

**Post-construction Monitoring Study for the  
Timber Road Wind Farm  
Paulding County, Ohio**

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**Year 4 Report  
April 1 – May 15, 2023**



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## EXECUTIVE SUMMARY

Paulding Wind Farm II-IV, LLCs, are operating the Timber Road Wind Farm II-IV (collectively, Timber Road Wind Farm [TRWF or Project]). This report details the post-construction monitoring (PCM) study conducted in 2023, consistent with the Project's Habitat Conservation Plan (HCP) and Incidental Take Permit (ITP; TE68782D) for Indiana and northern long-eared bats (Covered Species). Turbines were operated to feather turbine blades under an increased cut-in speed per the Project's HCP.

PCM was completed in accordance with the study plan, which was approved by the US Fish and Wildlife Service on March 14, 2023. The study plan was designed to achieve a 25% probability of detecting a single bat carcass (probability of detection [ $g$ ] of 0.25) for the 134 wind turbines at TRWF (i.e., a study-wide  $g$ ). The overall goal of this PCM study was to generate reliable fatality estimates for the Covered Species and to evaluate compliance with the incidental take authorization granted under the Project's ITP. More specifically, the objectives of this study were to estimate take for the Covered Species using the Evidence of Absence (EoA) framework as outlined in the HCP and to determine if adaptive management was necessary to maintain compliance with the Project's ITP.

Standardized carcass searches for bat carcasses were completed by technicians at two plot types: 70-meter (m; 230-foot [ft]) full plots and 100-m (328-ft) expanded road and pads (i.e., gravel road and pads with a 10-m [33-ft] buffer). Searcher efficiency and carcass persistence trials were also conducted to correct for detection and scavenger bias.

No Covered Species were found at the Project. Eighty-two bats were found during the study. The most commonly found bat species were the silver-haired bat (82.9%), the eastern red bat (13.4%), the hoary bat (2.4%), and the big brown bat (1.2%). Forty-one bird carcasses were recorded; no federally or state-listed birds were found.

The  $g$  was 0.234 (90% confidence interval: 0.222–0.246). Based on the data collected to date (2020–2023), the EoA model estimated mean annual fatality rates were 1.95 Indiana bats and 0.65 northern long-eared bat. The probability that the annual take rate exceeded the expected annual take rate was zero for Indiana bat and 0.05 for northern long-eared bat. The cumulative take estimates through 2023 were four Indiana bat fatalities and zero northern long-eared bat fatalities. The estimated levels of Indiana bat and northern long-eared bat take were below levels authorized within the ITP. No adaptive management actions are necessary at this time.

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## REPORT REFERENCE

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## INTRODUCTION

Paulding Wind Farm II-IV, LLCs, subsidiaries of EDP Renewables North America LLC (EDPR), are operating the Timber Road Wind Farm II-IV (TRWF or Project) in Paulding County, Ohio. EDPR obtained an Incidental Take Permit (ITP; TE68782D-0, dated May 8, 2020) for the federally listed as endangered Indiana bat (*Myotis sodalis*) and the federally listed as endangered<sup>1</sup> northern long-eared bat (*M. septentrionalis*; hereafter Covered Species) from the US Fish and Wildlife Service (USFWS). The Project has completed one fall-only study period (August 1 – October 15, 2020) and two full study periods (April 1 – May 15 and August 1 – October 15, 2021 and 2022) of compliance monitoring. This report presents the results of the final, spring-only, study period of compliance monitoring conducted under the ITP, from April 1 – May 15, 2023, to complete three full study periods of monitoring. The objectives of this study were to estimate take of the Covered Species using the Evidence of Absence (EoA) framework as outlined in the Habitat Conservation Plan (HCP; Paulding Wind Farm II-IV 2020) and determine if adaptive management was necessary to maintain compliance with the Project's ITP.

## STUDY AREA

The primary land cover type within 100 meters (m; 328 feet [ft]) of the turbines (i.e., within the Permit Area) is cultivated crops, which covers 99.7% of the Permit Area. All other land cover types collectively make up less than 1.0% of the total land cover (Figure 1; National Land Cover Database 2019). Three phases/wind farms make up the TRWF. Turbine capacities within the TRWF range from 1.8 megawatts (MW) to 4.2 MW, with hub heights ranging from 93 to 105 m; (305 to 345 ft), and rotor diameters ranging from 100 to 150 m (328 to 492 ft; Table 1). TRWF-II became operational in 2012, TRWF-III became operational in 2017, and TRWF-IV became operational in 2020. All turbines are within the migratory range of the Covered Species, and EDPR adjusted turbine operations to minimize impacts to the Covered Species (Table 2).

**Table 1. Phases, turbines, and operational dates of the Timber Road Wind Farm, Paulding County, Ohio.**

Phase	Turbine Type	Number of Turbines	Commercial Operational Date	Hub Height (m)	Blade Length (m)
II	Vestas V100 1.8 MW	55	2012	95	50
III	Gamesa G114 2.1 MW	48	2017	93	57
IV	Vestas V150 4.2 MW	24	2020	105	75
	Vestas V136 3.6 MW	7	2020	105	68

m = meter; MW = megawatt.

<sup>1</sup>. The northern long-eared bat was listed as threatened when the Incidental Take Permit was received. Its status changed to endangered on March 31, 2023 (US Fish and Wildlife Service 2023).

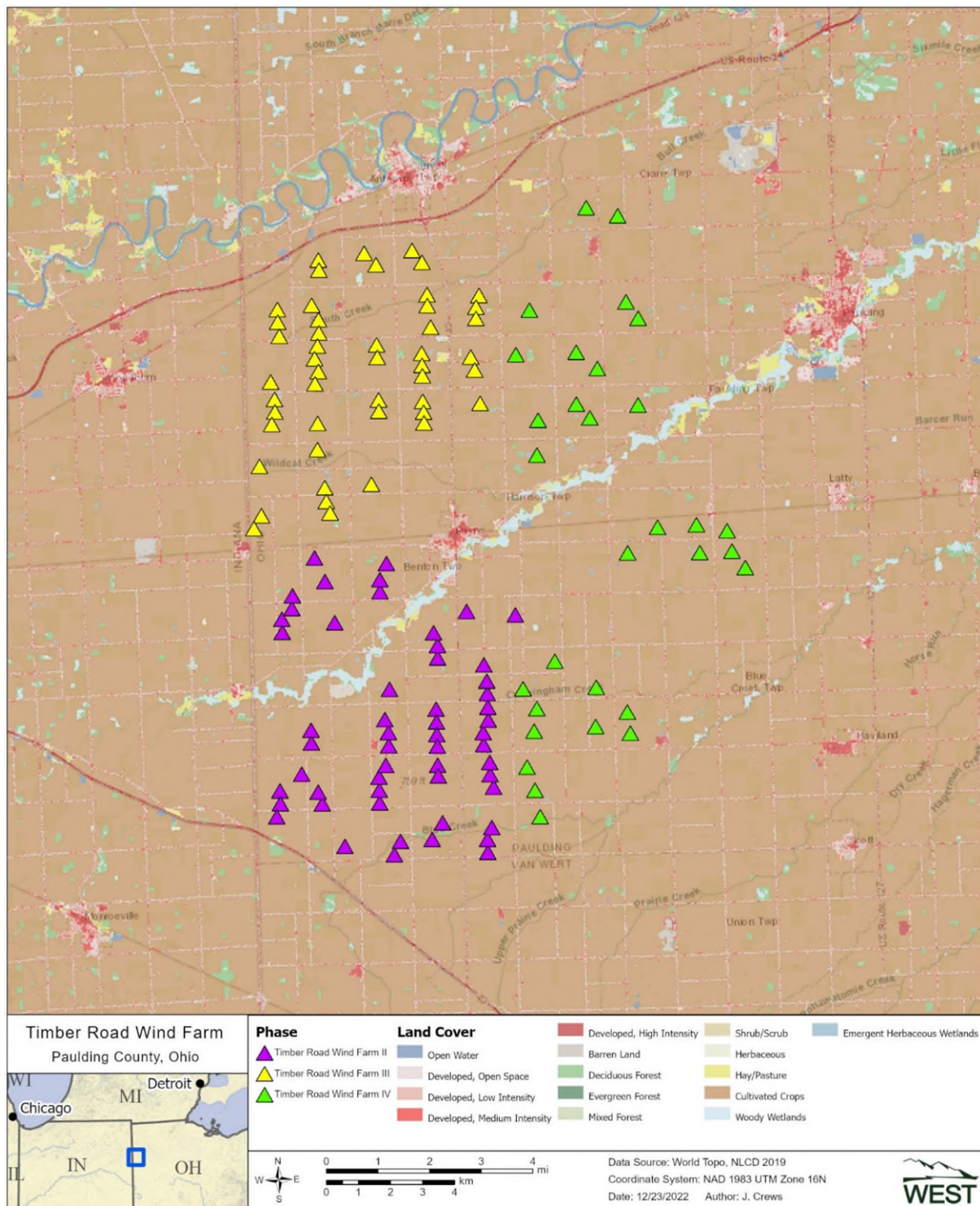


Figure 1. Turbine locations by phase and surrounding land cover at the Timber Road Wind Farm, Paulding County, Ohio.



**Table 2. Seasonal turbine operations regime at the Timber Road Wind Farm, Paulding County, Ohio.**

Season	Turbines	Time of Day	Cut-In Speed (m/s)	Feathering Below Cut-In <sup>1</sup> ?	Temperature Threshold <sup>2</sup>
Spring (April 1 – May 15)	All	0.5 hour before sunset to 0.5 hour after sunrise	3.5	Yes	10°C
Summer (May 16 – July 31)	All	0.5 hour before sunset to 0.5 hour after sunrise	3.0	Yes	None
Fall (August 1 – October 15)	II, III	0.5 hour before sunset to 0.5 hour after sunrise	5.0	Yes	10°C
Fall (August 1 – 31; September 16 – October 15)	IV	0.5 hour before sunset to 0.5 hour after sunrise	5.0	Yes	10°C
Fall (September 1 – 15) <sup>4</sup>	IV	0.5 hour before sunset to 0.5 hour after sunrise	6.9	Yes	10°C
Winter (October 16 – March 31)	All	Normal turbine operation <sup>3</sup>			

<sup>1</sup> Feathering means that turbine blades will be pitched into the wind such that they spin at less than one rotation per minute.

<sup>2</sup> Turbines will be feathered below cut-in when temperatures are above the threshold of 10 degrees Celsius (°C; 50 degrees Fahrenheit). In practice, the Project feathered on all nights regardless of temperature.

<sup>3</sup> The manufacturer's cut-in wind speed is 3.0 meters/second (m/s; 9.8 feet/second) across the Project turbines.

<sup>4</sup> Per Ohio Power Siting Board required Project Mitigation Plan (Timber Road Wind Farm 2021).

