2023–2025 Post-Construction Curtailment and Mortality Monitoring for Bats at Golden Hills Wind, California: Year 2 Report

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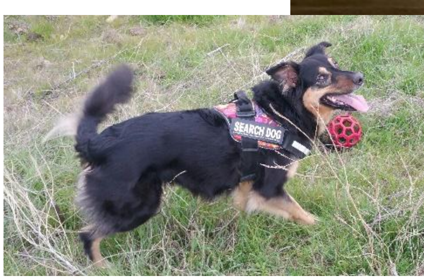

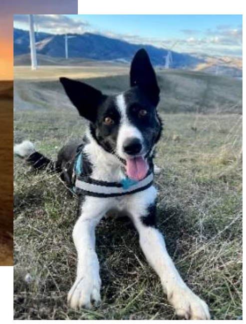

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Executive Summary

From April through October/early November in 2023 and 2024, Great Basin Bird Observatory (GBBO), in collaboration with H. T. Harvey & Associates, conducted the first two of three annual seasons of post-construction fatality monitoring for bats using trained scent-detection dogs at the Golden Hills (GH) Wind Energy Center in the Altamont Pass Wind Resources Area (APWRA). GH is an 85.92 MW facility, comprising 48 1.79-MW General Electric turbines, located in Alameda County, California, south of I-580 and east of the City of Livermore in an area of mixed agricultural use (primarily cattle grazing). This monitoring is focused on determining if adaptive management (AM) in the form of night-time cut-in-speed curtailment reduces the bat fatality rate at this facility compared to the results of 3 years of previous year-long monitoring with detection dogs conducted at the site from 2016–2019. In 2023 during Year 1 of this AM monitoring period, GH Wind increased the cut-in-speed of all facility turbines from 3.5 meters/second (m/sec) to 5.5 m/sec each night from sunset to sunrise from May through September and to 5.0 m/sec during October. In accordance with the Bat Adaptive Management Plan (BAMP) promulgated by Alameda County and the Alameda County Wind Repowering Technical Advisory Committee (TAC), in 2024 during Year 2 of the AM monitoring period GH Wind further increased the cut-in-speed of all facility turbines to 6.0 m/sec each night from April through September and maintained the 5.0 m/sec cut-in-speed in October.

As a basis for this AM monitoring, we selected 16 of 48 turbines at which 7-day-interval surveys will be conducted each year of the 3-year study from April through October using scent detection dogs. The surveys cover 115-m-radius circular plots around each turbine. We used stratified random sampling to select the turbines for surveys, with an effort made to include turbines of high, medium, and low bat fatality risk based on the prior 3-year study. Although the focus of this effort is monitoring bat fatalities, all fatalities encountered during surveys were documented and collected.

We conducted field trials to estimate overall carcass detectability (CD) for bats (single estimates integrating the influences of searcher efficiency and carcass removal) using freshly dead bat carcasses placed periodically throughout the study. The trial placements comprised 30 Mexican free-tailed bat (*Tadarida brasiliensis*) carcasses in Year 1 and 32 carcasses of four species in Year 2. All trial carcasses were collected if discovered by a survey team, but no persistence monitoring occurred. *GenEst* 1.4.9 was used to estimate CD and produce CD-adjusted fatality estimates for the monitoring period for all bats combined and individual species discovered as fatalities. We used data from the prior 3-year study to approximate bat fatality rates during the nonsampled offseason of this study (November – March) and thereby generate approximate annual fatality estimates for comparison against results from the prior study and the bat fatality threshold stipulated by the TAC.

During Year 1, 147 fatalities of at least 22 species were discovered on or near the survey plots, including three species of bats (n = 101) and 19 species of birds (n = 46). Of these, 94 bat fatalities qualified to be included in fatality estimates. During Year 2, 27 fatalities were discovered on or near the survey plots, including two confirmed species of bats (n = 22) and five species of birds (n = 5). Of these, 21 bat fatalities qualified to be included in fatality estimates. Based on an integrated analysis combining data for Years 1 and 2, the adjusted Year 1 7-month, facility-level fatality estimate for all bats combined was 7.77 fatalities per MW (95% CI: 5.37–

12.31) and the comparative estimate for Year 2 was significantly (79%) lower at 1.66 fatalities per MW (95% CI: 0.97–2.81). For the two common species, the declines in Year 2 represented a 77% reduction for Mexican free-tailed bats and an 81% reduction for hoary bats (*Lasiurus cinereus*). Further, compared to the three annual estimates from the prior full-year GH study (average 5.55 bat fatalities/MW, 95% CI: 5.15–5.95), the Year 1 annual estimate from this study (7.77 fatalities/MW adjusted to an approximate annual estimate of 7.87 fatalities/MW) was higher but not significantly different from the prior annual estimates, whereas the Year 2 estimate from this study (1.66 fatalities/MW adjusted to 1.76 fatalities/MW) was significantly lower than all prior estimates. These outcomes suggested that elevating the night-time turbine cut-in-speed from 5.5 m/sec from May–September in Year 1 to 6.0 m/sec from April–September in Year 2 contributed to the reduction in bat fatalities in Year 2. Abnormally high levels of winter/spring rainfall preceding Year 1 compared to Year 2 also likely played a role given the positive influence of rainfall on bat prey abundance and attendant bat activity/abundance and risk of collision mortality.

Increasing the night-time cut-in-speed of facility turbines from 3.5 m/sec to 5.5/5.0 m/sec in 2023 did not appreciably reduce the all-bat fatality rate compared to the prior 3-year average from the site. However, further elevating the night-time cut-in-speed to 6.0 m/sec in Year 2 for 6 months appeared to significantly reduce the fatality rate compared to both Year 1 of this study and the prior 3-year average. In accordance with the BAMP, during the third year of this AM monitoring effort in 2025, GH Wind will further increase the cut-in-speed of all facility turbines to 6.5 m/sec each night from sunset to sunrise from April through September and maintain the 5.0 m/sec night-time cut-in-speed in October.

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List of Contributors

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We also thank our capable field and lab crew for their essential assistance: Heidi Bencin, Renee Culver, Julia Ersan, Sara Fangton, Sarah Jackson, Sade Johnson, Michael Morales, Mussel Dogs, Lauralea Oliver, Skye Standish, Jacqueline Taylor, and Andrea Wuenschel.

Section 1.0 Introduction

This report summarizes the results of the first 2 of 3 years of post-construction monitoring of bat fatalities at the Golden Hills (GH) Wind facility to evaluate the effectiveness of adaptive management (AM) implemented in an effort to reduce the bat fatality rate at the facility. The facility occupies space that formerly supported numerous smaller, less-efficient, older-generation wind turbines that were operated for many years. Repowering of this facility represented the second phase by NextEra Energy Resources to repower their overall wind-energy operations in the Altamont Pass Wind Resource Area (APWRA), and was a component of an overall APWRA repowering program designed to achieve greater and more efficient energy production, while reducing turbine-related fatalities of primarily four focal raptor species plus a few other bird species of local conservation concern (Alameda County Community Development Agency 2014).

Three years of previous bird and bat fatality monitoring at the site (2016–2019; H. T. Harvey & Associates 2024) revealed annual bat fatality rates that exceeded the mortality threshold for all bats combined established as a performance metric in the Program Environmental Impact Report (PEIR) developed to guide repowering projects in the APWRA (Alameda County Community Development Agency 2014). As a result, in January 2023 the Alameda County Wind Repowering Technical Advisory Committee (TAC) developed a Bat Adaptive Management Plan (BAMP) in consultation with the GH and Golden Hills North (GHN) facility operators (TAC 2022). This BAMP mandated 3 years of blanket cut-in-speed curtailment from sunset to sunrise and standardized fatality monitoring from April through October. The TAC-approved BAMP formed the basis for the implemented scope of work. We report integrated Year 1 and Year 2 monitoring results here.

Section 2.0 Study Area

GH Wind is an 86-megawatt (MW) facility comprising 48 1.79-MW General Electric turbines located in Alameda County just north of Interstate 580 and east of the City of Livermore (Figure 1). The facility is owned and operated by Golden Hills Wind, LLC, a wholly owned subsidiary of NextEra Energy Resources, LLC, and began commercial operation in December 2015. This facility is located immediately across Interstate 580 to the south from NextEra's GHN Wind facility. The GH landscape is rolling hills with occasional steep slopes and rocky outcrops, covered with mostly grazed annual grassland, plus scattered small groves of riparian vegetation, and several primarily seasonal livestock ponds. The turbines are situated on hilltops and ridgelines, with the vertical relief between hill/ridge tops and intervening valleys typically ranging from 30–60 meters (m), and occasionally as much as 100 m. The turbines are generally arranged in strings of 2–3 turbines, with spacing between adjacent turbines within strings ranging from approximately 250–400 m, and a maximum nearest-neighbor distance between turbines of approximately 600 m. The 48 GH turbines have a hub height of 80 m and a rotor diameter of 100 m, which translates to a rotor-swept zone extending from 30–130 m above ground level. Many decommissioned old-generation turbines associated with the former Patterson Pass facility were present are just south of the GH facility, but most were removed during the winter of 2024/2025.

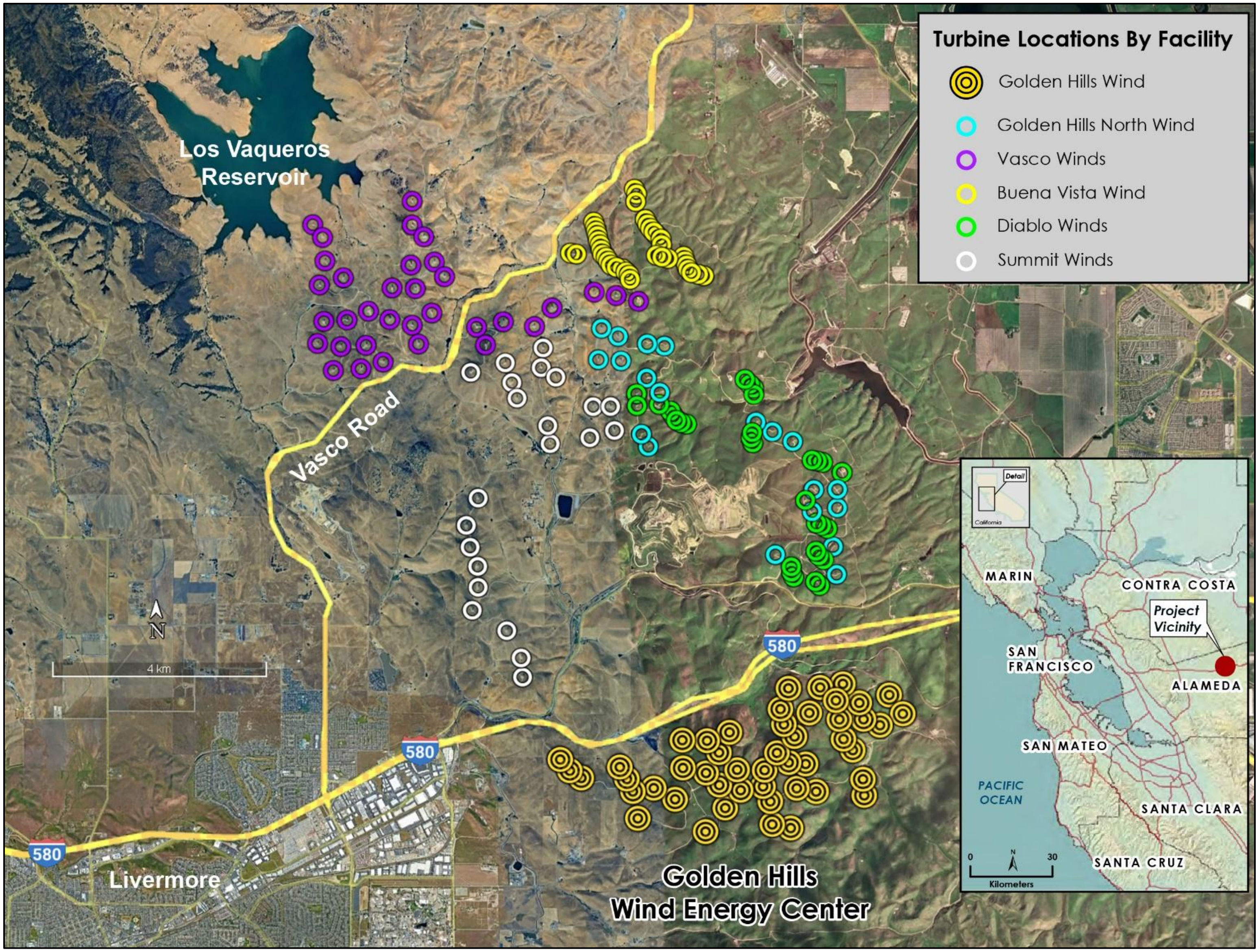

Figure 1. **Study area map depicting turbine arrays at Golden Hills Wind and neighboring facilities.**

Section 3.0 Methods

Table 1 summarizes the primary features of the fatality monitoring conducted during this study.

