Post-construction Fatality Monitoring Study for the Blue Creek Wind Farm Van Wert and Paulding Counties, Ohio

Intensive Monitoring – Year 2
Final Report
April 1 – May 15 and August 1 – October 15, 2021

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EXECUTIVE SUMMARY

Blue Creek Wind Farm, LLC is operating the Blue Creek Wind Farm (the Project) in Van Wert and Paulding counties, Ohio. The Project became operational in 2012 and consists of 152 2.0-megawatt (MW) Gamesa G90 wind turbines that have a 100-meter (m; 328-foot [ft]) hub height and a 45-m (148-ft) blade length. This report details the post-construction fatality monitoring studies conducted in 2021, consistent with Section 6.1.2 of the Project's Habitat Conservation Plan and Incidental Take Permit (ITP; TE69307D-1) for Indiana and northern long-eared bats. The Project is in Year 2 of the 35-year ITP and 2021 was the second year of monitoring under the HCP.

Post-construction fatality monitoring was conducted consistent with the 2021 Post-construction Monitoring Study Plan (Study Plan) for the Blue Creek Wind Farm, which was approved by the US Fish and Wildlife Service on April 1, 2021. The Study Plan was designed to achieve an overall probability of detection (*g)* of 0.15 based on data collected at the Project in 2020. The overall goal of this post-construction fatality monitoring study was to evaluate whether the level of take of Covered Species at the Project was within the level of take authorized by the ITP. More specifically, the objectives of this study were to: 1) estimate the fatalities of the Covered Species over the monitoring period and ITP term, 2) test if adaptive management triggers were met, and 3) provide an all-bat fatality estimate per MW and per turbine.

Standardized carcass searches were completed for bat carcasses at two plot types: full plots and road and pads. In spring and fall, 40 full plots and 112 road and pads were searched. Full plots were circular and extended to a 65-m (213-ft) radius from turbines in the spring, and a 70-m (230-ft) radius from turbine in the fall. Road and pads searches occurred within 100 m of the turbine on gravel road and pads. The search interval varied by plot type and season, from every 14 days on road and pads in the spring to twice per week on full plots in the fall. Searcher efficiency and carcass persistence trials were conducted to adjust for detection and scavenger bias.

One Indiana bat carcass was found on September 30, 2021. No northern-long eared bat carcasses were found during monitoring. The most commonly found bat species were silver-haired bat (80 carcasses; 41.9% of total carcasses) and eastern red bat (65 carcasses; 34.0%), followed by hoary bat (33 carcasses; 17.2%) and big brown bat (11 carcasses; 5.8%). One tri-colored bat carcass, a state-endangered species, was recorded at the Project on September 21, 2021. The overall all-bat fatality estimate was 5.99 bats per megawatt (90% Confidence Interval [CI]: 3.90–10.08) using the Huso estimator.

Covered Species fatality rates were estimated using Evidence of Absence. The 2021 overall probability of detection (*g*) value was 0.108 (95% CI: 0.072–0.150). Based on the count of Indiana bat and northern long-eared bat carcasses (one and zero, respectively) and the ITP term-to-date (2020 and 2021) *g* of 0.123 (95% CI: 0.102–0.146), we estimated that cumulatively, no more than nine Indiana bat fatalities and one northern long-eared bat fatality could potentially have occurred

during the ITP term-to-date. These values fall below the permitted take for each species (154 Indiana bats and 103 northern long-eared bats), meaning the cumulative Covered Species take estimates are in compliance with the ITP and the Project did not meet any long-term adaptive management triggers. Based on the rolling average (fall 2020 and spring and fall 2021) *g* of 0.134 (95% CI: 0.111–0.159), the probability that the estimated take rates exceeded the expected take rates for Indiana bat and northern long-eared bat did not exceed 95%, indicating the Project did not meet any short-term adaptive management triggers.

Table A. Habitat Conservation Plan and Incidental Take Permit compliance requirements and status based on the Intensive Monitoring conducted at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Requirement	Source	Status Based on Fall 2021 Intensive Monitoring Results
Conduct Intensive Monitoring in spring	HCP Section 6.1.2	Completed
Conduct Intensive Monitoring in fall	HCP Section 6.1.2	Completed
Use Evidence of Absence software to design a search protocol with a detection probability (*g*) value of 0.15, using prior year's site specific data	HCP Section 6.1.2	The monitoring plan was designed using the 2020 site specific data, and provided to the USFWS for review prior to the field season. The interim analysis after the spring season indicated that the Study Plan's *g* was projected to be 0.185 after completion of the fall monitoring effort.
Estimate mean take rates for the Covered Species	HCP Section 6.1.5	Mean take rates were 6.00 (95% CI: 0.43–18.85) Indiana bats per year and 2.00 (95% CI: 0.00–10.08) northern long-eared bats per year.
Estimate cumulative (ITP term to date) take estimates for the Covered Species	HCP Section 6.1.5	Cumulative take estimates were no more than nine Indiana bats and one northern long-eared bat during the ITP term to date.
Evaluate whether the short-term adaptive management threshold has been exceeded at the 95% credibility level	HCP Section 6.3.1	Probabilities that estimated take rates exceeded the short-term adaptive management thresholds were 52.9% for Indiana bat and 22.3% for northern long-eared bat, indicating no adaptive management was required.
Evaluate whether the cumulative take amount (*M**) has exceeded the permitted take amount at the 50% credibility level	HCP Section 6.3.1	The cumulative take estimates of no more than nine Indiana bats and one northern long-eared bat fall below the total permitted take for both of the Covered Species (154 Indiana bats and 103 northern long-eared bats), indicating the Project is in compliance with its permitted take levels.
Submit Intensive Monitoring report to the USFWS by April 1	HCP Section 6.1.6	Report submitted prior to April 1

Table A. Habitat Conservation Plan and Incidental Take Permit compliance requirements and status based on the Intensive Monitoring conducted at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Requirement	Source	Status Based on Fall 2021 Intensive Monitoring Results
Intensive Monitoring Report will include: 1. Information necessary to estimate take of Covered Species, such as: date, time, location, species, and sex, of all bat carcasses documented 2. Bias trial data 3. Calculated *g* value 4. Estimated average annual take rates and cumulative take estimates of the Covered Species 5. Adaptive management triggers activated (if any) and planned response 6. EoA inputs for the monitoring year 7. All-bat fatality rate 8. A record of ambient temperatures and wind speeds and the application of cut-in speeds during a representative sample of the minimization period	HCP Section 6.1.6	Report includes the required information in the following Sections: 1. Appendix A 2. Section 3.2 3. Section 3.3.5 4. Section 3.3.5.4 5. Sections 3.3.5.5 and 3.3.5.6 6. Appendix C 7. Section 3.3.4 8. Provided by Blue Creek Wind Farm LLC on November 11, 2021 (Avangrid Renewables 2021).
Report any Covered Species fatality to the USFWS and ODNR by phone within 24 hours of positive species identification	HCP Section 6.1.6	An unknown *Myotis* was found on September 30, 2021, and reported to USFWS and ODNR within 24 hours. The carcass was sent away for DNA analysis, and confirmed to be an Indiana bat on November 8; USFWS and ODNR were notified within 24 hours.
Provide the monitoring protocol the upcoming year of monitoring to the USFWS	HCP Section 6.1.2	Provided separately in the *2022 Post-Construction Monitoring Study Plan for the Blue Creek Wind Farm, Van Wert and Paulding counties, Ohio.*
Provide data and reporting on the supervisory control and data acquisition system from five turbines on April 4, August 4, and August 19.	ITP Section O.5.a.	Provided by Blue Creek Wind Farm LLC in emails dated April 2, August 4, and August 17, 2021.
Provide additional reporting on November 30 to document the implementation of the minimization and monitoring required by the HCP and ITP.	ITP Section O.5.b.	Provided by Blue Creek Wind Farm LLC on November 11, 2021 (Avangrid Renewables 2021).
Clearly state the fall 2020 estimates of Indiana bats and northern long-eared bats using Evidence of Absence software were based on normal operations, not on 5.0 m/s cut-in speeds.	ITP Section O.5.c.	Report accounts for this in analysis (see Section 2.5.3.4).

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REPORT REFERENCE

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INTRODUCTION

Blue Creek Wind Farm, LLC (Blue Creek), a subsidiary of Avangrid Renewables, LLC, is operating the Blue Creek Wind Farm (Project) in Van Wert and Paulding counties, Ohio. Blue Creek obtained an Incidental Take Permit (ITP; TE69307D-0) for the federally listed endangered Indiana bat (*Myotis sodalis*) and the federally listed threatened northern long-eared bat (*Myotis septentrionalis*; hereafter Covered Species) from the US Fish and Wildlife Service (USFWS) dated March 13, 2020. An amended ITP for the Project was received on March 31, 2021 (TE69307D-1).

The Habitat Conservation Plan (HCP) requires Compliance Monitoring to determine the level of take of the Covered Species relative to the amount authorized by the ITP. The Project is in Year 2 of the 35-year ITP and 2021 was the second year of monitoring under the HCP. Blue Creek contracted Western EcoSystems Technology, Inc. (WEST) to complete a post-construction fatality monitoring study designed to achieve a probability of detection, or *g*, of 0.15. The objectives of this study were to: 1) estimate the fatalities of the Covered Species over the monitoring period and ITP term, 2) test if adaptive management triggers were met, and 3) provide an all-bat fatality estimate per megawatt (MW) and per turbine. This report presents the results of the study conducted within the Project during the spring and fall of 2021, and the adaptive management trigger tests based on all monitoring data gathered since the ITP was issued.

METHODS

Blue Creek submitted the 2021 Post-construction Monitoring Study Plan for the Blue Creek Wind Farm (Study Plan) to the USFWS on March 24, 2021, via email and received approval on April 1, 2021 (Megan Seymour, USFWS, pers. comm). The Study Plan was submitted and approved by the Ohio Department of Natural Resources (ODNR) on April 1, 2021, following USFWS approval (Erin Hazelton, ODNR, pers. comm). The Study Plan was developed in accordance with the HCP's monitoring program and designed to achieve a *g* of 0.15 (i.e., a 15% probability of detecting a single bat carcass) cumulatively across the spring and fall monitoring periods. In accordance with the Project's ITP, WEST used data from the Project's 2020 post-construction fatality monitoring study (Ritzert et al. 2021) to develop the Study Plan. Following the completion of spring monitoring, Blue Creek used the spring values to determine that the Study Plan's *g* was projected to be 0.185 after completion of the fall monitoring effort. Blue Creek then coordinated with USFWS via phone/email, providing the results of spring 2021 surveys and fall 2021 approach on July 13, 2021, and confirmed the survey approach for the fall monitoring period via email on July 22, 2021.

1.1 Study Area

The Project became operational in 2012 and consists of 152 2.0-MW Gamesa G90 wind turbines that have a 100-meter (m; 328-foot [ft]) hub height and a 45-m (148-ft) blade length. The Project is located approximately six kilometers (four miles) north of the town of Van Wert, Ohio (Figure 1). The Project has an elevation of approximately 230 m (754 ft) above mean sea level with relatively

flat topography. Approximately 93% of the nearly 164-square kilometer (40,427-acre) Project is composed of cropland. Corn (*Zea mays*) and soybean (*Glycine max*) are the most common crop types (National Land Cover Database [NLCD] 2016). The next most common land cover is developed area (e.g., farmsteads), which accounts for approximately 6% of the Project Area (NLCD 2016). Deciduous forest, herbaceous cover, open water, barren land, and wetlands each account for less than 1% of the total land cover (NLDC 2016; Figure 1).

1.2 Standardized Carcass Searches

1.2.1 Number of Turbines Sampled, Search Frequency, and Plot Size

All 152 turbines at the Project were included in the study. Technicians conducted standardized carcass searches at two plot types: full plots and road and pads. Search effort varied by season, and was designed to maximize effort in the fall when the greatest number of Covered Species were expected to occur (Table 1). Forty turbines were searched as full plots and the remaining 112 turbines were searched as road and pads (Figure 1). Full plots were circular and extended to a maximum of 65-m (213-ft) radius from turbines in the spring and 70-m (230-ft) radius from turbines in the fall. Road and pads were searched to a maximum 100-m distance from turbines.

Table 1. Search effort by season and plot type at Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Season	Plot Type	Search Interval	Number of Turbines
Spring (April 1 – May 15)	100-m road and pad	14 days	112
	65-m full plot	7 days	40
Fall (August 1 – October 15)	100-m road and pad	7 days	112
	70-m full plot	3.5 days	40

m=meter.

One round of clearance searches occurred at all turbines prior to the start of the spring and fall monitoring seasons to collect carcasses that occurred prior to the spring and fall study periods.

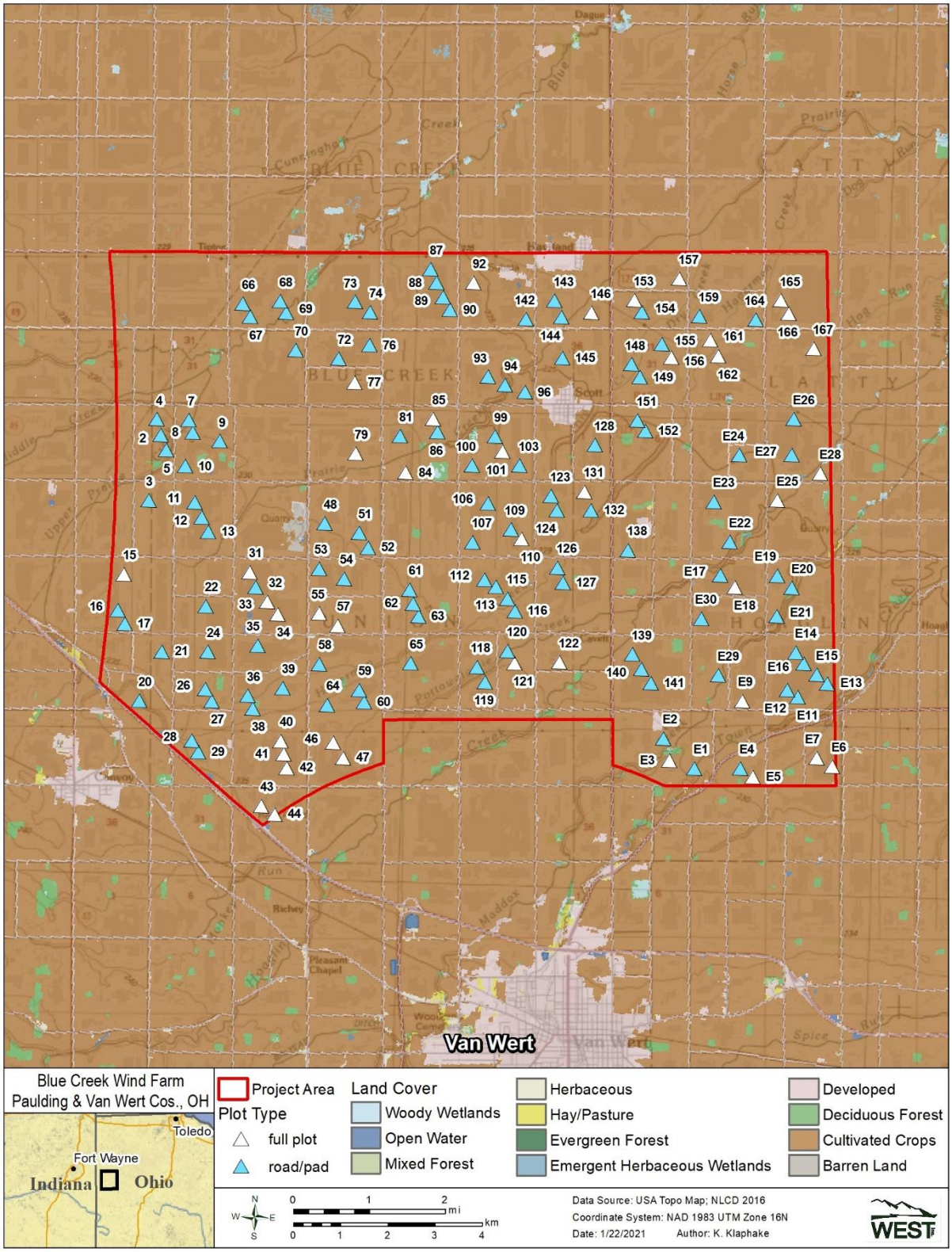

Figure 1. Search plot types used during the 2021 post-construction fatality monitoring at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021.

1.2.2 Plot Maintenance

Due to the majority of the Project being composed of corn and soybean fields, full plots were mowed prior to the start of fall surveys and were regularly mowed through October 15 to ensure vegetation did not exceed a maximum height of 15 centimeters (6 inches) to increase the detectability of carcasses on full plots. Plots that had weed growth or winter wheat were also mowed once in the spring.

Searcher efficiency rates were lower than expected during the initial rounds of bias trials in the fall (see Section 3.2.1). Although vegetation was mowed to 15 centimeters or less, due to high amounts of rain received regionally during the summer and fall, there was a higher density of vegetation at half of the plots compared to previous years, which resulted in difficult search conditions (Figure 2). To improve search conditions, Blue Creek decided to plow plots, thus exceeding the maintenance requirements of the Study Plan. Twenty plots were plowed during the weeks of August 16 and September 13 in an effort to return plot conditions to bare ground and improve searcher efficiency (Figure 2).

Figure 2. Representative photos of plot conditions prior to plowing (on left) and after the second round of plowing (on right) during the 2021 post-construction fatality monitoring at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021.

1.2.3 Search Methods

Technicians searched for carcasses on transects spaced 5 m (16 ft) apart at a rate of approximately 45–60 m per minute (min; 148–197 ft/min) on all full plots and road and pads. Technicians scanned the area for fatalities on both sides of the transect out to approximately 2.5 m (8.2 ft) to ensure full visual coverage of each plot or road and pad.

1.2.4 Data Collection

Carcass searches began after first light and ended by 1700 hours. Technicians recorded the date, start and end times, technician name, turbine number, weather data, type of search (full plot or road and pad), and any injured bats or bat carcasses found. If a bat was found, technicians placed a flag near the bat and continued the search.

After searching the entire plot, the technician returned to each found bat and recorded information on a tablet including the following: the date and time, species, sex and age (when possible), technician name, turbine number, distance from turbine, azimuth from turbine, location of bat as Universal Transverse Mercator (UTM) coordinates, habitat surrounding the bat, and estimated time of death (e.g., less than one day, two days). Technicians took digital photographs of the bat, any visible injuries, and the surrounding habitat. Bats found in non-search areas (e.g., outside of a plot boundary), or outside of the scheduled study period, were coded as incidental discoveries and were documented following the same protocol as those found during standard carcass searches but not included in the analyses.

The condition of each bat found was recorded using the following categories:

- Intact – a carcass that was complete, not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- Scavenged – the carcass showed signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass), or a carcass that was heavily infested by insects.
- Dismembered – an entire carcass was found in multiple pieces distributed more than 1.0 m (3.3 ft) apart from one another due to scavenging or other reasons.
- Injured – a bat found alive.

Bat carcasses were collected under the the Project's ITP (TE69307D-1) and WEST's Ohio Division of Wildlife Wild Animal Permit (SC210040). All bat carcasses found were placed in a re-sealable plastic bag and labeled with the unique carcass identification number, turbine number, and date, before being placed in a freezer on site. Leather and rubber gloves were used to handle all bat carcasses to eliminate possible transmission of rabies or other diseases. All species identifications were verified by biologists permitted to identify and handle federally and state listed bat species. Carcasses that could not be identified to species were submitted to a USFWS-

approved laboratory, Northern Arizona University School of Forestry and Center for Microbial Genetics and Genomics, for identification via genetic testing.

1.3 Bias Trials

1.3.1 Searcher Efficiency Trials

The objective of searcher efficiency trials was to estimate the percentage of bats found by searchers. Estimates of searcher efficiency were used to adjust the number of bats found by those missed by searchers to account for detection bias in fatality estimates.

Searcher efficiency trials were conducted in the same areas where standardized carcass searches occured. Trials were conducted throughout the study. One hundred twenty-two fresh-frozen bat carcasses obtained from the ODNR were used for searcher efficiency trials. Per the Study Plan, a minimum of 30 bats were placed on full plots and 30 were placed on road and pads in each season.

Searcher efficiency trials began when standardized carcass searches began. Searchers did not know when searcher efficiency trials were conducted or the location of trial carcasses. Each trial carcass was discreetly marked with a black zip-tie around the upper forelimb for identification as a searcher efficiency carcass after it was found. Trial carcasses were placed by the trial administrator prior to the standardized carcass searches scheduled for that day. Trial carcasses were dropped from waist-height or higher and allowed to land in a random posture. The number and location of trial carcasses found were recorded, and the number of trial carcasses available for detection during each search was determined immediately after each trial by the trial administrator. Searchers had one chance to locate trial carcasses during the first search after carcass placement.

1.3.2 Carcass Persistence Trials

The objective of carcass persistence trials was to estimate the average probability a carcass persisted, or was available for detection, in the field. Carcasses may be removed by scavenging or rendered undetectable by typical farming activities. Estimates of carcass persistence were used to adjust the number of bat carcasses found by those removed from the study area, thereby accounting for persistence bias. Of the 122 bats used for searcher efficiency trials (see above), 25 fresh-frozen bat carcasses obtained from the ODNR were left in place and used for carcass persistence trials. Thirty-five additional carcasses were placed as carcass persistence trials and did not serve as searcher efficiency trials. Therefore, a total of 60 bat carcasses were used for the carcass persistence trials.

Technicians conducting carcass searches monitored the trial carcasses over a 30-day period according to the following schedule as closely as possible. Carcasses were checked daily for the first four days (days 1–4 after placement), then on days 7, 10, 14, 21, and 30. Trial carcasses were left at the dropped location until removal by scavenging or other means, completely decomposed, or were at the end of the carcass persistence trial, whichever occurred first. At the end of the 30-day period, any remaining evidence of a carcass was removed from the search plot.

1.4 Search Plot Mapping

The boundaries and unsearchable areas of all full plots were recorded using a Trimble submeter global positioning satellite unit in spring and fall 2021 to accurately map plot boundaries, which may shift slightly between years and seasons, based on crop clearing. Road and pad boundaries do not change year to year and were previously mapped in 2020. The boundaries and unsearchable areas were used to quantify the amount of area searched relative to distance to turbine and to inform the distribution of carcasses around turbines to estimate the number of carcasses that fell outside search plot boundaries (see Section 2.5.1.5 below).

1.5 Statistical Analysis

Two fatality estimates were calculated: an all-bat fatality estimate based on the Huso estimator (Huso et al. 2015a), as specified in the HCP, and a take estimate based on Evidence of Absence (EoA) for Covered Species (Dalthorp et al. 2017, Huso et al. 2015b). Estimates of facility-related fatalities were based on:

1. Observed number of bats found during standardized searches;
2. Searcher efficiency, expressed as the proportion of searcher efficiency trial carcasses found by searchers;
3. Carcass persistence rates, expressed as the estimated average probability a trial carcass remained in the study area and was available for detection by the searchers;
4. Searched area adjustment.

1.5.1 Estimator Inputs For The Two Fatality Estimates

1.5.1.1 Carcasses Included In Fatality Estimates

One of the underlying assumptions of the Huso estimator, used for the all-bat estimate, is that searchers have a single opportunity to discover a carcass (Huso et al. 2015b, Huso et al. 2016). In practice, particularly when carcass persistence times are long, carcasses may be discovered that have been available for more than one search. To meet the assumptions of the Huso estimator, the time since death was estimated for each carcass in the field based on physical characteristics of the carcass in hand. A carcass was included in the fatality estimate if the estimated time since death was less than the search interval associated with that carcass, or if there was uncertainty about the estimated time since death. Unlike the all-bat estimate, the analysis protocol for the Covered Species was to include all carcasses found during standardized searches in the analysis because the EoA estimator does not assume searchers have a single opportunity to discover a carcass (Huso et al. 2015a, Dalthorp et al. 2017).

1.5.1.2 Estimation of Searcher Efficiency Rates

The all-bat fatality rate estimation and the Covered Species take estimation had identical methods for estimating searcher efficiency. For both methods the probability of a carcass being detected by a searcher, given the carcass was available to be found, was calculated using a logit regression model (Dalthorp et al. 2018). Potential covariates for the logit regression models included plot type (full plot or road and pad) and season. The best model was selected using an information

theoretic metric known as AICc, or corrected Akaike Information Criteria (Burnham and Anderson 2002). The most parsimonious model within two AICc units of the model with the lowest AICc value was selected.