## METHODS

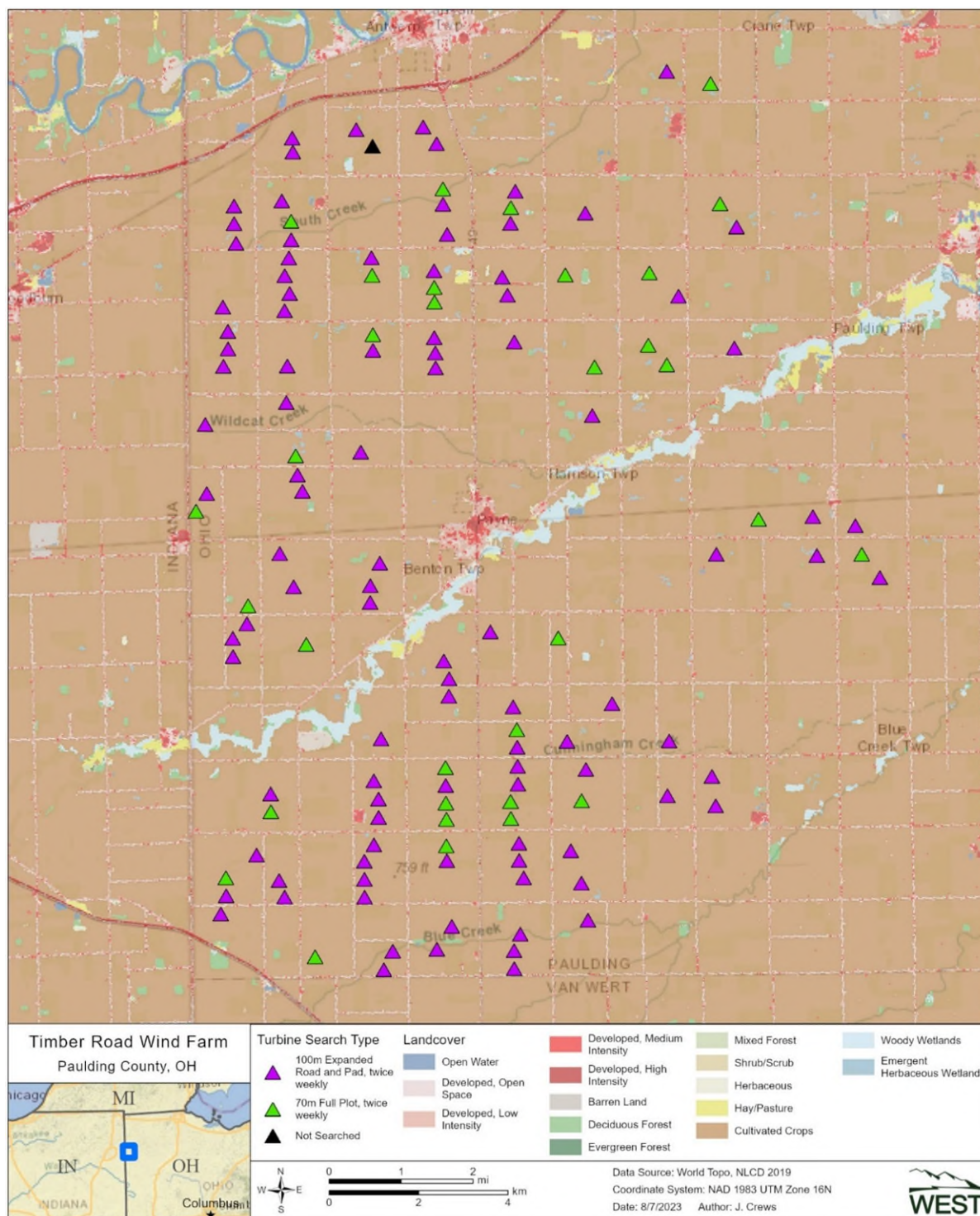
Western EcoSystems Technology, Inc. (WEST) used Project-specific data from previous post-construction monitoring (PCM) studies at the Project to develop a study plan that targeted a probability of detection (*g*) of 0.25 (Matteson et al. 2022, Hale et al. 2023) to meet the monitoring commitments in the HCP. WEST submitted a study plan to EDPR on February 3, 2023, and EDPR received approval from the USFWS on March 14, 2023 (K. Lott, USFWS, pers. comm.).

### Standardized Carcass Searches

#### *Number of Turbines Sampled, Search Frequency, and Plot Size*

Technicians conducted standardized carcass searches from April 1 – May 15, 2023, at 133 of 134 turbines at the Project, searching a combination of expanded road and pads and full plots (Figure 2). Due to a planning error in which one expanded road and pad plot was not included in any of the turbine search lists, one turbine was not searched during the survey period. Technicians searched 101 turbines as 100-m expanded road and pads twice weekly (Table 3). Expanded road and pads consisted of the gravel road and pad areas as well as a 10-m (33-ft) buffer around the gravel areas that were searched to a maximum of 100 m from the turbine base. Technicians searched 32 turbines within a 70-m (230-ft) radius of the turbine as a full plot twice weekly

(Table 3). The full plots and buffer areas of the expanded roads and pads were not mowed because surveys began before planting season and concluded before vegetation grew to a height that substantially impacted visibility of carcasses.



**Figure 2.** Turbine locations, spring turbine plot types and search intervals, and surrounding land cover at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.

**Table 3. Search effort during spring 2023 at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

<b>Plot Type</b>	<b>Plot Radius (m)</b>	<b>Number of Turbines</b>	<b>Search Interval</b>	<b>Searcher Type</b>
Expanded road and pad	100	101	3.5 days	Technician
Full plot	70	32	3.5 days	Technician

m = meter.

### *Search Methods*

WEST used technicians to conduct visual searches for carcasses. All personnel were trained to follow the Project's study plan, including proper handling and reporting of carcasses. Carcass searches were conducted during the day, beginning as early as first light.

### Expanded Road and Pad Searches

Technicians walked transects spaced five m (16 ft) apart at a rate of approximately 45–60 m per minute (m/min; 148–197 ft/min) on all gravel road and pad areas within 100 m of the turbine. The technicians scanned the area for fatalities on both sides of the transects out to approximately 2.5 m (8.2 ft) to ensure full visual coverage of each search area (Figure 3). Once the gravel road and pad area was searched, an additional 10-m (32-ft) wide transect was walked within a buffer area of cropland parallel to the gravel (Figure 4). The center of the 10-m-wide transect was five m from the edge of the gravel and technicians visually scanned for carcasses five m on each side of the transect for coverage of the search area.



**Figure 3. Representative photo of conditions on gravel of a 100-meter expanded road and pad plot at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**



**Figure 4. Representative photo of conditions on the buffer area of a 100-meter expanded road and pad at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**



### Plot Searches

Technicians visually searched within 70 m of the turbine base for fatalities by walking transects spaced five m apart at a rate of approximately 45–60 m/min (Figure 5). During the search both sides of the transects were scanned out to 2.5 m to ensure full visual coverage of the entire search plot.



**Figure 5. Representative photo of vegetation conditions in a 70-meter full plot at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

### *Data Collection*

Technicians recorded the date, start and end times, technician name, turbine number, type of search, and if any carcasses were found for each scheduled search. When a carcass was found, technicians placed a flag near it and continued the search. After searching the entire plot, the technician returned to record information for each carcass on a carcass information sheet, including the date and time, species, sex and age (when possible), technician name, turbine number, measured distance from turbine, azimuth from turbine, location of carcass using a geographic coordinate system (latitude and longitude), habitat surrounding carcass, carcass condition (e.g., intact, scavenged, dismembered), and estimated time of death (e.g., less than one day, two to three days).

The condition of each carcass found was 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—a carcass 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 or bird found alive

For bird carcasses, the following category was also used:

- Feather spot—10 or more feathers (excluding down), or two or more primary feathers at one location indicating predation or scavenging of a bird carcass

Technicians took digital photographs of each fatality, including any visible injuries, and surrounding habitat. No bird carcasses were collected, but a marker was placed next to each bird carcass to avoid duplicate counting. Bat carcasses were collected under the Project's ITP (TE68782D-0), WEST's Federal Native Endangered and Threatened Species Recovery Permit (ES234121), and WEST's State Scientific Collection Permit (SC210040). Technicians placed all bat carcasses in a re-sealable plastic bag, labeled with the unique carcass identification number, turbine number, and date, for storage in a freezer on site. Leather gloves covered by nitrile or latex gloves were used to handle all bat carcasses to eliminate possible transmission of rabies or other zoonotic diseases, and to reduce possible human scent bias on any carcasses used later in bias trials. Live, injured bats were recorded and considered fatalities for analysis purposes when observed in search areas, and were handled in accordance with permit conditions (left in place).

Carcasses found in non-search areas (e.g., outside of a plot boundary) or outside of the scheduled study period were recorded as incidental discoveries and documented following the same protocol for those found during standard searches, but were not included in the analysis.

#### *Carcass Identification and Agency Notification*

Identification of bird carcasses were verified by biologists with significant field experience in identification of birds and their feathers. The USFWS and the Ohio Department of Natural Resources (ODNR) would have been notified within 24 hours of positive identification of any state- or federally listed species, but none were identified during the searches. A permitted bat biologist (ESPER0039249) verified the identifications of all bat carcasses via photos at the end of the surveys. WEST staff delivered the carcasses to the ODNR District 1 field office in Columbus, Ohio, on July 19, 2023.

## Bias Trials

### *Searcher Efficiency Trials*

The objective of the searcher efficiency (SEEF) trials was to estimate the probability that a carcass was found by searchers. (SEEF) trials were conducted in the same areas where carcass searches occurred. Technicians conducting carcass surveys did not know when (SEEF) trials were being conducted or the locations of the trial carcasses. Trial carcasses consisted of eastern red bats (*Lasiurus borealis*), hoary bats (*L. cinereus*), big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), and an evening bat (*Nycticeius humeralis*) that had previously been found on site or provided by ODNR. Seventy-five bat carcasses were placed across plot types to account for potential differences in (SEEF) on expanded road and pads compared to full plots.

Multiple trials were conducted to measure potential changes in plot conditions on (SEEF) over the survey period. Each trial carcass was discreetly marked with a black zip-tie around the upper forelimb for identification as a study carcass after it was found. Carcasses were dropped from waist-height or higher and allowed to land in a random posture. The trial administrator placed carcasses prior to the technicians searching the plot, either the night before or the morning of searches depending on work schedules. Technicians did not know when the trial administrator placed carcasses.

Technicians had one chance to locate trial carcasses during the first search after carcass placement. The number and location of trial carcasses found during the search were recorded, and the number of trial carcasses available for detection was determined immediately after each trial by the person responsible for distributing the carcasses. Fifty trial carcasses were left in place and used for carcass persistence trials (CPT).

### *Carcass Persistence Trials*

The objective of (CPT) was to estimate the average probability a carcass would persist, or be available for detection, in the field, given the search interval. Carcasses could be removed by scavenging or rendered undetectable by typical farming activities. Twenty-five carcasses were planned for each plot type to incorporate the potential effects of varying weather and scavenger densities on carcass persistence. No more than two trial carcasses were placed on a plot to avoid potential over-seeding and attracting scavengers.

Technicians 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, then on days 7, 10, 14, 21, and 30. Trial carcasses were monitored until they were completely removed or the trial period ended.

## Search Area Mapping

The boundaries of 100-m road and pads had been mapped using sub-meter Global Positioning System (GPS) units in prior monitoring years. A 10-m (33-ft) radius projection was applied to previously collected road and pad boundaries to account for the expanded search area. Technicians recorded the boundaries of 70-m full plots using an Juniper Systems Geode GNS3

sub-meter GPS unit. The plot boundaries were used to verify if carcasses were found inside the search areas and to inform the distribution of carcasses around turbines.

### **Quality Assurance and Quality Control**

Quality assurance and quality control measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, technicians were responsible for inspecting data forms for completeness, accuracy, and legibility. 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 forms, and appropriate changes and measures were implemented. A Microsoft® SQL database was developed to store, organize, and retrieve survey data. All data forms and electronic data files were retained for reference.