Table 1. Key elements of TAC-approved study design for Golden Hills postconstruction bat adaptive management monitoring study.

Study Component	Description
Number of Turbines	48 1.79-MW General Electric
Size of Facility	85.92 MW
Length of Study	April–October 2023–2025
Search Area	115-m radius search area (4.15 ha)
Fatality Surveys	16 randomly selected turbines surveyed with scent-detection dogs at 7-day intervals
Carcass Detectability Trials	At least 15 bats placed during first half of monitoring period (spring/early summer) and 15 placed during second half (late summer/fall) during each annual monitoring period. Integrated annual and seasonal assessments of overall probability of carcass detection (CD) used to derived adjusted fatality estimates for bats.
Curtailment	During the Year 1 (2023) AM monitoring period, GH Wind increased the cut-in-speed (based on hub-height anemometer measurements) of all facility turbines from 3.5 m/sec to 5.5 m/sec each night from sunset to sunrise from May through September and to 5.0 m/sec during October. During Year 2 (2024), all facility turbines were operated from sunset to sunrise with a cut-in-speed of 6.0 m/sec from April through September and 5.0 m/sec in October.
Reports Due	Annually, 90 days after annual monitoring period ends

3.1 Fatality Surveys

3.1.1 Sampling Design and Survey Scheduling

We used stratified random sampling to select 16 of 48 turbines for conducting surveys during this study (Figure 2). We based the selections on the hotspot analysis presented in H. T. Harvey & Associates (2024), derived from single-year bat fatality estimates for each turbine based on 7-day surveys with detection dogs conducted over a 3-year period. To derive the sample of 16 turbines for this follow-up AM bat study, first we arbitrarily divided the 48 turbines into four groups based on the prior hotspot results: 1) high risk = top seven ratings, including all turbines rated as strong and moderate hotspots plus three rated as low hotspots, with annual fatality rates of 18.0–26.1 fatalities; 2) moderate risk = all other turbines rated as low hotspots (n = 7, annual fatality rate 13.9–15.8 fatalities); 3) low risk = all turbines rated as "neutral" spots (n = 15, annual fatality rate 8.2–13.7 fatalities); and 4) very low risk = all others rated as "cold" spots (n = 19, annual fatality rate 1.5–7.9 fatalities). To increase the likelihood of detecting an effect of curtailment, we excluded turbines classified as very low risk. Then we randomly selected five turbines from each remaining risk category and selected one more turbine without regard for its risk rating to compose the set of 16 turbines monitored during this study.

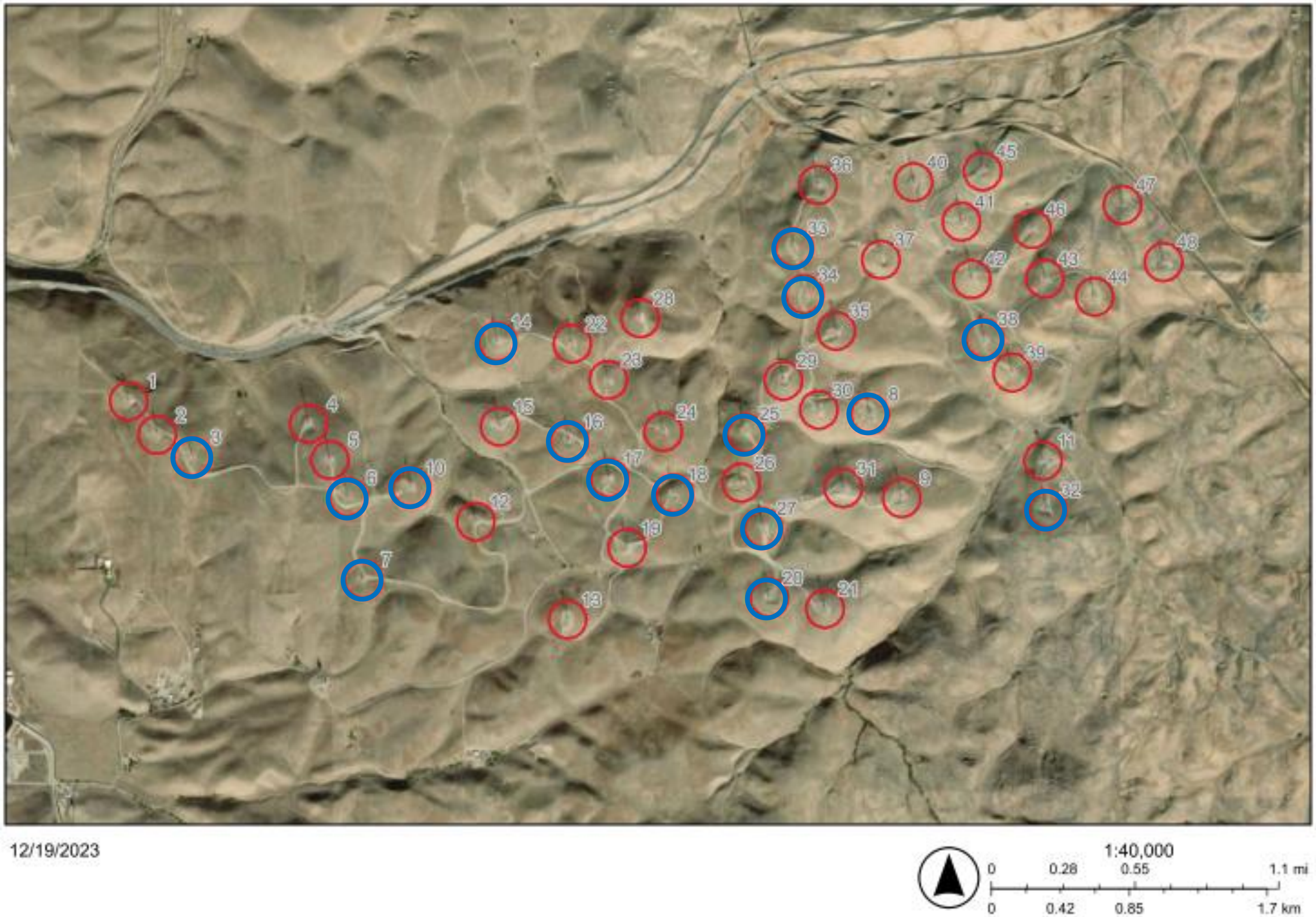

Figure 2. **Selected sampling plots (outlined in blue) subjected to 7-day-interval fatality surveys.**

Fatality searches were conducted each week for 31 weeks from April 3 through November 4, 2023 (Year 1) and during 29 of 31 weeks from April 1 through October 30, 2024. All searches were conducted using trained handlers and scent-detection dogs. Surveys proceeded according to predetermined schedules, with occasional variations due to circumstances beyond our control. When this occurred, we rescheduled the surveys to minimize deviation from the expected 7-day search interval to the degree possible.

3.1.2 Survey Protocols and Data Recording

All handlers (8 individuals over 2 years) and detection dogs (16 individuals over 2 years) involved in this study had prior experience conducting bird and bat fatality surveys or received intensive training and evaluation in advance of their involvement. Detection-dog surveys were performed using and adjusting to wind patterns. The dogs worked off-leash and the handlers used body movements, hand signals, verbal cues, and whistles to control the dog's movements to optimize coverage of the designated survey plots (GBBO and H. T. Harvey & Associates 2022, H. T. Harvey & Associates 2024a).

At the facility's direction, we reported all large-bird fatalities and injuries to the consultant conducting concurrent eagle-related monitoring at the site, who then collected and processed those incidents. When they detected bat and smaller bird fatalities, the handlers recorded specimen data and digital photographs using Field Maps (ESRI, Inc., Redlands, California) and customized data entry forms, running on GPS-enabled Samsung Galaxy Note tablets or the Field Maps phone app. The app was configured for offline use and included cached basemap imagery, turbine locations, survey plots, and roads as map layers. The data recorded for every fatality incident are described in Appendix A. Other data recorded each time a plot was searched included wind and weather conditions, classification of groundcover on the plot as a whole, and notes about relevant search-area access issues and constraints (e.g., livestock and facility/turbine maintenance activities). Carcass collection and processing followed protocols used during previous GH/GHN studies (GBBO and H. T. Harvey & Associates 2022; H. T. Harvey & Associates 2022, 2024a, 2024b), including transferring samples of all collected bats to the California Department of Wildlife (CDFW) Wildlife Health Lab in Rancho Cordova and the U.S. Geological Survey (USGS) Renewables-Wildlife Solutions Initiative lab in Boise, Idaho to support various tissue and genetics analyses. Genetic analysis was used to determine the species of unidentified bats when possible.

3.1.3 Survey Effort, Search Intervals, and Turbine Operation Gaps

Variation in the expected 7-day search intervals occurred during the monitoring period due to turbine maintenance, unhealthy air quality from wildfire smoke, the presence of cattle, and handler/canine matters. Schedule shifts of 1–2 days commonly occurred. In addition, 46 of 496 (9%) scheduled surveys were missed entirely in Year 1, with coverage gaps of 1–3 sequential weeks and up to 6 weeks total at individual turbines, primarily in response to safety matters relating to wildfire smoke, inclement weather, and/or ranch/facility operations. In Year 2, 69 of 496 (14%) scheduled surveys were missed entirely, with coverage gaps of 1–4 sequential weeks and up to 12 weeks total at individual turbines, again largely in response to safety matters, primarily due to extended turbine maintenance activities. Appendix B provides a summary of surveys, survey date ranges, and average search intervals by turbine.

3.2 Carcass Detectability Trials

3.2.1 Sampling Design

We conducted field trials to estimate carcass detectability (CD) using the TAC-approved Big *D* approach (Brown et al. 2016; Smallwood et al. 2018; GBBO and H. T. Harvey & Associates 2022; H. T. Harvey & Associates 2022, 2024a, 2024b). The overall approach included the following elements:

- Trial carcasses were placed throughout each 7-month monitoring period based on year-specific, randomized, spatially balanced placement designs and irrespective of when surveys were scheduled.
- Trial carcasses were handled and prepared to facilitate identification upon discovery and to minimize human odor.
- 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 or after surveys.
- CD estimates integrated the influences of imperfect searcher efficiency, bleed-through (i.e., carcass not detected on first survey but detected on a subsequent survey; see Warren-Hicks et al. 2013), and removal of carcasses by scavengers and abiotic factors.
- During each 7-month monitoring period, the goal was to place at least 15 bat carcasses during each of two designated field *Seasons*: *spring/early summer* (April 1 – July 15) and *late summer/fall* (July 16 – October 31) to enable effective estimation of detection rates for each monitoring year and season (10 samples per covariate class is considered the minimum for generating reliable detectability estimates; Huso et al. 2012).
- Placements were not specifically allocated to ensure minimum acceptable sample sizes for estimating differences related to *Substrate Visibility* classes, defined as bare ground and gravel roads/pads = *high* visibility, grazed short/medium grass/forb = *moderate* visibility, and tall fallow grass/forb = *low* visibility. Reasons for this include (a) the effectiveness of fatality searches with detection dogs generally is not dependent on visual constraints, and (b) limited availability of suitably fresh, trial carcasses. Nevertheless, where practical, we considered *Substrate Visibility* as a second covariate of potential interest in formulating the CD estimation model.

We sought representative variation in the time between placement and first survey of CD trial carcasses by placing small numbers of trial carcasses during most weeks of the study, irrespective of survey schedules, and by allowing detections to occur at any time after a trial carcass was placed. Placement locations were based on generalized random tessellation sampling (GRTS) spatially balanced allocation plans, which helped to ensure effective spatial and temporal representation across the selected survey plots, as well as effective randomization of placements relative to substrate variability. 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 helped ensure the validity of the Big *D* "binomial" approach to conducting CD 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).