1.5.1.3 Estimation of Carcass Persistence Rates

The all-bat fatality rate estimation and Covered Species take estimation had similar methods for estimating carcass persistence rates. Both methods used data collected during carcass persistence trials to estimate the average probability that a carcass persisted through a search interval and remained available to be located by searchers. Carcass persistence data were modeled using an interval-censored survival regression. Four candidate persistence distributions were considered: exponential, log-logistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Huso et al. 2015b, Dalthorp et al. 2018). Potential covariates for the carcass persistence models included plot type (full plot or road and pad) and season. The modeling process for the EoA estimate can accommodate covariates in both the location and scale parameters of the persistence time distribution, whereas the modeling process for the Huso estimator can accommodate covariates only in the location parameter. The most parsimonious model within two AICc units of the model with the lowest AICc value was selected as the best-fit model.

1.5.1.4 Detection Reduction Factor

For the Covered Species take estimation, the change in searcher efficiency between successive searches was defined by a parameter called the detection reduction factor (k) that ranged from zero to one. When k is zero it implies that a carcass that was missed on the first search would never be found thereafter. A k of one implies searcher efficiency remains constant no matter how many times a carcass is missed. The detection reduction factor was a required parameter for take estimation in EoA; a value of $k = 0.80$ was used for this study (per Appendix A of the Study Plan). The Huso estimator implicitly assumes $k = 0$ and does not take this parameter as an input.

1.5.1.5 Searched Area Adjustment

The searched area adjustment process was identical for the all-bat fatality rate estimation and the Covered Species take estimation but the carcasses included in the modeling process differed for the two estimators. All bat carcasses found during standardized searches were used to calculate the area adjustment for the Covered Species take estimate. Only carcasses that were estimated to have died within the search interval were used to estimate the area adjustment for the all-bat fatality estimate due to the Huso estimator's implicit assumption of $k = 0$ (see Detection Reduction Factor, Section 2.5.1.4).

The searched area adjustment accounted for all unsearched areas within 100 m of turbines. The searched area adjustment was calculated as a probability that ranged from zero to one. For example, an area adjustment of 0.75 meant that an estimated 75% of carcasses fell within the search area. The searched area adjustment was estimated as the product of the searched area around each turbine and a carcass-density distribution (within 100 m from the turbine base). The carcass density distribution was modeled using carcass location data collected during all of 2021 (this study; e.g., Huso and Dalthorp 2014). A truncated weighted maximum likelihood (TWL)

modeling approach (Khokan et al. 2013) as implemented in the windAC package (Studyvin et al. 2020) was used to estimate the carcass-density distribution. The TWL approach weights each carcass by the inverse of the product of the probability of detection and the proportion of area searched in each 1.0-m (3.3-ft) annulus around the turbine. Normal, gamma, Gompertz, Rayleigh and Weibull (parameterized according to R Development Core Team [2016], or Yee [2010]) distributions were fitted and AICc was used to select the best model.

The amount of searchable area within plots was measured in the field using sub-meter GPS technology (Section 2.4). The proportion of area searched was calculated in GIS as the amount of area searched divided by the total area within each 1.0-m annulus around the turbine.

1.5.2 All-bat Fatality Rate Estimation

The all-bat fatality rate was calculated using the Huso estimator (Huso 2011, Huso et al. 2015a). Inputs and assumptions of the Huso estimator are described in Section 2.5.1 above.

1.5.2.1 All-bat Fatality Estimate

All-bat fatality estimates per MW and turbine were calculated by plot type (full plot versus road and pad) and season. The weighted average of estimates by plot type was combined by the relative proportion of plots in each category (i.e., 40/152 for full plots and 112/152 for road and pads) to calculate overall fatality estimates.

1.5.2.2 Confidence Interval Calculation for All-bat Fatality Estimate

The 90% confidence intervals (CI) for each estimate were calculated using bootstrapping (Manly 1997; Appendix B). Bootstrapping is a computer simulation technique that is useful for calculating variances and confidence intervals for complicated test statistics. A total of 1,000 bootstrap replicates were used to calculate the 90% confidence interval of each estimate. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates were estimates of the lower limit and upper limit of 90% confidence intervals.

1.5.3 Covered Species Take Estimation

The EoA model and software (Huso et al. 2015a, Dalthorp et al. 2017) was used to calculate estimates of take and take rates of the Covered Species. The inputs into EoA were modeled using GenEst (a generalized estimator of fatality; Dalthorp et al. 2018, Simonis et al. 2018) and are described in Section 2.5.1 above.

1.5.3.1 Annual Site-Wide Probability of Detection (*g*)

A site-wide probability of detection (*g*) for each year in the ITP to date was calculated using EoA (Dalthorp et al. 2017; Appendix C) to enable the calculation of take estimates for the Covered Species. Each year's estimate of *g* was based on the searcher efficiency rate, carcass persistence, searched area adjustment and sampling fraction for each plot type, the arrival proportion (i.e., the estimated proportion of Covered Species expected to occur in the spring and fall monitoring periods), and the detection reduction factor (*k*; see definition in Section 2.5.1.4) taken from the HCP. Estimates were calculated using the EoA R package (EoA version 2.0.7),

using the Single Class and Multiple Class modules of EoA. In 2021, a single turbine (E7) that was searched as a full plot did not operate for 22 days during the fall season. Therefore, the relative weight for the full-plot fall search period was adjusted by the number of missing turbine-days of risk when estimating the annual *g*, consistent with the EoA user guide guidance to incorporate weights based on the expected relative arrival rates of carcasses.

1.5.3.2 Rolling Average Probability of Detection

The HCP specifies that the short-term adaptive management trigger is tested based on a rolling-average detection probability including the most recent six years of monitoring events. At present, that monitoring window includes fall 2020 and spring and fall 2021. Detection probabilities from fall 2020 and spring and fall 2021 were combined into the rolling average detection probability using the per-study *g* estimates and the relative weights (rho) for each study (Dalthorp et al. 2017). This detection probability was used to estimate the rolling average take rate and to test the short-term adaptive management trigger based on the monitoring data available to date within the six-year rolling interval specified in the HCP.

1.5.3.3 ITP Term-To-Date Probability of Detection

The HCP specifies that the long-term adaptive management trigger is tested based on whether the cumulative ITP-to-term cumulative take has exceeded the permitted take numbers. By definition, this test covers the entire period from ITP issuance through the present. Risk periods when monitoring did not occur (spring 2020) were assigned a low, near-zero detection probability (0.00001) as prescribed in the HCP (D. Dalthorp, USGS, pers. comm. December 8, 2017). Detection probabilities from spring and fall 2020 and spring and fall 2021 were combined into the ITP term (to date) detection probability using the per-year *g* estimates and the relative weights (rho) for each year (Dalthorp et al. 2017). This detection probability was used to estimate cumulative take and to test the long-term adaptive management trigger over the ITP term-to-date.

1.5.3.4 Weighting of Fall 2020 Data Based on Normal Operations

Because feathering of the turbine was maintained at 3.0 m/second (m/s; 9.8 ft/s) rather than increased to 5.0 m/s (16.4 ft/s) during fall 2020, when estimating *g* for the take estimates and adaptive management triggers, the relative weight (rho) for 2020 was adjusted to account for a greater level of risk during that season:

$$rho = spring\ arrival\ fraction + fall\ arrival\ fraction * \frac{1 - fatality\ reduction\ @\ 3.0\ m/s}{1 - fatality\ reduction\ @\ 5.0\ m/s}$$

The relative weight for 2020 when estimating *g* for the short-term adaptive management trigger was similar, but omitted the spring arrival fraction term. The expected spring and fall arrival fractions (0.11 and 0.89, respectively), and expected fatality reductions at 3.0 and 5.0 m/s cut-in speeds (0.325 and 0.68, respectively) are provided in the HCP. For 2021, the relative weight (rho) was 1.0, representing one year of operation with minimization as planned.

1.5.3.5 Assessment of Adaptive Management Triggers

The take rates of the Covered Species (λ in the EoA model/software) were calculated to assess whether the short-term adaptive management trigger (Section 6.3.1 of HCP) was met and if adaptive management responses were needed. The cumulative (ITP term-to-date) take estimates of both Covered Species were calculated to assess whether the estimated cumulative take (*M** in the EoA model/software) exceeded the permitted take.

1.6 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during analysis, and report writing. Following field surveys, technicians were responsible for inspecting data for completeness and accuracy. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the technician and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data, and appropriate changes were made in all affected steps.

1.7 Data Compilation and Storage

A Microsoft® SQL Server database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference.

RESULTS

1.8 Standardized Carcass Surveys

A total of 2,676 turbine searches occurred throughout the spring and fall monitoring periods (Table 2). Over 99% of scheduled searches on operational turbines were completed. Two road and pads and three full plot searches were missed due to turbine maintenance and lightning. During the last round of full plot searches on October 15, excessive rain resulted in unsafe search conditions on 20 full plots. After plot conditions dried out, surveys at these turbines were completed on October 18 and 19, 2021. No carcasses were found during these last two survey days.

Turbine E7 was under maintenance and non-operational in the fall until August 23, 2021. Turbine E7 was searched as a full plot after it began operation. A total of 191 bat carcasses were found during the clearing search, scheduled surveys, and incidentally (Table 3, Appendix A).

Table 2. Number of searches per plot type at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021.

Season	Plot Type	Search Interval	Number of Searches
Spring (April 1 – May 15)	100-m road and pad	14 days	336
	65-m full plot	7 days	237
Fall (August 1 – October 15)	100-m road and pad	7 days	1,228
	70-m full plot	3.5 days	875
Overall			**2,676**

m = meter.

1.8.1 Species Composition

The most commonly found bat species across all surveys and incidentally were silver-haired bat (*Lasionycteris noctivagans*; 80 carcasses; 41.9%), eastern red bat (*Lasiurus borealis*; 65 carcasses; 34.0%), hoary bat (*Lasiurus cinereus*; 33 carcasses; 17.2%), and big brown bat (*Eptesicus fuscus*; 11 carcasses; 5.8%; Table 3, Appendix A).

An unknown *Myotis* was recorded on September 30, 2021. In accordance with the HCP's reporting procedures, Megan Seymour (USFWS) and Erin Hazelton (ODNR) were notified within 24 hours, on September 30, 2021. A tissue sample was sent to Northern Arizona University for genetic testing. Genetic analysis results received on November 8, 2021, confirmed that the unknown *Myotis* was an Indiana bat. USFWS and ODNR were notified on November 9, 2021.

One tri-colored bat (*Perimyotis subflavus*), a state-endangered species, was recorded at the Project on September 21, 2021, and ODNR was notified within 24 hours, on September 22, 2021.

One heavily scavenged unidentified bat wing was found on September 3, 2021, that could not be identified to species by searchers or by a WEST permitted bat biologist. Megan Seymour was notifed via email on September 3, 2021, and agreed via email on September 7, 2021, with the decision to send a tissue sample to Northern Arizona University for genetic testing. Genetic testing determined that the previously unidentified bat was a big brown bat.

1.8.2 Carcasses Used In Bat Fatality Estimates

One hundred fifty-three bats were included in the all-bat fatality estimate and search area adjustment. One Indiana bat and zero northern long-eared bats were included in the Covered Species take estimate analysis. One hundred eighty-one bats were included in the Covered Species searched area adjustment (Table 3). Seven bat carcasses were excluded from both analyses because they were found off plot (e.g., outside the graveled search area of a turbine that was searched only as a road and pad). Three additional bats were excluded from both analyses because they were found during a clearing search. Twenty-eight bats were excluded from the all-bat fatality estimate because they had an estimated time of death longer than the search interval (e.g., a carcass found on a road and pad search plot in the fall was estimated to have a time of death longer than seven days). Those same 28 bats were included in the Covered Species searched area adjustment (per Section 2.5.1.5).

Table 3. Total number of bat carcasses and percent composition of carcasses discovered at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

	Total Fatalities		Outside Plot		Clearing Search		Total for Covered Species Searched Area Adjustment[1]		Removed Due to Estimated Time of Death for Huso[2]		Total for All-Bat Fatality Estimate and Searched Area Adjustment[2]	
Species	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
Full Plots												
silver-haired bat	69	40.6	2	100	0	0	67	40.6	4	15.4	63	45.3
eastern red bat	58	34.1	0	0	1	33.3	57	34.5	15	57.7	42	30.2
hoary bat	32	18.8	0	0	2	66.6	30	18.2	5	19.2	25	18.0
big brown bat	9	5.3	0	0	0	0	9	5.5	2	7.7	7	5.0
tri-colored bat	1	0.6	0	0	0	0	1	0.6	0	0	1	0.7
northern long-eared bat	0	0	0	0	0	0	0	0	0	0	0	0
Indiana bat	1	0.6	0	0	0	0	1	0.6	0	0	1	0.7
Full Plots Overall	**170**	**100**	**2**	**100**	**3**	**100**	**165**	**100**	**26**	**100**	**139**	**100**
Road and Pads												
silver-haired bat	11	52.4	3	60.0	0	0	8	50.0	0	0	8	57.1
eastern red bat	7	33.3	1	20.0	0	0	6	37.5	1	50	5	35.7
hoary bat	1	4.8	0	0	0	0	1	6.3	0	0	1	7.1
big brown bat	2	9.5	1	20.0	0	0	1	6.3	1	50	0	0
tri-colored bat	0	0	0	0	0	0	0	0	0	0	0	0
northern long-eared bat	0	0	0	0	0	0	0	0	0	0	0	0
Indiana bat	0	0	0	0	0	0	0	0	0	0	0	0
Road and Pads Overall	**21**	**100**	**5**	**100**	**0**	**0**	**16**	**100**	**2**	**100**	**14**	**100**
Total for All Plot Types	**191**		**7**		**3**		**181**		**28**		**153**	

[1.] The Covered Species searched area adjustment used the GenEst criteria for fatalities to include in the searched area adjustment modeling. Fatalities were removed from the searched area adjustment if they were found during the clearing search or off the plot.

[2.] The all-bat fatality estimate used the Huso criteria for fatalities to include in the estimate. Fatalities were removed if they were found during the clearing search, outside the plot, or if they had an estimated time of death longer than the search interval.

1.9 Bias Trials

1.9.1 Searcher Efficiency Trials

One-hundred twenty-two bat carcasses (11 big brown bats, 43 eastern red bats, 21 hoary bats, one Seminole bat [*Lasiurus seminolus*], and 46 silver-haired bats) were placed across 11 separate dates in the spring and fall (April 7, 16, 22 and 26, May 4, August 10, September 7, 14, and 30 and October 5 and 7) for searcher efficiency trials, of which 120 were available for searchers to find. Searcher efficiency rates ranged from 33.3% on full plots in the fall to 93.3% on road and pads in the spring (Table 4). For both the Covered Species take estimate and the all-bat fatality rate, the best-fit model for searcher efficiency included covariates for plot type and season (Appendix D).

Table 4. Searcher efficiency results as a function of plot type and season at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Season	Plot Type	Number Placed	Number Available	Number Found	% Found
Spring	Full Plots	30	30	17	56.7
	Road and Pads	30	30	28	93.3
Fall	Full Plots	31	30	10	33.3
	Road and Pads	31	30	25	88.3

1.9.2 Carcass Persistence Trials

Sixty bat carcasses (10 big brown bats, 20 eastern red bats, seven hoary bats, one seminole bat, and 22 silver-haired bats) were placed on five dates (April 1, 7, and 16 and August 2 and September 7). The best-fit model for carcass persistence rates for both the Covered Species estimate and all-bat fatality estimate was a lognormal distribution that included both plot type and season included as covariates for the location parameter, and no covariates for the scale parameter (Figures 3 and 4, Appendix D). The median persistence time ranged from 19.0 days on full plots in the spring to 1.6 days on road and pads in the fall (Table 5).

Table 5. Median persistence times for bat carcasses at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Season	Plot Type	Search Interval	Median Carcass Persistence Time (days)
Spring	Full Plots	14 days	19.0
	Road and Pads	7 days	7.9
Fall	Full Plots	7 days	3.9
	Road and Pads	3.5 days	1.6

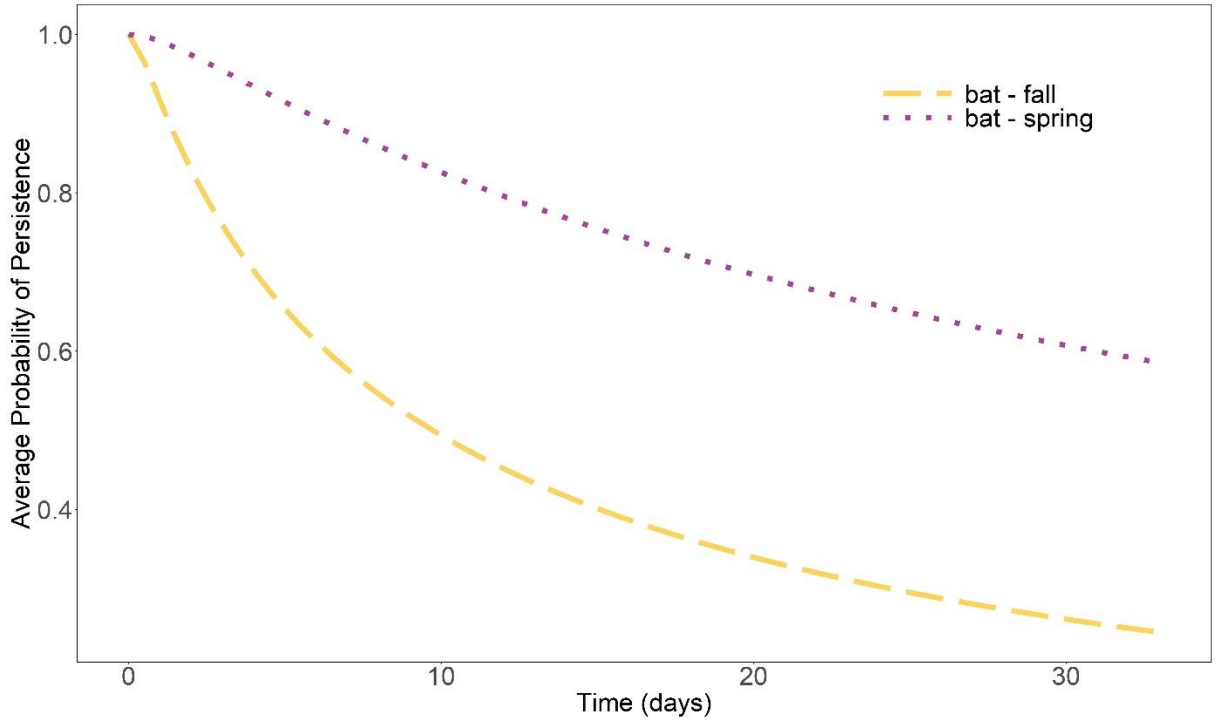

Figure 3. Average probability of persistence for bat carcasses through the 30-day carcass persistence trials on full plots at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

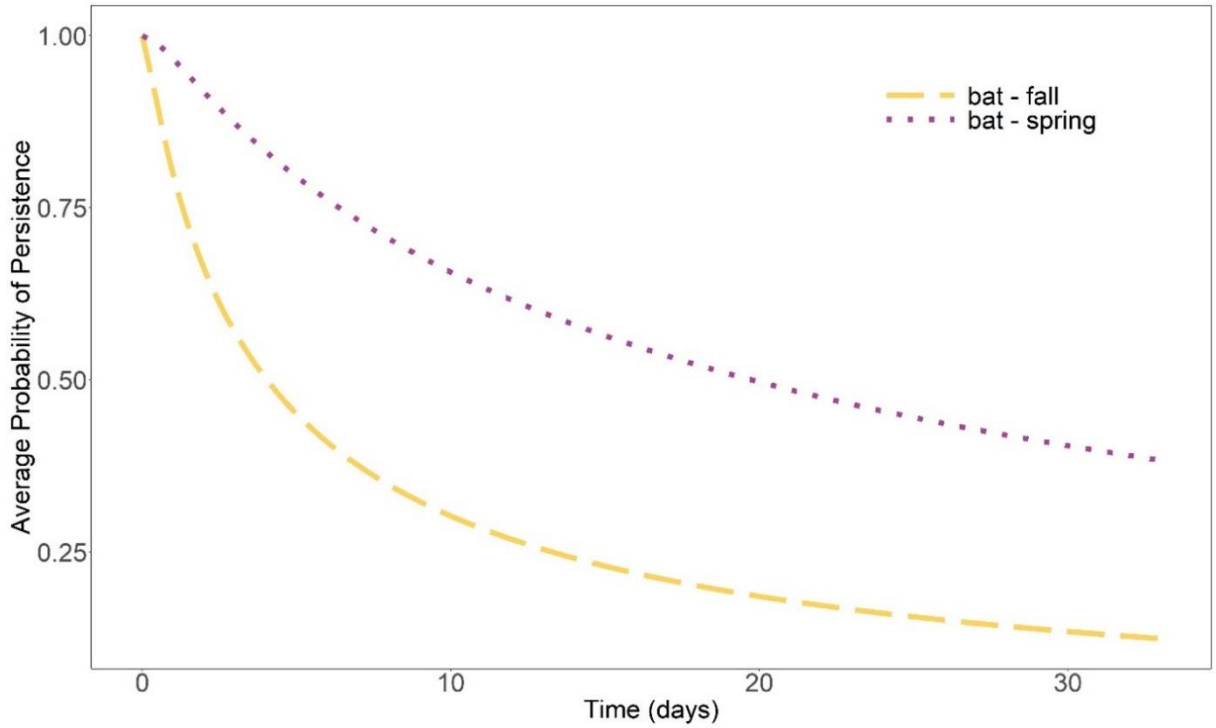

Figure 4. Average probability of persistence for bat carcasses through the 30-day carcass persistence trials on road and pads at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

1.10 Statistical Analysis

1.10.1 Searched Area Adjustment

Searched areas at the Project had no obstructions on the full plots or road and pads. Model selection (Appendix D) indicated normal carcass density distributions for both the all-bat and Covered Species searched area adjustments (Figures 5 and 6).