### **Statistical Analysis**

The EoA (Dalthorp et al. 2017) modeling framework was used to estimate take of the Covered Species. EoA was used with data collected in the field to estimate the overall probability of detecting a bat fatality, the take rate of Covered Species, and the number of Covered Species carcasses that occurred. Data used in the EoA model included number of Covered Species fatalities, the searched area adjustment (“DWP” in the software), the results of SEEF and CPT, the seasonal arrival distribution of bats (described below), and the detection reduction factor ( $k$ ; described below).

#### *Searcher Efficiency Estimation*

EoA uses raw SEEF data (e.g., number of found and available trial carcasses) to inform overall probability of detection. To determine if searcher efficiency data should be pooled, or separated by strata such as plot type or vegetation cover (gravel vs. non-gravel), WEST modeled SEEF using logistic regression. Model selection was completed using an information theoretic approach known as AICc, or corrected Akaike Information Criterion (Burnham and Anderson 2002). The best model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value. SEEF data were input into the EoA software according to the model selection results.

The change in SEEF between successive searches was defined by a parameter called the detection reduction factor ( $k$ ) that can range from zero to one. When  $k$  is zero, it implies a carcass that was missed on the first search would never be found on subsequent searches. A  $k$  of one implies SEEF remained constant no matter how many times a carcass was missed. Huso et al. (2017) estimated a value of  $k = 0.67$  for bats, and this value was used to calculate bat fatality estimates using EoA per the HCP.

#### *Carcass Persistence Rate Estimation*

Data collected during CPT were used to estimate the probability carcasses remained available to be located by the searcher, given the search interval (i.e., the time between scheduled searches). The average probability a carcass persisted was estimated using an interval-censored survival

regression with four potential distributions: exponential, loglogistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Dalthorp et al. 2018). Plot type and vegetation cover were included as potential covariates. The best model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value. The parameter estimates of the selected model ( $\alpha$  [shape] and  $\beta$  [scale], including the 95% confidence interval [CI] of  $\beta$ ) were used as inputs in the EoA Single Class module.

### *Area Adjustment*

The search area adjustment accounted for unsearched areas beneath turbines, and was calculated as a probability that ranged from zero to one. The area adjustment was estimated as the product of the proportion of searched area around each turbine and a carcass-density distribution. The proportion of area searched was calculated in a geographic information system as the amount of area searched divided by the total area searched at each 1.0-m annulus around the turbine. A truncated weighted maximum likelihood (TWL) modeling approach (Khokan et al. 2013) was used to estimate the carcass-density distribution using site-specific fatality locations. The TWL approach uses weights based on probability of detection and the proportion of area searched in each 1.0-m annulus around the turbine. Due to the variation in turbine sizes (hub heights range from 93–105 m and blade lengths range from 50–75 m [164–246 ft]), in previous years separate area adjustments were fit for each turbine by blade length (50 m, 57 m [187 ft], 68 m [223 ft], and 75 m), which also had a 1-to-1 correspondence with turbine type (Matteson et al. 2022, Hale et al. 2023; Table 1). Due to restricted sample sizes of carcasses included in the model, for this study the carcass-density distributions were calculated with fatalities pooled into two turbine type categories with similar blade lengths. An additional model was fit with area adjustment pooled across all turbines. Distributions considered were normal, gamma, Gompertz, and Weibull (parameterized according to R Development Core Team [2016] and Yee [2010]). The best model was selected using AICc.

### *Carcasses Excluded from Analysis*

Carcasses were excluded from analysis when the carcass was discovered outside of the spatial and temporal scope of the survey design. For example, carcasses found outside a designated plot were not included in the analysis because the TWL fitting procedure accounts for unsearched areas. Carcasses found prior to the start of surveys (e.g., a carcass found on a plot in the spring that was estimated to have died prior to April 1) were also excluded because the carcass occurred outside of the study period. Note that carcasses found on a plot incidentally (e.g., found by maintenance personnel) were included in the analysis if that plot had a scheduled search in the future, but within the same season. If a fatality of a Covered Species had been found outside of the spatial or temporal scope of the survey design, it would still be excluded from the area correction estimate, but would be included in the EoA fatality estimate following Dalthorp et al. (2020).

### *Covered Species Take and Detection Probability Estimates*

EoA was used to estimate the median cumulative take to-date ( $M^*$ ), mean annual take rate ( $\lambda$ ), and evaluate the probability that the estimated take rate ( $\lambda$ ) exceeded the expected take rate ( $\tau$ )



for Covered Species. Estimates were calculated using the EoA method (Dalthorp et al. 2017), using the Single Class, Multiple Class, and Multiple Years modules of EoA.

The  $g$  for the 2023 study period was estimated using the bias corrections for SEEF, carcass persistence, and area searched. In prior study periods with standardized carcass searches in both spring and fall, the assumed seasonality of risk for the Covered Species, which per the HCP, was 11% in the spring and 89% in the fall was also used to estimate  $g$ . The seasonal risk is used to weight the contributions of detection probability from different seasons in the overall  $g$  estimate. Differences in the level of turbine operations (e.g., turbines down for maintenance for extended periods within a season) were also considered.

The EoA Single Class module was used to estimate the detection probability in each search stratum. This resulted in alpha ( $\alpha$ ) and beta ( $\beta$ ) parameters that defined the beta distribution of detection probability in each stratum. The EoA Multiple Class module was then used to combine detection probability distributions across strata (i.e., 70-m full plots and 100-m expanded road and pads), with weights for each class (“DWP” in the software) defined by the within-season sampling fraction. The beta distribution parameters were set to  $Ba = 0.01$  and  $Bb = 1,000$  (a detection probability of  $10^{-5}$ ) for unsearched areas within each stratum.

Furthermore, the Multiple Years Module was used to estimate the site-wide, cumulative detection probability for the four monitoring study periods (2020 – 2023). The EoA Multiple Years Module requires the input  $p$ , which weights the years appropriately for combining beta distribution parameters. The value for  $p$  was set to 0.89 for 2020 because the ITP was issued in the fall, meaning about 89% of total annual risk was observed in monitoring data from 2020. In 2021 and 2022, the Project was fully operational for all seasons, so  $p$  was set to 1.00. In 2023,  $p$  was set to 0.11 as monitoring was only conducted during the spring. The results from the Multiple Years module ( $Ba$  and  $Bb$  parameters for the detection probability for the permit term to date) were used to estimate  $M^*$  (the median cumulative take over the life of the permit),  $\lambda$  (the underlying annual take rate) and its 90% CI, and the probability that  $\lambda > \tau$ , where  $\tau$  is the authorized take number divided by the number of years in the permit. Appendix D shows how the compliance metrics were calculated using the EoA graphical user interface<sup>2</sup>.

### *Adaptive Management Triggers*

The estimates from the EoA analysis were used to test two adaptive management triggers: a short-term test of whether the estimated take rate exceeded the expected take rate and a long-term test of whether permitted take had been met (Dalthorp and Huso 2015). Both the short- and long-term triggers were tested individually for each of the Covered Species.

### Evidence of Absence Short-term Trigger

The EoA short-term trigger is designed as an early warning signal that the Project may be on the path to exceeding permitted take ( $T$ ) by the end of the permit term. The short-term trigger is

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<sup>2</sup> There may be very minor differences between screen shots and the results in the main text because EoA is a stochastic estimator, leading to slightly different estimates each time the modules are run.

designed to determine if an adaptive management response is needed to prevent the cumulative take estimate from actuating a response to the long-term trigger test. The short-term trigger tests if the estimated annual take rate ( $\lambda$ ) exceeded the expected take rate ( $\tau = T \div \text{years in permit}$ ) at a confidence level of  $\alpha = 0.1$ , per the HCP. The Project's short-term trigger is designed to evaluate a rolling window of six years of PCM data. If, within any 6-year rolling window, the estimated take rate exceeds the expected take rate with 90% confidence, the short-term trigger would be met, indicating that the minimization plan in the HCP may need to be adjusted to ensure that the median cumulative take estimate ( $M^*$ ) remains within the permitted limit over the ITP term. Data from four monitoring study periods were used in this analysis (2020 – 2023) along with the values of  $p$  listed above (0.89, 1.00, 1.00, 0.11, respectively). Due to limitations with the EoA graphical user interface, for estimates of  $\lambda$  it was necessary to rescale the EoA-produced estimates to represent three full years of operation and monitoring using the sum of these  $p$  values. For adaptive management triggers associated with  $\lambda$ , it was necessary to scale the annual rate threshold ( $\tau$ ) to represent the level of risk in the moving average estimate of  $\lambda$ .

#### Evidence of Absence Long-term Trigger

The EoA long-term trigger is designed to test if the cumulative take to date is equal to or greater than the permitted take ( $T$ ). Per the HCP, cumulative take to date ( $M^*$ ) was estimated at a confidence level of  $\alpha = 0.5$  (using the median, or 50<sup>th</sup> credible bound, of the posterior distribution of estimated mortality). If the cumulative take to date at  $\alpha = 0.5$  is less than the total permitted take ( $M^* < T$ ), then the Project is in compliance with the ITP. If the cumulative take to date at  $\alpha = 0.5$  is greater than or equal to the total permitted take ( $M^* \geq T$ ), then the take limit has been met and the Project must enact avoidance measures.

## RESULTS

### Standardized Carcass Searches

One thousand five hundred sixty-one searches were conducted during the spring-only study period; 44 searches (less than 3%) were missed due to turbine maintenance, weather constraints, and/or safety hazards.

Eighty-two bat carcasses and 41 bird carcasses were found during surveys and incidentally (Appendix A). No federally or state-listed as threatened or endangered species were found during surveys or incidentally. The most commonly found bat species were the silver-haired bat (68 carcasses; 82.9%) and the eastern red bat (11 carcasses; 13.4%), followed by the hoary bat (two carcasses; 2.4%) and the big brown bat (one carcass; 1.2%).

### Statistical Analysis

#### *Bias Trials*

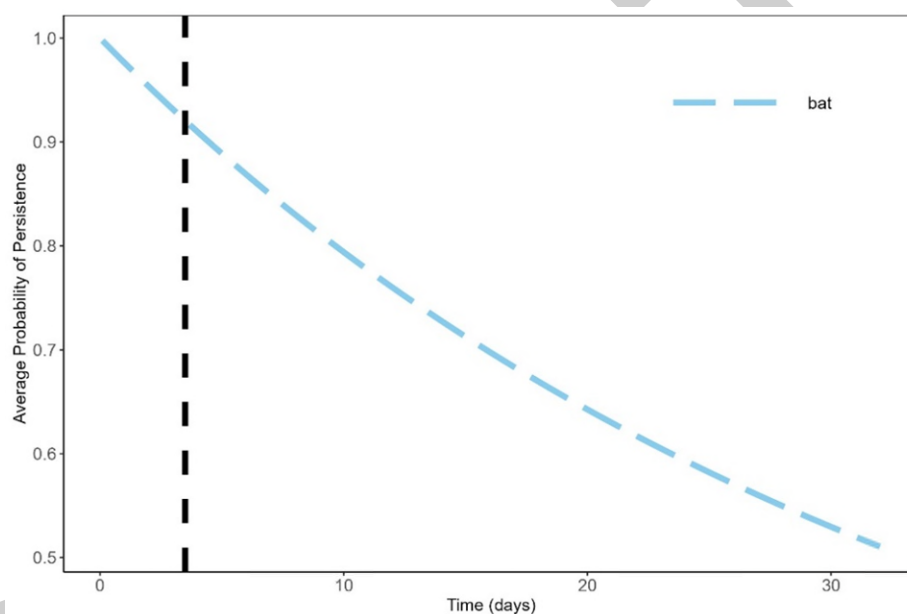
#### Searcher Efficiency Trials

Seventy-five carcasses were placed for SEEF trials on five separate dates; 33 were available for searchers to find on 100-m expanded road and pads and 26 were available for searchers to find

on 70-m full plots. The best-fit model for SEEF had no covariates, meaning there was no significant difference in SEEF between plot types (Appendix B1). Overall, 32 of 59 carcasses (54.2%) were found.