3.2.2 Composition of Trial Carcasses and Placement Protocols

We followed established methods for preparing and placing trial carcasses (GBBO and H. T. Harvey & Associates 2022; H. T. Harvey & Associates 2022, 2024a, 2024b). We used native bat species known to occur, or with the potential to occur, in the study area (California Energy Commission and California Department of Fish and Game 2007, Smallwood 2007). We avoided using other surrogate animals because of evidence that scavenging rates 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 were obtained as either fatalities in previous GH/GHN/Vasco Winds studies or from the CDFW Wildlife Health lab. Beginning in 2023, tissue samples were collected from all trial carcasses before use, either previously by the CDFW or for transfer to the CDFW/USGS.

3.2.3 Estimating Probability of Detection

We used *GenEst* 1.4.9 to produce estimates of CD and CD-adjusted fatality estimates (Dalthorp et al. 2018a, b; Simonis et al. 2018; Rabie et al. 2021). *GenEst* was designed to support independent estimation of searcher efficiency, carcass persistence, and bleed-through; however, a *GenEst* software developer produced a customized workaround to enable CD estimation based on the binomial Big *D* approach (H. T. Harvey & Associates 2024a). To develop the adjusted fatality estimates, we evaluated *Year*, *Season* and *Substrate Visibility* (as defined in Section 3.2.1) as potential covariates in the CD model.

To select a final CD model, we compared Akaike Information Criterion scores corrected for small sample sizes (AICc) for all possible, estimable candidate models to evaluate the merits of different additive and factorial combinations of the three covariates for predicting CD. We considered an AICc score reduction (ΔAICc) of more than two points indicative of an improved model (Burnham and Anderson 2002). We considered as potential final models only those that were based on a minimum of 10 detectability trials per covariate-class combination (Huso et al. 2012). In selecting a final model, we chose one that included *Season* if ΔAICc for such a model was ≤2.00 compared to the model with the lowest AICc value. The latter approach reflected the following factors:

- Both fatality and detectability data were expected to vary seasonally.
- Spatially randomized and temporally representative placements of trial carcasses throughout each monitoring year explicitly supported developing seasonal adjustment factors, if warranted.
- Including an informative season variable in the estimation models was recommended to bolster use of the customized *GenEst* routine for handling binomial detectability trials (D. Dalthorp, PowerStats, LLC [formerly USGS], personal communication).

3.3 Adjusted Fatality Estimates

We used *GenEst* to derive CD-adjusted, year-specific, 7-month fatality estimates for all bats combined and all individual species of bats detected as qualified fatalities. We report adjusted 7-month fatality estimates as median estimates ± 95% confidence intervals (CIs). We provide estimated total fatalities extrapolated by *GenEst* to represent the entire 48-turbine facility, plus fatalities per turbine and per MW of installed capacity based on the estimated facility-wide totals. To specifically illustrate comparative fatality rates among sampled turbines for the purpose of identifying potential fatality hotspots, we generated estimated turbine-specific fatality totals based on not having *GenEst* extrapolate the estimates to represent the entire facility.

GenEst incorporates distance weighted proportion (*DWP*) adjustment factors to account for the proportion of fatalities expected to be deposited within searched areas (Hull and Muir 2010; Huso and Dalthorp 2014; Simonis et al. 2018). To achieve consistency with all prior analyses/reports prepared to produce fatality estimates for bats at the GH and GHN facilities (GBBO and H. T. Harvey & Associates 2022; H. T. Harvey & Associates 2022, 2024a), as well as with all other previous studies conducted in the APWRA prior to 2023, we assumed a *DWP* factor of 1.0 for this analysis (Hull and Muir 2010). Based on our experiences at these sites, we acknowledge that bats are routinely deposited outside of the standard survey plots, such that using a DWP factor of 1.0 does not accurately represent the true distribution of bat fatalities at this site. However, as reflected in guidelines for the recently formulated *GenEst* DWP estimation module (Dalthorp et al. 2023), without complicated additional modeling beyond the scope of this monitoring project, that estimation module does not perform well when the known distribution of fatalities exhibits significant anisotropy (i.e., directionally biased distribution due to wind effects, for example). This characteristic strongly applies at GH (Figure 3; equally true at GHN—see GBBO and H. T. Harvey & Associates 2025).

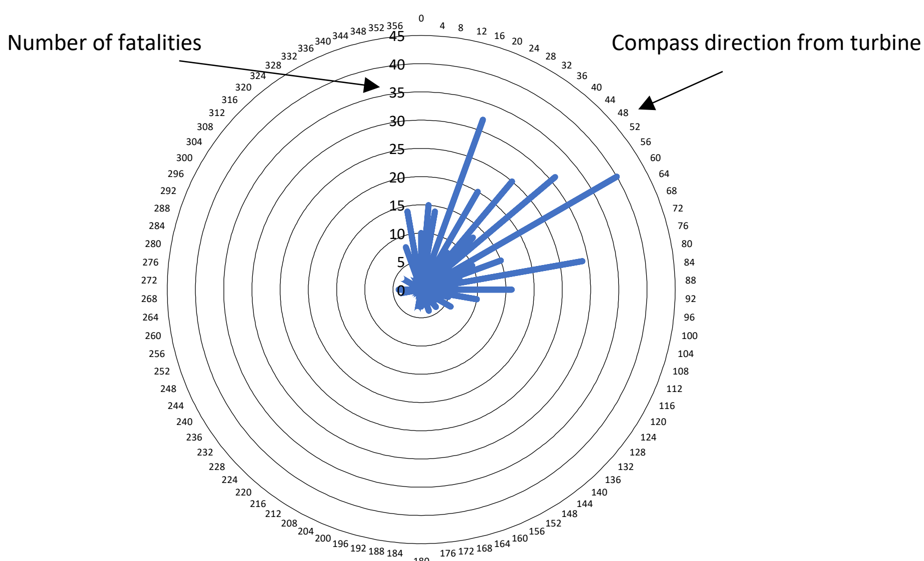

Figure 3. Distribution of bat fatalities relative to turbine position during the initial 3-year Golden Hills Wind fatality monitoring project (2016–2019) demonstrating substantial anisotropy related to primary southwesterly wind direction.

To estimate adjusted fatalities, we did not adjust for missed surveys and periods when selected turbines were offline for extended maintenance. *GenEst* estimation accommodates variable search intervals at individual turbines across sampling periods when fatalities are expected to occur and for which CD is estimated. In addition, when turbines were offline for 1–4 weeks for maintenance (see summary records in Appendix B), no turbine-related fatalities were accumulating at those turbines, so extrapolating estimates to account for those downtimes would overestimate the actual fatalities that accumulated during the study. We acknowledge, however, that the degree of turbine downtime was relatively high during Year 2 of this study, which may confound comparing the resulting fatality estimate—potentially biased low—against the Year 1 estimate and those from prior monitoring efforts that may not have been as affected by this issue.

3.3.1 Approximating Annual Fatality Estimates

To approximate annual fatality estimates based on only 7 months of sampling per year, we used data from the prior 3-year study to estimate the fatality rate during the seasonal periods that were not sampled during the current study, with the estimates limited to those derived from 7-day surveys with detection dogs at 16 turbines per year (H. T. Harvey & Associates 2024b). No AM curtailment regime was implemented during the prior study, but this was also the case during the unsampled offseason periods during the current study, so the estimates should not be biased in any particular direction. During the prior 3-year study, adjusted bat fatalities accumulated from November through March each year amounted to 3%, 10%, and 1% of the all-species totals summed over comparable November through October annual periods (with October 2019—not sampled—represented as the average for the prior three Octobers). Although the 10% contribution to the 2017–2018 sampling period may appear noteworthy, the estimated November–March fatality total (15 fatalities) was similar to the prior year (11 fatalities), whereas the estimated offseason total for 2018–2019 was only two fatalities.

Accordingly, to extrapolate the current 7-month adjusted fatality estimates to annual estimates for the purpose of comparing all-bat annual fatality estimates from the prior and current studies, we could either inflate each all-species 7-month estimate by 5% (average of 3 years of proportional adjusted fatality contributions from November – March from prior study) or by adding nine fatalities or 0.11 fatalities/MW (average of 3 years of adjusted fatality estimates for November – March from prior study). If offseason fatality levels from November through March were consistently proportional to fatality levels during April through October, then it would make sense to use an average proportional (%) adjustment factor. That was not the case during the prior 3-year study, however, with the higher percentage contribution of offseason fatalities during 2017–2018 due primarily to a lower fall fatality rate rather than a higher offseason rate (see Figure 5 in Section 4.3). For this reason, we adopted the additions approach to adjust the 7-month estimates from the current study to approximate annual estimates to compare against those from prior years. For all other purposes, we present and focus only on the original 7-month estimates.

Section 4.0 Results

4.1 Carcass Detectability

4.1.1 Composition and Placement of Trial Carcasses

In Year 1, a designated biologist not involved in fatality surveys opportunistically placed 30 trial carcasses on the 16 study plots during the 7-month study period: 15 during spring/early summer (April – July 15) and 15 during late summer/fall (July 16 – October) (Figure 4, Appendix C). The placements did not begin until late April due to constraints related to NextEra USFWS Special Purpose Utility (SPUT) permitting for the project. After that, 1–3 new placements occurred opportunistically across the study plots during 16 of the 28 remaining weeks of the 7-month monitoring period, with no new placements made from the second week of July through mid-August due to personnel constraints. All placements consisted of Mexican free-tailed bats due to limited availability of freshly dead and intact carcasses of other species. Two (7%) trial carcasses were placed on high-visibility substrates, 11 (37%) on moderate-visibility substrates, and 17 (57%) on low visibility substrates.

In Year 2, a designated biologist placed 32 trial carcasses on the 16 study plots: 15 during spring/early summer and 17 during late summer/fall (Figure 4, Appendix C). Personnel constraints precluded placements until the fourth week of the monitoring period After that, 1–6 new placements occurred opportunistically across the study plots during 11 of the 28 remaining weeks, with placement gaps of up to 3 weeks. The placements consisted of 20 Mexican free-tailed bats, 9 *Myotis* sp., 2 hoary bats (*Lasiurus cinereus*), and 1 big brown bat (*Eptesicus fucus*). Seven (21%) trial carcasses were placed on high-visibility substrates, 9 (28%) on moderate-visibility substrates, and 16 (50%) on low visibility substrates.

4.1.2 Probability of Detection

In Year 1, the detection-dog teams found 15 (50%) of the 30 trial carcasses on the original placement plots, all still intact but in various stages of desiccation/decomposition (Appendix D). One other carcass that had been placed along a roadway was subsequently found 6 days later off-plot, still intact and approximately 100 m farther away along the same roadway; this find was not classified as a relevant detection because it was found outside of the survey plot. Ten of 15 (63%) trial carcasses were found within 1 week following placement (i.e., during the first survey after placement). Five (31%) other trial carcasses were found within one month of placement. The final found trial carcass was not re-discovered for 139 days (in high cover, still intact but desiccated).

In Year 2, the detection-dog teams found 15 (47%) of the 32 trial carcasses on the original placement plots: 8 still intact and either still fresh or in the early stages of decomposition, and 7 scavenged and in various stages of decomposition (Appendix D). Five of 15 (33%) trial carcasses were found within 1 week after placement, four others within 1 month after placement, one 44 days after placement (placed on road, found as tuft of fur nearby in moderate visibility cover), and the final carcass was found 116 days after placement (placed and found in moderate visibility cover; found as small piece of taped wing).