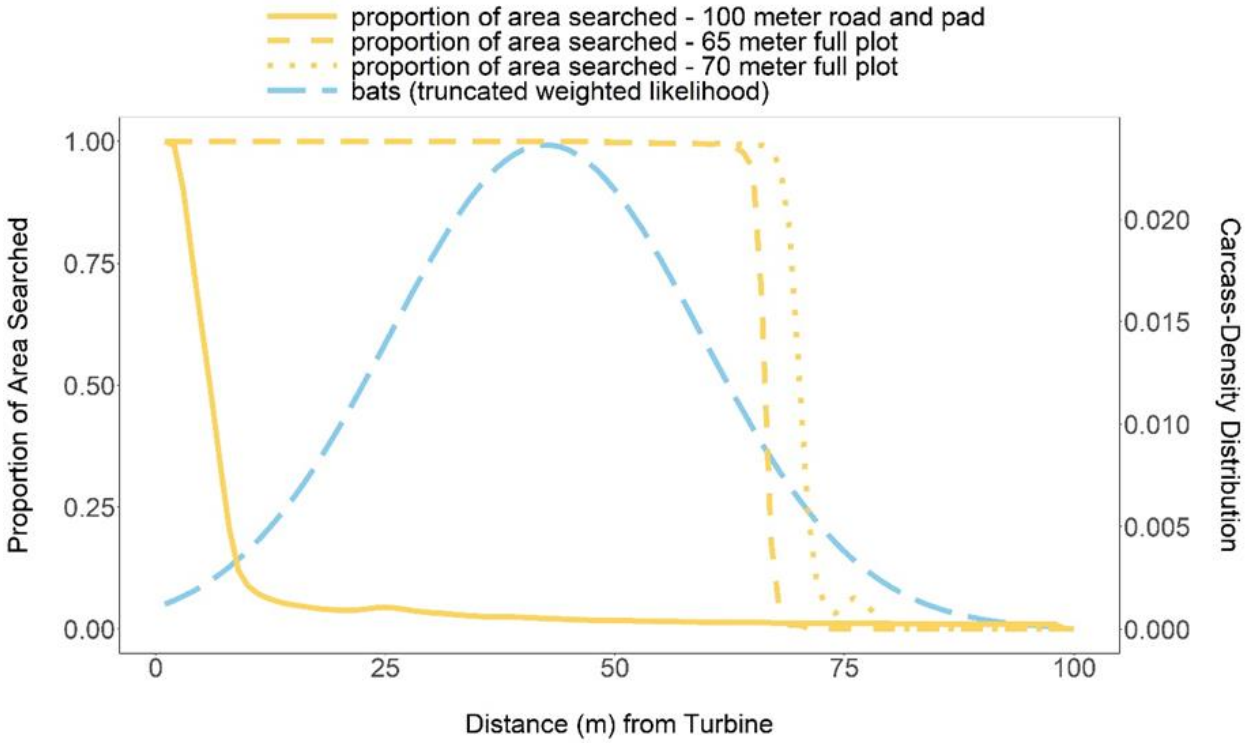

Figure 5. Proportion of area searched by search plot type with the normal best-fit distribution of bat carcasses found and used to calculate all-bat fatality estimates at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

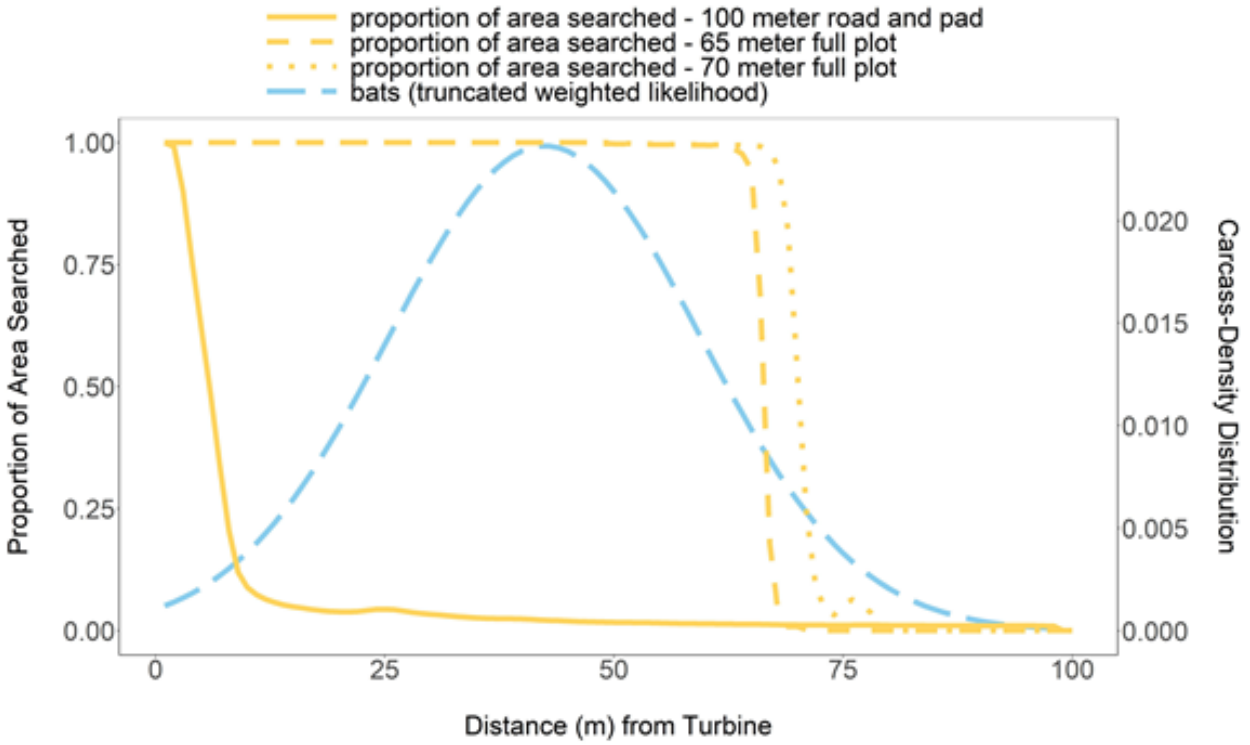

Figure 6. Proportion of area searched by search plot type with the normal best-fit distribution of bat carcasses found and used to calculate Covered Species take estimates at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

1.10.2 All-bat Fatality Rate Estimate Searched Area Adjustment Results

The estimated density weighted proportion (DWP) for the all-bat fatality estimate was 0.03 (90% CI: 0.02–0.05) on road and pads (Table 6). For 65-m full plots the DWP was 0.91 (90% CI: 0.83–0.98) and for 70-m full plots the DWP was 0.94 (90% CI: 0.88–0.99). In other words, road and pad searches within 100 m of the turbine captured an average of 3% of bat fatalities while 65-m full plots captured an average of 91% of potential bat fatalities and 70-m full plots captured an average of 94% of potential bat fatalities. A total of 153 bat carcasses were used to estimate the searched area adjustment for the all-bat fatality estimate (Table 3).

Table 6. Truncated weighted maximum likelihood searched area adjustment estimates for all-bat fatality rate estimation component of the analysis for the Blue Creek Wind Farm, April 1 – May 15 and August 1– October 15, 2021.

Plot Type	Searched Area Adjustment
65-m full plot	0.91
70-m full plot	0.94
Road and Pads	0.03

The carcass density followed a truncated normal distribution with the following parameters: 42.453 (parameter 1) and 16.999 (parameter 2) and a left-truncation bound at zero meters (m).

1.10.3 Covered Species Take Estimate Searched Area Adjustment Results

The estimated DWP for the Covered Species take estimate was 0.03 (90% CI: 0.02–0.05) on road and pads (Table 7). For 65-m full plots the DWP was 0.95 (90% CI: 0.88–0.99) and for 70-m full plots the DWP was 0.97 (90% CI: 0.92–0.99). In other words, road and pad searches within 100 m of the turbine captured an average of 3% of bat fatalities while 65-m and 70-m full plots captured 95% and 97% of potential bat fatalities, respectively. A total of 181 bat carcasses were used to estimate the searched area adjustment for take estimates (Table 3).

Table 7. Truncated weighted maximum likelihood searched area adjustment estimates for Covered Species take estimation component of the analysis for the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Plot Type	Searched Area Adjustment
65-m full plot	0.95
70-m full plot	0.97
Road and Pads	0.03

The carcass density followed a truncated normal distribution with the following parameters: 42.118 (parameter 1) and 14.965 (parameter 2) and a left-truncation bound at zero meters (m).

1.10.4 All-bat Fatality Rate Estimate

The all-bat fatality estimates were 5.99 bats per MW (90% CI: 3.90–10.08) and 11.98 bats per turbine (90% CI: 7.80–20.17; Table 8, Appendix B).

Table 8. Overall estimated all-bat fatality rates per megawatt and per turbine for post-construction fatality monitoring studies conducted at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Plot Type	Estimated Bat Fatalities per Megawatt	90% Confidence Interval	Estimated Bat Fatalities per Turbine	90% Confidence Interval
Full Plots	7.55	4.80–13.35	15.10	9.60–26.69
Road and Pads	5.43	2.76–10.40	10.86	5.52–20.81
Overall	**5.99**	**3.90–10.08**	**11.98**	**7.80–20.17**

1.10.5 Covered Species Take Estimate

1.10.5.1 Annual Site-wide Probability of Detection (*g*)

One Indiana bat carcass was found. No northern long-eared carcasses were found. The estimated *g* in 2021 was 0.108 (95% CI: 0.072–0.150; Table 9) for 2021. The searched area adjustment for plots and median carcass persistence rates for spring were higher than projected in the Study Plan, and the interim analysis after the spring season indicated that the Study Plan's *g* was projected to be 0.185 after completion of the fall monitoring effort. However, during the fall, searcher efficiency on full plots and median carcass persistence were lower than expected based on the Study Plan and spring 2021 data (Table 10).

Table 9. Estimated detection probability (*g*) using Evidence of Absence at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021[1].

Season	Plot Type	Sampling Fraction	Arrival Proportion	Turbine Operation[2]	Final Weight (ρ)	Median *g*	Lower 95% CI	Upper 95% CI
Spring	Full Plots	40/152	0.11	1.00	0.03	0.596	0.468	0.717
	Road and Pads	112/152	0.11	1.00	0.08	0.016	0.012	0.019
Fall	Full Plots	40/152	0.89	0.99	0.23	0.358	0.224	0.502
	Road and Pads	112/152	0.89	1.00	0.66	0.009	0.006	0.013
Overall (weighted average)			**1**	**–**	**1**	**0.108[3]**	**0.072**	**0.150**

1. See screenshots in Appendix C showing the inputs for Evidence of Absence based on these values.

2. Turbine Operation column accounts for missing turbine-days of risk when turbines were non-operational.

3. This value is a quantile from a weighted average of beta distributions and may not exactly match a weighted average of the point estimates above.

CI = confidence interval.

Table 10. Assumptions from the 2021 Study Plan and estimates from the 2021 post-construction fatality monitoring period for the Blue Creek Wind Farm.

	Spring				Fall			
	Road and Pads		Full Plots		Road and Pads		Full Plots	
Parameter	Study Plan	2021 Field Surveys	Study Plan	2021 Field Surveys	Study Plan	2021 Field Surveys	Study Plan	2021 Field Surveys
Searched Area Adjustment	0.052	0.03 (-)	0.744	0.95 **(+)**	0.052	0.03 (-)	0.879	0.97 (+)
Searcher Efficiency	72.5%	93.3% **(+)**	72.5%	56.7% **(-)**	72.5%	88.3% **(+)**	72.5%	33.3% **(-)**
Median Carcass Persistence (days)	5.6	7.9 (+)	5.6	19.0 **(+)**	5.6	1.6 **(-)**	5.6	3.9 **(-)**

(+) indicates a positive change, (-) indicates a negative change; substantial changes are in bold.

1.10.5.2 Rolling Average Probability of Detection

The estimated *g* used for the short-term adaptive management trigger test was 0.134 (95% CI: 0.111–0.159; Table 11). This value covers the monitoring periods available to date within the six-year rolling average interval (i.e., fall 2020, spring 2021, and fall 2021).

1.10.5.3 ITP Term-To-Date Probability of Detection

The estimated *g* used to estimate cumulative ITP term-to-date take was 0.123 (95% CI: 0.102–0.146; Table 11) for ITP years 1–2 (i.e., spring and fall, 2020–2021).

Table 11. Per-year, rolling average, and ITP term-to-date probabilities of detection (*g*), Ba, Bb, and the relative weight (rho) for the Blue Creek Wind Farm for ITP Years 1–2 (2020–2021).

Year	Ba[1]	Bb[1]	Rho[2]	*g*	95% Confidence Intervals
2020 (fall only, for rolling average)	75.8	442.1	2.11	0.146	0.117–0.178
2020 (spring + fall, for ITP term-to-date)[3]	77.3	515.8	1.99	0.130	0.104–0.159
2021 (spring + fall)	26.4	217.3	1	0.108	0.072–0.150
Rolling Average	**102.6**	**662.3**	**1.89**	**0.134**	**0.111–0.159**
ITP Term-To-Date	**102.9**	**734.2**	**2**	**0.123**	**0.102–0.146**

1. Ba and Bb are the parameters for the beta distribution used to characterize the probability of detection. The *g* value is the mean of that distribution.

2. Rho is the weight in the weighted average that is used to combine the probability of detection distributions across years and to scale λ to an annual rate (short term trigger) or interpret *M** (long term trigger). The weights are proportional to relative expected fatality rates for each study.

3. Detection probability in spring 2020 was set to an arbitrarily low near-zero value of 0.00001 to account for no monitoring during that season.

1.10.5.4 Covered Species Take Estimates

The two EoA models that produce a take estimate (*M*,* based on the ITP term-to-date *g*) and a take rate estimate (λ, based on the rolling average *g*) use different priors and produce different types of estimates; thus, the results of the two models will differ in most situations despite using the same search data and carcass count data (Table 11). The estimate of *M** is the EoA point estimate for the number of bat fatalities that could plausibly have occurred, given the search effort and the number of carcass detections. Based on the count of Indiana bat and northern long-eared bat carcasses (one and zero, respectively) and *g*, the estimated cumulative take (*M**) amounted to no more than nine Indiana bats and no more than one northern long-eared bat over the ITP term-to-date (i.e., *M** at α = 0.5 is no more than 9 for Indiana bats or 1 for northern long-eared bat). The mean estimated take rates (λ) were 6.00 (95% CI = 0.43–18.85) Indiana bats per year and 2.00 (90% CI = 0.00–10.08) northern long-eared bats per year based on the monitoring data available within the rolling average interval (Table 12). The estimate of λ is the EoA estimate for the average annual take rate that could plausibly have given rise to the estimate of *M*.* It is often higher than the estimate of *M** and if carcass counts remain constant from year to year, it decreases as more years of monitoring occur.

1.10.5.5 Adaptive Management—Evidence of Absence Short-term Trigger

The short-term trigger assesses the probability that the Covered Species estimated take rate exceeded the expected take rate, $Pr(\lambda > \tau)$. At a confidence level of α = 0.05, $Pr(\lambda > \tau)$ must be greater than or equal to 0.95 for the short-term trigger to fire. The expected average annual take rate developed in the HCP was 4.39 Indiana bats per year and 2.96 northern long-eared bats per year. For Indiana bat, $Pr(\lambda > \tau) = 0.529$ (Table 13, Figure 7). For northern long-eared bat, $Pr(\lambda > \tau) = 0.223$ (Table 13, Figure 7). Neither probability meets or exceeds 0.95, indicating the short-term trigger was not met and a short-term adaptive management response was not required.

1.10.5.6 Adaptive Management—Evidence of Absence Long-term Trigger

The cumulative take estimates were below the total permitted take for both of the Covered Species (154 Indiana bats and 103 northern long-eared bats over the 35-year permit term; Table 14, Figure 8). Thus, the long-term trigger was not met and the Project is in compliance for both species because *M** < T (i.e, total permitted take) for both species. Therefore, a long-term adaptive management response was not required.

Table 12. Estimated fatality rate (λ) and probability that estimated take rates exceeded expected annual take using Evidence of Absence for studies conducted within the rolling average interval at the Blue Creek Wind Farm, ITP Years 1–2 (2020–2021).

Species	Estimated Mean λ (95% CI)	Expected Take Rate Developed in HCP (τ)	Pr(λ > τ)*	Short-term Trigger Fires at α = 0.05?
Indiana bat	6.00 (0.43–18.85)	4.39	0.529	No
northern long-eared bat	2.00 (0.00–10.08)	2.96	0.223	No

* Pr(λ > τ) reads, "the probability that λ (the annual take rate) is greater than τ (the expected annual take rate based on the total permitted take, used as a threshold for adaptive management)." If this probability is less than 0.95 (e.g., α = 0.05 for a one-sided test), then no adaptive management is required because there is not sufficient evidence that the estimated annual take rate is greater than the expected annual take rate.

Table 13. Cumulative take estimate, permitted take estimate, and long-term trigger using Evidence of Absence for the ITP term-to-date at Blue Creek Wind Farm, ITP Years 1–2 (2020–2021).

Species	Estimated Cumulative Take (*M**)	Total Permitted Take (T)	Long-term Trigger Fires at α = 0.05?
Indiana bat (50th credible bound)	9	154	No
northern long-eared bat (50th credible bound)	1	103	No

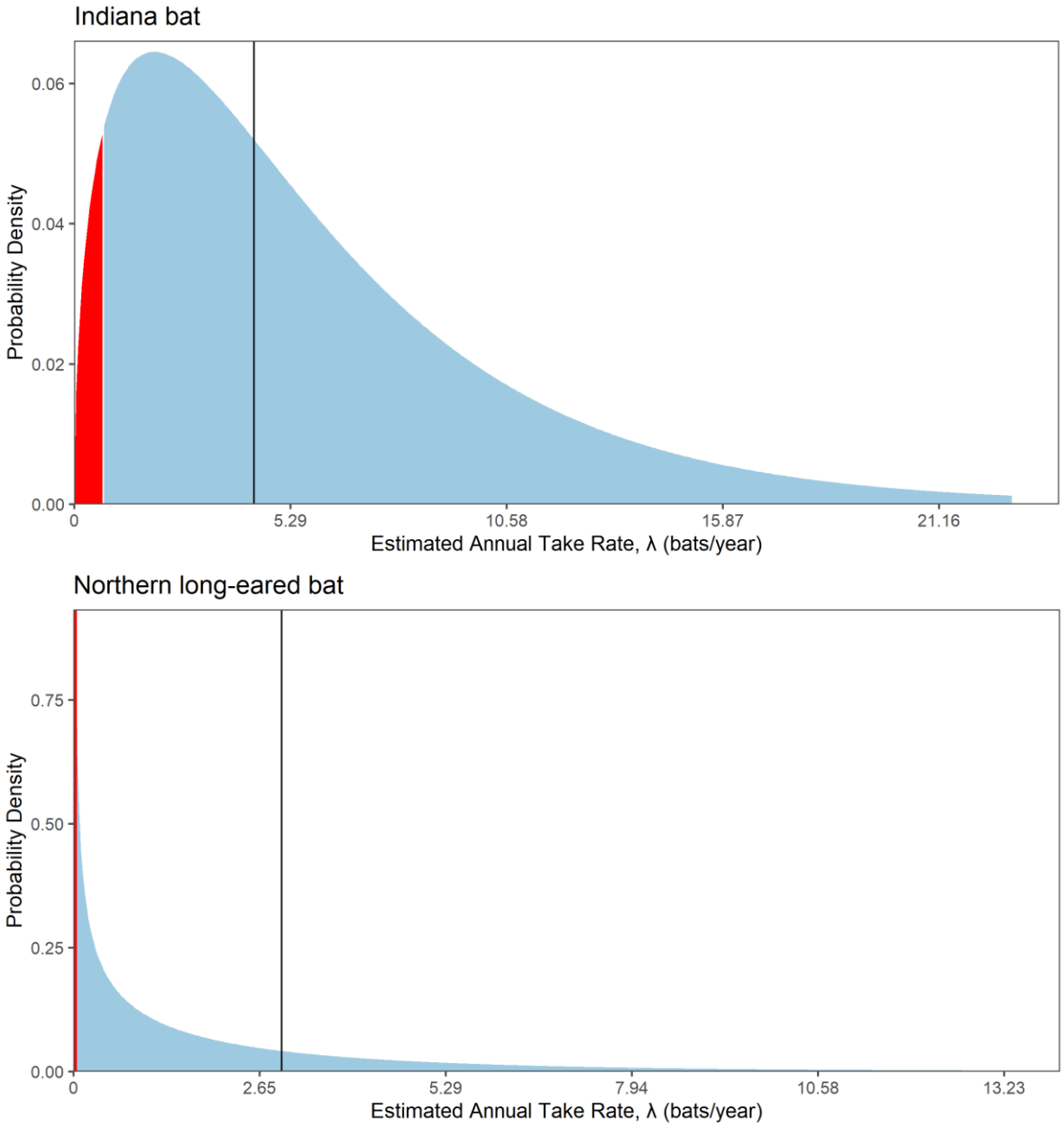

Figure 7. Estimated Covered Species take rates and short-term adaptive management trigger results for Indiana bat (top; *Myotis sodalis*) and northern long-eared bat (bottom; *M. septentrionalis*) for studies conducted within the rolling average interval at the Blue Creek Wind Farm, ITP Years 1–2 (2020 – 2021).

Note: The posterior distributions for the take rates are indicated by the curves above, with the lower 5% of the distributions colored in red. The black reference lines indicate the HCP's expected take rates. The triggers would fire when the red portions of the posterior distributions exceeded the expected take rates.

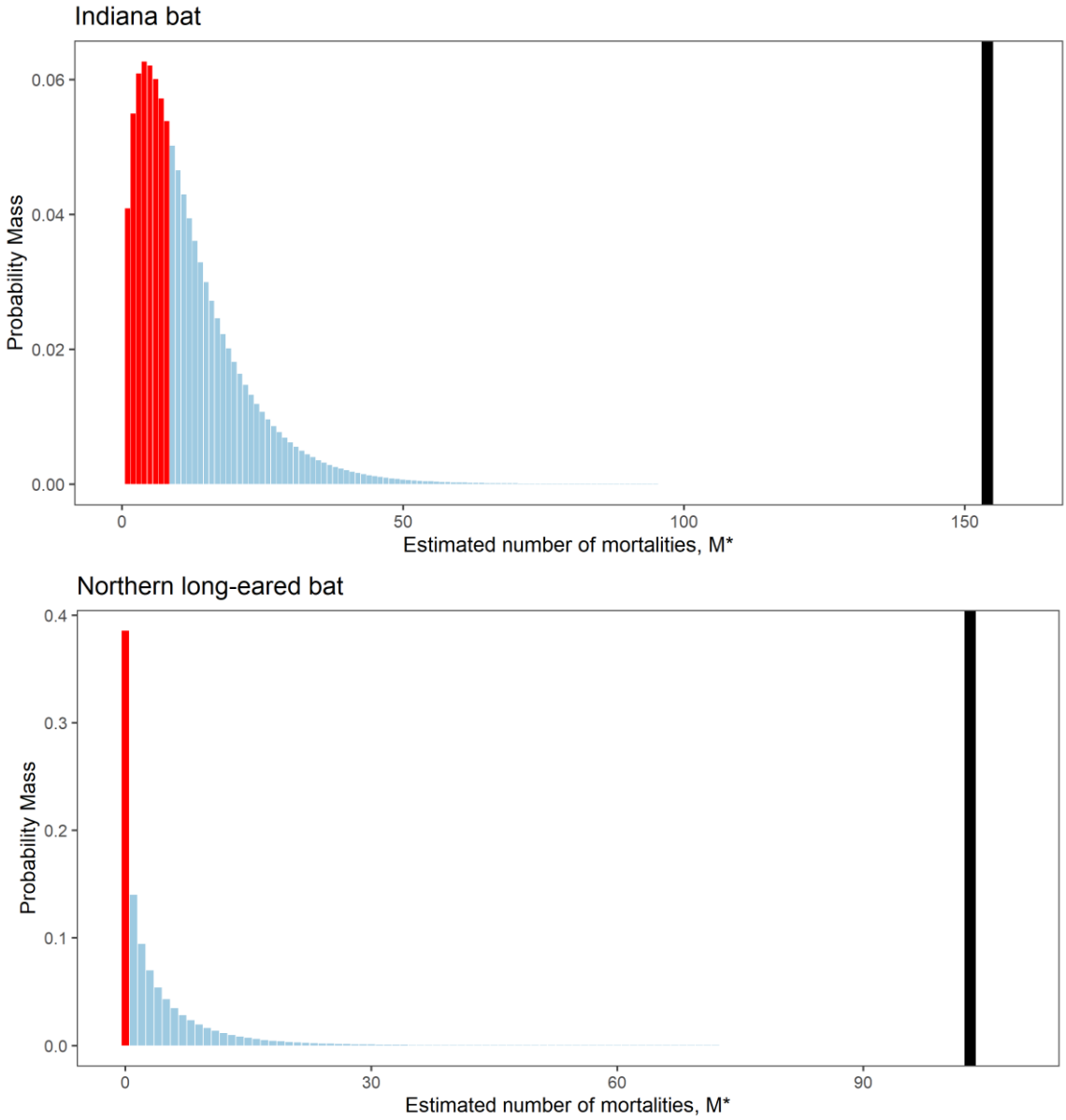

Figure 8. Estimated cumulative take and long-term adaptive management trigger results evaluated for Indiana bat (top; *Myotis sodalis*) and northern long-eared bat (bottom; *M. septentrionalis*) for the ITP term-to-date at the Blue Creek Wind Farm, ITP Years 1–2 (2020–2021).

Note: The posterior distributions of the estimated numbers of mortalities are given by the bar charts. The red portions of the bar charts indicate the lower 50% of the distributions (the locations of the long-term triggers). The heavy black reference lines show the HCP's permitted take amounts. The triggers would fire when the red portions of the posterior distribution equaled or exceeded the permitted take amounts.

CONCLUSIONS

The 2021 post-construction fatality monitoring was completed per the USFWS-approved Study Plan and consistent with the HCP's compliance monitoring requirements. Based on the count of Indiana bat and northern long-eared bat carcasses (one and zero, respectively) and the ITP term-to-date *g* of 0.123 (95% CI: 0.102–0.146), it was estimated that cumulatively, no more than nine Indiana bat fatalities and one northern long-eared bat fatality have occurred since the permit was issued. These values fall below the permitted take for each species, meaning the cumulative Covered Species take estimates are in compliance with the ITP and no long-term adaptive management is required. Based on the count of Covered Species bat carcasses and the monitoring period rolling average *g* of 0.134 (95% CI: 0.111–0.159), the probability that the annual take rates exceeded the short-term adaptive management thresholds for Indiana bat and northern long-eared bat did not exceed 95%, indicating no adaptive management is necessary. Table 14 provides a summary of HCP and ITP requirements and the status of each requirement.