### Carcass Persistence Trials

Fifty carcasses were used to estimate carcass persistence. Twenty-five carcasses were placed on 100-m expanded road and pads and 25 were placed on 70-m full plots. The best-fit model for carcass persistence had no covariates with an exponential distribution, suggesting there was no significant difference in carcass persistence between plot types (Appendix B2). The average probability that a carcass persisted through a 3.5-day search interval was 0.92 (90% CI: 0.89 – 0.94; Figure 6).



**Figure 6. The average probability of persistence, in days, for bat carcasses at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

Note: The vertical dashed line indicates the 3.5-day search interval used in this study.

### *Area Adjustment*

Four of the 82 bats found during the study period were excluded from modeling the area adjustment for EoA. Three carcasses were excluded from analysis because they were found off plot, whereas one carcass was excluded because the estimated time of death was prior to the start of surveys (Appendix C1).

The best-fit model for the distribution of bats with respect to distance from turbine base included blade length as a covariate, suggesting that the distribution of bats varied across turbine types (Appendix C2). Therefore, there were two TWL adjustments for bats across the two plot types. The TWL area adjustment for bats on 100-m expanded road and pads was estimated to range

from 0.18–0.23 (Table 4; Appendix C3–C6). The TWL area adjustment for bats on 70-m full plots was estimated to range from 0.76–0.81 (Table 4; Appendix C3–C6).

**Table 4. Truncated weighted maximum likelihood search area adjustment estimates by turbine blade length and plot type for the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

Blade Length (m)*	Plot Type	Distribution	Parameter 1	Parameter 2	Area Adjustment
50	100-m expanded road and pad	Gompertz	0.0451	0.0033	0.20
	70-m full plot	Gompertz	0.0451	0.0033	0.81
57	100-m expanded road and pad	Gompertz	0.0451	0.0033	0.23
	70-m full plot	Gompertz	0.0451	0.0033	0.78
68	100-m expanded road and pad	gamma	4.4783	0.0837	0.18
	70-m full plot	gamma	4.4783	0.0837	0.79
75	100-m expanded road and pad	gamma	4.4783	0.0837	0.18
	70-m full plot	gamma	4.4783	0.0837	0.76

\* 50-m blade and 57-m blade: n = 48 carcasses combined; 68-m blade and 75-m blade: n = 30 carcasses combined.  
m = meter.

### Covered Species Take Estimates

No Covered Species carcasses were found during the study. One Indiana bat and zero northern long-eared bats have been found to date under the ITP. The annual probability of detection distribution (*g*) achieved for the 2023 study period had a mean of 0.234 (90% CI: 0.222–0.246; Table 5). Inputs required to run the EoA Single Class module and stratum-specific *g* distribution values and inputs required for the Multiple Class module are described in Appendix D.

**Table 5. Annual probabilities of detection (*g*), *Ba*, *Bb*, and *p* for the Timber Road Wind Farm, Paulding County, Ohio, from 2020–2023.**

Year	<i>Ba</i> <sup>1</sup>	<i>Bb</i> <sup>1</sup>	<i>p</i> <sup>2</sup>	<i>g</i>	90% CI
2020	323.42	1,417.48	0.89	0.186	0.171–0.201
2021	2,365.45	4,863.69	1.00	0.327	0.318–0.336
2022	903.02	2,673.21	1.00	0.253	0.241–0.265
2023	777.24	2,540.88	0.11	0.234	0.222–0.246
Short-term Trigger (Last 3 Years) <sup>3</sup>	2,891.91	8,363.37	NA	0.257	0.250–0.264
Long-term Trigger (Cumulative)	2,891.91	8,363.37	NA	0.257	0.250–0.264

<sup>1</sup> *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.

<sup>2</sup> *p* is the weight in the weighted average that is used to combine the probability of detection distributions across years.

<sup>3</sup> For this study, data from the last three full study periods (fall 2020 – spring 2023) were used to evaluate the short-term trigger.

CI = confidence interval; NA = not applicable.

Mean annual take rates based on monitoring from the last three full study periods (fall 2020 – spring 2023) were estimated to be 1.95 (90% CI: 0.23–5.07) Indiana bats per year and 0.65 (90% CI: 0–2.49) northern long-eared bat per year. The expected average annual take rates reported in the HCP were 10.8 Indiana bats per year and 2.5 northern long-eared bats per year (Table 6).

Cumulative take under the ITP to-date (2020–2023),  $M^*$ , at  $\alpha = 0.5$  (50<sup>th</sup> credible bound), is estimated to be four Indiana bats and zero northern long-eared bats. The total take permitted by the ITP is 276 Indiana bats and 64 northern long-eared bats over the 30-year permit term.

### *Adaptive Management Triggers*

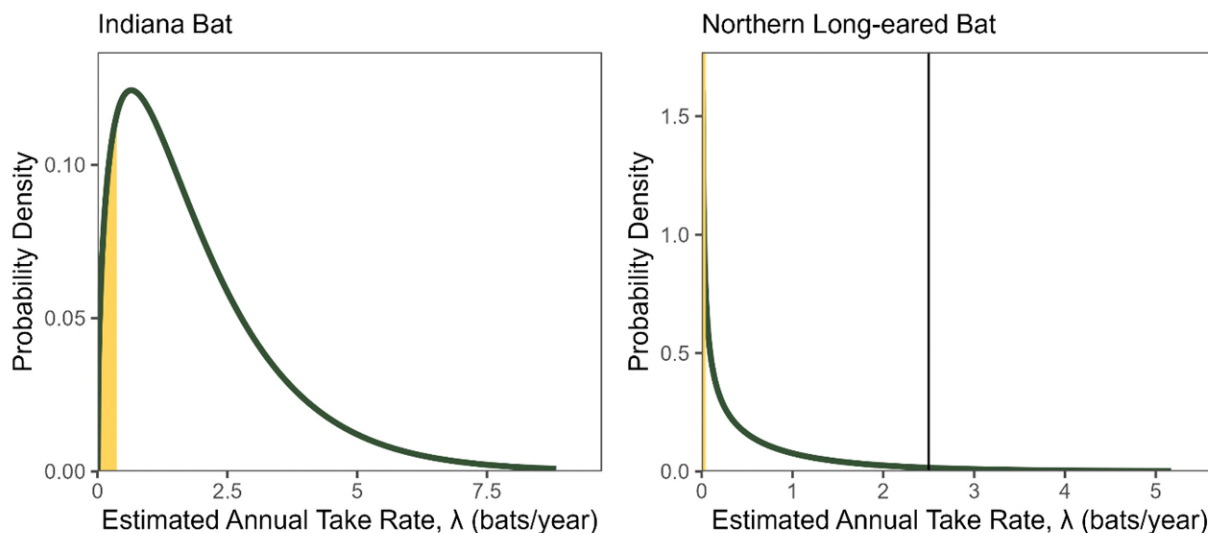
#### Evidence of Absence Short-term Trigger

The short-term trigger assesses the probability that the estimated take rate exceeded the expected take rate,  $\Pr(\lambda > \tau)$ . At a 90% confidence level ( $\alpha = 0.1$ ),  $\Pr(\lambda > \tau)$  must be greater than or equal to 0.90 for the short-term trigger to fire. For Indiana bat,  $\Pr(\lambda > \tau) = 0$ , and for northern long-eared bat,  $\Pr(\lambda > \tau) = 0.05$  (Table 6). Neither probability meets or exceeds 0.90, indicating the short-term trigger was not met and no adaptive management actions are necessary (Table 6, Figure 7).

**Table 6. Probability the estimated take rates exceeded the expected take rates for studies conducted within the rolling average interval at the Timber Road Wind Farm, Paulding County, Ohio, Incidental Take Permit Years 1–3.5 (2020–2023).**

Species	Mean $\lambda$ (90% Confidence Interval)	Expected Take Rate ( $\tau$ )	$\Pr(\lambda > \tau)^*$	Short-Term Trigger Fires at $\alpha = 0.1$ ?
Indiana bat	1.95 (0.23–5.07)	10.8	0	No
Northern long-eared bat	0.65 (0–2.49)	2.5	0.05	No

\*  $\Pr(\lambda > \tau)$  reads, “the probability that  $\lambda$  (the annual take rate) is greater than  $\tau$  (the expected annual take rate based on the total permitted take, used as a threshold for adaptive management).” If this probability is less than 0.90 (e.g.,  $\alpha = 0.1$  for a 1-sided test), then no adaptive management is triggered because there is not sufficient evidence that the estimated annual take rate is greater than the expected annual take rate.



**Figure 7. Estimated annual take rates ( $\lambda$ ), in bats per year, at the Timber Road Wind Farm, Paulding County, Ohio, Incidental Take Permit Years 1–3.5 (2020–2023).**

Note: The yellow region of the posterior distributions shows the region of the lower 10% quantile of the distributions (yellow region may not be visible when the posterior distribution is skewed heavily toward zero). The black vertical line in the northern long-eared bat panel marks the expected take rate. The expected take rate for the Indiana bat (10.8 bats per year) is not shown because it is far to the right of the posterior distribution. The short-term trigger evaluates whether the vertical line falls within or to the left of the yellow region of the posterior distributions. For both species, the short-term trigger is not met because the black vertical line (expected take rate) is not within or to the left of the yellow regions. In other words, the probability that estimated take rate is greater than the expected take rate does not exceed 90%.

#### Evidence of Absence Long-term Trigger

The estimated cumulative take to date,  $M^*$  at  $\alpha = 0.5$  (50<sup>th</sup> credible bound), is below the total permitted take for both Covered Species (Table 7). The long-term trigger was not met and TRWF is in compliance because  $M^* < T$  for both species. Therefore, an avoidance response is not necessary.

**Table 7. Cumulative take estimate to date using Evidence of Absence for studies conducted within the Incidental Take Permit term to date at Timber Road Wind Farm, Paulding County, Ohio, Incidental Take Permit Years 1–3.5 (2020–2023).**

Species	Cumulative take ( $M^*$ )	Permitted take (T)	Long-term trigger fires at $\alpha = 0.5$ ?
Indiana bat (50 <sup>th</sup> credible bound)	4	276	No
northern long-eared bat (50 <sup>th</sup> credible bound)	0	64	No

## CONCLUSIONS

The PCM effort completed in 2023 was consistent with the HCP's monitoring requirements and the Project's 2023 study plan. No Covered Species carcasses were found despite a high probability of detection in 2023. Estimates of potential take for the Covered Species were below the levels authorized by the ITP and no adaptive management actions are necessary at this time.

