr-19	Red-tailed Hawk	L	1080	4	28d	48	204	Intact-partial decomposed	Included
16-Apr-19	Red-tailed Hawk	L	1080	25	7d	20	205	Intact-partial decomposed	Included
03-May-19	Red-tailed Hawk	L	1080	46	7d	12	290	Intact-partial decomposed	Included
16-May-19	Red-tailed Hawk	L	1080	32	28d	32	346	Intact-partial decomposed	Included
27-May-19	Red-tailed Hawk	L	1080	12	7d	85	350	Scavenged-partial decomposed	Included
11-Jun-19	Red-tailed Hawk	L	1080	43	28d	31	8	Intact-partial decomposed	Included
30-Jul-19	Red-tailed Hawk	L	1080	43	28d	25	90	Intact-partial decomposed	Included
06-Aug-19	Red-tailed Hawk	L	1080	43	28d	51	140	Scavenged-decomposed	Included
06-Aug-19	Red-tailed Hawk	L	1080	43	28d	18	85	Intact-partial decomposed	Included
06-Aug-19	Red-tailed Hawk	L	1080	44	28d	31	140	Intact-partial decomposed	Included
11-Jun-19	Rock Pigeon	M	270	43	28d	10	60	Scavenged-feather spot	Included
08-Oct-18	Ruby-crowned Kinglet	S	6.5	6	7d	60	170	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
08-Oct-18	Ruby-crowned Kinglet	S	6.5	6	7d	80	190	Intact-fresh	Included
09-Oct-18	Ruby-crowned Kinglet	S	6.5	20	7d	70	140	Intact-partial decomposed	Included
19-Mar-19	Say's Phoebe	S	21	9	Incidental	115	260	Scavenged-feather spot	Excluded: off plot
30-Oct-18	Sora	S	74	16	28d	47	124	Scavenged-feather spot	Included
21-May-19	Swainson's Thrush	S	31	9	7d	100	80	Intact-partial decomposed	Included
21-May-19	Townsend's Warbler	S	8.8	9	7d	95	80	Scavenged-partial decomposed	Included
22-Apr-19	Tricolored Blackbird	S	59	1	Incidental	120	320	Intact-fresh	Excluded: off plot
17-May-19	Tricolored Blackbird	S	59	42	7d	50	340	Scavenged-partial decomposed	Included
23-Jul-19	Tricolored Blackbird	S	59	40	28d	36	70	Scavenged-partial decomposed	Included
02-Jul-19	Turkey Vulture	L (VL)	1830	48	28d	23	168	Intact-partial decomposed	Included
11-Dec-18	Unknown blackbird	S	52	37	28d	80	200	Scavenged-decomposed	Included
01-Apr-19	Unknown blackbird	S	52	1	7d	70	10	Scavenged-fresh	Included
20-May-19	Unknown blackbird	S	52	1	7d	100	210	Scavenged-feather spot	Included
20-May-19	Unknown blackbird	S	52	1	7d	65	350	Scavenged-feather spot	Included
30-May-19	Unknown blackbird	S	52	42	Incidental	115	320	Scavenged-feather spot	Excluded: off plot
30-May-19	Unknown blackbird	S	52	41	7d	95	260	Scavenged-feather spot	Included
03-Jun-19	Unknown blackbird	S	52	1	7d	102	320	Scavenged-feather spot	Included
08-Jul-19	Unknown blackbird	S	52	1	7d	100	30	Scavenged-feather spot	Included
01-Aug-19	Unknown blackbird	S	52	31	28d	32	10	Scavenged-feather spot	Included
19-Aug-19	Unknown blackbird	S	52	1	7d	90	310	Scavenged-feather spot	Included
17-Oct-18	Unknown buteo	L	1075	4	28d	63	268	Scavenged-feather spot	Included
26-Dec-18	Unknown duck	L	1000	15	Incidental	120	320	Scavenged-feather spot	Excluded: off plot
18-Sep-18	Unknown flycatcher	S	11	12	Incidental	120	70	Scavenged-partial decomposed	Excluded: off plot
14-Aug-19	Unknown flycatcher	S	11	9	7d	90	40	Scavenged-partial decomposed	Included
21-Aug-19	Unknown flycatcher	S	11	5	28d	105	24	Scavenged-partial decomposed	Included
26-Aug-19	Unknown flycatcher	S	11	12	7d	100	80	Intact-fresh	Included
29-Aug-19	Unknown flycatcher	S	11	39	7d	90	35	Scavenged-partial decomposed	Included
10-Oct-18	Unknown kinglet	S	6.5	28	7d	70	130	Scavenged-partial decomposed	Included
25-Oct-18	Unknown kinglet	S	6.5	22	28d	101	152	Scavenged-partial decomposed	Included
27-Sep-18	Unknown medium bird	M	170	41	7d	90	160	Scavenged-partial decomposed	Included
25-Oct-18	Unknown medium bird	M	276	39	7d	104	40	Scavenged-decomposed	Included
18-Sep-18	Unknown small bird	S	38	20	7d	100	55	Scavenged-feather spot	Included
19-Sep-18	Unknown small bird	S	38	36	7d	104	85	Scavenged-feather spot	Included
08-Oct-18	Unknown small bird	S	38	6	7d	79	70	Scavenged-feather spot	Included
08-Oct-18	Unknown small bird	S	38	6	7d	86	50	Scavenged-partial decomposed	Included
22-Oct-18	Unknown small bird	S	38	6	7d	104	355	Scavenged-partial decomposed	Included
23-Oct-18	Unknown small bird	S	38	9	7d	90	260	Scavenged-feather spot	Included