Table 14. Habitat Conservation Plan and Incidental Take Permit compliance requirements and status based on the Intensive Monitoring conducted at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Requirement	Source	Status Based on 2021 Intensive Monitoring Results
Conduct Intensive Monitoring in spring	HCP Section 6.1.2	Completed
Conduct Intensive Monitoring in fall	HCP Section 6.1.2	Completed
Use Evidence of Absence software to design a search protocol with a detection probability (g) value of 0.15, based on prior year's site specific data	HCP Section 6.1.2	The monitoring plan was designed using the 2020 site specific data, and provided to the USFWS for review prior to the field season. The interim analysis after the spring season indicated that the Study Plan's *g* was projected to be 0.185 after completion of the fall monitoring effort.
Estimate mean take rates for the Covered Species	HCP Section 6.1.5	Mean take rates were 6.00 (95% CI: 0.43–18.85) Indiana bats per monitoring period and 2.00 (95% CI: 0.00–10.08) northern long-eared bats per monitoring period.
Estimate cumulative (ITP term-to-date) take estimates for the Covered Species	HCP Section 6.1.5	Cumulative take estimates were no more than nine Indiana bats and one northern long-eared bat during the ITP term-to-date.
Evaluate whether the short-term adaptive management threshold has been exceeded at the 95% credibility level	HCP Section 6.3.1	Probabilities that estimated take rates exceeded the short-term adaptive management thresholds were 52.9% for Indiana bat and 22.3% for northern long-eared bat, indicating no adaptive management was required.
Evaluate whether the cumulative take amount (*M**) has exceeded the permitted take amount at the 50% credibility level	HCP Section 6.3.1	The cumulative take estimates of no more than nine Indiana bats and one northern long-eared bat fall below the total permitted take for both of the Covered Species (154 Indiana bats and 103 northern long-eared bats), indicating the Project is in compliance with its permitted take levels.
Submit Intensive Monitoring report to the USFWS by April 1	HCP Section 6.1.6	Report submitted prior to April 1.

Table 14. Habitat Conservation Plan and Incidental Take Permit compliance requirements and status based on the Intensive Monitoring conducted at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Requirement	Source	Status Based on 2021 Intensive Monitoring Results
Intensive Monitoring Report will include: 1. Information necessary to estimate take of Covered Species, such as: date, time, location, species, and sex, of all bat carcasses documented; 2. Bias trial data; 3. Calculated *g* value; 4. Estimated average annual take rates and cumulative take estimates of the Covered Species; 5. Adaptive management triggers activated (if any) and planned response; 6. EoA inputs for the monitoring year; 7. All-bat fatality rate; and 8. A record of ambient temperatures and wind speeds and the application of cut-in speeds during a representative sample of the minimization period.	HCP Section 6.1.6	Report includes the required information in the following Sections: 1. Appendix A 2. Section 3.2 3. Section 3.3.5 4. Section 3.3.5.4 5. Sections 3.3.5.5 and 3.3.5.6 6. Appendix C 7. Section 3.3.4 8. Provided by Blue Creek Wind Farm LLC on November 11, 2021 (Avangrid Renewables 2021).
Report any Covered Species fatality to the USFWS and ODNR by phone within 24 hours of positive species identification	HCP Section 6.1.6	An unknown *Myotis* was found on September 30, 2021, and reported to USFWS and ODNR within 24 hours. The carcass was sent away for DNA analysis, and confirmed to be an Indiana bat on November 8; USFWS and ODNR were notified within 24 hours.
Provide the monitoring protocol the upcoming year of monitoring to the USFWS	HCP Section 6.1.2	Provided separately in the *2022 Post-Construction Monitoring Study Plan for the Blue Creek Wind Farm, Van Wert and Paulding counties, Ohio.*
Provide data and reporting on the supervisory control and data acquisition system from five turbines on April 4, August 4, and August 19.	ITP Section O.5.a.	Provided by Blue Creek Wind Farm LLC in emails dated April 2, August 4, and August 17, 2021.
Provide additional reporting on November 30 to document the implementation of the minimization and monitoring required by the HCP and ITP.	ITP Section O.5.b.	Provided by Blue Creek Wind Farm LLC on November 11, 2021 (Avangrid Renewables 2021).

Table 14. Habitat Conservation Plan and Incidental Take Permit compliance requirements and status based on the Intensive Monitoring conducted at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021.

Requirement	Source	Status Based on 2021 Intensive Monitoring Results
Clearly state the fall 2020 estimates of Indiana bats and northern long-eared bats using Evidence of Absence software were based on normal operations, not on 5.0 m/s cut-in speeds.	ITP Section O.5.c.	Report accounts for this in analysis (see Section 2.5.3.4).

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Appendix A. Bat Carcasses Found During the 2021 Post-construction Fatality Monitoring at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021

Appendix A. Complete listing of bat carcasses found at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

Date	Species	Turbine	Survey Type	Time	Plot Type	Sex	Latitude	Longitude
4/8/2021	eastern red bat	128	carcass search	13:04:00	road and pad	unknown	40.98259	-84.57767
4/27/2021	silver-haired bat	47	carcass search	10:43:00	full plot	female	40.92316	-84.63998
4/30/2021	silver-haired bat	113	carcass search	14:31:00	road and pad	unknown	40.95579	-84.60135
4/30/2021	silver-haired bat	157	carcass search	09:59:00	full plot	female	41.01416	-84.55594
5/5/2021	silver-haired bat	74	carcass search	10:38:00	road and pad	female	41.00757	-84.63397
7/30/2021	hoary bat	55	clearance search	15:40:00	full plot	unknown	40.95034	-84.64625
7/30/2021	hoary bat	55	clearance search	15:16:00	full plot	unknown	40.95033	-84.64615
7/31/2021	eastern red bat	E6	clearance search	07:50:00	full plot	unknown	40.92123	-84.51708
8/2/2021	hoary bat	131	carcass search	15:39:00	full plot	unknown	40.9733	-84.57954
8/4/2021	eastern red bat	157	carcass search	09:55:00	full plot	unknown	41.01386	-84.55585
8/5/2021	hoary bat	31	carcass search	11:50:00	full plot	unknown	40.95749	-84.66319
8/9/2021	hoary bat	E6	carcass search	08:50:00	full plot	female	40.92149	-84.51709
8/9/2021	big brown bat	E28	carcass search	11:06:00	full plot	unknown	40.97703	-84.52069
8/9/2021	eastern red bat	E28	carcass search	11:07:00	full plot	unknown	40.97738	-84.52076
8/10/2021	hoary bat	42	carcass search	10:36:00	full plot	unknown	40.92084	-84.65425
8/10/2021	hoary bat	31	carcass search	12:50:00	full plot	unknown	40.95808	-84.66401
8/12/2021	eastern red bat	E25	carcass search	14:45:00	full plot	unknown	40.97206	-84.531
8/16/2021	eastern red bat	164	carcass search	15:43:00	road and pad	unknown	41.00599	-84.5366
8/16/2021	eastern red bat	165	carcass search	15:10:00	full plot	unknown	41.01016	-84.53113
8/17/2021	eastern red bat	47	carcass search	13:16:00	full plot	unknown	40.92235	-84.63998
8/17/2021	big brown bat	31	carcass search	15:38:00	full plot	unknown	40.95779	-84.664
8/17/2021	eastern red bat	41	carcass search	11:20:00	full plot	unknown	40.92314	-84.65484
8/17/2021	big brown bat	40	carcass search	12:33:00	full plot	unknown	40.92566	-84.65556
8/17/2021	hoary bat	46	carcass search	14:06:00	full plot	unknown	40.92575	-84.6424
8/19/2021	hoary bat	E28	carcass search	11:36:00	full plot	male	40.97667	-84.52042
8/19/2021	eastern red bat	E25	carcass search	10:42:00	full plot	unknown	40.97183	-84.53112
8/19/2021	eastern red bat	E28	carcass search	11:50:00	full plot	unknown	40.97695	-84.51973
8/19/2021	eastern red bat	157	carcass search	09:31:00	full plot	unknown	41.01368	-84.55641
8/19/2021	eastern red bat	157	carcass search	09:33:00	full plot	unknown	41.01389	-84.55539
8/19/2021	hoary bat	146	carcass search	11:49:00	full plot	unknown	41.00719	-84.57796
8/20/2021	eastern red bat	15	carcass search	08:30:00	full plot	unknown	40.95735	-84.69592
8/26/2021	eastern red bat	162	carcass search	08:20:00	full plot	female	40.99919	-84.54599
8/26/2021	eastern red bat	72	carcass search	10:26:00	road and pad	unknown	40.99901	-84.64163
8/26/2021	eastern red bat	146	carcass search	12:09:00	full plot	unknown	41.00737	-84.57847
8/26/2021	eastern red bat	E6	carcass search	10:29:00	full plot	unknown	40.9208	-84.51735
8/26/2021	eastern red bat	E25	carcass search	12:18:00	full plot	unknown	40.97205	-84.53081
8/26/2021	hoary bat	E7	carcass search	09:40:00	full plot	unknown	40.92259	-84.52078

Appendix A. Complete listing of bat carcasses found at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

Date	Species	Turbine	Survey Type	Time	Plot Type	Sex	Latitude	Longitude
8/26/2021	eastern red bat	165	carcass search	14:20:00	full plot	unknown	41.00951	-84.53032
8/27/2021	hoary bat	15	carcass search	07:50:00	full plot	unknown	40.95707	-84.69537
8/28/2021	eastern red bat	47	carcass search	10:00:00	full plot	unknown	40.92247	-84.63997
8/28/2021	eastern red bat	34	carcass search	11:45:00	full plot	unknown	40.95009	-84.65633
8/30/2021	hoary bat	122	carcass search	14:55:00	full plot	unknown	40.94117	-84.5857
8/30/2021	hoary bat	162	carcass search	09:14:00	full plot	unknown	40.99976	-84.54573
8/30/2021	eastern red bat	E28	carcass search	12:14:00	full plot	unknown	40.97694	-84.52032
8/30/2021	big brown bat	E3	carcass search	08:14:00	full plot	unknown	40.92259	-84.55768
8/30/2021	big brown bat	E3	carcass search	08:17:00	full plot	unknown	40.92231	-84.55764
8/31/2021	eastern red bat	34	carcass search	12:00:00	full plot	unknown	40.94947	-84.65723
8/31/2021	eastern red bat	43	carcass search	08:14:00	full plot	unknown	40.91297	-84.66057
8/31/2021	hoary bat	15	carcass search	08:10:00	full plot	unknown	40.95782	-84.69521
9/2/2021	big brown bat	157	carcass search	09:26:00	full plot	unknown	41.01412	-84.5559
9/2/2021	eastern red bat	146	carcass search	11:27:00	full plot	unknown	41.00719	-84.57842
9/2/2021	eastern red bat	162	carcass search	08:22:00	full plot	unknown	40.99908	-84.54604
9/2/2021	eastern red bat	E18	carcass search	10:05:00	full plot	unknown	40.95496	-84.54162
9/2/2021	silver-haired bat	165	carcass search	11:56:00	full plot	unknown	41.00966	-84.53063
9/3/2021	big brown bat	121	carcass search	07:43:00	full plot	unknown	40.94031	-84.59678
9/3/2021	eastern red bat	43	carcass search	08:19:00	full plot	unknown	40.91342	-84.66015
9/3/2021	eastern red bat	31	carcass search	12:59:00	full plot	unknown	40.95735	-84.66421
9/6/2021	silver-haired bat	148	carcass search	12:16:00	road and pad	male	40.99776	-84.56798
9/6/2021	silver-haired bat	165	carcass search	11:34:00	full plot	unknown	41.00995	-84.53084
9/6/2021	silver-haired bat	157	carcass search	13:00:00	full plot	unknown	41.01405	-84.55676
9/6/2021	silver-haired bat	165	carcass search	11:32:00	full plot	unknown	41.00991	-84.5303
9/6/2021	eastern red bat	157	carcass search	13:17:00	full plot	unknown	41.01365	-84.55646
9/6/2021	eastern red bat	121	carcass search	12:09:00	full plot	unknown	40.94037	-84.59674
9/7/2021	eastern red bat	57	carcass search	09:11:00	full plot	female	40.94772	-84.64113
9/7/2021	big brown bat	90	carcass search	11:48:00	road and pad	unknown	41.00775	-84.6139
9/7/2021	silver-haired bat	15	carcass search	07:44:00	full plot	unknown	40.9577	-84.695
9/7/2021	silver-haired bat	42	carcass search	09:30:00	full plot	unknown	40.92106	-84.65417
9/7/2021	silver-haired bat	42	carcass search	09:22:00	full plot	unknown	40.92095	-84.65414
9/7/2021	eastern red bat	44	carcass search	07:32:00	full plot	unknown	40.91173	-84.65663
9/9/2021	silver-haired bat	167	carcass search	07:50:00	full plot	male	41.00084	-84.52169
9/10/2021	eastern red bat	4	carcass search	08:32:00	road and pad	unknown	40.98686	-84.68745
9/10/2021	eastern red bat	27	carcass search	11:09:00	road and pad	unknown	40.93317	-84.67312
9/10/2021	silver-haired bat	131	carcass search	08:20:00	full plot	unknown	40.97319	-84.57974
9/10/2021	eastern red bat	46	carcass search	12:00:00	full plot	unknown	40.9253	-84.6432

Appendix A. Complete listing of bat carcasses found at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

Date	Species	Turbine	Survey Type	Time	Plot Type	Sex	Latitude	Longitude
9/10/2021	eastern red bat	43	carcass search	08:19:00	full plot	unknown	40.91331	-84.65985
9/10/2021	eastern red bat	41	carcass search	10:15:00	full plot	unknown	40.92329	-84.65464
9/10/2021	silver-haired bat	41	carcass search	10:37:00	full plot	unknown	40.92328	-84.65438
9/10/2021	hoary bat	43	carcass search	08:33:00	full plot	unknown	40.91351	-84.66004
9/13/2021	silver-haired bat	E18	carcass search	09:48:00	full plot	unknown	40.95536	-84.54157
9/13/2021	eastern red bat	E9	carcass search	10:48:00	full plot	unknown	40.93393	-84.53941
9/14/2021	silver-haired bat	85	carcass search	13:17:00	full plot	unknown	40.98731	-84.61779
9/14/2021	silver-haired bat	89	carcass search	14:09:00	road and pad	unknown	41.01004	-84.61538
9/14/2021	silver-haired bat	151	carcass search	12:29:00	road and pad	unknown	40.98671	-84.56607
9/14/2021	eastern red bat	131	carcass search	14:18:00	full plot	unknown	40.97377	-84.57943
9/14/2021	eastern red bat	43	carcass search	08:40:00	full plot	unknown	40.91352	-84.66019
9/14/2021	hoary bat	131	carcass search	14:03:00	full plot	unknown	40.97373	-84.5793
9/16/2021	big brown bat	167	carcass search	08:04:00	full plot	unknown	41.001	-84.52265
9/17/2021	big brown bat	40	carcass search	11:22:00	full plot	unknown	40.92553	-84.65573
9/17/2021	eastern red bat	40	carcass search	11:34:00	full plot	unknown	40.92593	-84.65525
9/17/2021	hoary bat	110	carcass search	15:12:00	full plot	unknown	40.96454	-84.59552
9/17/2021	eastern red bat	77	carcass search	12:29:00	full plot	unknown	40.99408	-84.63755
9/17/2021	hoary bat	15	carcass search	07:52:00	full plot	unknown	40.95749	-84.69571
9/20/2021	silver-haired bat	E3	carcass search	07:41:00	full plot	female	40.92194	-84.55832
9/20/2021	silver-haired bat	165	carcass search	14:20:00	full plot	female	41.01004	-84.53064
9/20/2021	silver-haired bat	E25	carcass search	12:38:00	full plot	male	40.97244	-84.53127
9/20/2021	silver-haired bat	E5	carcass search	08:34:00	full plot	male	40.91931	-84.53752
9/20/2021	silver-haired bat	E18	carcass search	11:46:00	full plot	male	40.95556	-84.54215
9/20/2021	silver-haired bat	161	carcass search	09:45:00	full plot	male	41.00236	-84.54846
9/20/2021	big brown bat	E17	carcass search	10:08:00	road and pad	unknown	40.9571	-84.54639
9/20/2021	silver-haired bat	E13	carcass search	08:25:00	road and pad	unknown	40.93722	-84.51876
9/20/2021	hoary bat	E14	carcass search	09:12:00	road and pad	unknown	40.94267	-84.5267
9/20/2021	eastern red bat	E7	carcass search	09:56:00	full plot	unknown	40.9231	-84.52091
9/20/2021	hoary bat	E28	carcass search	13:33:00	full plot	unknown	40.97695	-84.52049
9/20/2021	silver-haired bat	E25	carcass search	12:21:00	full plot	unknown	40.97196	-84.53162
9/20/2021	silver-haired bat	E25	carcass search	12:23:00	full plot	unknown	40.97191	-84.53185
9/20/2021	silver-haired bat	E5	carcass search	08:43:00	full plot	unknown	40.9191	-84.53767
9/20/2021	silver-haired bat	E25	carcass search	12:17:00	full plot	unknown	40.97193	-84.53161
9/20/2021	silver-haired bat	162	carcass search	08:30:00	full plot	unknown	40.9996	-84.54657
9/20/2021	silver-haired bat	122	carcass search	14:53:00	full plot	unknown	40.94117	-84.58596
9/20/2021	hoary bat	161	carcass search	09:38:00	full plot	unknown	41.00227	-84.54838
9/20/2021	silver-haired bat	161	carcass search	09:58:00	full plot	unknown	41.00279	-84.54745

Appendix A. Complete listing of bat carcasses found at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

Date	Species	Turbine	Survey Type	Time	Plot Type	Sex	Latitude	Longitude
9/20/2021	eastern red bat	121	carcass search	14:07:00	full plot	unknown	40.94039	-84.59671
9/20/2021	eastern red bat	167	carcass search	07:29:00	full plot	unknown	41.00099	-84.52205
9/20/2021	hoary bat	157	carcass search	10:44:00	full plot	unknown	41.01381	-84.55579
9/21/2021	silver-haired bat	15	carcass search	08:46:00	full plot	female	40.9573	-84.69566
9/21/2021	silver-haired bat	55	carcass search	09:45:00	full plot	male	40.95011	-84.64628
9/21/2021	silver-haired bat	55	carcass search	10:06:00	full plot	male	40.95001	-84.64676
9/21/2021	silver-haired bat	15	carcass search	08:41:00	full plot	male	40.95771	-84.69582
9/21/2021	silver-haired bat	79	carcass search	12:27:00	full plot	male	40.98064	-84.63728
9/21/2021	silver-haired bat	44	carcass search	08:21:00	full plot	unknown	40.91168	-84.65721
9/21/2021	silver-haired bat	41	carcass search	11:20:00	full plot	unknown	40.92312	-84.65443
9/21/2021	hoary bat	41	carcass search	11:09:00	full plot	unknown	40.92369	-84.65528
9/21/2021	eastern red bat	42	carcass search	10:27:00	full plot	unknown	40.92023	-84.65441
9/21/2021	eastern red bat	47	carcass search	12:54:00	full plot	unknown	40.92213	-84.64051
9/21/2021	hoary bat	40	carcass search	12:14:00	full plot	unknown	40.926	-84.65641
9/21/2021	eastern red bat	33	carcass search	14:48:00	full plot	unknown	40.95199	-84.65925
9/21/2021	silver-haired bat	153	carcass search	07:40:00	full plot	unknown	41.01004	-84.56765
9/21/2021	tricolored bat	131	carcass search	16:12:00	full plot	unknown	40.97369	-84.57963
9/21/2021	silver-haired bat	85	carcass search	14:12:00	full plot	unknown	40.98717	-84.61803
9/21/2021	hoary bat	131	carcass search	16:08:00	full plot	unknown	40.97367	-84.57946
9/21/2021	silver-haired bat	85	carcass search	14:18:00	full plot	unknown	40.98753	-84.61804
9/21/2021	silver-haired bat	55	carcass search	10:06:00	full plot	unknown	40.95	-84.64664
9/21/2021	eastern red bat	15	carcass search	08:27:00	full plot	unknown	40.95732	-84.69543
9/21/2021	hoary bat	77	carcass search	13:26:00	full plot	unknown	40.99367	-84.63785
9/21/2021	silver-haired bat	126	carcass search	12:19:00	road and pad	unknown	40.95936	-84.58644
9/21/2021	silver-haired bat	101	carcass search	14:06:00	full plot	unknown	40.98136	-84.60068
9/21/2021	silver-haired bat	93	carcass search	10:35:00	road and pad	unknown	40.99523	-84.60443
9/21/2021	silver-haired bat	141	carcass search	07:41:00	road and pad	unknown	40.93698	-84.5629
9/21/2021	hoary bat	101	carcass search	13:55:00	full plot	unknown	40.98123	-84.59991
9/21/2021	silver-haired bat	101	carcass search	14:05:00	full plot	unknown	40.98056	-84.60077
9/23/2021	silver-haired bat	156	carcass search	09:10:00	full plot	unknown	40.99944	-84.55787
9/23/2021	silver-haired bat	131	carcass search	13:19:00	full plot	unknown	40.9733	-84.58015
9/23/2021	silver-haired bat	92	carcass search	10:41:00	full plot	unknown	41.01327	-84.60854
9/23/2021	eastern red bat	131	carcass search	13:11:00	full plot	unknown	40.97312	-84.57925
9/23/2021	silver-haired bat	131	carcass search	13:12:00	full plot	unknown	40.97301	-84.57979
9/24/2021	silver-haired bat	E9	carcass search	14:19:00	full plot	unknown	40.93358	-84.53918
9/25/2021	silver-haired bat	34	carcass search	08:30:00	full plot	male	40.94921	-84.65659
9/27/2021	silver-haired bat	162	carcass search	08:42:00	full plot	male	40.99966	-84.54582

Appendix A. Complete listing of bat carcasses found at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

Date	Species	Turbine	Survey Type	Time	Plot Type	Sex	Latitude	Longitude
9/27/2021	eastern red bat	121	carcass search	14:12:00	full plot	unknown	40.9413	-84.59694
9/27/2021	silver-haired bat	121	carcass search	14:01:00	full plot	unknown	40.94031	-84.59761
9/28/2021	silver-haired bat	34	carcass search	13:14:00	full plot	female	40.94978	-84.65641
9/28/2021	eastern red bat	85	carcass search	11:55:00	full plot	male	40.98757	-84.61765
9/28/2021	silver-haired bat	34	carcass search	13:20:00	full plot	unknown	40.94966	-84.65719
9/28/2021	silver-haired bat	44	carcass search	07:59:00	full plot	unknown	40.91222	-84.65749
9/28/2021	hoary bat	33	carcass search	13:58:00	full plot	unknown	40.95224	-84.65935
9/28/2021	eastern red bat	46	carcass search	12:20:00	full plot	unknown	40.92558	-84.64215
9/28/2021	silver-haired bat	84	carcass search	09:18:00	full plot	unknown	40.9772	-84.62438
9/28/2021	eastern red bat	16	incidental	08:05:00	road and pad	unknown	40.95061	-84.69665
9/28/2021	silver-haired bat	15	carcass search	08:26:00	full plot	unknown	40.95708	-84.6956
9/28/2021	silver-haired bat	84	carcass search	09:35:00	full plot	unknown	40.97704	-84.62382
9/30/2021	silver-haired bat	156	carcass search	10:35:00	full plot	unknown	40.99924	-84.55868
9/30/2021	Indiana bat	156	carcass search	10:35:00	full plot	unknown	40.99884	-84.55835
9/30/2021	silver-haired bat	167	carcass search	08:00:00	full plot	unknown	41.00082	-84.52246
9/30/2021	hoary bat	E28	carcass search	15:05:00	full plot	unknown	40.97689	-84.52052
9/30/2021	eastern red bat	E28	carcass search	15:10:00	full plot	unknown	40.97689	-84.52052
10/1/2021	hoary bat	84	carcass search	10:21:00	full plot	female	40.97714	-84.62519
10/1/2021	silver-haired bat	15	carcass search	07:50:00	full plot	male	40.95758	-84.69602
10/1/2021	silver-haired bat	47	carcass search	11:33:00	full plot	unknown	40.92293	-84.63986
10/1/2021	silver-haired bat	110	carcass search	14:17:00	full plot	unknown	40.9642	-84.5959
10/1/2021	eastern red bat	79	carcass search	11:00:00	full plot	unknown	40.98053	-84.6375
10/1/2021	eastern red bat	29	carcass search	11:28:00	road and pad	unknown	40.92368	-84.67689
10/1/2021	silver-haired bat	8	carcass search	09:57:00	road and pad	unknown	40.98444	-84.67891
10/4/2021	silver-haired bat	E28	carcass search	13:15:00	full plot	unknown	40.97694	-84.51988
10/4/2021	eastern red bat	E25	carcass search	12:26:00	full plot	unknown	40.97213	-84.53157
10/4/2021	eastern red bat	161	carcass search	09:33:00	full plot	unknown	41.00258	-84.54769
10/5/2021	eastern red bat	33	carcass search	13:46:00	full plot	unknown	40.95276	-84.65895
10/7/2021	silver-haired bat	E6	carcass search	09:24:00	full plot	female	40.92097	-84.51706
10/7/2021	hoary bat	153	carcass search	11:37:00	full plot	unknown	41.00991	-84.56751
10/9/2021	silver-haired bat	131	carcass search	12:40:00	full plot	unknown	40.97354	-84.57931
10/9/2021	silver-haired bat	21	carcass search	13:51:00	road and pad	unknown	40.942674	-84.68569
10/9/2021	hoary bat	44	carcass search	08:13:00	full plot	unknown	40.91175	-84.65763
10/11/2021	silver-haired bat	E25	carcass search	10:54:00	full plot	male	40.97247	-84.53122
10/11/2021	silver-haired bat	31	carcass search	14:10:00	full plot	unknown	40.95787	-84.66355
10/11/2021	eastern red bat	121	carcass search	12:38:00	full plot	unknown	40.94089	-84.59705
10/11/2021	silver-haired bat	165	carcass search	11:44:00	full plot	unknown	41.00995	-84.53113

Appendix A. Complete listing of bat carcasses found at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

Date	Species	Turbine	Survey Type	Time	Plot Type	Sex	Latitude	Longitude
10/12/2021	eastern red bat	44	carcass search	10:36:00	full plot	unknown	40.91156	-84.65682
10/12/2021	silver-haired bat	44	carcass search	10:55:00	full plot	unknown	40.91156	-84.65682
10/12/2021	silver-haired bat	84	carcass search	10:01:00	full plot	unknown	40.97704	-84.62511
10/12/2021	silver-haired bat	101	carcass search	12:06:00	full plot	unknown	40.981189	-84.60015
10/12/2021	silver-haired bat	57	carcass search	08:50:00	full plot	unknown	40.948295	-84.64165

Appendix B. All-bat Fatality Rates and Adjustment Factors for 2021 Post-construction Fatality Monitoring Conducted at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021

Appendix B. All-bat fatality rates using the Huso estimator and adjustment factors, with 90% confidence intervals, for all plots during 2021 post-construction fatality monitoring conducted at the Blue Creek Wind Farm from April 1 – May 15 and August 1 – October 15, 2021.