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**Appendix A. Carcasses Found during the 2023 Post-construction Monitoring Surveys  
at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

**Appendix A. Carcasses found at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine (m)</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
<b>Bat Carcasses</b>						
04/06/2023	eastern red bat	51	209	carcass search	70-m full plot	injured
04/07/2023	silver-haired bat	74	249	carcass search*	70-m full plot	scavenged
04/10/2023	silver-haired bat	55	402	carcass search	70-m full plot	scavenged
04/12/2023	eastern red bat	29	347	carcass search	100-m expanded road and pad	scavenged
04/12/2023	eastern red bat	8	419	carcass search	100-m expanded road and pad	injured
04/12/2023	silver-haired bat	83	226	carcass search	100-m expanded road and pad	scavenged
04/12/2023	silver-haired bat	34	247	carcass search	100-m expanded road and pad	intact
04/12/2023	silver-haired bat	9	345	carcass search	100-m expanded road and pad	scavenged
04/15/2023	eastern red bat	51	430	carcass search	100-m expanded road and pad	scavenged
04/15/2023	silver-haired bat	18	401	carcass search	100-m expanded road and pad	scavenged
04/15/2023	silver-haired bat	25	405	incidental	70-m full plot	intact
04/17/2023	silver-haired bat	70	229	carcass search	70-m full plot	scavenged
04/17/2023	silver-haired bat	59	405	carcass search	70-m full plot	intact
04/18/2023	silver-haired bat	65	426	carcass search	70-m full plot	scavenged
04/19/2023	eastern red bat	26	415	carcass search	100-m expanded road and pad	scavenged
04/19/2023	eastern red bat	27	427	carcass search	100-m expanded road and pad	scavenged
04/19/2023	silver-haired bat	8	237	carcass search	100-m expanded road and pad	scavenged
04/19/2023	silver-haired bat	20	313	carcass search	100-m expanded road and pad	intact
04/19/2023	silver-haired bat	24	344	carcass search	100-m expanded road and pad	intact
04/19/2023	silver-haired bat	40	419	carcass search	100-m expanded road and pad	scavenged
04/19/2023	silver-haired bat	15	427	carcass search	100-m expanded road and pad	scavenged
04/20/2023	silver-haired bat	50	229	carcass search	70-m full plot	intact
04/20/2023	silver-haired bat	124	231	carcass search*	100-m expanded road and pad	intact
04/20/2023	silver-haired bat	72	236	carcass search	100-m expanded road and pad	intact
04/20/2023	silver-haired bat	18	408	carcass search	70-m full plot	scavenged
04/21/2023	silver-haired bat	56	252	carcass search	70-m full plot	scavenged
04/21/2023	silver-haired bat	63	318	carcass search	70-m full plot	scavenged
04/21/2023	silver-haired bat	21	324	carcass search	100-m expanded road and pad	scavenged
04/21/2023	silver-haired bat	18	416	carcass search	70-m full plot	intact
04/21/2023	silver-haired bat	92	427	carcass search	100-m expanded road and pad	intact
04/22/2023	silver-haired bat	14	309	carcass search	100-m expanded road and pad	scavenged
04/22/2023	silver-haired bat	43	310	carcass search	100-m expanded road and pad	scavenged
04/22/2023	silver-haired bat	46	317	carcass search	100-m expanded road and pad	scavenged
04/22/2023	silver-haired bat	27	328	carcass search	100-m expanded road and pad	scavenged
04/22/2023	silver-haired bat	6	334	carcass search	100-m expanded road and pad	intact

**Appendix A. Carcasses found at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine (m)</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
04/22/2023	silver-haired bat	45	335	carcass search	100-m expanded road and pad	scavenged
04/24/2023	silver-haired bat	45	402	carcass search	70-m full plot	scavenged
04/24/2023	silver-haired bat	54	402	carcass search	70-m full plot	scavenged
04/24/2023	silver-haired bat	86	403	carcass search	100-m expanded road and pad	scavenged
04/25/2023	eastern red bat	70	223	carcass search	70-m full plot	scavenged
04/25/2023	eastern red bat	38	321	carcass search	70-m full plot	scavenged
04/25/2023	silver-haired bat	69	321	carcass search	70-m full plot	scavenged
04/25/2023	silver-haired bat	56	416	carcass search	70-m full plot	scavenged
04/25/2023	silver-haired bat	30	431	carcass search	100-m expanded road and pad	intact
04/26/2023	silver-haired bat	17	255	carcass search	100-m expanded road and pad	scavenged
04/26/2023	silver-haired bat	2	255	carcass search	100-m expanded road and pad	intact
04/28/2023	silver-haired bat	36	422	carcass search	70-m full plot	scavenged
04/29/2023	eastern red bat	62	347	carcass search	100-m expanded road and pad	scavenged
04/29/2023	hoary bat	21	314	carcass search	100-m expanded road and pad	scavenged
04/29/2023	hoary bat	57	347	carcass search	100-m expanded road and pad	intact
04/29/2023	silver-haired bat	20	226	carcass search	100-m expanded road and pad	scavenged
04/29/2023	silver-haired bat	59	254	carcass search	100-m expanded road and pad	scavenged
04/29/2023	silver-haired bat	33	309	carcass search*	100-m expanded road and pad	scavenged
04/29/2023	silver-haired bat	21	347	carcass search	100-m expanded road and pad	scavenged
05/01/2023	silver-haired bat	15	227	carcass search	100-m expanded road and pad	scavenged
05/01/2023	silver-haired bat	23	238	carcass search	70-m full plot	intact
05/02/2023	silver-haired bat	38	426	carcass search	70-m full plot	scavenged
05/02/2023	silver-haired bat	42	426	carcass search	70-m full plot	dismembered
05/02/2023	silver-haired bat	42	426	carcass search	70-m full plot	scavenged
05/04/2023	silver-haired bat	12	411	carcass search	70-m full plot	scavenged
05/05/2023	silver-haired bat	35	321	carcass search	70-m full plot	intact
05/05/2023	silver-haired bat	38	337	carcass search	100-m expanded road and pad	scavenged
05/05/2023	silver-haired bat	59	417	carcass search	100-m expanded road and pad	scavenged
05/06/2023	silver-haired bat	27	226	carcass search	100-m expanded road and pad	intact
05/06/2023	silver-haired bat	41	344	carcass search	100-m expanded road and pad	scavenged
05/08/2023	big brown bat	17	407	carcass search	70-m full plot	intact
05/08/2023	silver-haired bat	35	219	carcass search	70-m full plot	scavenged
05/08/2023	silver-haired bat	62	305	carcass search	70-m full plot	intact
05/08/2023	silver-haired bat	38	407	carcass search	70-m full plot	intact
05/09/2023	eastern red bat	13	323	carcass search	100-m expanded road and pad	scavenged
05/09/2023	silver-haired bat	23	422	carcass search	70-m full plot	scavenged
05/10/2023	eastern red bat	23	309	carcass search	100-m expanded road and pad	scavenged

**Appendix A. Carcasses found at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine (m)</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
05/10/2023	silver-haired bat	48	309	carcass search	100-m expanded road and pad	scavenged
05/10/2023	silver-haired bat	53	313	carcass search	100-m expanded road and pad	scavenged
05/10/2023	silver-haired bat	7	347	carcass search	100-m expanded road and pad	scavenged
05/11/2023	silver-haired bat	33	210	carcass search	70-m full plot	scavenged
05/11/2023	silver-haired bat	65	230	carcass search	100-m expanded road and pad	intact
05/11/2023	silver-haired bat	34	238	carcass search	70-m full plot	scavenged
05/12/2023	silver-haired bat	0	222	carcass search	100-m expanded road and pad	scavenged
05/12/2023	silver-haired bat	0	318	carcass search	70-m full plot	scavenged
05/12/2023	silver-haired bat	52	421	carcass search	100-m expanded road and pad	scavenged
05/12/2023	silver-haired bat	33	430	carcass search	100-m expanded road and pad	scavenged
<b>Bird Carcasses</b>						
03/30/2023	killdeer	5	238	incidental*	70-m full plot	scavenged
04/03/2023	Cooper's hawk	36	406	carcass search*	100-m expanded road and pad	scavenged
04/03/2023	killdeer	26	412	carcass search	100-m expanded road and pad	intact
04/03/2023	red-tailed hawk	45	411	carcass search	70-m full plot	scavenged
04/04/2023	Lapland longspur	5	426	carcass search	70-m full plot	intact
04/04/2023	dark-eyed junco	44	422	carcass search	70-m full plot	scavenged
04/04/2023	golden-crowned kinglet	56	422	carcass search	70-m full plot	intact
04/04/2023	unidentified raptor	41	321	carcass search	70-m full plot	scavenged
04/04/2023	unidentified sparrow	42	336	carcass search	70-m full plot	scavenged
04/05/2023	chipping sparrow	48	313	carcass search	100-m expanded road and pad	scavenged
04/05/2023	red-tailed hawk	39	331	carcass search*	100-m expanded road and pad	scavenged
04/06/2023	horned lark	42	412	carcass search	100-m expanded road and pad	scavenged
04/11/2023	killdeer	33	318	carcass search	70-m full plot	intact
04/11/2023	ruby-crowned kinglet	32	308	carcass search	70-m full plot	scavenged
04/12/2023	killdeer	32	414	carcass search	100-m expanded road and pad	scavenged
04/12/2023	ruby-crowned kinglet	43	412	carcass search	100-m expanded road and pad	scavenged
04/12/2023	turkey vulture	32	328	carcass search	100-m expanded road and pad	scavenged
04/13/2023	chipping sparrow	59	405	carcass search	70-m full plot	scavenged
04/13/2023	chipping sparrow	90	409	carcass search	100-m expanded road and pad	scavenged
04/13/2023	ruby-crowned kinglet	49	402	carcass search	70-m full plot	scavenged
04/14/2023	golden-crowned kinglet	58	308	carcass search	70-m full plot	scavenged
04/14/2023	killdeer	51	422	carcass search	70-m full plot	scavenged
04/15/2023	golden-crowned kinglet	46	335	carcass search	100-m expanded road and pad	feather spot
04/15/2023	northern flicker	12	430	carcass search	100-m expanded road and pad	scavenged
04/19/2023	horned lark	8	427	carcass search	100-m expanded road and pad	scavenged
04/20/2023	brown creeper	90	403	carcass search	100-m expanded road and pad	scavenged

**Appendix A. Carcasses found at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine (m)</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
04/20/2023	swamp sparrow	88	403	carcass search	100-m expanded road and pad	scavenged
04/21/2023	blue jay	44	414	carcass search	100-m expanded road and pad	intact
04/26/2023	brown thrasher	62	343	carcass search	100-m expanded road and pad	dismembered
04/28/2023	horned lark	45	218	carcass search	70-m full plot	scavenged
04/28/2023	horned lark	50	308	carcass search	70-m full plot	intact
04/28/2023	horned lark	11	325	carcass search	70-m full plot	scavenged
04/28/2023	horned lark	56	426	carcass search	70-m full plot	scavenged
04/29/2023	golden-crowned kinglet	76	338	carcass search	100-m expanded road and pad	scavenged
05/02/2023	horned lark	63	308	carcass search	70-m full plot	scavenged
05/02/2023	red-winged blackbird	53	416	carcass search	70-m full plot	intact
05/09/2023	bobolink	18	336	carcass search	70-m full plot	scavenged
05/09/2023	killdeer	56	422	carcass search	70-m full plot	feather spot
05/12/2023	chimney swift	1	424	carcass search	100-m expanded road and pad	scavenged
05/12/2023	killdeer	14	307	carcass search	70-m full plot	scavenged
05/12/2023	rock pigeon	41	321	carcass search	70-m full plot	scavenged

\* Carcass was found outside the search area.

m = meter.