24-Oct-18	Unknown small bird	S	38	26	7d	70	50	Scavenged-feather spot	Included
29-Oct-18	Unknown small bird	S	38	12	7d	43	180	Scavenged-feather spot	Included
19-Dec-18	Unknown small bird	S	38	28	7d	30	249	Scavenged-partial decomposed	Included
08-Jan-19	Unknown small bird	S	38	38	28d	71	290	Scavenged-feather spot	Included
14-Jan-19	Unknown small bird	S	38	6	7d	70	310	Scavenged-feather spot	Included
25-Feb-19	Unknown small bird	S	38	17	7d	50	80	Scavenged-feather spot	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
22-Apr-19	Unknown small bird	S	38	6	7d	40	270	Scavenged-feather spot	Included
13-May-19	Unknown small bird	S	38	17	7d	100	30	Scavenged-feather spot	Included
27-May-19	Unknown small bird	S	38	6	7d	103	70	Scavenged-feather spot	Included
30-May-19	Unknown small bird	S	38	41	Incidental	118	290	Scavenged-feather spot	Excluded: off plot
30-May-19	Unknown small bird	S	38	46	7d	80	120	Scavenged-feather spot	Included
18-Jun-19	Unknown small bird	S	38	20	7d	95	50	Scavenged-partial decomposed	Included
11-Jul-19	Unknown small bird	S	38	11	28d	102	50	Scavenged-partial decomposed	Included
12-Jul-19	Unknown small bird	S	38	9	7d	12	60	Scavenged-partial decomposed	Included
19-Aug-19	Unknown small bird	S	38	12	7d	30	150	Scavenged-feather spot	Included
09-Sep-19	Unknown small bird	S	38	12	7d	104	50	Scavenged-partial decomposed	Included
09-Sep-19	Unknown small bird	S	38	12	7d	95	85	Scavenged-partial decomposed	Included
10-Sep-19	Unknown small bird	S	38	10	28d	25	34	Scavenged-partial decomposed	Included
02-Oct-18	Unknown small grebe	M	450	16	28d	61	40	Scavenged-partial decomposed	Included
08-Oct-18	Unknown sparrow	S	25	6	7d	100	290	Scavenged-partial decomposed	Included
03-Jun-19	Unknown warbler	S	9.3	6	Incidental	108	40	Intact-partial decomposed	Excluded: off plot
17-Jun-19	Unknown warbler	S	9.3	6	7d	104	40	Intact-partial decomposed	Included
11-Sep-19	Unknown warbler	S	9.3	36	Incidental	115	30	Scavenged-partial decomposed	Excluded: off plot
25-Sep-18	Vaux's Swift	S	18	8	7d	100	80	Scavenged-fresh	Included
04-Oct-18	Vaux's Swift	S	18	41	7d	80	100	Scavenged-feather spot	Included
07-May-19	Vaux's Swift	S	18	20	7d	20	140	Scavenged-feather spot	Included
07-May-19	Warbling Vireo	S	12	20	7d	104	30	Intact-partial decomposed	Included
19-Sep-18	Western Meadowlark	S	100	26	7d	60	200	Scavenged-feather spot	Included
24-Sep-18	Western Meadowlark	S	100	6	7d	78	60	Scavenged-partial decomposed	Included
26-Sep-18	Western Meadowlark	S	100	36	7d	51	120	Scavenged-feather spot	Included
26-Sep-18	Western Meadowlark	S	100	36	7d	35	160	Scavenged-feather spot	Included
02-Oct-18	Western Meadowlark	S	100	8	7d	42	270	Scavenged-feather spot	Included
02-Oct-18	Western Meadowlark	S	100	20	7d	99	180	Scavenged-feather spot	Included
01-Nov-18	Western Meadowlark	S	100	11	28d	86	234	Scavenged-feather spot	Included
13-Nov-18	Western Meadowlark	S	100	40	28d	38	48	Scavenged-feather spot	Included
26-Nov-18	Western Meadowlark	S	100	6	7d	103	320	Scavenged-feather spot	Included
20-Dec-18	Western Meadowlark	S	100	42	7d	30	180	Scavenged-feather spot	Included
03-Jan-19	Western Meadowlark	S	100	24	28d	41	190	Scavenged-feather spot	Included
03-Jan-19	Western Meadowlark	S	100	46	7d	15	210	Scavenged-feather spot	Included
04-Jan-19	Western Meadowlark	S	100	35	28d	91	88	Scavenged-feather spot	Included
09-Jan-19	Western Meadowlark	S	100	28	7d	70	355	Scavenged-feather spot	Included
10-Jan-19	Western Meadowlark	S	100	42	7d	100	355	Intact-partial decomposed	Included
05-Feb-19	Western Meadowlark	S	100	9	7d	70	180	Scavenged-partial decomposed	Included
12-Feb-19	Western Meadowlark	S	100	14	28d	85	40	Scavenged-feather spot	Included
19-Feb-19	Western Meadowlark	S	100	39	7d	3	220	Intact-partial decomposed	Included
21-May-19	Western Meadowlark	S	100	9	7d	60	270	Scavenged-feather spot	Included
04-Jun-19	Western Meadowlark	S	100	8	7d	70	140	Scavenged-feather spot	Included
05-Jun-19	Western Meadowlark	S	100	28	7d	70	170	Scavenged-fresh	Included
30-Jun-19	Western Meadowlark	S	100	6	7d	45	150	Intact-partial decomposed	Included