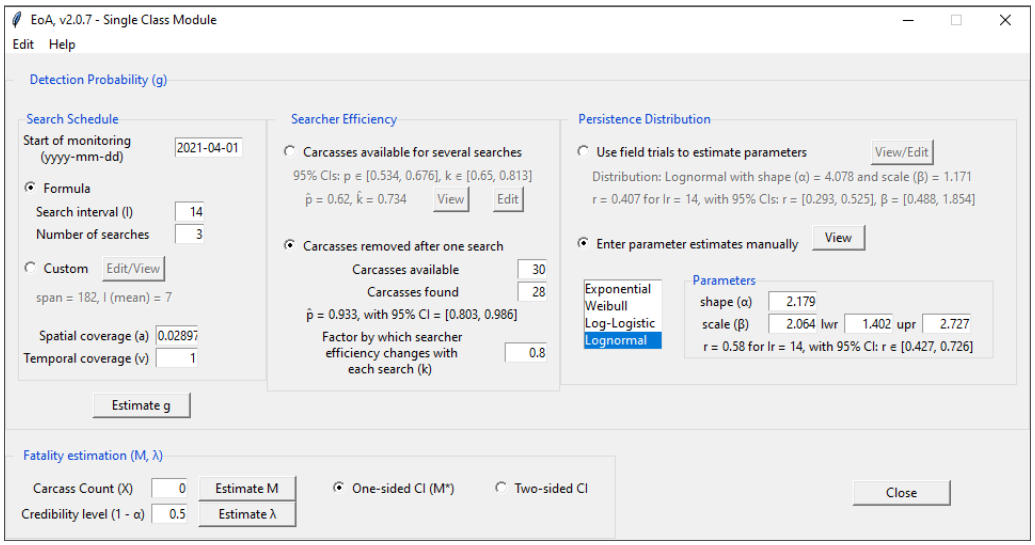
	Full Plot 40 Turbines Searched		Road and Pad 112 Turbines Searched	
Season	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Searched Area Adjustment				
Spring	0.91	0.83–0.98	0.03	0.02–0.05
Fall	0.94	0.88–0.99	0.03	0.02–0.05
Searcher Efficiency				
Spring	0.57	0.43–0.70	0.93	0.87–0.98
Fall	0.33	0.21–0.47	0.84	0.73–0.93
Average Probability of a Carcass Persisting Through the Search Interval**				
Spring	0.87	0.80–0.94	0.58	0.45–0.71
Fall	0.72	0.59–0.84	0.37	0.25–0.49
Probability of Available and Detected				
Spring	0.50	0.37–0.63	0.54	0.41–0.67
Fall	0.24	0.14–0.35	0.31	0.20–0.42
Number of Fatalities***				
Spring	1	n/a*	3	n/a*
Fall	138	101–176	11	6–16
Estimated Fatality Rates (Fatalities/Turbine/Season)				
Spring	0.05	n/a*	1.53	n/a*
Fall	15.04	9.25–26.03	9.33	4.86–18.29
Estimated Fatality Rates (Fatalities/Megawatt/Seasons)				
Spring	0.03	n/a*	0.76	n/a*
Fall	7.52	4.63–13.02	4.67	2.43–9.15

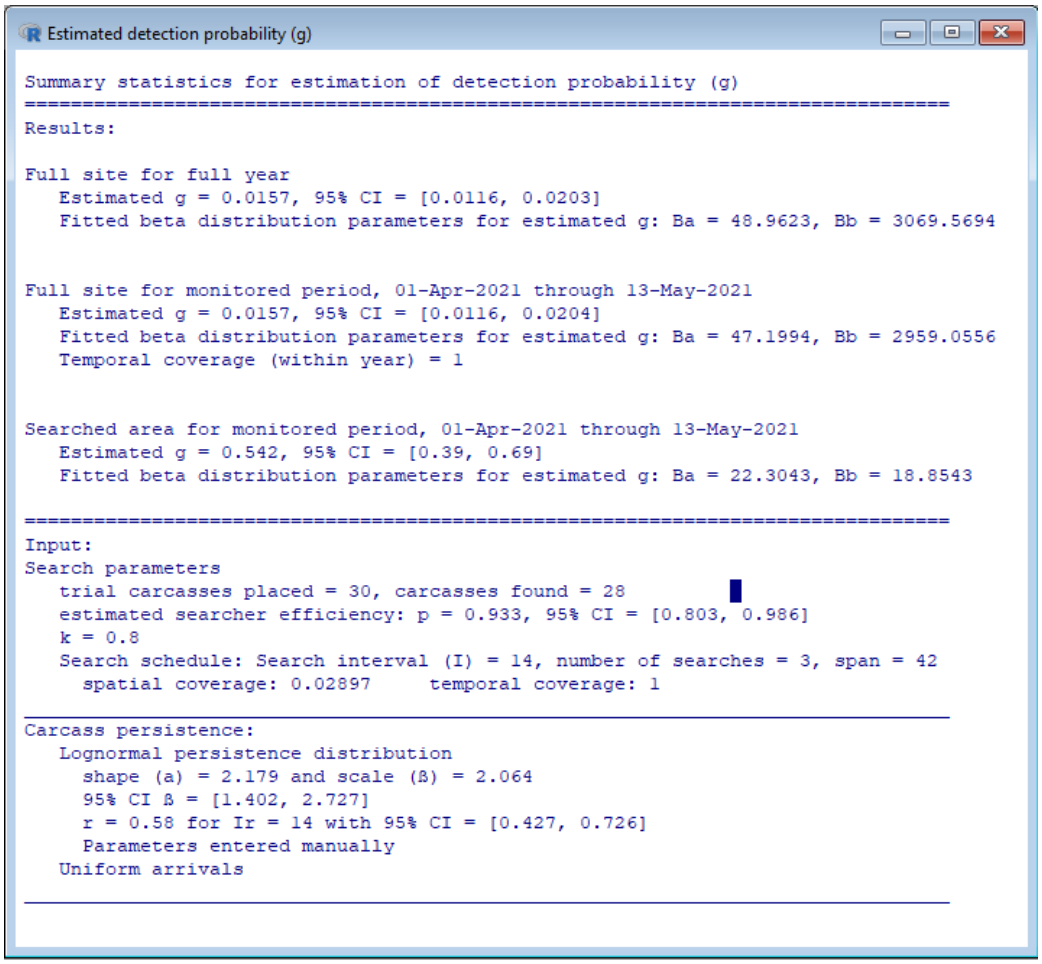
*Confidence intervals (CI) were not calculated when the number of observed carcasses was less than five because Horvitz-Thompson estimators such as the Huso estimator are known to be unreliable when carcass counts are less than five (Korner-Nievergelt et al. 2012).

**In the spring the search interval was 14 days on road and pads and weekly on full plots. In the fall the search interval was weekly on road and pads and twice a week on full plots.

***The confidence intervals on the number of fatalities represent the turbine to turbine variation in fatality counts.

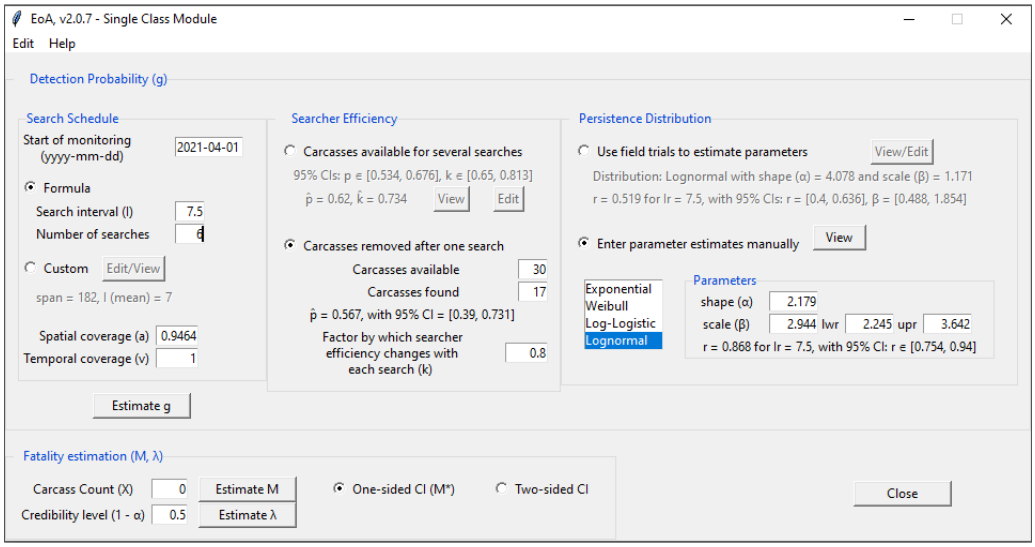
Appendix C. Additional Information for the Evidence of Absence Analysis at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021

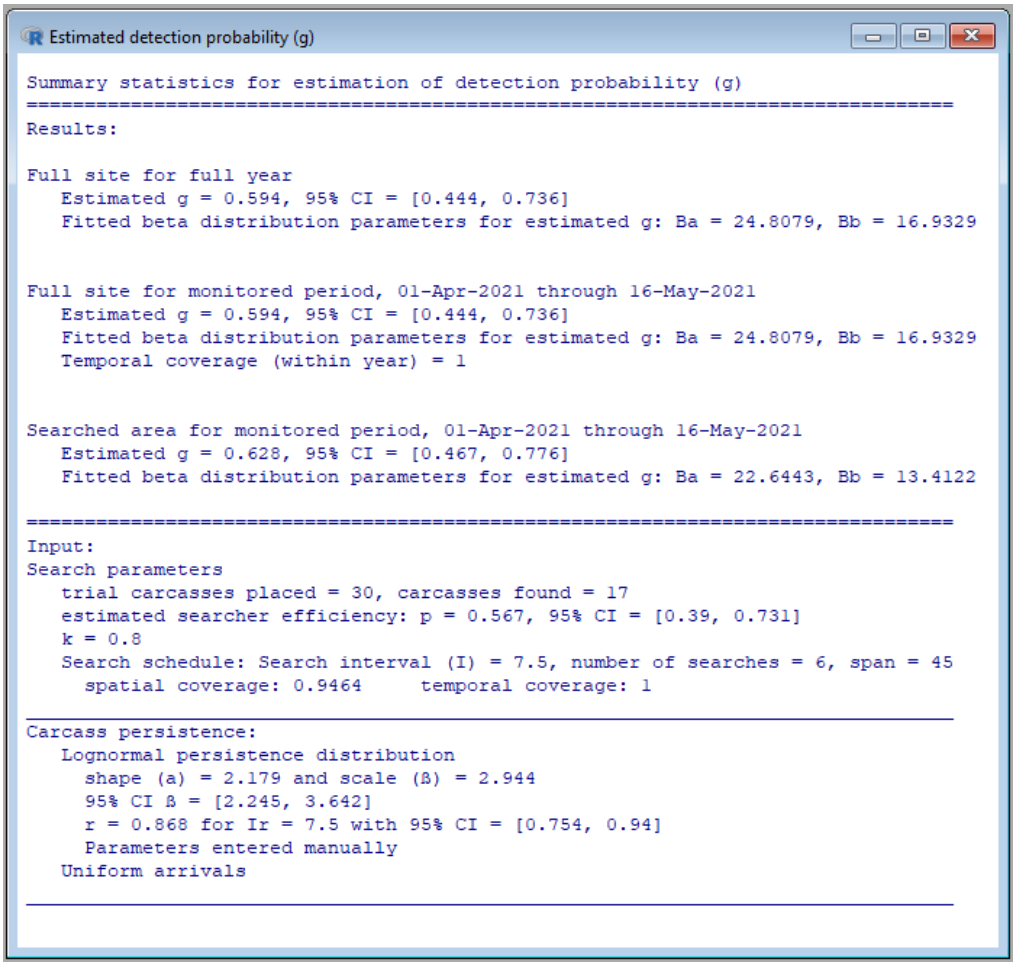




Appendix C1. Inputs and outputs from the Evidence of Absence* Graphical User Interface Single Class Module for Indiana bat and northern long-eared bat for road and pads during spring 2021. Inputs are based on values reported in the main text.

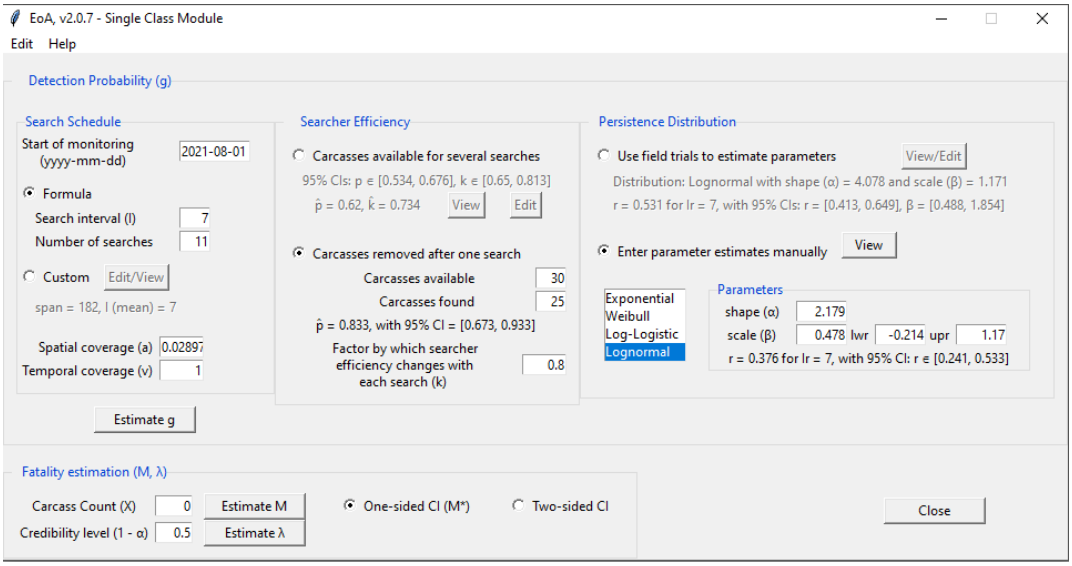
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.

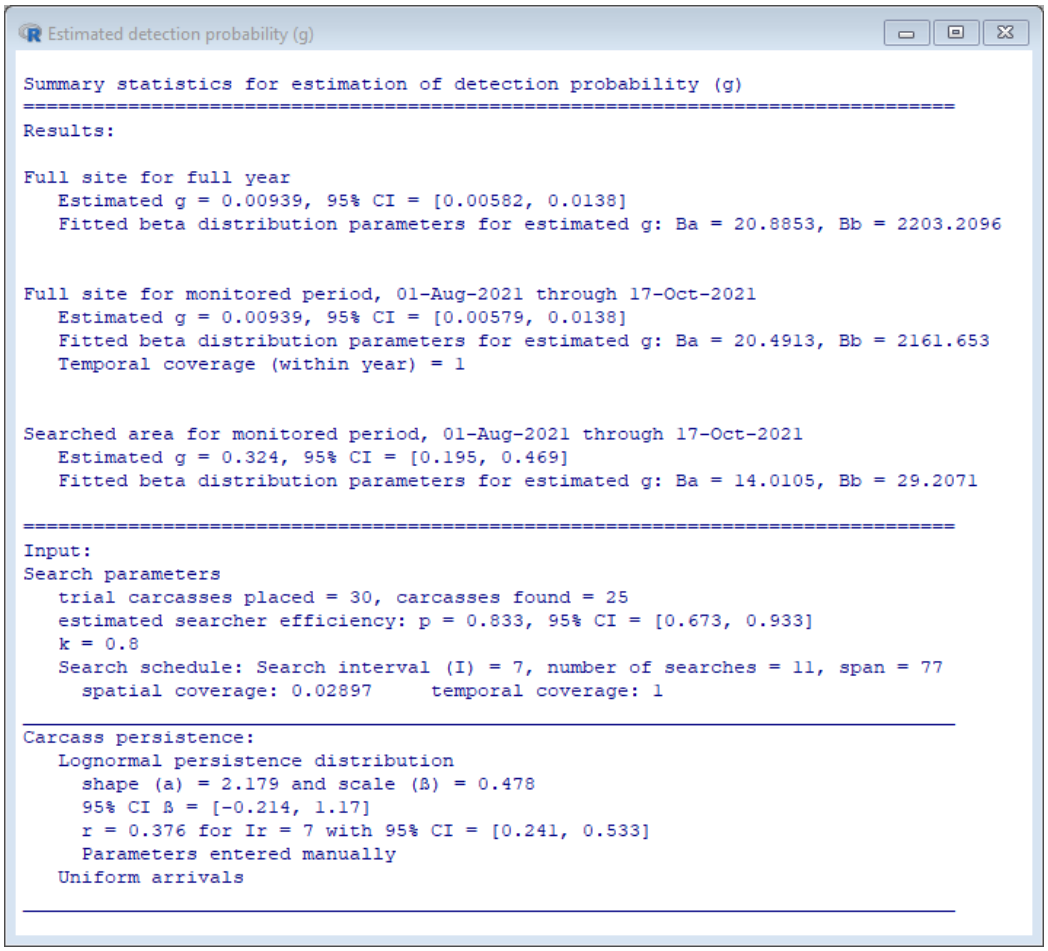




Appendix C2. Inputs and outputs from the Evidence of Absence* Graphical User Interface Single Class Module for Indiana bat and northern long-eared bat for full plots during spring 2021. Inputs are based on values reported in the main text.

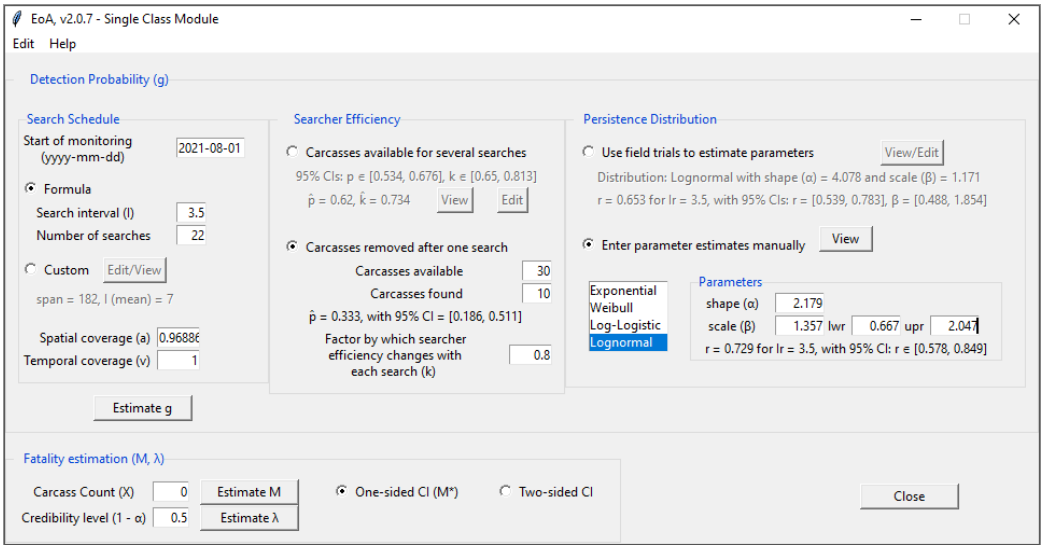
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.

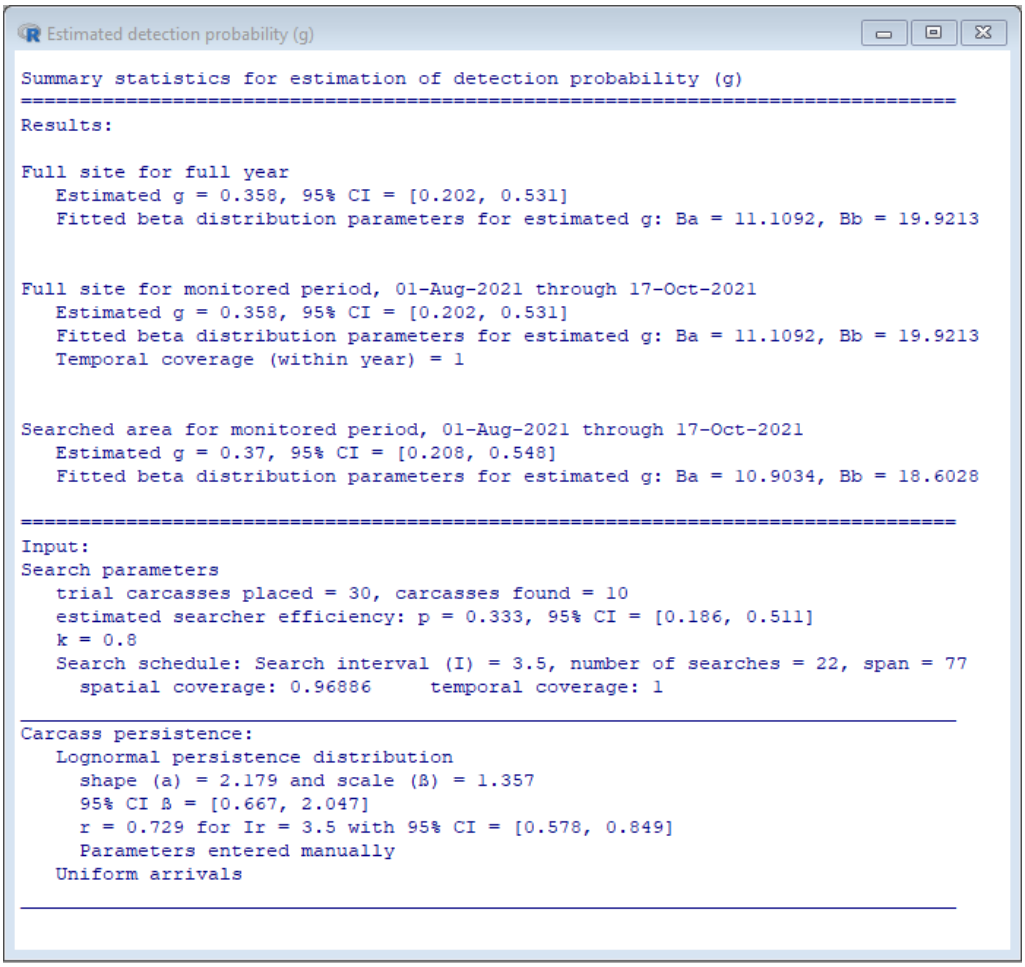




Appendix C3. Inputs and outputs from the Evidence of Absence* Graphical User Interface Single Class Module for Indiana bat and northern long-eared bat for road and pads during fall 2021. Inputs are based on values reported in the main text

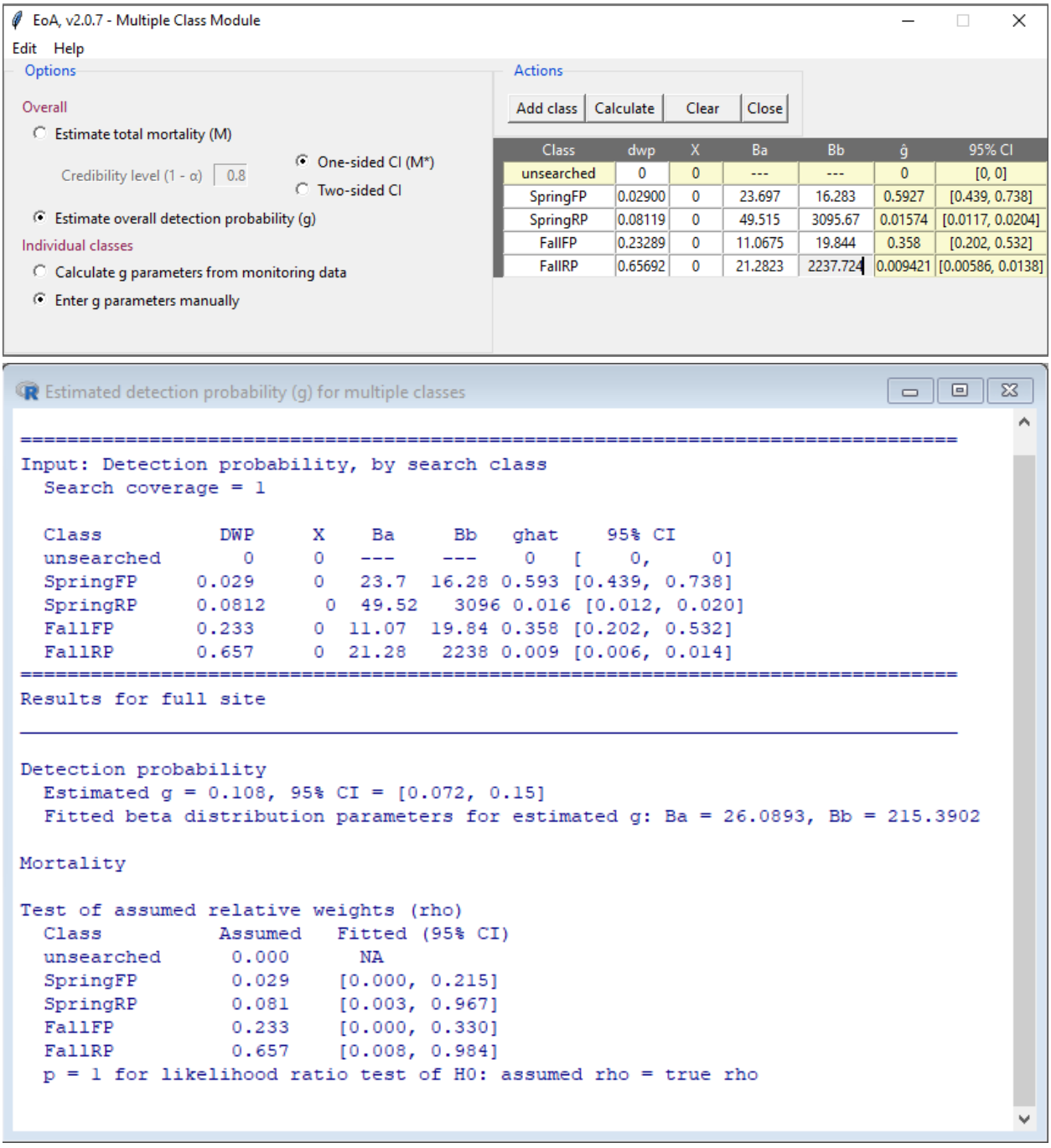
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.