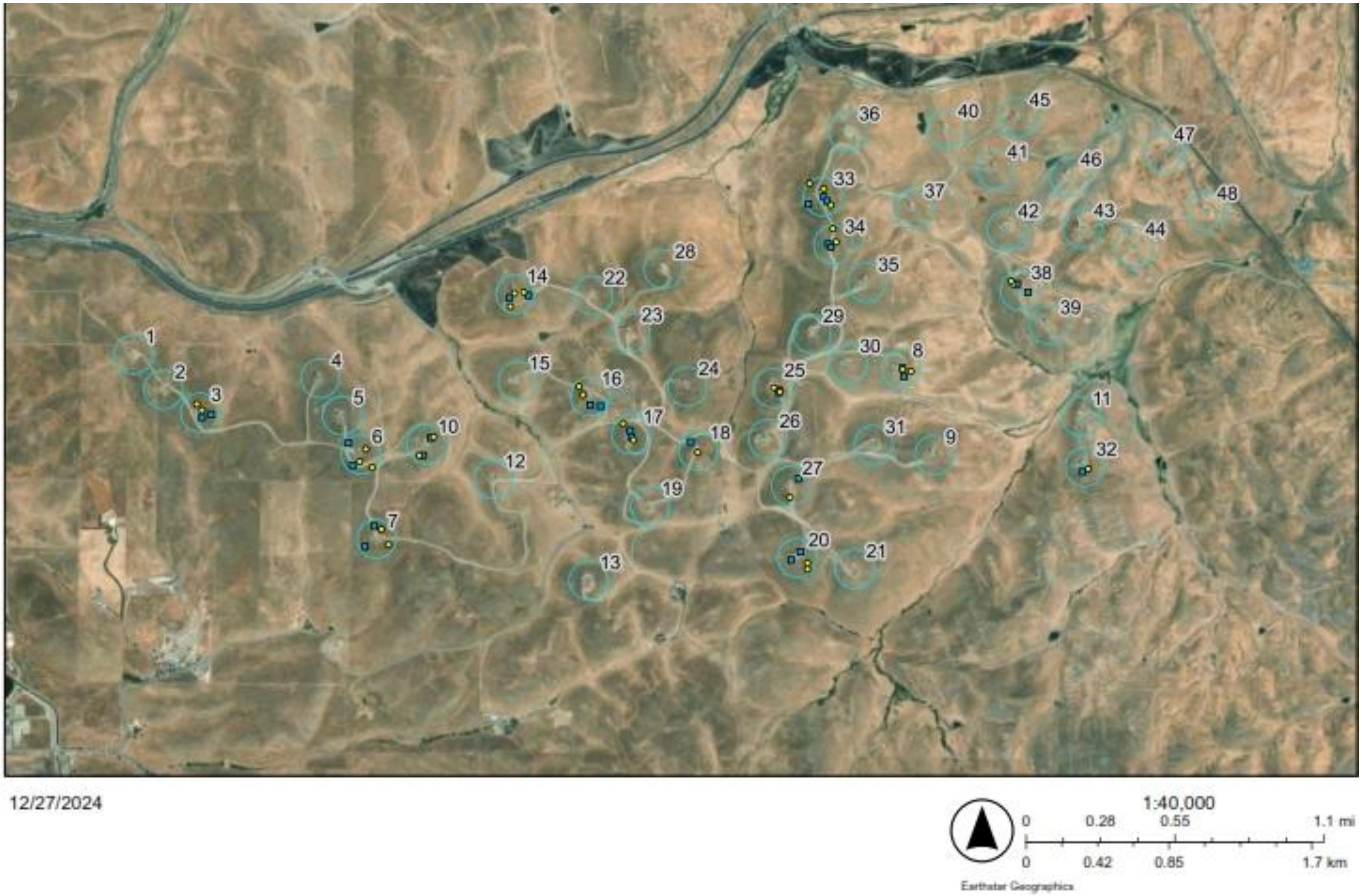

Figure 4. **Placement of bat carcass detectability trial specimens in Year 1 (yellow circles) and Year 2 (blue squares) of this study at Golden Hills Wind.**

GenEst modeling and AICc scores revealed the null model as the top model (Table 2). The ΔAICc values for all three models with only a single covariate (*Year*, *Season*, or *Substrate Visibility*) were ≤2.08, indicating marginally competitive alternative models. The model with *Season* included had the second lowest AICc score and the model with *Substrate Visibility* had the third lowest AICc score; however, modeling *Substrate Visibility* did not meet our sample-size threshold for further consideration, with only nine carcasses placed on high-visibility substrates across the two monitoring years. Accordingly, following a *GenEst* developer's recommended guidance for applying the nonstandard Big D approach to evaluating CD (see H. T. Harvey & Associates 2024a) and given a competitive model with ΔAICc ≤2, we selected the model with *Season* included to estimate adjusted fatalities. Inclusion of the *Season* covariate reflected higher overall detectability in spring/early summer (57%) compared to late summer/fall (41%). For reference, the model with only *Year* included reflected slightly higher overall detectability in Year 1 (50%) compared to Year 2 (47%), and the model with only *Substrate Visibility* included reflected low detectability (22%) for the few carcasses placed on high-visibility substrates, and similarly higher detectability on moderate- and low-visibility substrates (52–55%).

4.2 Composition of Fatality Incidents

In Year 1, the detection-dog teams found 101 bat carcasses or carcass fragments during standardized surveys that were classified as representing individual bats. Fragments of two hoary bats and eight Mexican free-tailed bats were identified to species based on genetic analysis (Appendix E). Seven individuals were excluded from analyses because they were discovered outside of all survey plots. The remaining 94 carcasses included 63 Mexican free-tailed bats, 29 hoary bats, and 2 special-status western red bats (*Lasiurus frantzii*; a California species of special concern). Bat carcasses were found every month, with the lowest proportion found in April (3%) and the highest proportions in September (35%) and October (31%).

In Year 2, the detection-dog teams found 21 bat carcasses or fragments during standardized surveys representing individual bats. All were found during a survey and none were excluded from estimating adjusted fatalities. The carcasses included 15 Mexican free-tailed bats and 6 hoary bats. Bat carcasses were found every month, with the lowest proportion in June (5%) and the highest proportions in September (29%) and October (19%).

Fatality data for birds are not reported here but will be shared with agencies per permit reporting requirements.

4.3 Fatality Estimates

4.3.1 Year 1

Based on the integrated 2-year *GenEst* analysis, the Year 1 (2023) 7-month median fatality estimates for all bats combined were 667 total bats (95% CI: 462–1057) for the entire facility, 13.91 fatalities per turbine (95% CI: 9.62–22.03 and 7.77 bats per MW (95% CI: 5.37–12.31) (Table 3). The estimated all-bat fatality rate was significantly higher during late summer/fall than during spring/early summer, with that pattern applying to all identified species (Table 3). Notably, only Mexican free-tailed bats and hoary bats were found as fatalities during spring/early summer in both years.

Table 2. *GenEst* carcass detectability (CD) candidate models evaluated to estimate adjusted bat fatalities based on sampling conducted at 16 turbines from April through October in 2023 and 2024 at Golden Hills Wind.

Formula *p*[1]	Formula *k*[2]	AICc[3]	∆AICc
p ~ constant	k fixed at 0	87.95	**0.00**
p ~ Season[4]	k fixed at 0	88.49	0.54
p ~ Substrate Visibility[5]	k fixed at 0	89.19	1.24
p ~ Year	k fixed at 0	90.03	2.08
p ~ Season + Substrate Visibility	k fixed at 0	90.48	2.53
p ~ Year + Season	k fixed at 0	90.65	2.70
p ~ Year + Substrate Visibility	k fixed at 0	91.46	3.51
p ~ Year * Season	k fixed at 0	92.42	4.47
p ~ Year + Season + Substrate Visibility	k fixed at 0	92.83	4.88
p ~ Season + Substrate Visibility + Season : Substrate Visibility	k fixed at 0	93.01	5.06
p ~ Year * Substrate Visibility	k fixed at 0	94.35	6.40
p ~ Year + Season + Substrate Visibility + Year : Season	k fixed at 0	95.05	7.10
p ~ Year + Season + Substrate Visibility + Season : Substrate Visibility	k fixed at 0	95.41	7.46
p ~ Year + Season + Substrate Visibility + Year : Substrate Visibility	k fixed at 0	95.88	7.93
p ~ Year + Season + Substrate Visibility + Year : Season + Season : Substrate Visibility	k fixed at 0	97.87	9.92
p ~ Year + Season + Substrate Visibility + Year : Season + Year : Substrate Visibility	k fixed at 0	98.10	10.15
p ~ Year + Season + Substrate Visibility + Year : Substrate Visibility+ Season : Substrate Visibility	k fixed at 0	98.92	10.97
p ~ Year + Season + Substrate Visibility + Year : Season + Year : Substrate Visibility+ Season : Substrate Visibility	k fixed at 0	101.16	13.21
p ~ Year * Season * Visibility	k fixed at 0	108.55	20.60

1 Describes variation in the median probability of detection (CD) among covariate classes.
2 Describes 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) (see H. T. Harvey & Associates 2024a).
3 Akaike Information Criterion corrected for small samples sizes.
4 Selected model. Two seasons: spring/early summer (early April – July 15) and late summer/fall (July 16 – October).
5 Three categories: high = high-visibility bare dirt or gravel road/pad, moderate = moderate-visibility grazed short grass/forb, and low = tall fallow grass/forb.

Table 3. **Adjusted 7-month (April through October) fatality estimates by year and season for all bats combined and individual species based on sampling at 16 turbines with estimates extrapolated by *GenEst* to represent the entire 48-turbine Golden Hills Wind facility.**

Species	Year	Season[1]	Contributing Fatalities	Fatalities per Turbine		Fatalities per MW		Total Fatalities	
				Median	95% CI	Median	95% CI	Median	95% CI
All bats combined	2023	Spring/Early Summer	18	2.00	1.15–3.40	1.12	0.64–1.90	96	55–163
		Late Summer/Fall	76	11.84	7.68–19.74	6.62	4.29–11.03	568	369–947
	Total		94	13.91	9.62–22.03	7.77	5.37–12.31	667	462–1057
	2024	Spring/Early Summer	7	0.77	0.29–1.44	0.43	0.16–0.81	37	14–69
		Late Summer/Fall	14	2.14	1.07–4.07	1.20	0.60–2.28	103	51–196
	Total	Combined	21	2.97	1.74–5.04	1.66	0.97–2.81	142	83–242
Mexican free-tailed bat	2023	Spring/Early Summer	15	1.66	0.90–2.88	0.93	0.51–1.61	80	43–138
		Late Summer/Fall	48	7.50	4.67–12.67	4.19	2.61–7.08	360	224–608
	Total	Combined	63	9.22	6.27–14.45	5.15	3.50–8.07	443	301–693
	2024	Spring/Early Summer	5	0.53	0.17–1.13	0.30	0.09–0.63	26	8–54
		Late Summer/Fall	10	1.52	0.64–2.97	0.85	0.35–1.66	73	30–143
	Total	Combined	14	2.09	1.09–3.62	1.17	0.61–2.02	100	52–174
Hoary bat	2023	Spring/Early Summer	3	0.33	0.06–0.78	0.18	0.0.3–0.43	16	3–37
		Late Summer/Fall	26	3.97	2.30–7.11	2.22	1.28–3.97	190	110–341
	Total	Combined	29	4.30	2.56–7.51	2.40	1.43–4.19	207	123–360
	2024	Spring/Early Summer	2	0.22	0.04–0.56	0.12	0.02–0.31	11	2–27
		Late Summer/Fall	4	0.58	0.15–1.48	0.33	0.08–0.82	28	7–71
	2024	Combined	6	0.83	0.24–1.69	0.46	0.14–0.94	40	12–81
Western red bat	2023	Spring/Early Summer	0	–	–	–	–	–	–
		Late Summer/Fall	2	0.29	0.04–0.82	0.16	0.02–0.46	14	2–39
	2024	Combined	0	–	–	–	–	–	–

[1] Spring/early summer = April – July 15; late summer/fall = July 16 – October.

Evaluated on a monthly basis across 5 years of past and current monitoring, the monthly adjusted fatality estimates from September and October 2023 (Year 1 of this study) were by far the highest yet recorded at the site, and the Year 1 estimates for spring/early summer (April – July) were equal to or substantially higher compared to the same period from all other years (Figure 5).

Turbine-specific fatality totals estimated without having *GenEst* extrapolate the estimates to represent the entire facility were comparatively low at WTGs 07, 25, and 34 (2.5–6.1 estimated fatalities), moderate at eight turbines (8.8–18.1 fatalities per turbine), and higher at WTGs 10, 20, and 27 (18.7–25.9 fatalities per turbine) (Figure 6; compare against turbine locations shown in Figure 2).