**Appendix B. Searcher Efficiency and Carcass Persistence Model Fitting Results at the  
Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

**Appendix B1. Searcher efficiency models for bats from the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023 (n = 59 carcasses).**

<b>Covariates</b>	<b>k Value</b>	<b>AICc</b>	<b>Delta AICc</b>
Plot Delineation	k fixed at 0.67	81.59	0
No Covariates	k fixed at 0.67	83.44	1.85*
Plot Search Type	k fixed at 0.67	84.36	2.77

\* Selected model.

k = detection reduction factor; AICc = corrected Akaike Information Criterion; Delta AICc = change in AICc.

**Appendix B2. Carcass persistence models with covariates and distributions for bats at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023 (n = 50 carcasses).**

<b>Location Covariates</b>	<b>Scale Covariates</b>	<b>Distribution</b>	<b>AICc</b>	<b>Delta AICc</b>
No Covariates	No Covariates	Weibull	219.48	0
No Covariates	–	exponential	220.44	0.96*
Plot Search Type	No Covariates	Weibull	221.47	1.99
No Covariates	No Covariates	loglogistic	221.67	2.19
No Covariates	Plot Search Type	Weibull	221.71	2.23
Plot Search Type	–	exponential	222.25	2.77
No Covariates	No Covariates	lognormal	222.72	3.24
Plot Delineation	No Covariates	Weibull	223.53	4.05
No Covariates	Plot Delineation	Weibull	223.64	4.16
Plot Search Type	Plot Search Type	Weibull	223.78	4.30
Plot Search Type	No Covariates	loglogistic	223.88	4.40
No Covariates	Plot Search Type	loglogistic	223.91	4.43
Plot Delineation	–	exponential	224.25	4.77
Plot Search Type	No Covariates	lognormal	224.74	5.26
No Covariates	Plot Search Type	lognormal	224.93	5.45
No Covariates	Plot Delineation	loglogistic	225.79	6.31
Plot Delineation	No Covariates	loglogistic	225.86	6.38
Plot Search Type + Plot Delineation	No Covariates	Weibull	226.00	6.52
No Covariates	Plot Search Type + Plot Delineation	Weibull	226.11	6.63
Plot Search Type	Plot Search Type	loglogistic	226.22	6.74
Plot Delineation	No Covariates	lognormal	226.44	6.96
Plot Search Type + Plot Delineation	–	exponential	226.61	7.13
No Covariates	Plot Delineation	lognormal	226.75	7.27
Plot Search Type	Plot Search Type	lognormal	227.08	7.60
Plot Delineation	Plot Delineation	Weibull	228.15	8.67
Plot Search Type	Plot Search Type + Plot Delineation	Weibull	228.44	8.96
Plot Search Type + Plot Delineation	Plot Search Type	Weibull	228.53	9.05
Plot Search Type + Plot Delineation	No Covariates	lognormal	228.92	9.44
No Covariates	Plot Search Type + Plot Delineation	lognormal	229.22	9.74
Plot Delineation	Plot Delineation	loglogistic	230.43	10.95
Plot Delineation	Plot Search Type + Plot Delineation	Weibull	230.87	11.39
Plot Search Type + Plot Delineation	Plot Delineation	Weibull	230.87	11.39
Plot Delineation	Plot Delineation	lognormal	231.12	11.64
Plot Search Type + Plot Delineation	Plot Search Type	lognormal	231.49	12.01
Plot Search Type	Plot Search Type + Plot Delineation	lognormal	231.67	12.19
Plot Search Type + Plot Delineation	Plot Delineation	lognormal	233.83	14.35

\* Selected model.

AICc = corrected Akaike Information Criterion; Delta AICc = change in AICc.

**Appendix C. Truncated Weighted Likelihood Area Adjustment Model Fitting Results at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**



**Appendix C1. Number and percent (%) of bat carcasses found and total included in the area adjustment calculation for the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

Species	Included in Area Adjustment		Outside Search Area*		Outside Study Period*		Total	
	Total	%	Total	%	Total	%	Total	%
silver-haired bat	65	83.3	3	100	0	0	68	82.9
eastern red bat	10	12.8	0	0	1	100	11	13.4
hoary bat	2	2.6	0	0	0	0	2	2.4
big brown bat	1	1.3	0	0	0	0	1	1.2
<b>Total</b>	<b>78</b>	<b>100</b>	<b>3</b>	<b>100</b>	<b>1</b>	<b>100</b>	<b>82</b>	<b>100</b>

\* Carcasses not included in analysis.

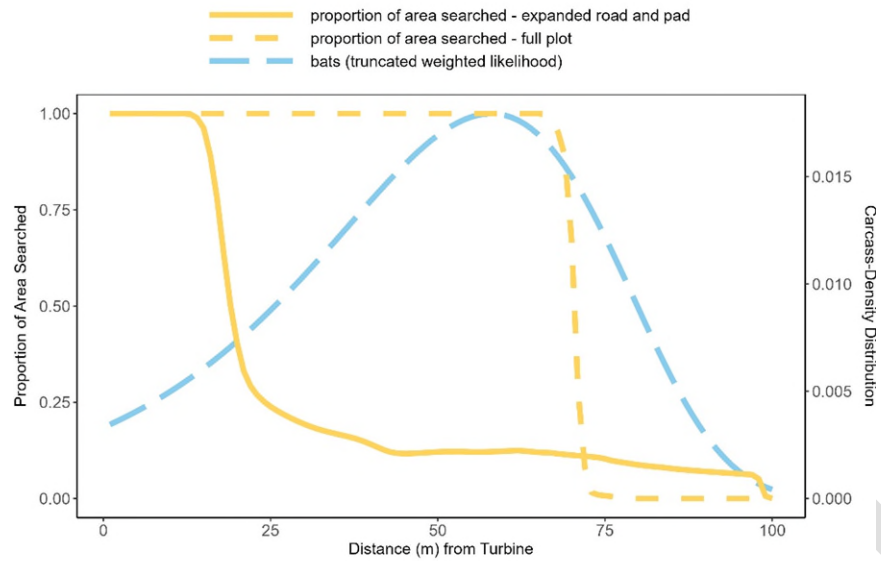
Sums may not equal totals shown due to rounding.

**Appendix C2. Truncated weighted maximum likelihood (TWL) search area adjustment models for the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023. Due to limited samples sizes, separate TWL models were fit across two strata of turbines each with two different but comparable blade lengths.**

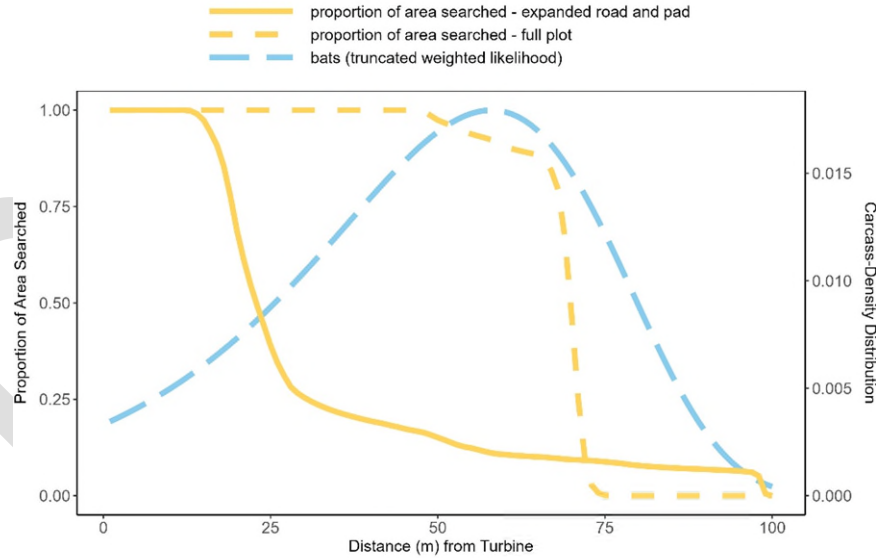
50-m and 57-m Blades	68-m and 75-m Blades	Pooled	AICc	Delta AICc
Gompertz	gamma	normal	3,348.70	0*
Gompertz	Weibull		3,350.21	1.51
Gompertz	normal		3,354.11	5.41
-	-		3,358.91	10.21
normal	gamma	Gompertz	3,359.21	10.51
normal	Weibull		3,360.72	12.02
normal	normal		3,364.62	15.92
-	-		3,367.14	18.45
Gompertz	Gompertz	Weibull	3,371.60	22.90
-	-		3,379.02	30.33
Weibull	gamma		3,381.44	32.74
normal	Gompertz		3,382.10	33.41
Weibull	Weibull	gamma	3,382.95	34.26
Weibull	normal		3,386.85	38.16
gamma	gamma		3,396.71	48.01
gamma	Weibull		3,398.22	49.53
gamma	normal	gamma	3,402.12	53.43
-	-		3,403.62	54.92
Weibull	Gompertz		3,404.34	55.64
gamma	Gompertz		3,419.61	70.91

\* Selected model.

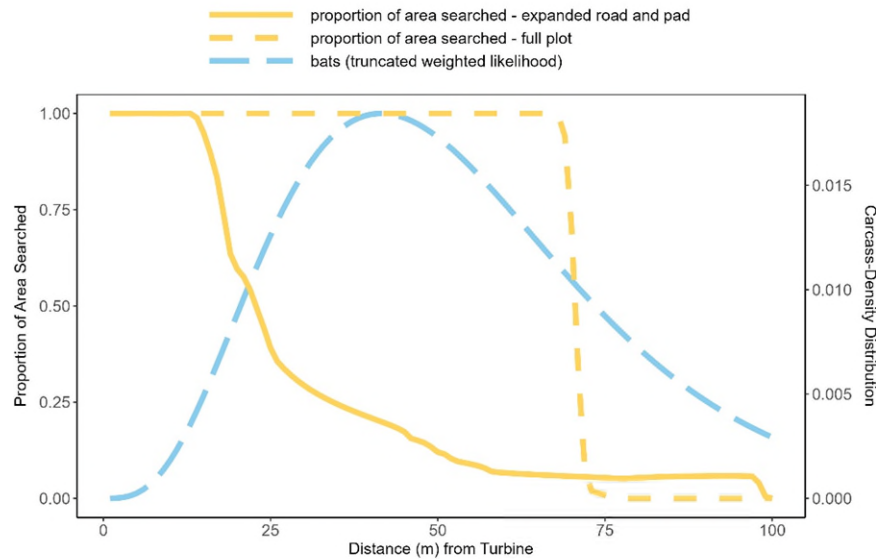
m = meter; AICc = corrected Akaike Information Criterion; Delta AICc = change in AICc.