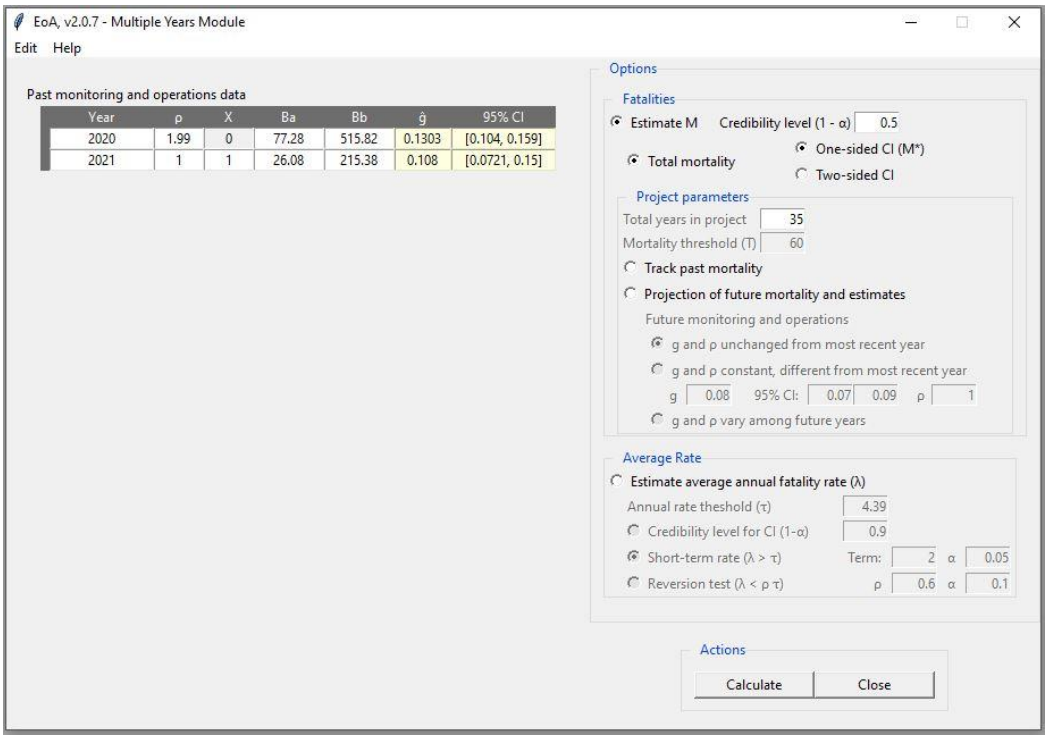
Appendix C4. Inputs and outputs from the Evidence of Absence* Graphical User Interface Single Class Module for Indiana bat and northern long-eared bat for full plots during fall 2021. Inputs are based on values reported in the main text.

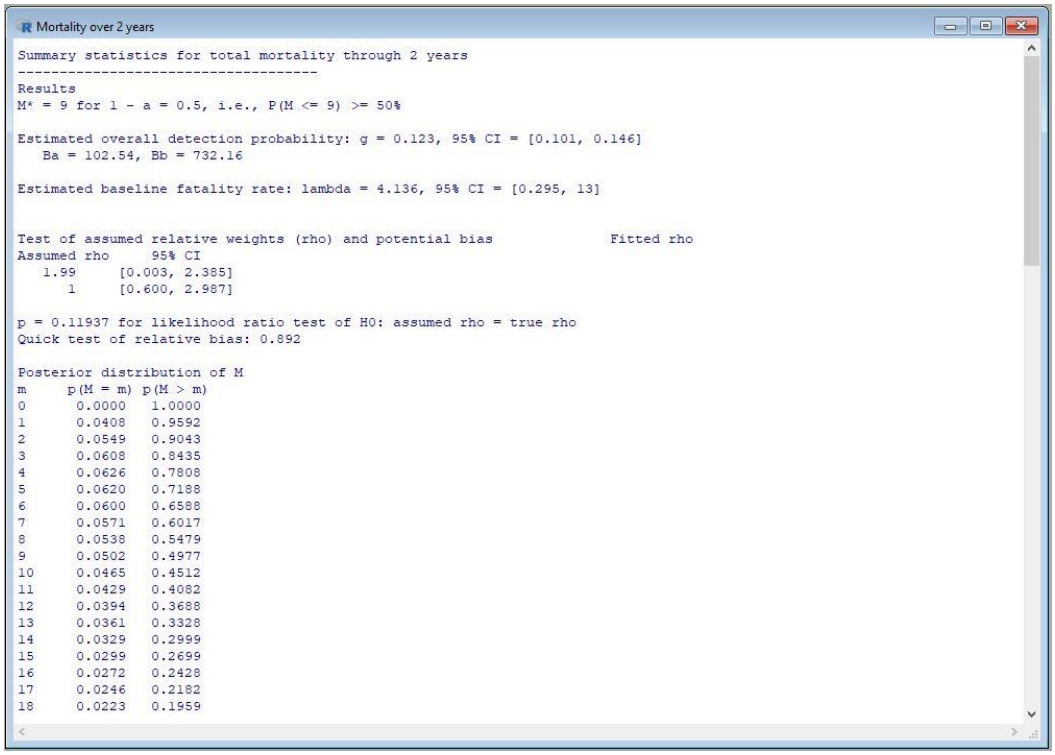
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.



Appendix C5. Inputs and outputs from the Evidence of Absence* Graphical User Interface Multiple Class Module for Indiana bat and northern long-eared bat rolling average detection probability and short term trigger test. Inputs are based on values reported in the main text.

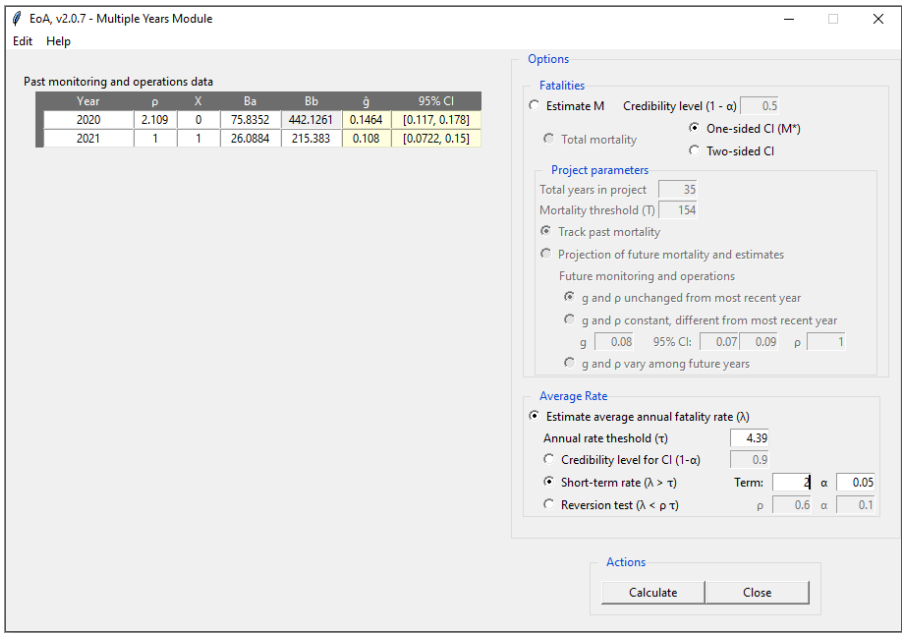
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.

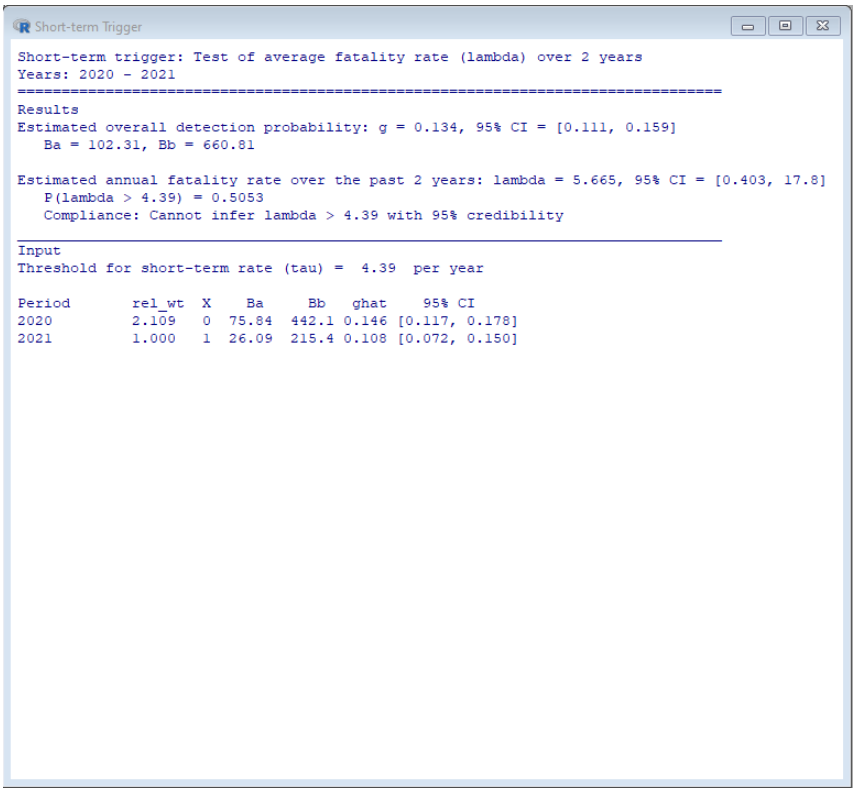




Appendix C6. Inputs and outputs from the Evidence of Absence* Graphical User Interface Multiple Year Module for Indiana bat ITP term-to-date detection probability and cumulative take estimate (*M). Inputs are based on values reported in the main text.**

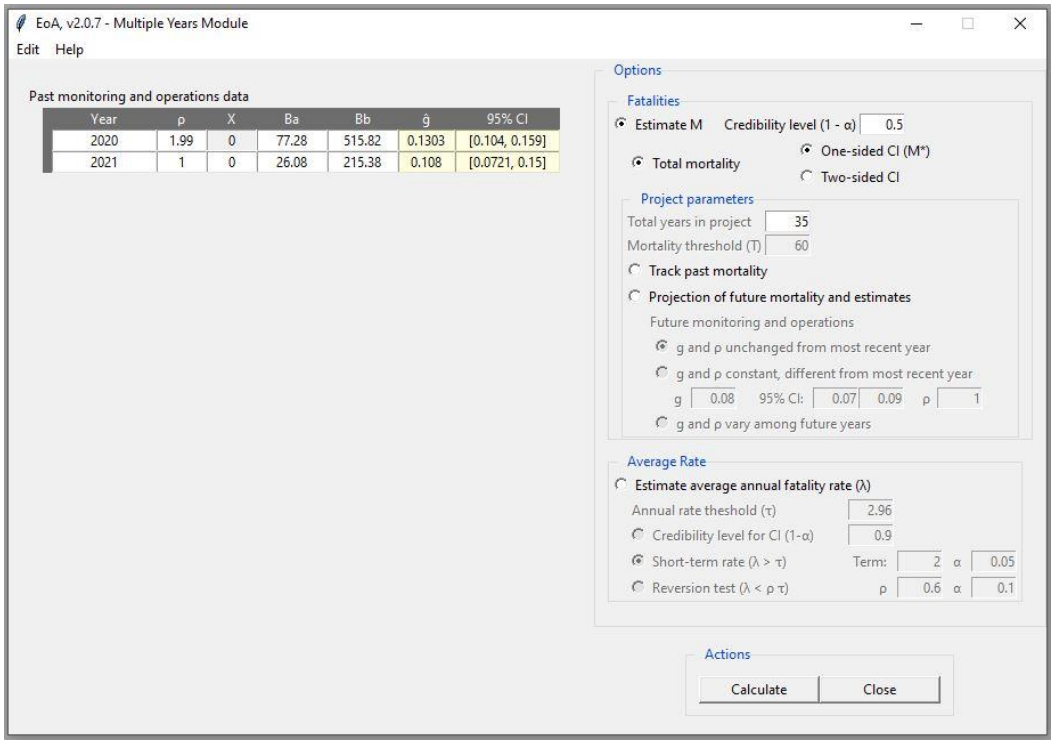
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.

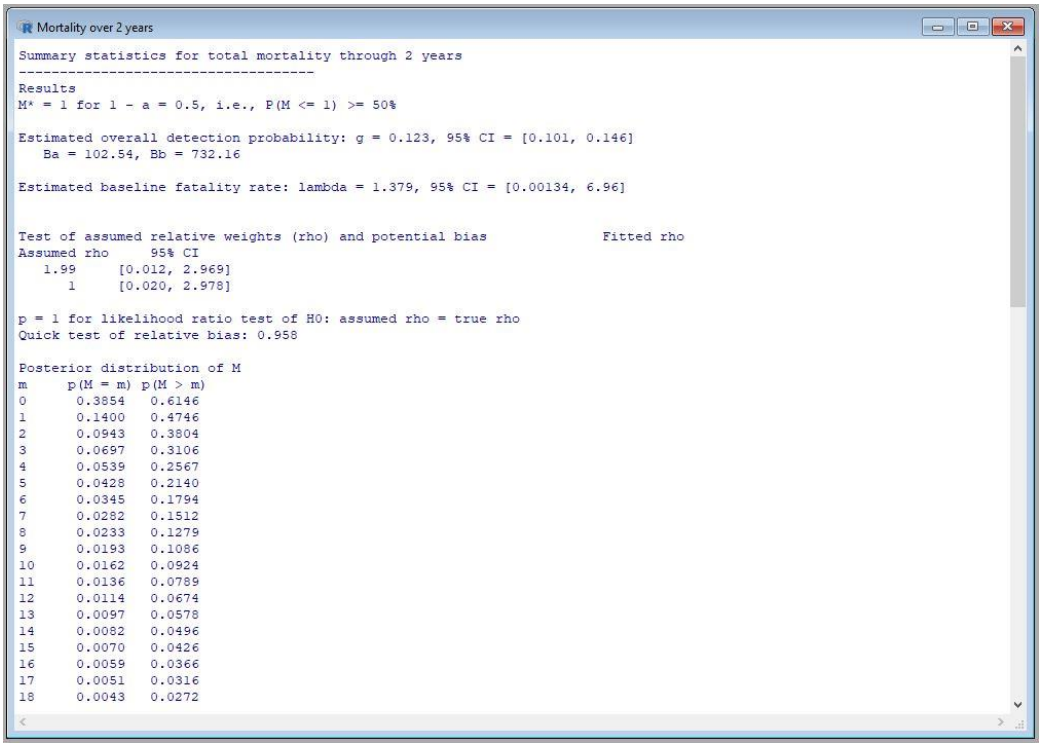




Appendix C7. Inputs and outputs from the Evidence of Absence* Graphical User Interface Multiple Year Module for Indiana bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text. The average annual take rate (lambda) estimated here is lower than that given in the text because the EoA GUI automatically scales the take rate by the sum of the weights (rho; 3.109) rather than the total Covered Species arrival (1.89).

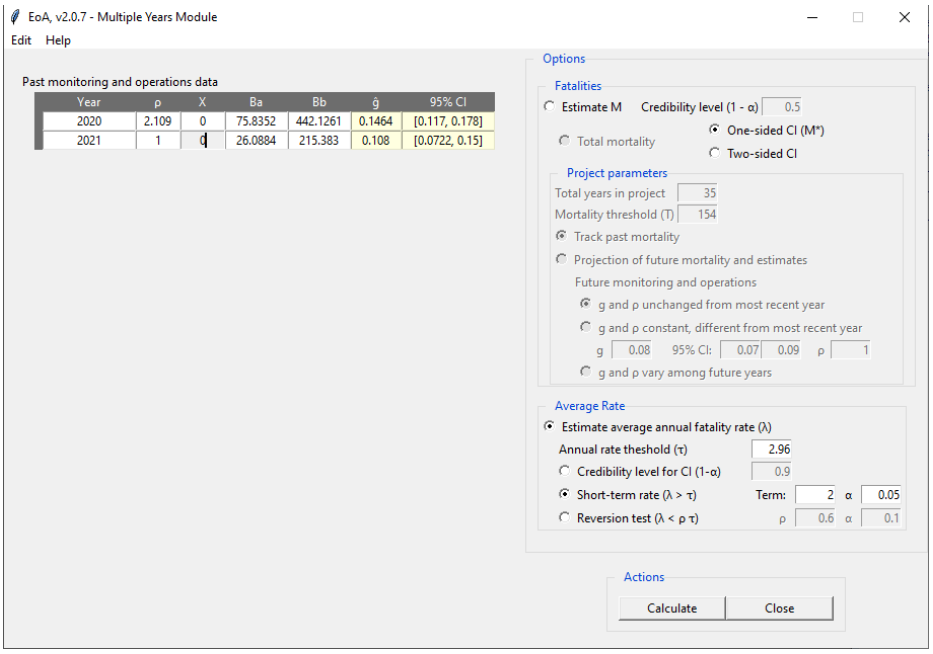
* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.

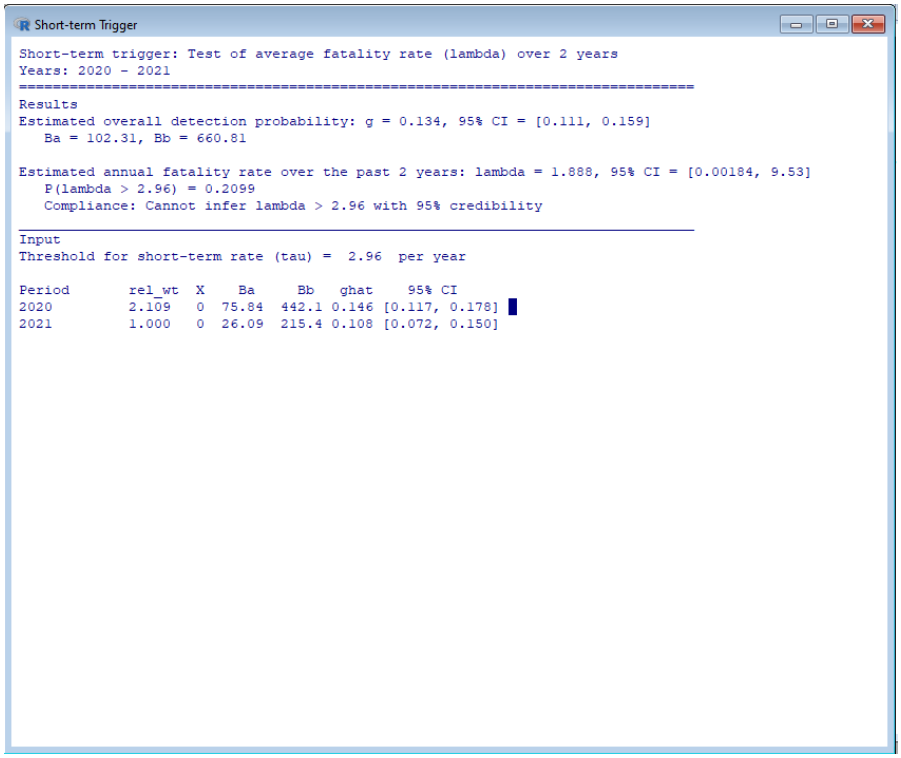




Appendix C8. Inputs and outputs from the Evidence of Absence* Graphical User Interface Multiple Year Module for northern long-eared bat ITP term-to-date detection probability and cumulative take estimate (*M). Inputs are based on values reported in the main text.**

* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.





Appendix C9. Inputs and outputs from the Evidence of Absence* Graphical User Interface Multiple Year Module for northern long-eared bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text. The average annual take rate (lambda) estimated here is lower than that given in the text because the EoA GUI automatically scales the take rate by the sum of the weights (rho; 3.109) rather than the total Covered Species arrival (1.89).

* EoA estimates of the Ba and Bb parameters are stochastic and will be slightly different every time the estimate is completed. This usually results in differences in estimated *g* values that differ by less than 0.001 between runs, but occasionally, slightly larger differences can occur.

Appendix D. Model Fitting Results for Searcher Efficiency, Carcass Persistence, and Truncated Weighed Likelihood Area Adjusments at the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021

Appendix D1. Searcher efficiency logit regression models for bats from the searcher efficiency trials at the Blue Creek Wind Farm, April 1 – May 15 and August 1 – October 15, 2021. All-bat and Covered Species estimates used the same model.

Covariates	AICc	DeltaAICc
Season + Plot Type	127.19	0[1]
Season + Plot Type + Season:Plot Type[2]	129.32	2.14
Plot Type	129.91	2.72
Season	153.09	25.90
No Covariates	154.80	27.61

[1]. Selected model.

[2]. The colon denotes an interaction between the variables.

AICc = corrected Aikake Information Criterion.