4.3.2 Year 2

The Year 2 (2024) 7-month median fatality estimates for all bats combined were 142 total bats (95% CI: 83–242) for the entire facility, 2.97 fatalities per turbine (95% CI: 1.74–5.04), and 1.66 fatalities per MW (95% CI: 0.97–2.81) (Table 3). The Year 2 estimated fatality totals were significantly lower for all species compared to Year 1 (Figures 5 and 7). As in Year 1, the estimated all-bat fatality rate in Year 2 was significantly higher during late summer/fall than during spring/early summer (Table 3). The monthly per-MW fatality estimates from Year 2 (2024) of this study were generally comparable to Years 2 and 3 (2018–2019) of the prior study (Figure 5).

Figure 5 also illustrates monthly site-wide total power generation at the facility in megawatt-hours (MWH) during the prior and 2023 sampling periods (U.S. Energy Information Administration 2025; no data currently available for 2024). Total power generation between April and October varied from 211,614–212,667 MWH among years of the original 3-year study (highest in Year 2) and dropped 16% in 2023 (first year with night-time cut-in-speed curtailment) compared to the annual average for 2017–2019. No distinct patterns were evident in comparing monthly power generation and fatality rates. Notably, the high fatality rates observed from August through October 2023 corresponded to average (September) to below-average (August and October) power generation compared to the same months in prior years. However, the moderately high fatality rates observed from August through October in 2017 corresponded to mostly average to above average power generation compared to subsequent years.

Turbine-specific fatality totals were universally lower—mostly much lower—at all turbines in Year 2 compared to Year 1 (Figure 6). Compared within Year 2, low totals occurred at WTGs 3, 17, and 38 (0–1.7 estimated fatalities/turbine), moderately low totals occurred at seven turbines (2.3–2.4 estimated fatalities/turbine), moderately high totals occurred at WTGs 6, 10, and 16 (3.7–4.1 estimated fatalities/turbine), and higher totals occurred at WTGs 7, 20, and 33 (4.8–6.0 fatalities/turbine). WTG20 had at least moderately high fatality totals in both years, whereas the relative rankings of other turbines generally changed markedly between years.

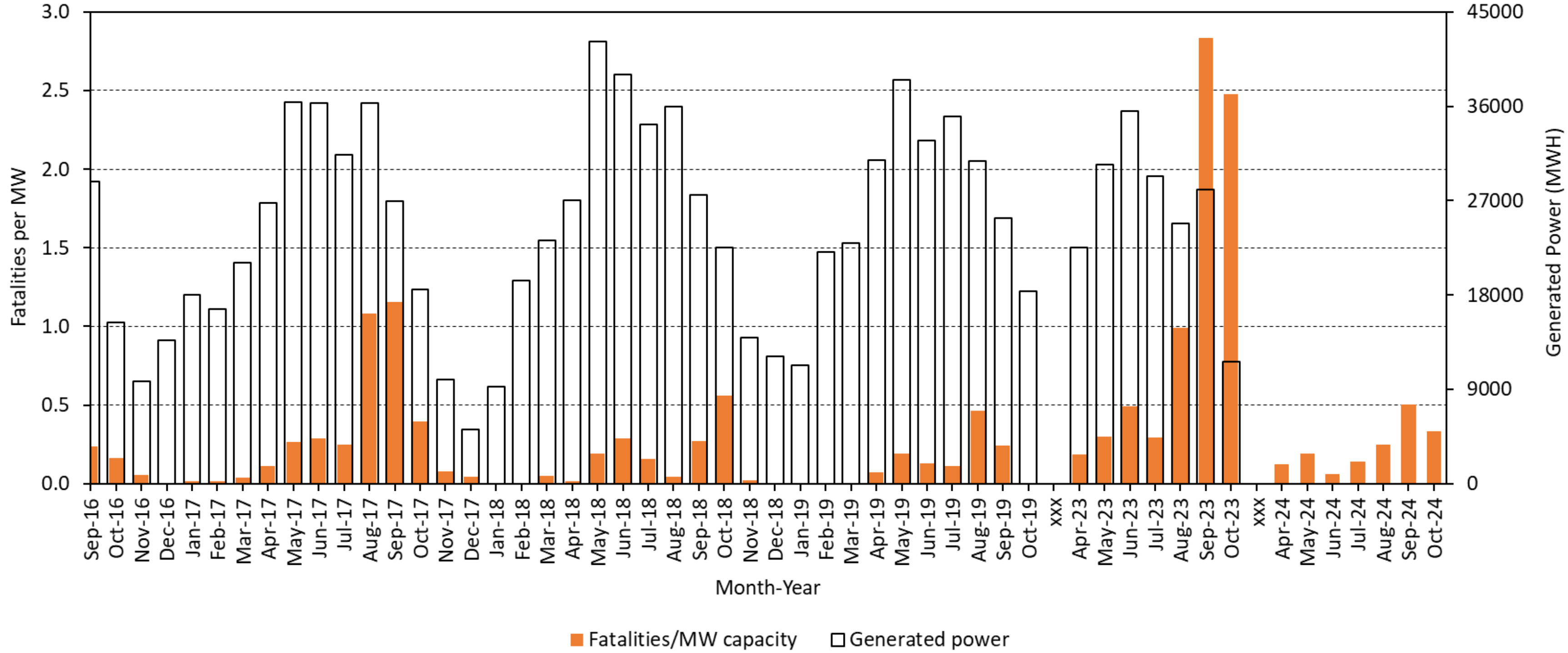

Figure 5. **Monthly adjusted estimates of bat fatalities per MW of nameplate capacity from 3 years of previous year-long monitoring and 2 years of April–October monitoring during the current study at Golden Hills Wind, shown in relation to monthly power generation (no data currently available for 2024).**

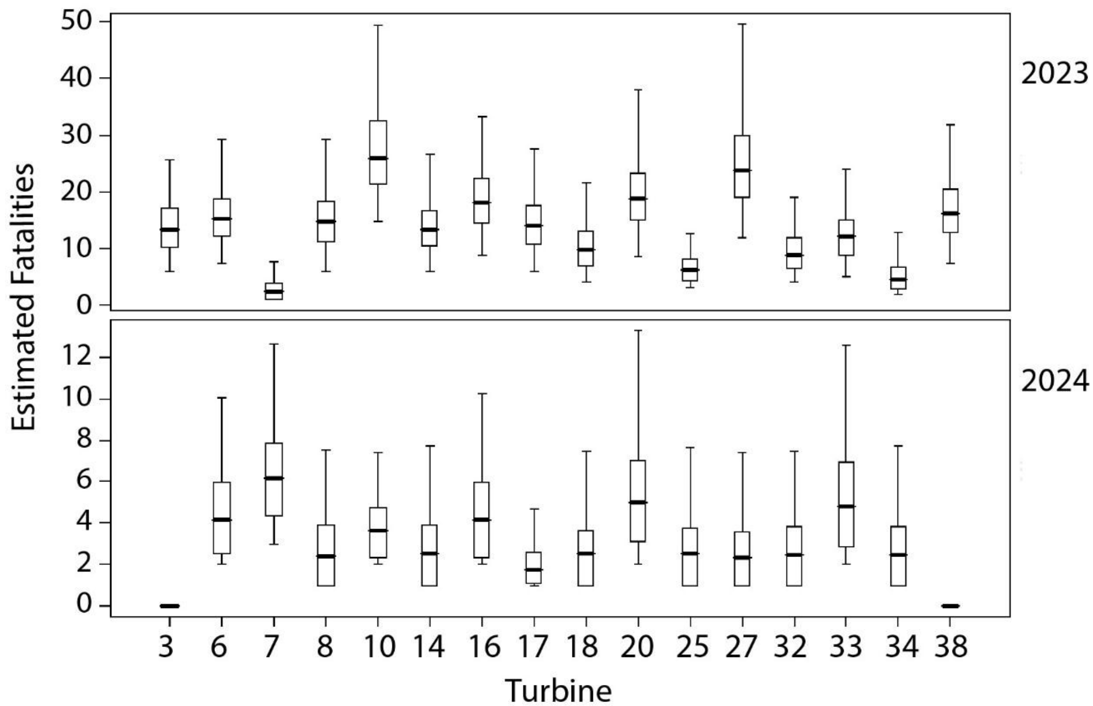

Figure 6. **Adjusted 7-month fatality estimates (median, interquartile range, and 95% confidence interval) for all bats combined by year and turbine based on annual sampling from April through October at Golden Hills Wind (see Figure 2 for turbine locations).**

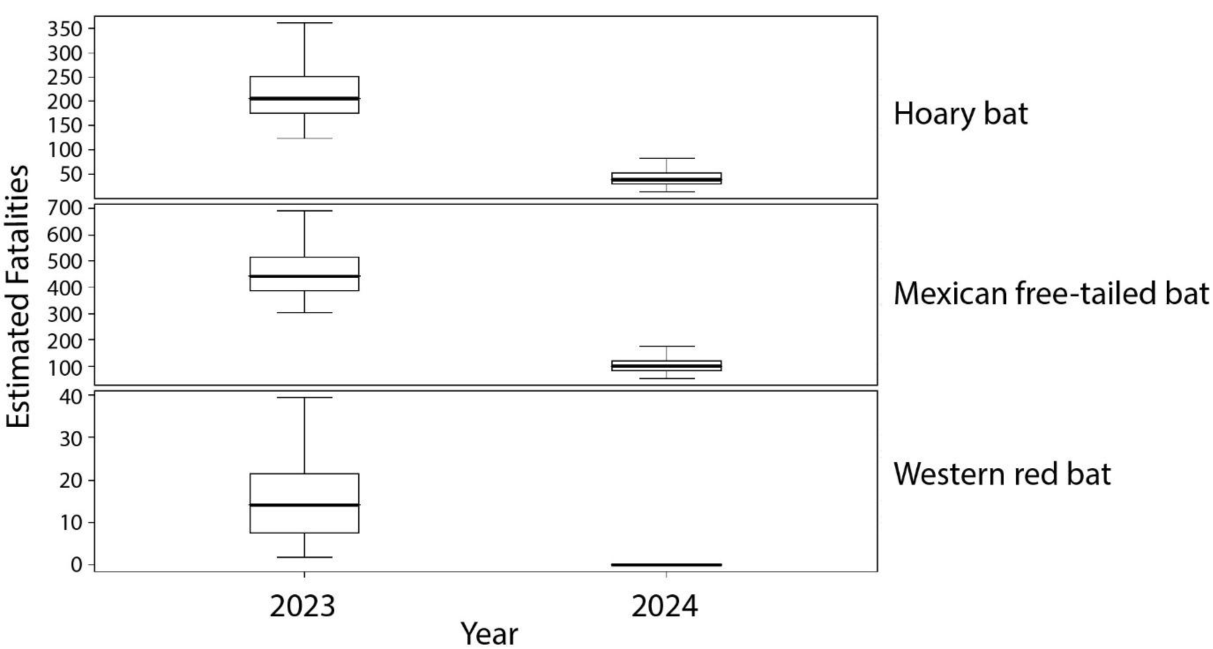

Figure 7. **Adjusted 7-month, facility-level fatality estimates (median, interquartile range, and 95% confidence interval) by year and species based on annual sampling at 16 turbines from April through October at Golden Hills Wind.**

4.3.3 Potential Effects of Turbine Downtime

Compared to the initial 3-year study and Year 1 of this study, downtime to support required turbine maintenance was higher than average in Year 2 of this study and, as a result, may have resulted in artificially low fatality estimates. Notably, the only two turbines with zero fatalities in a given year (WTGs 03 and 38 in Year 2) were subject to minimal downtime in both monitoring years. Otherwise, only WTG14 was subject to extended downtime in Year 1 (3 weeks), whereas five turbines were subject to 2–9 weeks of downtime in Year 2 (WTGs 10, 16, 17, 20, and especially 27). Three turbines were subjected to more than 3 weeks of aggregate turbine downtime, all in Year 2: WTGs 17, 20, and 27. WTG27 was subject to substantial downtime during approximately 9 of 12 weeks (largest sequential extent 4 weeks) between mid-June and mid-September in 2024. WTG17 was subject to an aggregate total of 4 weeks, including approximately 3 weeks of sequential downtime in August 2024. WTG20 was subject to an aggregate total of 4 weeks, including approximately 2 weeks of sequential downtime in May 2024. Only one other turbine was subject to approximately 2 weeks of sequential downtime (WTG32), and no other turbines were subject to sequential downtime affecting more than one 7-day search interval.