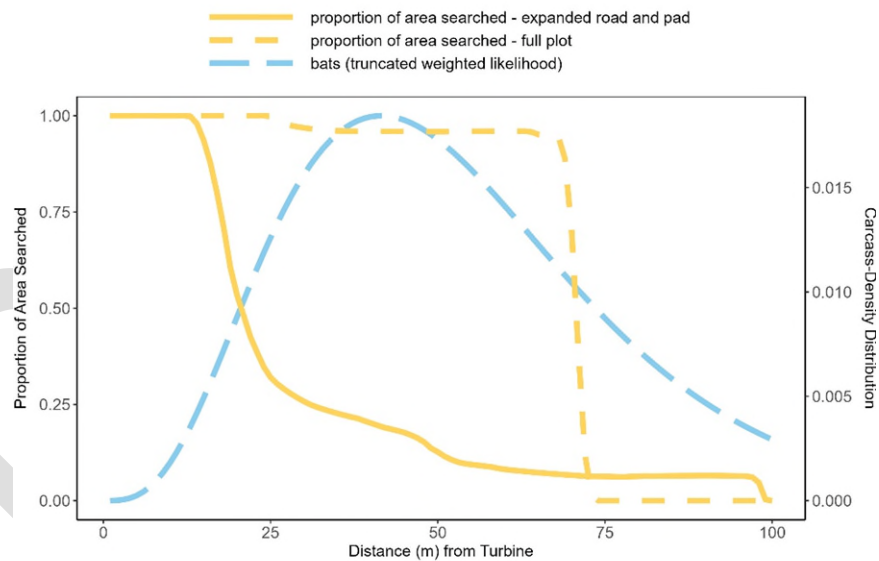
**Appendix C3. Estimated carcass-density distribution for bats found at turbines with 50-meter blades, and proportion of area searched by distance from turbine at Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**



**Appendix C4. Estimated carcass-density distribution for bats found at turbines with 57-meter blades, and proportion of area searched by distance from turbine at Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**



**Appendix C5. Estimated carcass-density distribution for bats found at turbines with 68-meter blades, and proportion of area searched by distance from turbine at Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**



**Appendix C6. Estimated carcass-density distribution for bats found at turbines with 75-meter blades, and proportion of area searched by distance from turbine at Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

**Appendix D. Inputs for Single Class and Multiple Class Modules in Evidence of Absence  
at the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

**Appendix D1. Inputs needed to run Evidence of Absence: Single Class Module for the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.\***

Plot Type	Blade Length (m)	Search Interval (days)	Average Number of Searches	Spatial Coverage (a)	Temporal Coverage	Searcher Efficiency		Carcass Persistence**	
						Carcasses Available	Carcasses Found	Shape ( $\alpha$ )	Scale ( $\beta$ )
100-m expanded road and pad	50	3.5	12	0.20	1	59	32	NA	20.76
	57	3.5	12	0.23	1	59	32	NA	20.76
	68	3.5	12	0.18	1	59	32	NA	20.76
	75	3.5	12	0.18	1	59	32	NA	20.76
70-m full plot	50	3.5	12	0.81	1	59	32	NA	20.76
	57	3.5	12	0.78	1	59	32	NA	20.76
	68	3.5	12	0.79	1	59	32	NA	20.76
	75	3.5	12	0.76	1	59	32	NA	20.76

\* The detection reduction factor (k) was assumed to equal 0.67 for all strata, per Huso et al. (2017).

\*\* An exponential distribution was assumed for carcass persistence. The 95% upper and lower confidence limits on  $\beta$  were set to 28.79 and 14.95, respectively.  
m = meter; NA = not applicable.

**Appendix D2. Inputs needed to run Evidence of Absence model to combine across plot types within the spring study period: Multiple Class Module for the Timber Road Wind Farm, Paulding County, Ohio, from April 1 – May 15, 2023.**

Plot Type	Blade Length (m)	Ba	Bb	Within-season Sampling Fraction
Unsearched	57	0.01	1000.00	0.01
	50	141.98	908.49	0.31
100-m expanded road and pad	57	137.26	741.21	0.28
	68	139.69	985.60	0.02
	75	150.85	1114.18	0.13
70-m full plot	50	73.53	59.29	0.10
	57	79.57	70.74	0.07
	68	74.60	64.58	0.03
	75	83.07	77.32	0.04

m = meter.

**Appendix D3. Inputs needed to run Evidence of Absence model to combine across years: Multiple Years Module for the Timber Road Wind Farm, Paulding County, Ohio, from 2020–2023.**

Year	Ba	Bb	Weights ( $\rho$ )
2020	323.42010	1417.47875	0.89
2021	2365.44809	4863.68559	1.00
2022	903.02479	2673.20841	1.00
2023	777.23763	2543.25402	0.11

EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ **Formula**

Search interval (I)

Number of searches

☐ **Custom** [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ **Carcasses available for several searches**

95% CIs: p  [0.531, 0.676], k  [0.649, 0.812]

p̂ = 0.62, k̂ = 0.735 [View](#) [Edit](#)

☒ **Carcasses removed after one search**

Carcasses available

Carcasses found

p̂ = 0.542, with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ **Use field trials to estimate parameters** [View/Edit](#)

Distribution: Lognormal with shape (α) = 4.078 and scale (β) = 1.171

r = 0.653 for I<sub>r</sub> = 3.5, with 95% CIs: r = [0.534, 0.766], β = [0.488, 1.854]

☒ **Enter parameter estimates manually** [View](#)

**Parameters**

**Exponential**

rate

**Weibull**

scale (β)  I<sub>wr</sub>  I<sub>upr</sub>

**Log-Logistic**

**Lognormal**

r = 0.92 for I<sub>r</sub> = 3.5, with 95% CI: r  [0.892, 0.942]

**Fatality estimation (M, λ)**

Carcass Count (X)  [Estimate M](#)

Credibility level (1 - α)  [Estimate λ](#)

☒ **One-sided CI (M\*)** ☐ **Two-sided CI**

[Close](#)

**Estimated detection probability (g)**

File Edit

Summary statistics for estimation of detection probability (g)

=====

Results:

Full site for full year

Estimated g = 0.136, 95% CI = [0.116, 0.159]

Fitted beta distribution parameters for estimated g: Ba = 135.1286, Bb = 854.8965

Full site for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.136, 95% CI = [0.116, 0.159]

Fitted beta distribution parameters for estimated g: Ba = 135.1286, Bb = 854.8965

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.682, 95% CI = [0.573, 0.782]

Fitted beta distribution parameters for estimated g: Ba = 50.9686, Bb = 23.7211

=====

Input:

Search parameters

trial carcasses placed = 59, carcasses found = 32

estimated searcher efficiency: p = 0.542, 95% CI = [0.416, 0.665]

k = 0.67

Search schedule: Search interval (I) = 3.5, number of searches = 13, span = 45.5

spatial coverage: 0.20 temporal coverage: 1

-----

Carcass persistence:

Exponential persistence distribution

scale (β) = 20.76

95% CI β = [14.95, 28.79] and r = 0.92 for I<sub>r</sub> = 3.5 with 95% CI = [0.892, 0.942]

Parameters entered manually

Uniform arrivals

**Appendix D4. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 100-meter expanded road and pad searches at 55 turbines with a blade length of 50 meters, searched at a 3.5-day interval.**

EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ **Formula**

Search interval (I)

Number of searches

☐ **Custom** [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs: p  [0.53, 0.676], k  [0.65, 0.816]

p̂ = 0.62, k̂ = 0.735 [View](#) [Edit](#)

☒ Carcasses removed after one search

Carcasses available

Carcasses found

p̂ = 0.542, with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters [View/Edit](#)

Distribution: Lognormal with shape (α) = 4.078 and scale (β) = 1.171

r = 0.653 for I<sub>r</sub> = 3.5, with 95% CIs: r = [0.529, 0.777], β = [0.488, 1.854]

☒ Enter parameter estimates manually [View](#)

**Parameters**

☒ Exponential

rate

☐ Weibull

scale (β)  lwr  upr

☐ Log-Logistic

☐ Lognormal

r = 0.92 for I<sub>r</sub> = 3.5, with 95% CI: r  [0.892, 0.942]

Carcass Count (X)  [Estimate M](#)

Credibility level (1 - α)  [Estimate λ](#)

☒ One-sided CI (M\*) ☐ Two-sided CI

[Close](#)

### Estimated detection probability (g)

File Edit

Summary statistics for estimation of detection probability (g)

=====

Results:

Full site for full year

Estimated g = 0.156, 95% CI = [0.133, 0.181]

Fitted beta distribution parameters for estimated g: Ba = 135.7887, Bb = 735.3653

Full site for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.156, 95% CI = [0.133, 0.181]

Fitted beta distribution parameters for estimated g: Ba = 135.7887, Bb = 735.3653

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.678, 95% CI = [0.57, 0.777]

Fitted beta distribution parameters for estimated g: Ba = 51.8739, Bb = 24.67

=====

Input:

Search parameters

trial carcasses placed = 59, carcasses found = 32

estimated searcher efficiency: p = 0.542, 95% CI = [0.416, 0.665]

k = 0.67

Search schedule: Search interval (I) = 3.5, number of searches = 13, span = 45.5

spatial coverage: 0.23 temporal coverage: 1

-----

Carcass persistence:

Exponential persistence distribution

scale (β) = 20.76

95% CI β = [14.95, 28.79] and r = 0.92 for I<sub>r</sub> = 3.5 with 95% CI = [0.892, 0.942]

Parameters entered manually

Uniform arrivals

-----

**Appendix D5. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 100-meter expanded road and pad searches at 48 turbines with a blade length of 57 meters, searched at a 3.5-day interval.**



EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ Formula

Search interval (I)

Number of searches

☐ Custom [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs:  $p \in [0.53, 0.676]$ ,  $k \in [0.65, 0.816]$

$\hat{p} = 0.62$ ,  $k = 0.735$  [View](#) [Edit](#)

☒ Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.542$ , with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters [View/Edit](#)

Distribution: Lognormal with shape ( $\alpha$ ) = 4.078 and scale ( $\beta$ ) = 1.171

$r = 0.653$  for  $I_r = 3.5$ , with 95% CIs:  $r \in [0.529, 0.777]$ ,  $\beta \in [0.488, 1.854]$

☒ Enter parameter estimates manually [View](#)

**Parameters**

rate

scale ( $\beta$ )  lwr  upr

$r = 0.92$  for  $I_r = 3.5$ , with 95% CI:  $r \in [0.892, 0.942]$

**Fatality estimation (M,  $\lambda$ )**

Carcass Count (X)  [Estimate M](#)

Credibility level (1 -  $\alpha$ )  [Estimate  \$\lambda\$](#)

☒ One-sided CI (M\*) ☐ Two-sided CI

[Close](#)

**Appendix D6. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 100-meter expanded road and pad searches at seven turbines with a blade length of 68 meters, searched at a 3.5-day interval.**

EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ Formula

Search interval (I)

Number of searches

☐ Custom [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs:  $p \in [0.53, 0.676]$ ,  $k \in [0.65, 0.816]$

$\hat{p} = 0.62$ ,  $k = 0.735$  [View](#) [Edit](#)

☒ Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.542$ , with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters [View/Edit](#)

Distribution: Lognormal with shape ( $\alpha$ ) = 4.078 and scale ( $\beta$ ) = 1.171

$r = 0.653$  for  $I_r = 3.5$ , with 95% CIs:  $r \in [0.529, 0.777]$ ,  $\beta \in [0.488, 1.854]$

☒ Enter parameter estimates manually [View](#)

**Parameters**

rate

scale ( $\beta$ )  lwr  upr

$r = 0.92$  for  $I_r = 3.5$ , with 95% CI:  $r \in [0.892, 0.942]$

**Fatality estimation (M,  $\lambda$ )**

Carcass Count (X)  [Estimate M](#)

Credibility level (1 -  $\alpha$ )  [Estimate  \$\lambda\$](#)

☒ One-sided CI (M\*) ☐ Two-sided CI

[Close](#)