Appendix D2. Carcass persistence models with covariates and distributions for bats at the Blue Creek Wind Farm, April 1 – May 15 and August 1– October 15, 2021. All-bat and Covered Species estimates used the same model, but none of the models with scale covariates would have been available to the all-bat fatality estimate because the Huso estimator does not accommodate covariates in the scale parameter.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season + Plot Type	No Covariates	lognormal	256.23	0[1]
Season + Plot Type	No Covariates	loglogistic	256.94	0.71
Season + Plot Type	Plot Type	lognormal	258.30	2.07
Season	No Covariates	lognormal	258.59	2.36
Season + Plot Type	Season	lognormal	258.61	2.38
Season + Plot Type	Plot Type	loglogistic	258.81	2.58
Season	No Covariates	loglogistic	258.91	2.68
Season + Plot Type	Season	loglogistic	259.33	3.10
Season + Plot Type	No Covariates	Weibull	259.84	3.61
Season	Season	lognormal	260.41	4.18
Season	Plot Type	lognormal	260.58	4.35
Season	Plot Type	loglogistic	260.72	4.49
Season + Plot Type	Season + Plot Type	lognormal	260.77	4.54
Season	Season	loglogistic	260.87	4.64
Season + Plot Type	Season + Plot Type	loglogistic	261.28	5.05
Season	No Covariates	Weibull	261.81	5.58
Season + Plot Type	Season	Weibull	261.85	5.62
Season + Plot Type	Plot Type	Weibull	262.02	5.79
Season	Season	Weibull	262.16	5.93
Season	Season + Plot Type	lognormal	262.32	6.09
Season	Season + Plot Type	loglogistic	262.69	6.46
Season	Plot Type	Weibull	263.93	7.70
Season + Plot Type	-	exponential[2]	264.02	7.79
Season + Plot Type	Season + Plot Type	Weibull	264.02	7.79
Season	Season + Plot Type	Weibull	264.09	7.86
Plot Type	Plot Type	lognormal	268.00	11.77
Plot Type	Plot Type	loglogistic	268.01	11.78
Plot Type	No Covariates	loglogistic	268.10	11.87
Plot Type	No Covariates	lognormal	268.46	12.23
Season	-	exponential[2]	268.70	12.47
No Covariates	Plot Type	loglogistic	269.16	12.93
No Covariates	Plot Type	lognormal	269.39	13.16
No Covariates	No Covariates	loglogistic	269.47	13.24
No Covariates	No Covariates	lognormal	270.01	13.78

Appendix D2. Carcass persistence models with covariates and distributions for bats at the Blue Creek Wind Farm, April 1 – May 15 and August 1– October 15, 2021. All-bat and Covered Species estimates used the same model, but none of the models with scale covariates would have been available to the all-bat fatality estimate because the Huso estimator does not accommodate covariates in the scale parameter.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	Plot Type	Weibull	270.10	13.87
Plot Type	Season + Plot Type	lognormal	270.27	14.04
No Covariates	Season + Plot Type	Weibull	270.31	14.08
Plot Type	Plot Type	Weibull	270.32	14.09
Plot Type	Season + Plot Type	loglogistic	270.35	14.12
Plot Type	Season	loglogistic	270.40	14.17
No Covariates	Season + Plot Type	lognormal	270.47	14.24
No Covariates	Season + Plot Type	loglogistic	270.70	14.47
Plot Type	Season	lognormal	270.76	14.53
No Covariates	No Covariates	Weibull	270.77	14.54
No Covariates	Season	loglogistic	271.17	14.94
No Covariates	Season	Weibull	271.23	15.00
Plot Type	No Covariates	Weibull	271.35	15.12
No Covariates	Season	lognormal	271.50	15.27
Plot Type	Season + Plot Type	Weibull	271.72	15.49
Plot Type	Season	Weibull	272.82	16.59
Plot Type	–	exponential[2]	282.53	26.30
No Covariates	–	exponential[2]	282.63	26.40

[1.] Selected model.

[2.] The exponential model does not have a scale parameter.

AICc = corrected Aikake Information Criterion.

Appendix D3. Searched area adjustment models for the all-bat fatality rate for the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021.

Distribution	AICc	Delta AICc
normal	16,963.16	0[1]
Gompertz	16,991.52	28.35
Weibull	17,096.11	132.94
Rayleigh	17,319.46	356.30
gamma	17,428.23	465.07

[1.] Selected model.

AICc = corrected Akaike Information Criterion.

Appendix D4. Searched area adjustment models for the Covered Species take estimate for the Blue Creek Wind Farm, from April 1 – May 15 and August 1 – October 15, 2021.

Distribution	AICc	Delta AICc
normal	16,816.19	0[1]
Gompertz	16,850.47	34.28
Weibull	16,939.04	122.85
gamma	17,365.80	549.61
Rayleigh	17,396.94	580.75

[1.] Selected model.

AICc = corrected Akaike Information Criterion.

Attachment 2
2022 Post-Construction Monitoring Study Plan for the Blue Creek Wind Farm

2022 Post-construction Monitoring Study Plan for the Blue Creek Wind Farm Van Wert and Paulding Counties, Ohio

February 4, 2022

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WEST

NATURAL RESOURCES SCIENTIFIC SOLUTIONS

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INTRODUCTION

Blue Creek Wind Farm, LLC (Blue Creek), a subsidiary of Avangrid Renewables, LLC, is currently operating the Blue Creek Wind Farm (Project) in Van Wert and Paulding counties, Ohio. The Project became operational in 2012 and consists of 152 2.0-megawatt (MW) Gamesa G90 wind turbines that have a 100 meter (m; 328 foot [ft]) hub height and a 45 m (148 ft) blade length. Blue Creek developed a Habitat Conservation Plan (HCP) and obtained an Incidental Take Permit (ITP; TE69307D-0) from the U.S. Fish and Wildlife Service (USFWS) for the federally listed endangered Indiana bat (*Myotis sodalis*), and the federally listed threatened northern long-eared bat (*Myotis septentrionalis*; hereafter Covered Species) from the USFWS on March 13, 2020 (Blue Creek Wind Farm 2020).

The HCP requires Compliance Monitoring to determine the level of take of the Covered Species relative to the amount of take authorized by the ITP. Blue Creek contracted WEST to develop the 2022 post-construction fatality monitoring study plan using data from the 2021 study to update Evidence of Absence (EoA) inputs, per Section 6.1.2 of the HCP and N.1.c of the ITP, such as searcher efficiency, carcass persistence, and proportion of carcasses in search plots.

STUDY AREA

The Project is approximately six kilometers (km; four miles [mi]) north of the town of Van Wert (Figure 1), lies approximately 230 meters (m; 754 feet [ft]) above mean sea level, and has relatively flat topography. Approximately 93% of the nearly 164-square kilometer (40,427-acre) area within the Project is composed of cropland. Corn (*Zea mays*) and soybean (*Glycine max*) are the most common crop types. The next most common land cover is developed area (e.g., farmsteads), which accounts for approximately 6% of the Project. Deciduous forest, herbaceous cover, open water, barren land, and wetlands each account for less than 1% of the total land cover (Table 1, Figure 1).

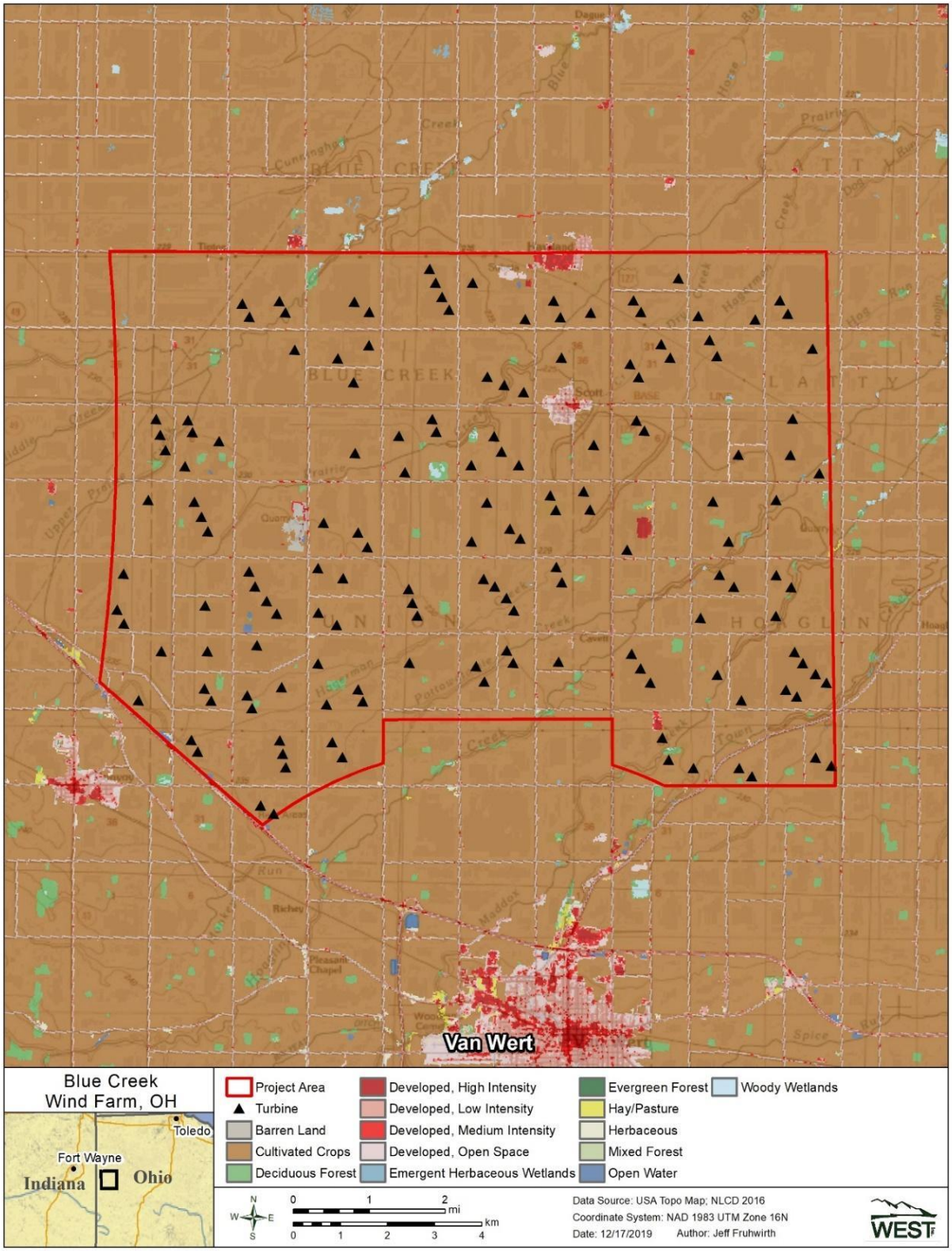

Figure 1. Land cover types of the Blue Creek Wind Farm, Van Wert and Paulding counties, Ohio.

Table 1. Land cover types, coverage, and percent (%) composition within the Blue Creek Wind Farm, Van Wert and Paulding counties, Ohio.

Land Cover Types	Coverage (Acres)	% Composition
Cultivated Crops	37,677	93.2
Developed[1]	2271	5.6
Deciduous Forest	322	0.8
Barren Land	73	0.2
Woody Wetlands	29	0.1
Open Water	28	0.1
Emergent Herbaceous Wetlands	12	<0.1
Herbaceous	9	<0.1
Hay/Pasture	4	<0.1
Mixed Forest	2	<0.1
Total	**40,427**	**100**

Data from National Land Cover Database 2016.

[1] Developed areas include high, medium, and low-intensity developed areas, as well as developed, open space.

METHODS

As required by Section 6.1.2 of the HCP and N.1.c of the Project's ITP, the 2022 post-construction monitoring plan was designed with a *g,* or probability of detecting an individual bat carcass of a Covered Species, of 0.15, based on the prior year's site specific data. The 2022 post-construction monitoring study plan was designed to achieve a site-wide estimate for *g*, or, of 0.15 during the spring and fall monitoring periods. Determining *g* requires estimating the proportion of carcasses that may fall in search areas, searcher efficiency, carcass persistence, and timing of bat fatalities. WEST defined these variables using data collected during the spring and fall of 2021 (Appendix A), information on *Myotis* fatality timing described by USFWS (2016), and the detection reduction factor (*k*), consistent with the 2021 monitoring report. Functions from the EoA software (Dalthorp et al. 2017) were used to calculate *g* under a range of potential plot configurations and search intervals. Screenshots showing the *g* calculations in the EoA software are provided in Appendix B.

The proposed methods for 2022 were revised from previous years based on changes to key inputs recorded in the 2021 monitoring period. In 2021, carcass persistence probability in the fall was lower than anticipated, and searcher efficiency was lower on cleared plots compared to the assumptions used within the 2021 study plan (Table 2).

Table 2. Assumptions from the 2021 Study Plan and estimates from 2021 monitoring at the Blue Creek Wind Farm.

	Spring				Fall			
	Cleared Plots		Road and Pad		Cleared Plots		Road and Pad	
Parameter	2021 Study Plan	Spring 2021 Field Surveys	2021 Study Plan	Spring 2021 Field Surveys	2021 Study Plan	Fall 2021 Field Surveys	2021 Study Plan	Fall 2021 Field Surveys
Searched Area Adjustment	0.744[1]	0.910	0.052[2]	0.030	0.879[3]	0.940	0.052[2]	0.030
Searcher Efficiency	0.725	0.567	0.725	0.933	0.725	0.333	0.725	0.883
Carcass Persistence Distribution	Lognormal	Lognormal	Lognormal	Lognormal	Lognormal	Lognormal	Lognormal	Lognormal
Median Carcass Persistence	5.6 days	19.0 days	5.6 days	7.9 days	5.6 days	3.9 days	5.6 days	1.6 days

[1] The search area adjustment value for cleared plots in spring based on a 65-meter (m; 213-foot [ft]) plot radius.

[2] The search area adjustment value for road and pad plots is based on a 100-m (328-ft) plot radius.

[3] The search area adjustment value for cleared plots in fall is based on a 70-m (230-ft) plot radius.

In 2022, we propose to conduct road and pad searches in spring and searches of both full plots and with road and pad plots in fall. Most carcasses are expected to occur during the fall and a relatively low amount are expected to occur in the spring; therefore, search effort for each season mirrors the expected arrival proportions and is designed to achieve an overall *g* of 0.15 for 2022. The highest amount of search effort is concentrated in the fall, when arrival proportions predict that the highest amount of risk occurs. Monitoring will include an intensive search effort in the fall, with searches occurring at 40, 70-m (230-ft) cleared plots twice a week (Table 3). We propose to use dog-handler teams to conduct cleared plot searches. The number and type of search plots (cleared plots and road and pad plots) will be the same as fall 2021, but searcher efficiency rates for dog-handler teams are expected to be more stable in a range of environmental conditions. Detection dogs conducting carcass searches will be trained on the scent of bat carcasses and must achieve searcher efficiency rates of 75% or greater for bats on cleared plots prior to being approved to conduct post-construction monitoring. For planning purposes, WEST conservatively assumed that 75% searcher efficiency would be achieved on cleared plots by dog-handler teams.

Table 3. Proposed plot types, search interval, and search team by season at the Blue Creek Wind Farm, Paulding and Van Wert counties, Ohio.

Season	Search Team	Plot Type	Number of Plots	Search Interval
Spring (April 1–May 15)	Human	100 m Road and Pad	152	14.0 days
Fall (August 1-October 15)	Human	100 m Road and Pad	112	7.0 days
	Dog-handler	70 m Cleared Plot	40	3.5 days

Components of the study at the Project will include:

1. Standardized carcass searches at all turbines;
2. Searcher efficiency trials to estimate the proportion of bat carcasses found by detection dogs and technicians;
3. Carcass persistence trials to estimate the length of time that a bat carcass remains in the field for possible detection; and
4. Statistical analysis to calculate bat fatality rates.

Standardized Carcass Searches

Standardized carcass searches will be completed at the Project for bat carcasses during the spring (April 1 – May 15) and fall (August 1 – October 15) monitoring periods for the Covered Species.

Number of Turbines Sampled, Search Area/Plot Size, and Search Frequency

All 152 turbines are included in the study. Technicians will conduct searches of two plot types: cleared plots and road and pad plots. Search frequency and numbers of plot types will vary by season (Table 3). One round of clearing searches will be completed at all turbines prior to the start of the spring (April 1-May 15) and fall (August 1 – October 15) monitoring periods.

Cleared plots will be circular and road and pad searches will occur on the gravel roads and pads at each turbine. Road and pad searches will occur within a 100 m (328 ft) radius of the turbine on the gravel roads and pads during spring and fall. Cleared plot searches will only take place during the fall and will extend to a maximum 70-m radius from the base of the turbine. Plot type designations for fall at individual turbines (cleared plot and road and pad plots) will remain the same as used in 2021. Cleared plots will be mowed prior to the start of fall surveys and as needed through October 15, to ensure vegetation does not exceed a maximum height of 15 centimeters (6 inches).

Road and Pad Search Methods

Technicians will walk transects spaced 5 m (16 ft) apart at a rate of approximately 45 – 60 m per minute (min; 148 – 197 ft/min) on gravel road and pad areas within 100 m of the turbine base. Technicians will scan the area for fatalities on both sides of the transect out to approximately 2.5 m (8.2 ft) to ensure full visual coverage of each plot. When a carcass is found, a flag will be dropped near it and the rest of the road and pad plot will be searched. Once the entire road and pad search has been completed the technician will return to all found carcasses for data collection.

Dog-Handler Team Search Methods

Wind speed and direction will be taken into account at the start of every turbine search to determine the ideal starting point and number of transects needed to cover the plot. Handlers will orient dogs to start searches perpendicular to the wind to maximize scent detection. Transect width may vary with wind speed and crop density, which affects scent dispersal across the search area, but will average 15 m (49 ft) apart in cleared plots. After a dog correctly alerts to a bat carcass, a flag will be placed at the site and the detection dog will receive either a food reward or a short play session. Once the search of the plot is completed the handler will return to all carcasses found to collect data.

Data Collection

Carcass searches will begin after first light and end by 1700 hours. Technicians will record the date, start and end times, technician name, turbine number, weather data, type of search (cleared plot or road and pad), bats found alive or injured bats, and bat carcasses.

After searching the entire plot, the technician will return to each bat and record information on a fatality data sheet, including the date and time, species, sex and age (when possible), technician name, turbine number, distance from turbine, azimuth from turbine, location of bat as Universal Transverse Mercator (UTM) or latitude/longitude coordinates, habitat surrounding the bat, and estimated time of death (e.g., less than one day, two days; Appendix C). Technicians will take digital photographs of the bat, any visible injuries, and the surrounding landscape. Bats found in non-search areas (e.g., outside of a plot boundary), or outside of the scheduled search time, will be coded as incidental discoveries and will be documented following the same protocol for those found during standard searches. Bats found outside of the plot boundary will not be included in analysis; bats found on plot outside of scheduled searches will be included in area correction calculations for EoA analyses.

The condition of each bat found will be recorded using the following categories:

- Intact—a carcass that is complete, not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- Scavenged—an entire carcass that shows signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass), or a carcass that has been heavily infested by insects.
- Dismembered—an entire carcass that is found in multiple pieces distributed more than 1.0 m (3.3 ft) apart from one another due to scavenging or other reasons.
- Injured—a bat found alive with visible physical injuries
- Alive—not visibly injured.

Bats will be collected under the appropriate permits, including the Project's ITP, the consultant's Native Endangered and Threatened Species Recovery Permit, and Ohio Division of Wildlife Wild Animal Permit. All bat carcasses found will be placed in a re-sealable plastic bag and labeled with the unique carcass identification number, turbine number, and date, before being placed in a freezer on site. Leather and rubber gloves will be used to handle all bat carcasses to eliminate possible transmission of rabies or other diseases. All species identifications will be verified by biologists permitted to identify and handle federally listed bat species. The USFWS and Ohio Department of Natural Resources (ODNR) will be notified by phone within 24 hours of any positive identification of a Covered Species. All bat carcasses will be kept in a freezer on-site and submitted to the ODNR at the end of the study, or transferred to permitted researchers as coordinated with ODNR.

Live bats that are discovered will be recorded (labeled as intact). When injured bats are found, the following protocols will be applied: a wildlife rehabilitator licensed and qualified to treat bats will be contacted to recover the bat and evaluate it for potential rehabilitation or euthanasia, per WEST's ODNR Scientific Collection Permit (SC210040).The ODNR wind-energy biologist will be notified. If an injured bat is a state or federally listed species, or suspected to be a *Myotis* species, the ODNR and USFWS will be contacted for further direction. If a live bat with no visible injuries is found, WEST will coordinate with ODNR for further direction.

Searcher Efficiency Trials

The objective of searcher efficiency trials is to estimate the percentage of bats found by searchers. Estimates of searcher efficiency will be used to adjust the number of bats found for those missed by observers, to account for detection bias in fatality estimates.

Searcher efficiency trials will be conducted in the same areas where carcass searches occur. Trials will be conducted throughout the study period to estimate searcher efficiency by season and plot type. Thirty bat trial carcasses will be placed and available during searches, per plot type, per season, for a total of 90 available bat trial carcasses (Table 4). Bat carcasses used for

searcher efficiency trials will be either obtained from or carcasses collected at the Project will be used, with permission from ODNR.

Table 4. Number of bat carcasses to be used in searcher efficiency trials in 2022 by season and plot type during post-construction monitoring at Blue Creek Wind Farm in Paulding and Van Wert Counties, Ohio.

Season	Plot Type	Number of Carcasses
Spring	100-meter Road and Pad	30
Fall	70-meter Cleared Plots	30
	100-meter Road and Pad	30
Total		**90**

Searcher efficiency trials will begin when carcass searches begin. Technicians conducting carcass searches will not know when trials are conducted or the location of the trial carcasses. Each trial carcass will be discreetly marked with a black zip-tie around the upper forelimb for identification as a study carcass after it is found. Trial carcasses for dog-handler teams will be placed the day before searches are scheduled to allow the trial carcass to thaw and the scent to settle on the plot. To avoid the possibility of detection dogs following a human scent trail to trial carcasses a random path will be taken to and from carcass locations. Trial carcasses will be dropped from waist-height or higher and allowed to land in a random posture. The number and location of trial carcasses found during the subsequent search will be recorded, and the number of trial carcasses available for detection during each search will be determined immediately after each trial by the person responsible for distributing the trial carcasses. Searchers will have one chance to locate trial carcasses during the first search after carcass placement. A subset of searcher efficiency trials will be left in the field to use as carcass persistence trials, per the HCP.

Carcass Persistence Trials

The objective of carcass persistence trials is to estimate the average probability that a carcass that arrives at the facility will persist until the next search. Carcasses may be removed by scavenging, or rendered undetectable by typical farming activities. Estimates of carcass persistence will be used to adjust the number of carcasses found for those removed from the study area, thereby accounting for persistence bias. Fifteen bats will be dropped per plot type per season, for a total of 45 carcass persistence trials. A subset of carcasses used for searcher efficiency trials will be left in the field and used for carcass persistence trials as outlined in the HCP. Bat carcasses either obtained from or carcasses collected at the Project will be used, with permission from ODNR.

Technicians conducting carcass searches will monitor the trial carcasses over a 30-day period according to the following schedule, as closely as possible. Carcasses will be checked daily for the first four days (days 1–4 after placement), then on day 7, 10, 14, 21, and 30. Trial carcasses will be left at the location until they are removed by scavenging or other means, completely decomposed, or at the end of the carcass persistence trial, whichever occurs first. At the end of

the 30-day period, any evidence of the carcasses that remain will be removed from the search plot.

Statistical Analysis

Two fatality estimates will be calculated: a Covered Species take estimate based on EoA (Huso et al. 2015a, Dalthorp et al. 2017) and an all-bat fatality estimate based on the Huso (2011) estimator, as specified in the HCP. Estimates of facility-related fatalities will be based on:

1) Observed number of bats found during standardized searches during the monitoring period;
2) Searcher efficiency, expressed as the proportion of trial carcasses found by observers during searcher efficiency trials;
3) Carcass persistence rates, expressed as the estimated average probability a trial carcass is expected to remain in the study area and be available for detection by the observers during searches;
4) Adjustments for area searched.

The best available methodology will be used to adjust for the proportion of carcasses expected to fall within searched areas, as described within the HCP.

Take Estimation

The EoA model and software (Huso et al. 2015a, Dalthorp et al. 2017) will be used to assess take rates and cumulative take of the covered species.

Site-Wide Probability of Detection (*g*)

A site-wide probability of detection (*g*) will be calculated using EoA (Dalthorp et al. 2017) to enable the calculation of take estimates for the Covered Species. The estimate of *g* will be based on the searcher efficiency rate, the detection reduction factor (*k*), carcass persistence probability, proportion of carcasses in the search area, and the proportion of bat carcasses expected during the study period.

Searcher efficiency, carcass persistence probability, and proportion of carcasses in the search area will be estimated for *g* using the same methods implemented for fatality estimates that were used in the 2020 and 2021 post-construction fatality monitoring reports (i.e., GenEst [Dalthorp et al. 2018, 2019; Simonis et al. 2018] for EoA inputs and Huso for the all-bat estimate). The detection reduction factor will be assumed to be 0.8, consistent with the monitoring reports. The *Myotis* arrival proportions described within the Midwest Wind Habitat Conservation Plan (USFWS 2016) will be used to estimate the proportion of Covered Species expected to occur in the spring and fall monitoring periods.

Assessment of Adaptive Management Triggers

The take rates of the Covered Species (λ in the EoA model/software) will be calculated to assess whether the short-term adaptive management trigger (Section 6.3.1 of HCP) has been met. The cumulative (ITP term to date) take estimates of both Covered Species will be calculated to assess whether the estimated cumulative take amount (M* in the EoA model/software) has exceeded the permitted take amount. The results of both the short-term and long-term adaptive management trigger tests will be reported, per Section 6.1.6 of the Project's HCP.