Despite these gaps in turbine operations during which no surveys occurred at the relevant turbines, search intervals averaged 7.2–9.4 days at all but one turbine in both years (Appendix B). Further, search-interval variation amounted to ±3 days or less at 13 of 16 turbines in Year 1 (as reflected in standard deviations [SD] from the mean) and at 8 of 16 turbines in Year 2. The only exception with a higher average search interval was WTG27 in Year 2 (11.7 days), and the only exceptions with notably higher SDs were WTG14 in Year 1 (SD ±5.20) and WTG17 (SD ± 6.34) and WTG27 (SD ± 8.44) in Year 2.

Section 5.0 Discussion

5.1 Carcass Detectability

Estimated CD during this study across the two annual sampling periods (57% in spring/early summer, 41% in late summer/fall) was similar to the values documented using the same methods during the same annual 7-month sampling periods at the adjacent GHN facility (54% and 49%, respectively; GBBO and H. T. Harvey & Associates 2025). The current GH 2-year estimates were also similar to the winter/spring and summer/fall estimates for 7-day surveys with dogs from the prior bird and bat study at the site from 2016–2019 (71% and 42%, respectively; H. T. Harvey & Associates 2024a), and the late summer/fall rate was slightly higher than the rate documented during the fall-only survey conducted in 2021 (43%; H. T. Harvey & Associates 2022). Prior to this 2023–2024 study, the CD rate for fall alone had dropped significantly across each of the four previous years of study, and then dropped again slightly between Year 1 and Year 2 of the current study.

5.2 Composition of Fatality Incidents

No bat species were detected during this study that were not detected during the previous 3-year GH study (H. T. Harvey & Associates 2024a). The two most common species, hoary bat and Mexican free-tailed bat, are open aerial foragers that make migratory movements. Western red bats forage primarily in open areas along streams and riverine habitats, which would suggest that their populations in the region are small. This species is listed as a California Species of Special Concern, primarily due to loss or degradation of preferred riparian habitat, and California populations are considered at risk (Williams 1986, Pierson et al. 2000, CDFW 2023).

5.3 Fatality Estimates

The adjusted 7-month fatality estimates generated using *GenEst* based on the integrated 2-year dataset confirmed a significant decline in bat fatalities between Year 1 (2023) and Year 2 (2024), including all three species thus far documented as fatalities. The declines amounted to a 77% reduction for Mexican free-tailed bats, an 81% reduction for hoary bats, and a 100% decline for western red bats. This suggests that elevating the night-time turbine cut-in-speed to 6.0 m/sec for 6 months in Year 2 from contributed to a substantial reduction in bat fatalities in Year 2. This result matches the pattern documented during the concurrent GHN AM study with the same curtailment schedule (GBBO and H. T. Harvey & Associates 2025) and is consistent with prior studies showing that mortality reduction for bats often increases markedly when the cut-in-speed is increased from 5.0 to 6.0 m/sec and especially 6.5 m/sec (Good et al. 2011, Hein et al. 2014, Endangered Species Recovery Committee and Hawaii Department of Land and Natural Resources – Division of Forestry and Wildlife 2024).

WTGs 10 and 20 had relatively high numbers and WTGs 06, 08, 14, 16, 18, 27, and 33 had at least moderate numbers of fatalities in both monitoring years (Figure 6; compare against locations in Figure 2). WTG 10 was classified as a moderate hotspot and WTG 20 as a very strong hotspot based on results of the original 3-year study (H. T. Harvey & Associates 2024a). WTGs 06, 08, 14, 16, and 27 were classified as moderate to strong hotspots based on the prior study, whereas WTGs 18 and 33 were classified as neutral spots. WTG32 was the only strong to very strong hotpot identified from the prior study for which we have thus far recorded only low to moderate fatality rates in this study (zero in Year 2). Otherwise, the distribution of fatalities across the two annual monitoring periods illustrated no obvious spatial clustering nor apparent macro-scale landscape features that might have contributed to the patterns.

Turbine downtime might have affected some of these comparisons. Turbine downtime largely precludes turbine-related fatalities and reduces fatality accumulations that may be discovered once surveys resume at a newly operational turbine. Fatality estimates that do not explicitly account for this effect may underestimate what the turbine-specific fatality totals would have been had the turbines remained fully operational. However, turbine downtime for periodic maintenance is common across wind facilities, and *GenEst* easily accommodates extrapolating estimates across variable search intervals caused by resulting survey gaps. In addition, although new turbine-specific CD placements were temporarily discontinued during extended maintenance operations, previously placed trials that had not yet been searched for or had not yet been found prior to the maintenance period could have been found once surveys resumed if they remained discoverable. If not found after surveys resumed, then the relevant, seasonal CD estimate would have been correspondingly reduced and the resulting fatality estimate for that turbine and seasonal period elevated as a result, thereby at least partially offsetting any reduction caused by the turbine downtime. Accordingly, concern about the effects of periodic short-term downtime on fatality estimates generally is not warranted, whereas sequential or accumulated downtime extended across many weeks could have an atypically large impact on estimates that do not account for the extended turbine-specific downtime.

If WTG27 had not been subject to 9 weeks of sequential downtime during the survey period, the estimated fatality rate at this turbine in Year 2 (2.3 total fatalities) may have been higher and more similar to the high Year 1 estimate for this turbine (23.8 total fatalities). Similarly, an even higher Year 2 estimate for WTG20 might have further emphasized this turbine as at least a potential moderate hotspot for bat fatalities. In contrast, even a modestly elevated Year 2 estimate would not have markedly changed WTG17s ranking among turbines with low to moderate fatality rates. Thus, turbine downtime might have marginally influenced a few turbine-specific hotspot indications, but it is unlikely that this influence markedly affected the overall annual fatality estimates to the point of yielding biased insight about comparative fatality rates among years.

Variable weather preceding the Year 1 and Year 2 sampling periods also likely affected the year-specific fatality estimates during this study. The winter/spring precipitation preceding the 2023 monitoring period reached record levels in central and northern California (18.7" from November 2022 through April 2023 at Altamont weather station), whereas the 2024 monitoring period was preceded by comparatively moderate rainfall (10.7" from October 2023 through April 2024 at Altamont weather station; Western Regional Climate Center 2024). The difference in moisture levels probably contributed to variable insect abundance and attendant bat activity during the two annual sampling periods; however, compared to the GHN facility that lies immediately adjacent to Bethany Reservoir and encompasses other smaller ponds/reservoirs and drainages, the GH facility has few water features to attract bats. Accordingly, the comparable declines in bat activity at both sites during Year 2 of the AM curtailment regime suggest that the elevated cut-in-speed curtailment contributed strongly to the reduction in fatality levels at both sites.

Variable sampling periods and variation in turbine operational levels confound comparing estimated fatality rates from this study and the prior 3-year, year-round study at the facility (H. T. Harvey & Associates 2024a). The sampling inconsistencies also confound comparing the current 7-month estimates against the TAC-derived mortality threshold for all bats combined, which was based on annual fatality estimates (Alameda County TAC 2022). Nevertheless, as outlined in Section 3.3.1, we adopted a reasonable approach to extrapolating the 7-month estimates from this study to annual estimates based on the offseason adjusted fatality totals documented during the prior 3-year study. In contrast, higher than average turbine downtime in Year 2 also might have biased low the fatality estimate for that year of this study, but we did not seek to contrive overly complicated adjustments to account for that potential, likely modest, factor.

Compared to the estimated annual per-MW values from the prior 3-year year-round GH study (H. T. Harvey & Associates 2024a), the Year 1 7-month spring-fall estimates from this study (667 total fatalities, 7.77 fatalities per MW) adjusted to approximate annual estimates (676 total fatalities, 7.87 fatalities per MW) were slightly higher but not significantly different from the prior annual estimates, whereas the Year 2 annual estimates from this study (adjusted from 142 to 151 total fatalities, and 1.66 to 1.76 fatalities per MW) were significantly lower than all prior estimates (Figure 8). In contrast, the Year 1 and Year 2 per-MW 7-month fatality estimates from this study were significantly 1.7–3.3 times lower than the 7-month estimates from the concurrent GHN bat AM study (Year 1: 13.10 fatalities/MW, 95% CI: 10.21–17.58; Year 2: 5.41 fatalities/MW, 95% CI: 3.97–7.66; GBBO and H. T. Harvey & Associates 2025). We suspect the stark difference between the two neighboring facilities reflects the comparative abundance on and around GHN of reservoirs, drainages, and the Altamont Landfill, which produce more insects and therefore attract more foraging bats.

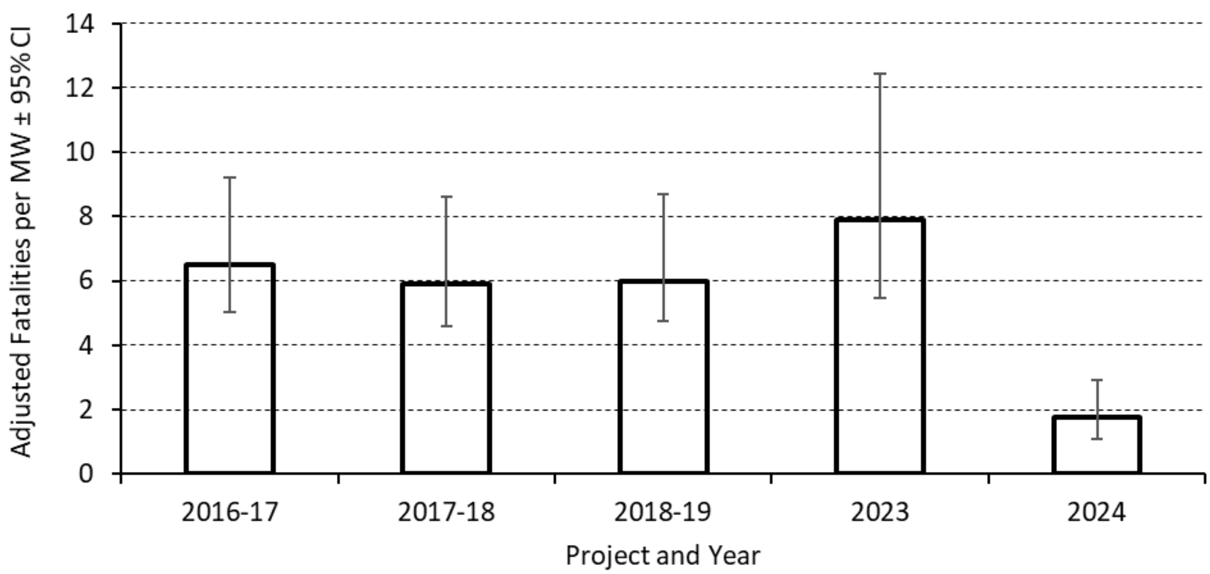

Figure 8. Adjusted all-bat fatality estimates from original 3-year Golden Hills Wind fatality monitoring study (year-long estimates; 2016–2019) and current study (April – October estimates extrapolated to annual estimates; 2023–2024).

Section 6.0 Management Implications

Increasing the night-time cut-in-speed of facility turbines from 3.5 m/sec to 5.5/5.0 m/sec in 2023 did not reduce the all-bat fatality rate below the specified TAC mortality threshold, nor did it reduce the fatality rate compared to the prior 3-year study at the site. However, further elevating the night-time cut-in-speed to 6.0 m/sec for 6 months in Year 2 appeared to significantly reduce the fatality rate compared to Year 1 and the prior 3-year average. To further evaluate the apparent influence of higher cut-in-speeds on bat fatality rates at this facility, during the third year of this AM monitoring effort in 2025, GH Wind will increase the cut-in-speed of all facility turbines to 6.5 m/sec each night from sunset to sunrise from April through September, and will maintain the 5.0 m/sec cut-in-speed in October (TAC 2022).