Date	Species	Size Class[1]	Average Mass (g)[2]	Turbine	Survey Type	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[3]
01-Jul-19	Western Meadowlark	S	100	9	7d	50	80	Scavenged-partial decomposed	Included
02-Jul-19	Western Meadowlark	S	100	15	7d	70	240	Scavenged-feather spot	Included
23-Jul-19	Western Meadowlark	S	100	37	28d	39	90	Scavenged-feather spot	Included
31-Jul-19	Western Meadowlark	S	100	48	28d	29	350	Scavenged-partial decomposed	Included
17-Aug-19	Western Meadowlark	S	100	33	28d	91	330	Scavenged-feather spot	Included
20-Aug-19	Western Meadowlark	S	100	8	7d	100	320	Scavenged-partial decomposed	Included
19-Sep-18	White-throated Swift	S	32	15	7d	40	350	Scavenged-feather spot	Included
22-Oct-18	White-throated Swift	S	32	1	7d	100	280	Scavenged-feather spot	Included
22-Oct-18	White-throated Swift	S	32	6	7d	103	280	Scavenged-feather spot	Included
22-Oct-18	White-throated Swift	S	32	12	7d	30	240	Scavenged-feather spot	Included
26-Nov-18	White-throated Swift	S	32	1	7d	95	220	Scavenged-partial decomposed	Included
27-Nov-18	White-throated Swift	S	32	44	28d	33	80	Scavenged-partial decomposed	Included
06-Dec-18	White-throated Swift	S	32	46	7d	20	120	Scavenged-partial decomposed	Included
11-Dec-18	White-throated Swift	S	32	37	28d	18	150	Scavenged-partial decomposed	Included
19-Dec-18	White-throated Swift	S	32	15	7d	30	110	Intact-fresh	Included
28-Jan-19	White-throated Swift	S	32	1	7d	70	100	Scavenged-feather spot	Included
18-Jun-19	White-throated Swift	S	32	20	7d	100	60	Scavenged-partial decomposed	Included
28-Jun-19	White-throated Swift	S	32	32	Incidental	18	220	Scavenged-partial decomposed	Excluded: on plot not discovered
24-Jul-19	White-throated Swift	S	32	4	28d	27	20	Intact-fresh	Included
25-Jul-19	White-throated Swift	S	32	46	7d	30	30	Intact-fresh	Included
28-Aug-19	White-throated Swift	S	32	47	28d	100	90	Other, see notes	Included
22-Apr-19	Wilson's Warbler	S	7	17	7d	85	40	Intact-partial decomposed	Included
23-Apr-19	Wilson's Warbler	S	7	20	7d	85	60	Intact-partial decomposed	Included
07-Aug-19	Wilson's Warbler	S	7	36	7d	90	60	Scavenged-partial decomposed	Included
28-May-19	Yellow Warbler	S	9.8	20	7d	40	60	Scavenged-partial decomposed	Included
29-Aug-19	Yellow Warbler	S	9.8	46	7d	80	50	Scavenged-partial decomposed	Included
29-Oct-18	Yellow-rumped Warbler	S	12.3	1	7d	70	120	Scavenged-partial decomposed	Included