Huso Estimator

Estimation of Searcher Efficiency Rates

Searcher efficiency estimates will be calculated using a logistic regression model (Agresti 2007). Potential covariates for these logistic regression models will include plot type and season. Logistic regression models the natural logarithm of the odds of finding an available carcass as a function of selected covariates. The model assumes that searchers have a single opportunity to discover a carcass. The best model will be selected using sample-size corrected Akaike Information Criteria (AICc; Burnham and Anderson 2002).

Estimation of Carcass Persistence Rates

Estimates of carcass persistence rates will be used to adjust carcass counts for removal bias. The average probability of persistence of a carcass through the effective search interval will be estimated using interval-censored survival regression (Kalbfleisch and Prentice 2002, Huso et al. 2018). Survival regression is a statistical technique used to model and estimate the time until an event occurs (in this case, carcass removal), possibly as a function of covariates. The effective search interval will be defined as the shorter of the actual search interval and that period of time after which the average probability of persistence would be 0.01. The Huso estimator (Huso 2011) uses the effective search interval to reduce bias in fatality estimates when persistence times are substantially less than the search interval. Exponential, log-logistic, lognormal, and Weibull distributions will be fitted to the carcass persistence trial data. The best model will be selected using AICc.

Carcasses Excluded from Fatality Estimation

One of the underlying assumptions of the Huso estimator is that searchers have a single opportunity to discover a carcass (Huso et al. 2016, Rabie et al. 2021). In practice, particularly when carcass persistence times are long, carcasses may be discovered that have been available for more than one search. In order to meet the assumptions of the Huso estimator, the time since death will be estimated for each carcass in the field (Appendix C). A bat carcass will be included in fatality estimates if the carcass was found within the search plot during a scheduled search and the estimated time since death is less than the search interval associated with that carcass to meet the assumption that searches have a single opportunity for detection. Bat carcasses for which time since death cannot definitively be estimated will conservatively be included in the fatality estimate.

Searched Area Adjustment

A carcass-density distribution will be modeled to account for the proportion of carcasses falling within searched and unsearched areas, resulting in a density-weighted proportion (DWP) of area searched. If sample sizes are large enough, a model will be fit using site-specific data from the current monitoring year. If fewer than 20 carcasses are found in the spring, an area adjustment will be fitted to the data using a site-specific dataset with a similar curtailment regime.

Adjusted Facility-Related Bat Fatality Rates

All-bat fatality estimates per turbine and per MW will be calculated. The weighted average of estimates by plot type will be combined by the relative proportion of plots in each category (i.e., 40/152 for plots and 112/152 for road and pads during fall) to estimate overall bat fatality rates within a season. Seasonal estimates will be summed to obtain overall bat fatality rates across season and plot type.

Confidence Interval Calculation

The 90% confidence intervals for each estimate will be calculated using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for estimating confidence intervals for complicated test statistics. A total of 1,000 bootstrap replicates will be used to calculate the 90% confidence interval of each estimate. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates will be estimates of the lower limit and upper limit of 90% confidence intervals.

REPORTING

This monitoring study will provide information on the potential occurrence of threatened or endangered bat carcasses, the information necessary to produce take estimates of the Covered Species associated with operation of the Project, as well as the information necessary to produce an all-bat fatality estimate for spring and fall 2022. The datasheets will be stored by the consultant and provided to the USFWS upon request.

A final report will be prepared by March 1, 2023, including the results of the spring and fall monitoring. The report will be presented in standard scientific format (Introduction, Methods, Results, Conclusions, and References). The report will include date, time, location, species, and sex of all bats documented; searcher efficiency and carcass persistence estimates; estimated *g* value; estimated average annual take rates and cumulative take estimates of the Covered Species; adaptive management triggers (if any); EoA inputs for the monitoring year; and an all-bat fatality rate.

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Appendix A. Evidence of Absence Inputs Used to Predict g for Spring and Fall 2022

Appendix A1. Inputs required by the Evidence of Absence software that were used to estimate study-wide *g* to develop the 2021 post-construction study plan.[1]

Season and Plot Type	Number of Turbines	Search Interval (days)	Number of Searches	Area Correction[2]	Spatial Coverage (a)[3]	Temporal Coverage (v)[4]	Searcher Efficiency		Carcass Persistence	
							Carcasses Available[5]	Carcasses Found[5]	Shape (α)[6]	Scale (β)[6]
Spring: 100 m Roads and Pads	152	14	3	0.0291	0.0291	0.11	1,000	800	2.179	2.064
Fall: 100 m Roads and Pads	112	7	11	0.0291	0.0214	0.89	1,000	800	2.179	2.944
Fall: 70 m Cleared Plots	40	3.5	22	0.9687	0.2549	0.89	1,000	750	2.179	1.357

1. *k* was assumed to equal 0.8 per the Habitat Conservation Plan.

2. Blue Creek 2021 (Rodriguez et al. 2022).

3. The area correction value multiplied by the sampling fraction (number of turbines / 152) serves as the *a* input in the Evidence of Absence GUI.

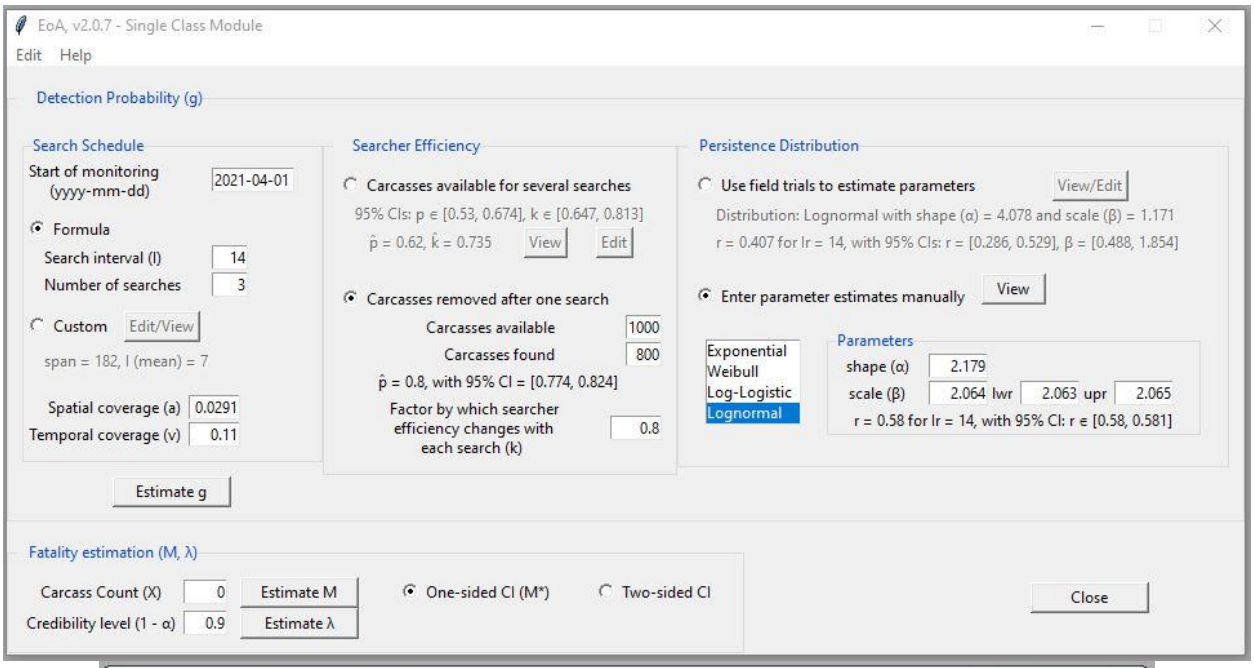
4. As specified in U.S. Fish and Wildlife Service 2016.

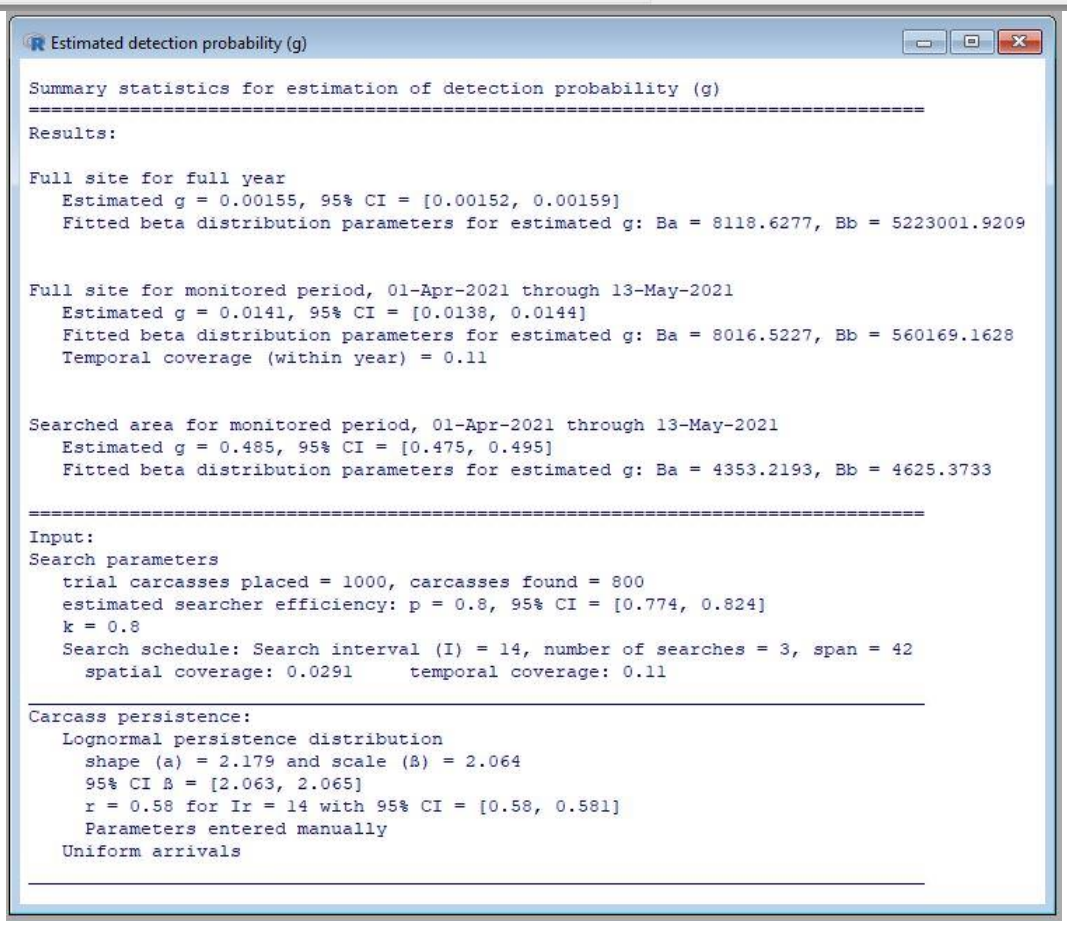
5. The number of trials used in the study plan *g* calculation are much higher than the planned Searcher Efficiency placements (30 per plot type per season). This is because the study plan is meant to obtain a precise point estimate for study-wide *g*.

6. A lognormal distribution was assumed for carcass persistence. EoA requires 95% upper and lower confidence intervals for β; th ese were set to +/- 0.001 of listed scale. The 95% confidence interval is narrow because the study plan is meant to obtain a precise point estimate for study-wide *g*.

m = meter.

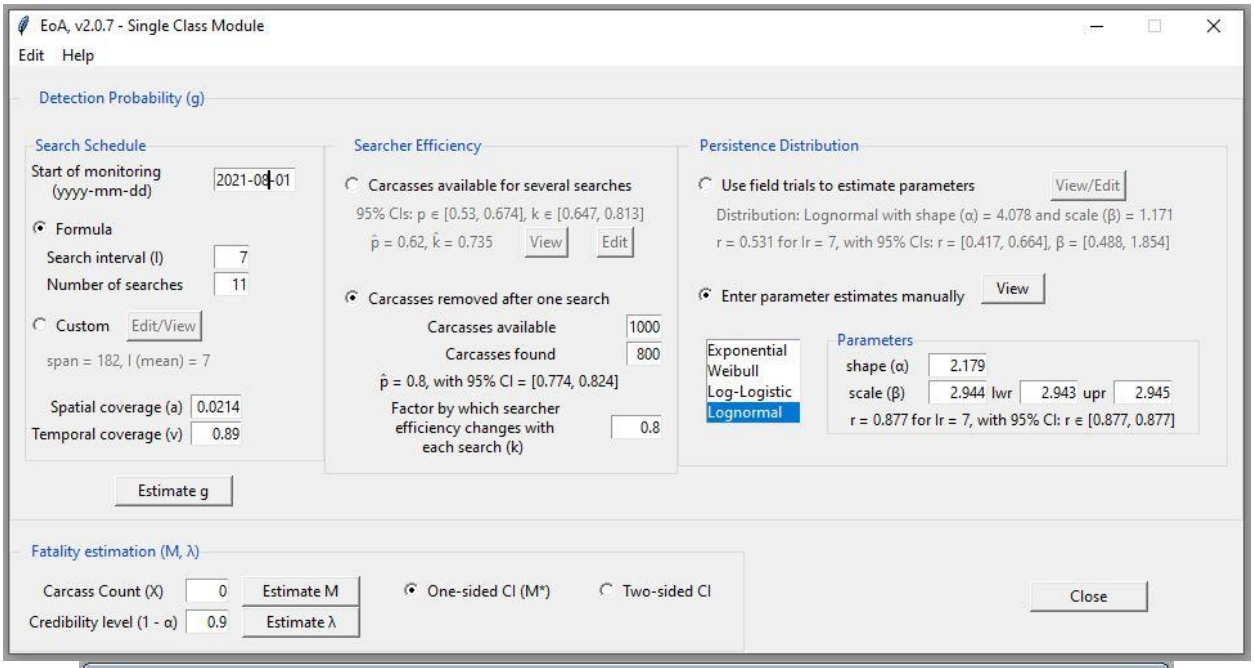
Appendix B. Screenshots from Evidence of Absence Software Used to Predict *g* for Spring and Fall 2022

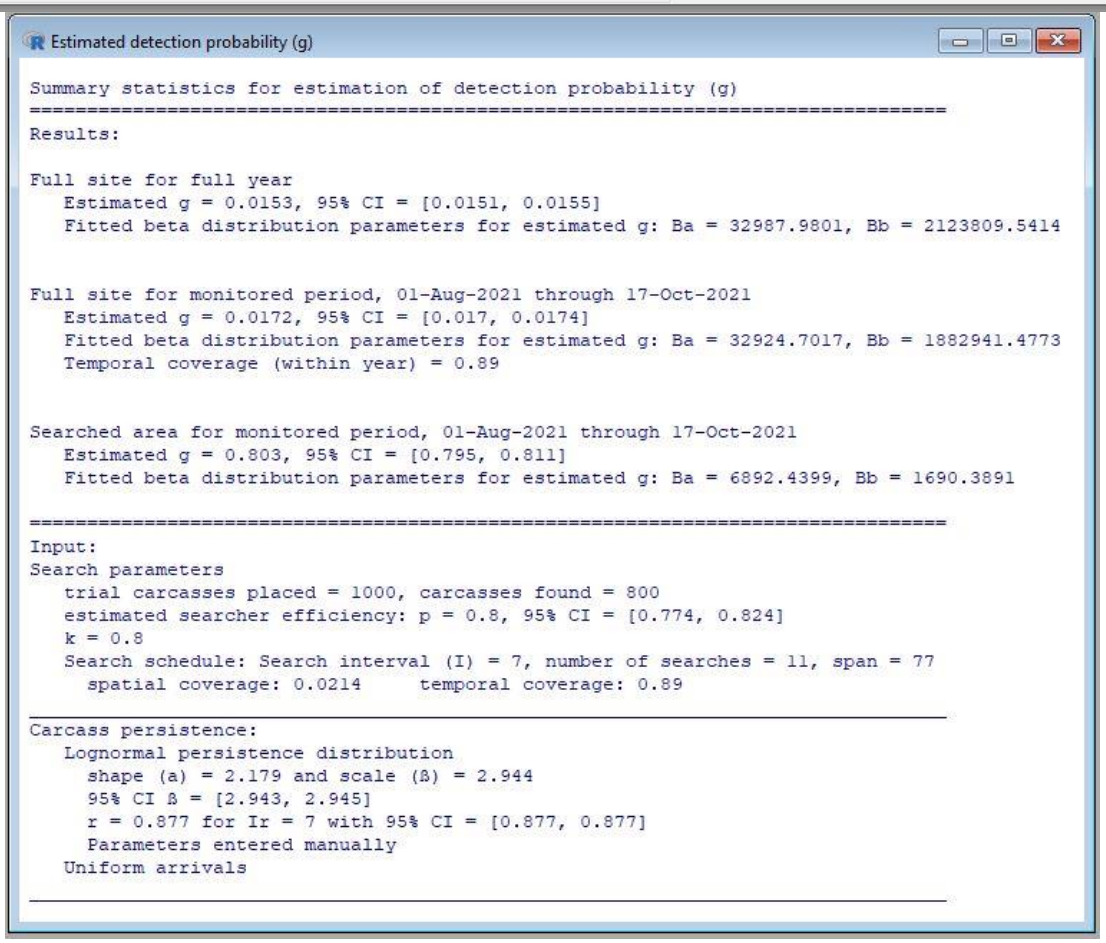




Appendix B1. Input and output screenshots for spring 100-meter road and pad (152 turbines; 14-day search interval) at the Blue Creek Wind Farm.

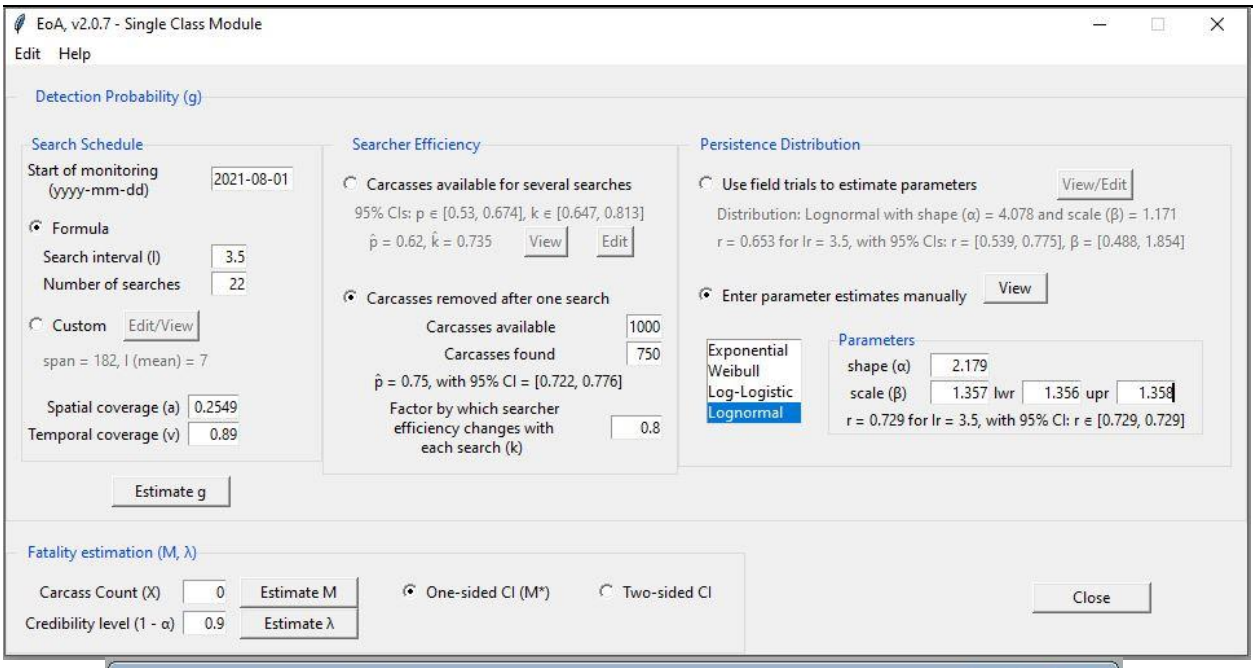
Note: spatial coverage = 0.0291 * 152 / 152 turbines

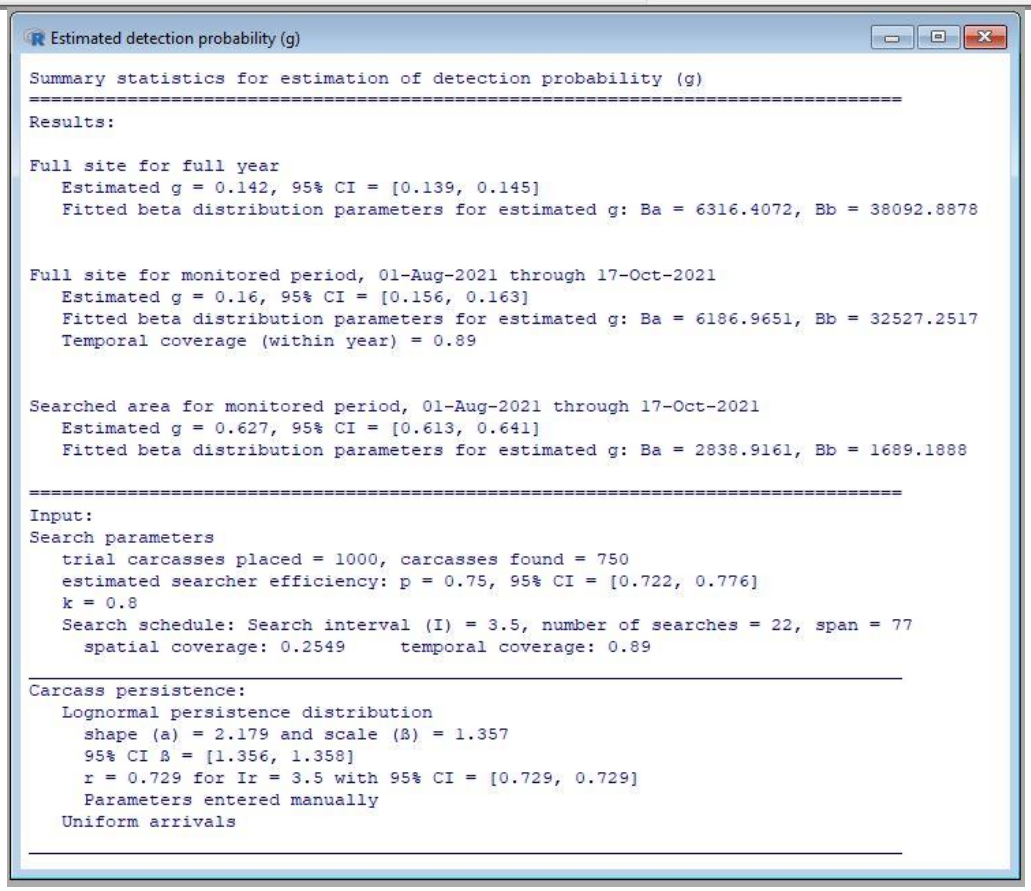




Appendix B2. Input and output screenshots for fall 100-meter road and pad (112 turbines; 7-day search interval) at the Blue Creek Wind Farm.

Note: Spatial coverage = 0.0291 * 112 / 152 turbines





Appendix B3. Input and output screenshots for fall 70 m cleared plots (40 turbines; 3.5 day search interval) at the Blue Creek Wind Farm.

Note: Spatial coverage = 0.9687 * 40 / 152 turbines

Appendix C. Estimated Time of Death Information Sheet

ESTIMATED TIME OF DEATH INFORMATION SHEET

Last Night

- Eyes will be round and fluid filled, or slightly dehydrated
    - Bat eyes dry much slower than bird eyes
    - Bird eyelids usually closed, open to check eyes
- No decomposition, no smell
- No infestation beyond flies and eggs
    - Possible to have very small maggots if carcass found after noon
- Joints of body flexible
    - Bat wing membranes flexible

2–3 Days

- Eyes sunken or missing
    - Bat eyes may still be intact
- May be infested with small-medium sized maggots, beetles, flies, and ants
- Strong smell of decomposition
- Small holes in skin or body from insects (if no infestation noticed)

4–7 Days

- Eyes missing
- Internal scavenging evident
    - Carcass may be full of large maggots (days 4-5) or only a shell with a few large maggots remaining (days 6-7) (during warm days)
- Carcass may be hollow
- Fur may have begun to fall off and appear as “fluff” around bat
    - Typically if carcass was rained on and then dried

7–14 Days

- Mostly skin, feathers and bones
- Skin tightened to skeletal system
- Mostly devoid of insects
    - Possibly a beetle, no maggots

Over 2 weeks

- Body desiccated (mummified in appearance)