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Appendix A. Data Recorded for Documented Fatalities

1. A 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, 2023, would be #20231011-03.
2. Date and time found.
3. Identification number of closest operational (fully functioning/intact) turbine (presumed to be the focal turbine if during a standard fatality search).
4. GPS coordinates of the carcass, using the Universal Transverse Mercator (UTM), North American Datum 1983 (NAD83) coordinate system, accurate to ±3–4 m.
5. Distance (m) and direction (degrees) of the carcass 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. Categorical description of substrate on which carcass was found, determined at the scale of approximately a few square meters centered on the carcass: turbine pad, road, bare dirt/disturbed soil, grazed/short grass, or tall fallow grass/forb.
9. Species or closest taxonomic group possible of the carcass. For example, a California myotis (*Myotis californicus*) could be classified as such, or as an unknown myotis, or (as a last resort) an unknown bat.
10. Evidence for species identification; e.g., measurements, distinctive pelage, hair sample, 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.
13. Carcass condition:
    - *Intact – fresh*: carcass flexible, no signs of decomposition
    - *Intact – partially decomposed*: stiff-flesh present; insects have begun to reduce carcass
    - *Intact – decomposed:* intact/mummified/rotten carcass or 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/fur; evidence of vertebrate scavenging
    - *Injured*
    - *Other, see notes*
14. 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 describe evidence of blunt-force trauma (i.e., broken bones, lacerations, severed body parts, major contusions, etc.), internal bleeding, other injuries, emaciation, disease, etc.
15. 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 (not applicable on this project).

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

- *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), and/or location precludes confident assessment.

16. Categorical estimated time since death: fresh, <1 week, <1 month, or >1 month.
17. Types of insects observed on/in carcass, if any, with brief description of kind and size.
18. Scavenger/predator: type of predator or scavenger (bird, large mammal, small mammal, or invertebrate), if possible, to determine, and the effects of scavenging/predation.
19. Categorical condition of flesh: fresh, gooey, dried, or none.
20. Categorical condition of eyes: round and fluid-filled, sunken, dried, or none.
21. Additional notes about special circumstances, carcass condition, details for identification of rare species, obvious injuries, and potential cause of death if other than those listed above.
22. 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. At least four 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.

Appendix B. Summary of Fatality Surveys Conducted During Study: Years 1 and 2

	Year 1				Year 2			
Turbine	**Number of Surveys**	**Date of First Survey**	**Date of Last Survey**	**Search Interval Average ± SD**	**Number of Surveys**	**Date of First Survey**	**Date of Last Survey**	**Search Interval Average ± SD**
WTG-03	30	3-Apr-2023	30-Oct-23	7.2 ± 1.57	29	04-Apr-24	30-Oct-24	7.5 ± 1.95
WTG-06	30	3-Apr-2023	31-Oct-23	7.3 ± 1.44	29	04-Apr-24	30-Oct-24	7.5 ± 2.32
WTG-07	29	3-Apr-2023	30-Oct-23	7.5 ± 1.84	29	04-Apr-24	30-Oct-24	7.5 ± 2.01
WTG-08	27[1]	5-Apr-2023	1-Nov-23	8.1 ± 2.67	28[1]	02-Apr-24	28-Oct-24	7.7 ± 2.67
WTG-10	30	3-Apr-2023	30-Oct-23	7.2 ± 1.57	24[2]	04-Apr-24	30-Oct-24	9.1 ± 4.19
WTG-14	25[3]	4-Apr-2023	30-Oct-23	8.7 ± 5.20	28[1]	06-Apr-24	30-Oct-24	7.7 ± 3.23
WTG-16	29	4-Apr-2023	31-Oct-23	7.5 ± 1.88	26[4]	06-Apr-24	30-Oct-24	8.3 ± 4.67
WTG-17	29	4-Apr-2023	1-Nov-23	7.5 ± 1.86	23[5]	06-Apr-24	30-Oct-24	9.4 ± 6.34
WTG-18	30	4-Apr-2023	31-Oct-23	7.2 ± 1.24	27[1]	06-Apr-24	30-Oct-24	8.0 ± 3.52
WTG-20	28[1]	6-Apr-2023	2-Nov-23	7.8 ± 2.17	26[6]	01-Apr-24	28-Oct-24	8.4 ± 4.80
WTG-25	29	5-Apr-2023	1-Nov-23	7.5 ± 1.84	28[1]	02-Apr-24	28-Oct-24	7.7 ± 2.47
WTG-27	28[1]	6-Apr-2023	2-Nov-23	7.8 ± 2.15	19[7]	01-Apr-24	28-Oct-24	11.7 ± 8.44
WTG-32	28[1]	5-Apr-2023	2-Nov-23	7.8 ± 2.32	27[1]	01-Apr-24	28-Oct-24	8.1 ± 3.55
WTG-33	25[8]	6-Apr-2023	4-Nov-23	8.8 ± 3.23	29	02-Apr-24	28-Oct-24	7.5 ± 2.60
WTG-34	25[8]	6-Apr-2023	2-Nov-23	8.8 ± 3.84	28[1]	10-Apr-24	28-Oct-24	7.4 ± 2.56
WTG-38	28[1]	5-Apr-2023	31-Oct-23	7.7 ± 2.14	28[1]	01-Apr-24	28-Oct-24	7.8 ± 2.67

[1] Three or four surveys missed mostly non-sequentially for various reasons (safety/personnel matters, ranch operations, and/or facility maintenance operations).
[2] Two surveys missed non-sequentially due to facility maintenance operations; five surveys missed non-sequentially mostly due to livestock constraints.
[3] Three surveys missed non-sequentially and three surveys missed sequentially mostly due to safety matters.
[4] Two surveys missed non-sequentially and three surveys missed sequentially for various reasons (personnel matter, facility maintenance operations, and livestock constraints).
[5] Three surveys missed in a row twice and two surveys missed non-sequentially for facility maintenance operations and personnel matters.
[6] Two surveys missed non-sequentially and three surveys missed sequentially mostly due to facility maintenance operations.
[7] Nine surveys missed sequentially 2–4 at a time and three surveys missed non-sequentially mostly due to facility maintenance operations.
[8] Six surveys missed mostly non-sequentially for various reasons (safety/personnel/dog matters and ranch operations).

Appendix C. Carcass Detectability Trial Specimen Placements: Years 1 and 2

Date Placed	Turbine	UTM East	UTM North	Placement Substrate	Species	Size Class	Detected?	Date Found	Carcass Age at Discovery (days)
Year 1									
27-Apr-23	17	619802	4174660	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	2-May-23	5
27-Apr-23	20	620775	4173912	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
02-May-23	16	619563	4174810	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	9-May-23	7
04-May-23	25	620682	4174899	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	10-May-23	6
04-May-23	38	622096	4175562	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	No		
22-May-23	16	619627	4174802	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
30-May-23	14	619187	4175455	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
01-Jun-23	33	620937	4176063	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
10-Jun-23	34	620965	4175780	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	26-Oct-23	138
23-Jun-23	34	620983	4175767	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
23-Jun-23	8	621418	4175054	Road	Mexican free-tailed bat	Medium	Yes	28-Jun-23	5
28-Jun-23	33	620846	4176019	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	No		
03-Jul-23	6	618153	4174431	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	31-Jul-23	28
03-Jul-23	25	620682	4174914	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	6-Jul-23	3
07-Jul-23	7	618235	4173950	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	24-Jul-23	17
16-Aug-23	10	618619	4174600	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	Yes	21-Aug-23	5
16-Aug-23	33	620954	4176033	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	No		
06-Sep-23	38	622156	4175514	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	No		
06-Sep-23	32	622493	4174459	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	Yes	7-Sep-23	1
12-Sep-23	17	619809	4174621	Grazed/Short Grass	Mexican free-tailed bat	Medium	No		
12-Sep-23	18	620166	4174601	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	26-Sep-23	14
22-Sep-23	3	617257	4174705	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
22-Sep-23	14	619074	4175438	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
03-Oct-23	27	620810	4174386	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	Yes	2-Nov-23	30
12-Oct-23	20	620827	4173958	Grazed/Short Grass	Mexican free-tailed bat	Large	No		
12-Oct-23	6	618129	4174565	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	Yes	16-Oct-23	4
17-Oct-23	7	618291	4174072	Road	Mexican free-tailed bat	Medium	Yes	23-Oct-23	6
17-Oct-23	8	621425	4175006	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	19-Oct-23	2
19-Oct-23	3	617310	4174722	Tall Fallow Grass/Forb	Mexican free-tailed bat	Large	No		
28-Oct-23	10	618575	4174496	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	31-Oct-23	3

Date Placed	Turbine	UTM East	UTM North	Placement Substrate	Species	Size Class	Detected?	Date Found	Carcass Age at Discovery (days)
Year 2									
27-Apr-24	6	618235	4174528	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
27-Apr-24	17	619826	4174608	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	10-May-24	13
17-May-24	27	620758	4174277	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
09-Jun-24	3	617222	4174779	Tall Fallow Grass/Forb	*Myotis* sp.	Small	Yes	20-Jun-24	11
09-Jun-24	20	620873	4173854	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	18-Jun-24	9
09-Jun-24	33	620977	4176011	Tall Fallow Grass/Forb	*Myotis* sp.	Small	Yes	17-Jun-24	8
03-Jul-24	14	619161	4175473	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	04-Jul-24	1
03-Jul-24	25	620655	4174925	Road	Mexican free-tailed bat	Medium	No		
03-Jul-24	17	619760	4174702	Tall Fallow Grass/Forb	*Myotis* sp.	Small	Yes	04-Jul-24	1
06-Jul-24	38	622073	4175558	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	08-Jul-24	2
06-Jul-24	7	618333	4174057	Tall Fallow Grass/Forb	Hoary bat	Large	No		
06-Jul-24	3	617252	4174746	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	30-Oct-24	116
09-Jul-24	10	618550	4174499	Tall Fallow Grass/Forb	*Myotis* sp.	Small	Yes	20-Jul-24	11
09-Jul-24	18	620206	4174536	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
09-Jul-24	20	620871	4173890	Tall Fallow Grass/Forb	Hoary bat	Large	No		
30-Jul-24	6	618198	4174457	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	02-Aug-24	3
30-Jul-24	8	621419	4175050	Road	Big brown bat	Large	No		
30-Jul-24	14	619081	4175383	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	24-Aug-24	25
04-Aug-24	33	620851	4176135	Grazed/Short Grass	*Myotis* sp.	Small	No		
18-Aug-24	38	622057	4175581	Bare Dirt/Disturbed Soil	Mexican free-tailed bat	Medium	No		
14-Sep-24	16	619496	4174915	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
14-Sep-24	34	620995	4175870	Road	*Myotis* sp.	Small	Yes	28-Oct-24	44
07-Oct-24	10	618636	4174607	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	No		
07-Oct-24	33	620936	4176108	Grazed/Short Grass	*Myotis* sp.	Small	No		
07-Oct-24	25	620689	4174903	Bare Dirt/Disturbed Soil	Mexican free-tailed bat	Medium	No		
07-Oct-24	7	618377	4173966	Tall Fallow Grass/Forb	*Myotis* sp.	Small	No		
19-Oct-24	6	618273	4174419	Tall Fallow Grass/Forb	Mexican free-tailed bat	Medium	Yes	30-Oct-24	11
19-Oct-24	8	621471	4175039	Grazed/Short Grass	Mexican free-tailed bat	Medium	No		
19-Oct-24	34	621012	4175793	Bare Dirt/Disturbed Soil	Mexican free-tailed bat	Medium	No		
19-Oct-24	32	622529	4174478	Grazed/Short Grass	Mexican free-tailed bat	Medium	Yes	21-Oct-24	2
16-Oct-24	16	619519	4174865	Grazed/Short Grass	*Myotis* sp.	Small	Yes	26-Oct-24	10
16-Oct-24	14	619102	4175466	Turbine Pad	Mexican free-tailed bat	Medium	No		

Appendix D. Condition of Fatality Incidents at Time of Discovery: Years 1 and 2

In both years, a majority (64% Year 1, 55% Year 2) of the documented bat fatalities were found as complete carcasses (meaning all major body parts were present) either freshly killed or in the early stages of decomposition, in some cases with fur, skin, or internal organs and tissues having been removed by insects and/or rodents (Table D-1). The remaining fatalities were found as incomplete carcasses where either a blade strike, predator, scavenger, advanced decomposition and dispersal, or abiotic factors had removed one or more major body parts that potentially could be found somewhere else and qualify as a separate fatality if not properly matched to the documented remains.