[1] S = small (average species mass ≤100 g); M = medium (101–500 g); L = large (501–1799 g); VL = very large (≥1800 g) – generally grouped with large birds.
[2] Sources: Sibley (2016) for birds and University of Michigan (2019) for bats.
[3] Included = included in adjusted fatality estimates. Excluded: off plot = carcass excluded from adjusted fatality estimates because found outside all survey plots. Excluded: on plot incidental = carcass excluded from adjusted fatality estimates because it was discovered incidental to standard surveys by a relevant surveyor or was left in place and never found by surveyors.

Appendix P. Facility-Wide Adjusted Fatality Estimates for All Bat and Bird Species Calculated Using *GenEst*: Year 1

Note: Although estimated here for all species regardless of sample size, species-specific estimates based on fewer than five documented fatalities are considered unreliable (Huso et al. 2012).

Species	Size Class	Contributing Fatalities	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
			Median	95% CI	Median	95% CI	Median	95% CI
Bats								
Mexican free-tailed bat	S	113	5.63	4.25 – 8.30	3.14	2.38 – 4.64	270	204 – 398
Hoary bat	S	73	3.85	2.78 – 5.90	2.15	1.55 – 3.30	185	133 – 283
Western red bat	S	5	0.22	0.10 – 0.45	0.13	0.06 – 0.25	11	5 – 21
Big brown bat	S	2	0.09	0.04 – 0.22	0.05	0.02 – 0.12	4	2 – 10
Silver-haired bat	S	1	0.03	0.02 – 0.05	0.01	0.01 – 0.03	1	1 – 3
Unknown bat	S	1	0.05	0.02 – 0.12	0.03	0.01 – 0.07	2	1 – 6
Birds								
American kestrel	M	4	0.12	0.08 – 0.20	0.07	0.05 – 0.11	6	4 – 10
American pipit	S	2	0.09	0.04 – 0.21	0.05	0.02 – 0.12	4	2 – 10
Barn owl	M	2	0.06	0.04 – 0.12	0.03	0.02 – 0.07	3	2 – 6
Black-headed grosbeak	S	3	0.14	0.06 – 0.29	0.08	0.03 – 0.16	7	3 – 14
Black-throated gray warbler	S	1	0.05	0.02 – 0.15	0.02	0.01 – 0.06	2	1 – 5
Brewer's blackbird	S	1	0.04	0.02 – 0.10	0.03	0.01 – 0.08	3	1 – 7
Brown-headed cowbird	S	1	0.05	0.02 – 0.16	0.03	0.01 – 0.09	3	1 – 8
Burrowing owl	M	2	0.06	0.04 – 0.13	0.04	0.02 – 0.07	3	2 – 6
Cliff swallow	S	1	0.04	0.02 – 0.10	0.02	0.01 – 0.06	2	1 – 5
Common poorwill	M	1	0.03	0.02 – 0.04	0.02	0.01 – 0.02	1	1 – 2
Common raven	L	1	0.03	0.02 – 0.04	0.02	0.01 – 0.02	1	1 – 2
Eurasian Collared-Dove	M	1	0.03	0.02 – 0.07	0.02	0.01 – 0.02	1	1 – 2
European starling	S	8	0.49	0.21 – 0.94	0.05	0.03 – 0.08	4	3 – 7
Ferruginous hawk	L	3	0.08	0.06 – 0.15	0.05	0.03 – 0.08	4	3 – 7
Golden eagle[1]	L	6	0.17	0.13 – 0.31	0.10	0.07 – 0.17	8	6 – 15
Grasshopper sparrow	S	1	0.04	0.02 – 0.10	0.02	0.01 – 0.06	2	1 – 5

Species	Size Class	Contributing Fatalities	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
			Median	95% CI	Median	95% CI	Median	95% CI
Hermit warbler	S	1	0.04	0.02 – 0.10	0.02	0.01 – 0.05	2	1 – 5
Horned lark	S	41	2.04	1.46 – 2.99	1.14	0.82 – 1.67	98	70 – 143
House finch	S	1	0.08	0.02 – 0.28	0.04	0.01 – 0.16	4	1 – 14
House wren	S	23	1.12	0.73 – 1.65	0.62	0.41 – 0.92	54	35 – 79
Mourning dove	M	3	0.08	0.06 – 0.16	0.05	0.03 – 0.09	4	3 – 7
Orange-crowned warbler	S	4	0.19	0.08 – 0.40	0.11	0.05 – 0.22	9	4 – 19
Red-tailed hawk	L	55	1.40	1.20 – 2.17	0.78	0.67 – 1.21	67	58 – 104
Red-winged blackbird	S	1	0.08	0.02 – 0.27	0.05	0.01 – 0.15	4	1 – 13
Rock pigeon	M	1	0.03	0.02 – 0.04	0.02	0.01 – 0.02	1	1 – 2
Rough-legged hawk	L	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	1	1 – 3
Savannah sparrow	S	1	0.07	0.02 – 0.27	0.04	0.01 – 0.15	4	1 – 13
Short-eared owl	M	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	1	1 – 3
Swainson’s thrush	S	1	0.04	0.02 – 0.10	0.02	0.01 – 0.06	2	1 – 5
Townsend's warbler	S	2	0.08	0.04 – 0.17	0.05	0.02 – 0.09	4	2 – 8
Tricolored blackbird	S	1	0.04	0.02 – 0.10	0.02	0.01 – 0.06	2	1 – 5
Turkey vulture	L	5	0.14	0.10 – 0.23	0.08	0.06 – 0.13	7	5 – 11
Vaux's swift	S	3	0.15	0.06 – 0.34	0.08	0.03 – 0.19	7	3 – 17
Virginia rail	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	1	1 – 3
Warbling vireo	S	2	0.09	0.04 – 0.21	0.05	0.02 – 0.12	4	2 – 10
Western flycatcher	S	2	0.08	0.04 – 0.17	0.05	0.02 – 0.09	4	2 – 8
Western meadowlark	S	23	1.36	0.85 – 2.22	0.76	0.48 – 1.24	65	41 – 107
Western tanager	S	2	0.13	0.04 – 0.36	0.07	0.02 – 0.20	6	2 – 17
White-tailed kite	M	1	0.03	0.02 – 0.04	0.01	0.01 – 0.02	1	1 – 2
White-throated swift	S	15	0.88	0.50 – 1.49	0.49	0.28 – 0.83	42	24 – 72
Wilson's warbler	S	3	0.13	0.06 – 0.27	0.07	0.03 – 0.15	6	3 – 13
Unknown blackbird	S	5	0.22	0.10 – 0.43	0.12	0.06 – 0.24	11	5 – 21
Unknown raptor	L	3	0.08	0.06 – 0.12	0.04	0.03 – 0.07	4	3 – 6
Unknown large bird	L	2	0.05	0.04 – 0.11	0.03	0.02 – 0.06	3	2 – 5
Unknown medium bird	M	1	0.03	0.02 – 0.05	0.02	0.01 – 0.03	1	1 – 3
Unknown small bird	S	17	0.90	0.54 – 1.48	0.51	0.30 – 0.83	43	26 – 71

[1] We consider the documented on- and off-plot fatality totals to be the most accurate mortality indices for golden eagles during this study (see Section 4.3.2 for further discussion). For this monitoring year, the unadjusted total fatality count (8 eagles) and the adjusted median fatality estimate were the same.

Appendix Q. Facility-Wide Adjusted Fatality Estimates for All Bat and Bird Species Calculated Using *GenEst*: Year 2

Note: Although estimated here for all species regardless of sample size, species-specific estimates based on fewer than five documented fatalities are considered unreliable (Huso et al. 2012).

			Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
Species	Size Class	Contributing Fatalities	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Bats[1]								
Mexican free-tailed bat	S	64	5.90	4.40 – 8.87	3.30	2.46 – 4.95	283	211 – 426
Hoary bat	S	44	4.17	2.92 – 6.32	2.33	1.63 – 3.53	200	140 – 303
Western red bat	S	2	0.17	0.04 – 0.45	0.09	0.02 – 0.25	8	2 – 22
California myotis	S	1	0.08	0.02 – 0.28	0.05	0.01 – 0.16	4	1 – 13
Unknown bat	S	2	0.22	0.04 – 0.66	0.12	0.02 – 0.37	11	2 – 32
Birds								
American kestrel	M	9	0.22	0.19 – 0.30	0.13	0.10 – 0.17	11	9 – 14
American pipit	S	3	0.98	0.06 – 5.90	0.55	0.03 – 3.30	47	3 – 283
Barn owl	M	3	0.07	0.06 – 0.09	0.04	0.03 – 0.05	4	3 – 4
Burrowing owl	M	22	0.60	0.48 – 0.81	0.33	0.27 – 0.45	29	23 – 39
Common raven	L	2	0.06	0.04 – 0.10	0.03	0.02 – 0.05	3	2 – 5
European starling	S	5	0.42	0.10 – 2.24	0.23	0.06 – 1.25	20	5 – 108
Ferruginous hawk	L	3	0.08	0.06 – 0.14	0.05	0.03 – 0.08	4	3 – 6
Golden eagle[1]	***L***	***14***	***0.39***	***0.29 – 0.56***	***0.22***	***0.16 – 0.31***	***19***	***14 – 27***
Hermit thrush	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
Hermit warbler	S	2	0.09	0.04 – 0.20	0.05	0.02 – 0.11	4	2 – 10
Horned lark	S	34	3.70	1.49 – 14.38	2.07	0.83 – 8.04	178	72 – 690
House finch	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
House wren	S	1	0.04	0.02 – 0.12	0.02	0.01 – 0.06	2	1 – 6
Killdeer	S	1	0.04	0.02 – 0.11	0.02	0.01 – 0.06	2	1 – 6
Loggerhead shrike	S	1	0.28	0.02 – 2.11	0.16	0.01 – 1.18	14	1 – 101
Mallard	L	2	0.07	0.04 – 0.13	0.04	0.02 – 0.07	3	2 – 6
Mountain bluebird	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
Mourning dove	M	1	0.03	0.02 – 0.04	0.01	0.01 – 0.02	1	1 – 2

Species	Size Class	Contributing Fatalities	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
			Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Northern harrier	M	1	0.03	0.02 – 0.03	0.01	0.01 – 0.02	1	1 – 2
Prairie falcon	L	1	0.03	0.02 – 0.04	0.01	0.01 – 0.02	1	1 – 2
Red-tailed hawk	L	28	0.80	0.63 – 1.11	0.45	0.35 – 0.62	38	30 – 53
Ruby-crowned kinglet	S	4	0.39	0.08 – 2.28	0.22	0.05 – 1.27	19	4 – 110
Rufous hummingbird	S	1	0.04	0.02 – 0.11	0.02	0.01 – 0.06	2	1 – 5
Savannah sparrow	S	1	0.27	0.02 – 1.97	0.15	0.01 – 1.10	13	1 – 94
Sharp-shinned hawk	M	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 4
Townsend's warbler	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
Tree swallow	S	1	0.04	0.02 – 0.11	0.02	0.01 – 0.06	2	1 – 5
Tricolored blackbird		0	0.00	0.00 0.00	0.00	0.00 0.00	0	0 0
Turkey vulture	L	2	0.05	0.04 – 0.08	0.03	0.02 – 0.04	3	2 – 4
Vaux's swift	S	3	0.09	0.06 – 0.17	0.05	0.03 – 0.10	4	3 – 8
Warbling vireo	S	3	0.12	0.06 – 0.23	0.06	0.03 – 0.13	6	3 – 11
Western flycatcher	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
Western kingbird	S	1	0.04	0.02 – 0.12	0.02	0.01 – 0.06	2	1 – 6
Western meadowlark	S	15	1.07	0.39 – 4.00	0.60	0.22 – 2.24	52	19 – 192
Western tanager	S	1	0.04	0.02 – 0.11	0.02	0.01 – 0.06	2	1 – 6
White-tailed kite	M	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 4
White-throated swift	S	19	1.23	0.48 – 4.26	0.69	0.27 – 2.38	59	23 – 204
Wilson's warbler	S	3	0.10	0.06 – 0.20	0.06	0.03 – 0.11	5	3 – 10
Yellow warbler	S	1	0.04	0.02 – 0.12	0.02	0.01 – 0.06	2	1 – 6
Unidentified blackbird	S	4	0.13	0.08 – 0.24	0.08	0.05 – 0.13	6	4 – 12
Unidentified flycatcher	S	2	0.31	0.04 – 2.26	0.17	0.02 – 1.26	15	2 – 108
Unidentified vireo	S	1	0.04	0.02 – 0.12	0.02	0.01 – 0.07	2	1 – 6
Unidentified warbler	S	4	0.16	0.08 – 0.32	0.09	0.05 – 0.18	7	4 – 15
Unidentified small bird	S	11	0.66	0.24 – 2.48	0.37	0.14 – 1.38	31	12 – 119

[1] Estimates for bats are based exclusively on data collected during 7-day interval surveys conducted by detection–dog teams at 16 turbines, with facility totals extrapolated from those estimates.