Table D-1. Condition at Time of Discovery of Bats Found as Fatalities On or Near a Survey Plot

	Year 1		Year 2	
Carcass Condition	**Number**	**%**	**Number**	**%**
Intact – fresh	18	18	1	5
Intact – early decomposition	46	46	11	50
Dismembered – fresh	1	1	1	5
Scavenged – fresh	6	6	2	9
Scavenged – early decomposition	28	28	7	32
Scavenged – decomposed	2	2	0	0
Total Number	101	–	22	–

Appendix E. Bat Fatality and Injury Incidents Documented During Study: Years 1 and 2

Species	Date	Turbine[1]	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[2]
Year 1						
Mexican free-tailed bat	11-Apr-23	14	63	34	Intact-partial decomposed	Included
Mexican free-tailed bat	24-Apr-23	6	57	34	Intact-fresh	Included
Hoary bat	24-Apr-23	6	30	89	Intact-fresh	Included
Mexican free-tailed bat	19-May-23	27	50	29	Intact-partial decomposed	Included
Mexican free-tailed bat	24-May-23	25	111	35	Scavenged-partial decomposed	Included
Hoary bat	24-May-23	38	58	52	Intact-partial decomposed	Included
Hoary bat	30-May-23	16	48	15	Scavenged-partial decomposed	Included
Mexican free-tailed bat	30-May-23	16	98	65	Intact-partial decomposed	Included
Mexican free-tailed bat	12-Jun-23	6	86	47	Intact-partial decomposed	Included
Mexican free-tailed bat	13-Jun-23	17	86	53	Intact-fresh	Included
Mexican free-tailed bat	13-Jun-23	14	106	42	Intact-partial decomposed	Included
Mexican free-tailed bat	19-Jun-23	10	85	68	Intact-partial decomposed	Included
Mexican free-tailed bat	19-Jun-23	3	48	333	Scavenged-partial decomposed	Included
Mexican free-tailed bat	19-Jun-23	3	97	39	Scavenged-partial decomposed	Included
Mexican free-tailed bat	23-Jun-23	20	78	22	Scavenged-partial decomposed	Included
Mexican free-tailed bat	28-Jun-23	38	120	60	Intact-partial decomposed	Excluded
Mexican free-tailed bat	29-Jun-23	33	94	101	Scavenged-decomposed	Included
Mexican free-tailed bat	06-Jul-23	25	115	49	Intact-partial decomposed	Included
Mexican free-tailed bat	06-Jul-23	32	103	71	Scavenged-partial decomposed	Included
Mexican free-tailed bat	26-Jul-23	38	98	76	Scavenged-partial decomposed	Included
Mexican free-tailed bat	31-Jul-23	10	53	59	Intact-fresh	Included
Mexican free-tailed bat	02-Aug-23	25	122	42	Intact-partial decomposed	Excluded
Mexican free-tailed bat	07-Aug-23	10	56	24	Intact-partial decomposed	Included
Hoary bat	10-Aug-23	20	64	20	Intact-partial decomposed	Included
Mexican free-tailed bat	14-Aug-23	6	58	38	Intact-partial decomposed	Included
Hoary bat	16-Aug-23	38	55	57	Intact-partial decomposed	Included
Hoary bat	16-Aug-23	38	68	38	Scavenged-partial decomposed	Included
Mexican free-tailed bat	17-Aug-23	27	45	42	Intact-partial decomposed	Included
Hoary bat	21-Aug-23	10	93	26	Intact-partial decomposed	Included
Mexican free-tailed bat	21-Aug-23	10	93	25	Intact-partial decomposed	Included
Mexican free-tailed bat	25-Aug-23	33	73	46	Intact-fresh	Included
Hoary bat[3]	28-Aug-23	6	9	124	Scavenged-partial decomposed	Included
Mexican free-tailed bat	28-Aug-23	6	52	70	Intact-partial decomposed	Included
Mexican free-tailed bat	29-Aug-23	18	52	74	Intact-partial decomposed	Included
Mexican free-tailed bat	07-Sep-23	27	41	40	Dismembered-fresh	Included
Mexican free-tailed bat	07-Sep-23	27	98	72	Intact-fresh	Included
Hoary bat	07-Sep-23	33	43	354	Intact-fresh	Included
Hoary bat	07-Sep-23	32	18	132	Scavenged-fresh	Included
Mexican free-tailed bat[3]	12-Sep-23	10	43	29	Scavenged-decomposed	Included
Mexican free-tailed bat	12-Sep-23	10	49	27	Intact-partial decomposed	Included

Species	Date	Turbine[1]	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[2]
Mexican free-tailed bat	12-Sep-23	10	92	72	Intact-partial decomposed	Included
Mexican free-tailed bat	12-Sep-23	7	11	79	Intact-partial decomposed	Included
Hoary bat	13-Sep-23	8	28	358	Scavenged-partial decomposed	Included
Hoary bat	13-Sep-23	8	38	58	Scavenged-partial decomposed	Included
Hoary bat	13-Sep-23	8	91	56	Intact-partial decomposed	Included
Mexican free-tailed bat	14-Sep-23	14	85	36	Intact-partial decomposed	Included
Mexican free-tailed bat	14-Sep-23	14	106	34	Intact-fresh	Included
Hoary bat	16-Sep-23	33	102	55	Intact-partial decomposed	Included
Mexican free-tailed bat	16-Sep-23	33	105	45	Scavenged-partial decomposed	Included
Mexican free-tailed bat	16-Sep-23	27	65	31	Scavenged-partial decomposed	Included
Hoary bat	16-Sep-23	20	29	59	Scavenged-partial decomposed	Included
Mexican free-tailed bat	16-Sep-23	20	29	59	Intact-fresh	Included
Mexican free-tailed bat	16-Sep-23	20	65	4	Intact-partial decomposed	Included
Mexican free-tailed bat	19-Sep-23	3	22	48	Intact-partial decomposed	Included
Mexican free-tailed bat	19-Sep-23	3	77	20	Intact-fresh	Included
Hoary bat	19-Sep-23	10	74	19	Intact-partial decomposed	Included
Hoary bat	19-Sep-23	10	107	56	Scavenged-partial decomposed	Included
Mexican free-tailed bat	19-Sep-23	10	120	56	Intact-partial decomposed	Excluded
Western red bat	25-Sep-23	10	43	357	Intact-partial decomposed	Included
Hoary bat	26-Sep-23	14	36	28	Scavenged-fresh	Included
Hoary bat	26-Sep-23	16	97	15	Intact-fresh	Included
Mexican free-tailed bat[3]	26-Sep-23	16	87	16	Intact-fresh	Included
Hoary bat	26-Sep-23	16	110	15	Scavenged-fresh	Included
Western red bat	26-Sep-23	18	36	56	Scavenged-fresh	Included
Mexican free-tailed bat[3]	27-Sep-23	8	126	42	Scavenged-partial decomposed	Excluded
Mexican free-tailed bat	27-Sep-23	38	101	81	Intact-fresh	Included
Mexican free-tailed bat	27-Sep-23	32	77	31	Intact-partial decomposed	Included
Mexican free-tailed bat[3]	27-Sep-23	32	109	73	Intact-partial decomposed	Included
Mexican free-tailed bat	28-Sep-23	20	121	71	Intact-partial decomposed	Excluded
Mexican free-tailed bat	28-Sep-23	20	107	73	Intact-fresh	Included
Hoary bat	28-Sep-23	27	148	37	Intact-partial decomposed	Excluded
Hoary bat	02-Oct-23	14	48	35	Intact-partial decomposed	Included
Mexican free-tailed bat	03-Oct-23	18	73	17	Scavenged-partial decomposed	Included
Hoary bat	03-Oct-23	18	87	40	Scavenged-partial decomposed	Included
Hoary bat	04-Oct-23	38	113	46	Intact-partial decomposed	Included
Mexican free-tailed bat	09-Oct-23	3	102	14	Intact-partial decomposed	Included
Mexican free-tailed bat	09-Oct-23	3	69	316	Intact-partial decomposed	Included
Mexican free-tailed bat	10-Oct-23	17	44	8	Intact-partial decomposed	Included
Mexican free-tailed bat	10-Oct-23	17	94	46	Scavenged-partial decomposed	Included
Mexican free-tailed bat	10-Oct-23	17	74	102	Scavenged-partial decomposed	Included
Mexican free-tailed bat	10-Oct-23	16	90	7	Scavenged-fresh	Included
Hoary bat	10-Oct-23	16	76	9	Intact-fresh	Included
Hoary bat	10-Oct-23	16	80	28	Scavenged-partial decomposed	Included
Hoary bat	11-Oct-23	8	76	69	Scavenged-partial decomposed	Included
Hoary bat[3]	11-Oct-23	38	120	53	Scavenged-partial decomposed	Excluded
Hoary bat	13-Oct-23	20	87	54	Intact-partial decomposed	Included

Species	Date	Turbine[1]	Distance From Turbine (m)	Bearing From Turbine (°)	Carcass Condition	Included to Estimate Adjusted Fatalities?[2]
Mexican free-tailed bat	13-Oct-23	27	65	31	Intact-partial decomposed	Included
Mexican free-tailed bat	13-Oct-23	27	67	49	Intact-partial decomposed	Included
Hoary bat	16-Oct-23	6	70	45	Intact-partial decomposed	Included
Mexican free-tailed bat[3]	19-Oct-23	38	78	60	Scavenged-partial decomposed	Included
Mexican free-tailed bat	20-Oct-23	34	99	38	Scavenged-partial decomposed	Included
Mexican free-tailed bat	20-Oct-23	27	76	77	Scavenged-partial decomposed	Included
Mexican free-tailed bat	20-Oct-23	20	106	32	Scavenged-partial decomposed	Included
Mexican free-tailed bat[3]	24-Oct-23	17	83	28	Scavenged-fresh	Included
Mexican free-tailed bat	24-Oct-23	17	108	37	Intact-fresh	Included
Hoary bat	25-Oct-23	8	92	54	Intact-fresh	Included
Mexican free-tailed bat[3]	25-Oct-23	8	102	46	Scavenged-partial decomposed	Included
Mexican free-tailed bat	25-Oct-23	25	52	94	Intact-fresh	Included
Mexican free-tailed bat	26-Oct-23	34	64	59	Intact-partial decomposed	Included
Mexican free-tailed bat	26-Oct-23	27	115	40	Intact-partial decomposed	Included
Mexican free-tailed bat	26-Oct-23	27	103	39	Intact-partial decomposed	Included
Year 2						
Hoary bat	11-Apr-24	7	25	355	Dismembered-fresh	Included
Mexican free-tailed bat	23-Apr-24	6	90	60	Intact-partial decomposed	Included
Mexican free-tailed bat	02-May-24	7	70	50	Scavenged-partial decomposed	Included
Mexican free-tailed bat	03-May-24	17	82	38	Intact-partial decomposed	Included
Mexican free-tailed bat	10-May-24	16	15	20	Intact-fresh	Included
Hoary bat	12-Jun-24	10	55	25	Intact-partial decomposed	Included
Mexican free-tailed bat	03-Jul-24	10	61	10	Scavenged-partial decomposed	Included
Mexican free-tailed bat	26-Jul-24	33	93	30	Scavenged-partial decomposed	Included
Mexican free-tailed bat	09-Aug-24	33	109	30	Intact-partial decomposed	Included
Hoary bat	10-Aug-24	18	59	66	Intact-partial decomposed	Included
Hoary bat	26-Aug-24	25	57	30	Intact-partial decomposed	Included
Mexican free-tailed bat	17-Sep-24	20	98	50	Scavenged-partial decomposed	Included
Mexican free-tailed bat	23-Sep-24	27	44	55	Intact-partial decomposed	Included
Mexican free-tailed bat	23-Sep-24	20	60	10	Scavenged-partial decomposed	Included
Mexican free-tailed bat	25-Sep-24	34	107	20	Scavenged-fresh	Included
Hoary bat	25-Sep-24	14	46	351	Intact-partial decomposed	Included
Mexican free-tailed bat	26-Sep-24	6	49	65	Intact-partial decomposed	Included
Mexican free-tailed bat	10-Oct-24	7	20	54	Intact-partial decomposed	Included
Mexican free-tailed bat[3]	16-Oct-24	16	72	70	Scavenged-partial decomposed	Included
Mexican free-tailed bat	21-Oct-24	32	70	140	Scavenged-partial decomposed	Included
Mexican free-tailed bat	21-Oct-24	20	123	100	Intact-partial decomposed	Excluded
Hoary bat	22-Oct-24	8	45	60	Scavenged-fresh	Included

1 See Figure 2 for turbine locations.
2 Included = included in adjusted fatality estimates. Excluded = excluded from adjusted fatality estimates because carcass was found outside of all survey plots.
3 Identified by genetic analysis.