[2] We consider the documented on- and off-plot fatality totals to be the most accurate mortality indices for golden eagles during this study (see Section 4.3.2 for further discussion). For this monitoring year, that unadjusted count was 14 eagles, including one injured eagle found off plot that was tallied with the on-plot incidents and included to derive the adjusted estimate. It is not reasonable to think that five more eagles were killed during this monitoring year but were never detected.

Appendix R. Facility-Wide Adjusted Fatality Estimates for All Bat and Bird Species Calculated Using *GenEst*: Year 3

Note: Although estimated here for all species regardless of sample size, species-specific estimates based on fewer than five documented fatalities are considered unreliable (Huso et al. 2012).

	Size	Contributing	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
Species	**Class**	**Fatalities**	**Estimate**	**95% CI**	**Estimate**	**95% CI**	**Estimate**	**95% CI**
Bats								
Mexican free-tailed bat	S	64	2.77	1.98 – 4.28	1.55	1.11 – 2.39	133	95 – 205
Hoary bat	S	49	5.62	2.05 – 32.63	3.14	1.15 – 18.23	270	99 – 1566
Western red bat	S	4	0.13	0.08 – 0.26	0.07	0.05 – 0.15	6	4 – 13
California myotis[1]	S	1	0.10	0.02 – 0.57	0.06	0.01 – 0.32	5	1 – 27
Silver-haired bat	S	1	0.04	0.02 – 0.11	0.02	0.01 – 0.06	2	1 – 5
Western mastiff bat	S	1	0.04	0.02 – 0.08	0.02	0.01 – 0.05	2	1 – 4
Unknown bat	S	5	0.32	0.10 – 0.96	0.18	0.06 – 0.54	15	5 – 46
Birds								
American kestrel	M	7	0.19	0.15 – 0.29	0.11	0.08 – 0.16	9	7 – 14
American pipit	S	3	0.22	0.06 – 0.60	0.12	0.03 – 0.33	10	3 – 29
Black-throated gray warbler	S	1	0.05	0.02 – 0.15	0.03	0.01 – 0.08	2	1 – 7
Blue-gray gnatcatcher	S	1	0.05	0.02 – 0.17	0.03	0.01 – 0.10	2	1 – 8
Brewer's blackbird	S	1	0.08	0.02 – 0.35	0.04	0.01 – 0.19	4	1 – 17
Burrowing owl	M	13	0.34	0.27 – 0.49	0.19	0.15 – 0.28	16	13 – 24
Common raven	L	1	0.02	0.02 – 0.03	0.01	0.01 – 0.02	1	1 – 1
European starling	S	5	0.25	0.10 – 0.57	0.14	0.06 – 0.32	12	5 – 27
Fox sparrow	S	1	0.05	0.02 – 0.15	0.03	0.01 – 0.08	2	1 – 7
Golden eagle[2]	***L***	***8***	0.20	0.17 – 0.25	***0.11***	***0.09 0.14***	***9***	***8 – 12***
Hermit thrush	S	1	0.05	0.02 – 0.15	0.03	0.01 – 0.09	2	1 – 7
Horned lark	S	23	1.24	0.78 – 2.12	0.69	0.43 – 1.18	60	37 – 102
House wren	S	7	0.40	0.16 – 0.90	0.22	0.09 – 0.50	19	8 – 43
Killdeer[1]	S	1	0.08	0.02 – 0.33	0.04	0.01 – 0.18	4	1 – 16
Lincoln sparrow	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
Mallard	L	1	0.03	0.02 – 0.04	0.02	0.01 – 0.02	1	1 – 2

Species	Size Class	Contributing Fatalities	Fatalities Per Turbine		Fatalities Per MW		Total Fatalities	
			Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Mountain bluebird	S	1	0.03	0.02 – 0.06	0.02	0.01 – 0.03	2	1 – 3
Mourning dove	M	3	0.07	0.06 – 0.10	0.04	0.03 – 0.05	3	3 – 5
Northern harrier	M	1	0.03	0.02 – 0.06	0.02	0.01 – 0.03	1	1 – 3
Orange-crowned warbler	S	1	0.03	0.02 – 0.07	0.02	0.01 – 0.04	2	1 – 3
Peregrine falcon	L	1	0.03	0.02 – 0.04	0.02	0.01 – 0.02	1	1 – 2
Red-tailed hawk	L	23	0.57	0.48 – 0.79	0.32	0.27 – 0.44	28	23 – 38
Rock pigeon	M	1	0.03	0.02 – 0.06	0.02	0.01 – 0.03	1	1 – 3
Ruby-crowned kinglet	S	3	0.15	0.06 – 0.37	0.08	0.03 – 0.20	7	3 – 18
Sora	S	1	0.08	0.02 – 0.34	0.05	0.01 – 0.19	4	1 – 16
Swainson's thrush	S	1	0.03	0.02 – 0.06	0.02	0.01 – 0.03	2	1 – 3
Townsend's warbler	S	1	0.03	0.02 – 0.06	0.02	0.01 – 0.04	2	1 – 3
Tricolored blackbird	S	2	0.11	0.04 – 0.37	0.06	0.02 – 0.20	5	2 – 18
Turkey vulture	L	1	0.02	0.02 – 0.03	0.01	0.01 – 0.02	1	1 – 2
Unidentified blackbird	S	9	0.47	0.21 – 0.91	0.26	0.12 – 0.51	23	10 – 44
Unidentified flycatcher	S	4	0.23	0.08 – 0.58	0.13	0.05 – 0.32	11	4 – 28
Unidentified grebe	M/L	1	0.03	0.02 – 0.06	0.02	0.01 – 0.03	1	1 – 3
Unidentified raptor	M/L	2	0.05	0.04 – 0.07	0.03	0.02 – 0.04	2	2 – 3
Unidentified medium bird	M	1	0.03	0.02 – 0.04	0.02	0.01 – 0.02	1	1 – 2
Unidentified small bird	S	25	1.29	0.82 – 2.08	0.72	0.46 – 1.16	62	39 – 100
Unidentified sparrow	S	1	0.05	0.02 – 0.15	0.03	0.01 – 0.08	2	1 – 7
Unidentified warbler	S	1	0.05	0.02 – 0.15	0.03	0.01 – 0.09	2	1 – 7
Vaux's swift	S	3	0.13	0.06 – 0.29	0.07	0.03 – 0.16	6	3 – 14
Warbling vireo	S	1	0.03	0.02 – 0.06	0.02	0.01 – 0.04	2	1 – 3
Western meadowlark	S	28	1.65	1.05 – 2.72	0.92	0.58 – 1.52	79	50 – 131
White-throated swift	S	14	0.83	0.46 – 1.54	0.46	0.25 – 0.86	40	22 – 74
Wilson's warbler	S	3	0.11	0.06 – 0.22	0.06	0.03 – 0.12	5	3 – 11
Yellow warbler	S	2	0.08	0.04 – 0.19	0.04	0.02 – 0.11	4	2 – 9
Yellow-rumped warbler	S	1	0.05	0.02 – 0.15	0.03	0.01 – 0.09	2	1 – 7

[1] We consider the documented on- and off-plot fatality totals to be the most accurate mortality indices for golden eagles during this study (see Section 4.3.2 for further discussion). For this monitoring year, there were no off-plot incidents recorded.

Appendix S. Details Concerning Time-Since-Death Aging of Golden Eagle Carcasses Removed From Fatality Estimation in Year 1 Because Carcass Deposition Predated the Survey Effort

Specimen ID	Discovery Date	On Plot?	Turbine ID	Age	Cause of Death	Estimated Time Since Death (months)	Carcass Condition	General Notes
20160920-08	20-Sep-16	Yes	14	Nonadult	Blade strike?	>1	Intact-decomposed: skull and body intact; body cavity collapsed; some dispersed tail and body feathers; legs only bone; probable broken wing	
20160920-09	20-Sep-16	Yes	24	Unknown	Blade strike	>1	Decomposed: head only	From headless fatality found 17 May 2016: R Culver
20160927-03	27-Sep-16	Yes	17	Subadult	Blade strike?	>1	Intact-partial decomposed: desiccated, body cavity mostly cleaned out; probable broken wing; large pile of fly/beetle pupae under carcass	
20161011-07	11-Oct-16	Yes	3	Unknown	Blade strike	>1	Decomposed: partial wing	Part of fatality found 20 May 2016: R Culver