**Appendix D7. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 100-meter expanded road and pad searches at 24 turbines with a blade length of 75 meters, searched at a 3.5-day interval.**

EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ Formula

Search interval (I)

Number of searches

☐ Custom [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs: p  [0.53, 0.676], k  [0.65, 0.816]

p̂ = 0.62, k = 0.735 [View](#) [Edit](#)

☒ Carcasses removed after one search

Carcasses available

Carcasses found

p̂ = 0.542, with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters [View/Edit](#)

Distribution: Lognormal with shape (α) = 4.078 and scale (β) = 1.171

r = 0.653 for Ir = 3.5, with 95% CIs: r = [0.529, 0.777], β = [0.488, 1.854]

☒ Enter parameter estimates manually [View](#)

**Parameters**

**Exponential**

rate

**Weibull**

scale (β)  lwr  upr

**Log-Logistic**

**Lognormal**

r = 0.92 for Ir = 3.5, with 95% CI: r  [0.892, 0.942]

**Fatality estimation (M, λ)**

Carcass Count (X)  [Estimate M](#)

Credibility level (1 - α)  [Estimate λ](#)

☒ One-sided CI (M\*) ☐ Two-sided CI

[Close](#)

Estimated detection probability (g)

File Edit

### Summary statistics for estimation of detection probability (g)

Results:

Full site for full year

Estimated g = 0.552, 95% CI = [0.467, 0.635]

Fitted beta distribution parameters for estimated g: Ba = 73.8498, Bb = 59.9412

Full site for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.552, 95% CI = [0.467, 0.635]

Fitted beta distribution parameters for estimated g: Ba = 73.8498, Bb = 59.9412

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.681, 95% CI = [0.574, 0.78]

Fitted beta distribution parameters for estimated g: Ba = 52.5874, Bb = 24.5818

Input:

Search parameters

trial carcasses placed = 59, carcasses found = 32

estimated searcher efficiency: p = 0.542, 95% CI = [0.416, 0.665]

k = 0.67

Search schedule: Search interval (I) = 3.5, number of searches = 13, span = 45.5

spatial coverage: 0.81 temporal coverage: 1

Carcass persistence:

Exponential persistence distribution

scale (β) = 20.76

95% CI β = [14.95, 28.79] and r = 0.92 for Ir = 3.5 with 95% CI = [0.892, 0.942]

Parameters entered manually

Uniform arrivals

**Appendix D8. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 70-meter full plot searches at 20 turbines with a blade length of 50 meters, searched at a 3.5-day interval.**



EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ **Formula**

Search interval (I)

Number of searches

☐ **Custom** [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs: p  [0.53, 0.676], k  [0.65, 0.816]

$\hat{p} = 0.62$ ,  $k = 0.735$  [View](#) [Edit](#)

☒ Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.542$ , with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters [View/Edit](#)

Distribution: Lognormal with shape ( $\alpha$ ) = 4.078 and scale ( $\beta$ ) = 1.171

$r = 0.653$  for  $I_r = 3.5$ , with 95% CIs:  $r = [0.529, 0.777]$ ,  $\beta = [0.488, 1.854]$

☒ Enter parameter estimates manually [View](#)

**Parameters**

**Exponential**

rate

**Weibull**

scale ( $\beta$ )  lwr  upr

**Log-Logistic**

**Lognormal**

$r = 0.92$  for  $I_r = 3.5$ , with 95% CI:  $r = [0.892, 0.942]$

**Fatality estimation (M,  $\lambda$ )**

Carcass Count (X)  [Estimate M](#)

Credibility level (1 -  $\alpha$ )  [Estimate  \$\lambda\$](#)

☒ One-sided CI (M\*) ☐ Two-sided CI

[Close](#)

Estimated detection probability (g)

File Edit

Summary statistics for estimation of detection probability (g)

=====

Results:

Full site for full year

Estimated g = 0.533, 95% CI = [0.453, 0.612]

Fitted beta distribution parameters for estimated g: Ba = 79.0744, Bb = 69.2946

Full site for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.533, 95% CI = [0.453, 0.612]

Fitted beta distribution parameters for estimated g: Ba = 79.0744, Bb = 69.2946

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.683, 95% CI = [0.577, 0.781]

Fitted beta distribution parameters for estimated g: Ba = 53.6857, Bb = 24.8847

=====

Input:

Search parameters

trial carcasses placed = 59, carcasses found = 32

estimated searcher efficiency: p = 0.542, 95% CI = [0.416, 0.665]

k = 0.67

Search schedule: Search interval (I) = 3.5, number of searches = 13, span = 45.5

spatial coverage: 0.78 temporal coverage: 1

-----

Carcass persistence:

Exponential persistence distribution

scale ( $\beta$ ) = 20.76

95% CI  $\beta = [14.95, 28.79]$  and  $r = 0.92$  for  $I_r = 3.5$  with 95% CI = [0.892, 0.942]

Parameters entered manually

Uniform arrivals

-----

**Appendix D9. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 70-meter full plot searches at 17 turbines with a blade length of 57 meters, searched at a 3.5-day interval.**

EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ **Formula**

Search interval (I)

Number of searches

☐ **Custom**

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs:  $p \in [0.53, 0.676]$ ,  $k \in [0.65, 0.816]$

$\hat{p} = 0.62$ ,  $k = 0.735$

☒ Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.542$ , with 95% CI =  $[0.416, 0.665]$

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters

Distribution: Lognormal with shape ( $\alpha$ ) = 4.078 and scale ( $\beta$ ) = 1.171

$r = 0.653$  for  $I_r = 3.5$ , with 95% CIs:  $r \in [0.529, 0.777]$ ,  $\beta \in [0.488, 1.854]$

☒ Enter parameter estimates manually

**Parameters**

rate

scale ( $\beta$ )  lwr  upr

$r = 0.92$  for  $I_r = 3.5$ , with 95% CI:  $r \in [0.892, 0.942]$

### Fatality estimation (M, $\lambda$ )

Carcass Count (X)   ☒ One-sided CI (M\*) ☐ Two-sided CI

Credibility level (1 -  $\alpha$ )

### Estimated detection probability (g)

File Edit

Summary statistics for estimation of detection probability (g)

=====

Results:

Full site for full year

Estimated  $g = 0.535$ , 95% CI =  $[0.453, 0.617]$

Fitted beta distribution parameters for estimated  $g$ :  $Ba = 75.7855$ ,  $Bb = 65.7646$

Full site for monitored period, 01-Apr-2023 through 16-May-2023

Estimated  $g = 0.535$ , 95% CI =  $[0.453, 0.617]$

Fitted beta distribution parameters for estimated  $g$ :  $Ba = 75.7855$ ,  $Bb = 65.7646$

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Apr-2023 through 16-May-2023

Estimated  $g = 0.678$ , 95% CI =  $[0.57, 0.776]$

Fitted beta distribution parameters for estimated  $g$ :  $Ba = 52.6309$ ,  $Bb = 25.028$

=====

Input:

Search parameters

trial carcasses placed = 59, carcasses found = 32

estimated searcher efficiency:  $p = 0.542$ , 95% CI =  $[0.416, 0.665]$

$k = 0.67$

Search schedule: Search interval (I) = 3.5, number of searches = 13, span = 45.5

spatial coverage: 0.79 temporal coverage: 1

-----

Carcass persistence:

Exponential persistence distribution

scale ( $\beta$ ) = 20.76

95% CI  $\beta = [14.95, 28.79]$  and  $r = 0.92$  for  $I_r = 3.5$  with 95% CI =  $[0.892, 0.942]$

Parameters entered manually

Uniform arrivals

-----

**Appendix D10. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 70-meter full plot searches at three turbines with a blade length of 68 meters, searched at a 3.5-day interval.**

EoA, v2.0.7 - Single Class Module

Edit Help

### Detection Probability (g)

**Search Schedule**

Start of monitoring (yyyy-mm-dd)

☒ **Formula**

Search interval (I)

Number of searches

☐ **Custom** [Edit/View](#)

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

[Estimate g](#)

**Searcher Efficiency**

☐ Carcasses available for several searches

95% CIs: p  [0.53, 0.676], k  [0.65, 0.816]

p̂ = 0.62, k̂ = 0.735 [View](#) [Edit](#)

☒ Carcasses removed after one search

Carcasses available

Carcasses found

p̂ = 0.542, with 95% CI = [0.416, 0.665]

Factor by which searcher efficiency changes with each search (k)

**Persistence Distribution**

☐ Use field trials to estimate parameters [View/Edit](#)

Distribution: Lognormal with shape (α) = 4.078 and scale (β) = 1.171

r = 0.653 for I<sub>r</sub> = 3.5, with 95% CIs: r = [0.529, 0.777], β = [0.488, 1.854]

☒ Enter parameter estimates manually [View](#)

**Parameters**

**Exponential**

rate

**Weibull**

scale (β)  I<sub>wr</sub>  I<sub>ur</sub>

**Log-Logistic**

**Lognormal**

r = 0.92 for I<sub>r</sub> = 3.5, with 95% CI: r  [0.892, 0.942]

**Fatality estimation (M, λ)**

Carcass Count (X)  [Estimate M](#)

Credibility level (1 - α)  [Estimate λ](#)

☒ One-sided CI (M\*) ☐ Two-sided CI

[Close](#)

**Estimated detection probability (g)**

File Edit

Summary statistics for estimation of detection probability (g)

=====

Results:

Full site for full year

Estimated g = 0.517, 95% CI = [0.441, 0.594]

Fitted beta distribution parameters for estimated g: Ba = 84.242, Bb = 78.5498

Full site for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.517, 95% CI = [0.441, 0.594]

Fitted beta distribution parameters for estimated g: Ba = 84.242, Bb = 78.5498

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Apr-2023 through 16-May-2023

Estimated g = 0.681, 95% CI = [0.577, 0.777]

Fitted beta distribution parameters for estimated g: Ba = 55.8412, Bb = 26.1699

=====

Input:

Search parameters

trial carcasses placed = 59, carcasses found = 32

estimated searcher efficiency: p = 0.542, 95% CI = [0.416, 0.665]

k = 0.67

Search schedule: Search interval (I) = 3.5, number of searches = 13, span = 45.5

spatial coverage: 0.76 temporal coverage: 1

-----

Carcass persistence:

Exponential persistence distribution

scale (β) = 20.76

95% CI β = [14.95, 28.79] and r = 0.92 for I<sub>r</sub> = 3.5 with 95% CI = [0.892, 0.942]

Parameters entered manually

Uniform arrivals

**Appendix D11. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for spring 2023, 70-meter full plot searches at eight turbines with a blade length of 75 meters, searched at a 3.5-day interval.**



EoA, v2.0.7 - Multiple Class Module

Edit Help

Options

Overall

☐ Estimate total mortality (M)

Credibility level ( $1 - \alpha$ )

☒ One-sided CI ( $M^*$ )

☐ Two-sided CI

☒ Estimate overall detection probability (g)

Individual classes

☐ Calculate g parameters from monitoring data

☒ Enter g parameters manually

Actions

Add class Calculate Clear Close

Class	dwp	X	Ba	Bb	ĝ	95% CI
unsearched	0.01	0	0.01	1000.00	0	[0, 0]
50-m blade FP	0.10	0	73.53	59.29	0.5536	[0.469, 0.637]
57-m blade FP	0.07	0	79.57	70.74	0.5294	[0.45, 0.608]
68-m blade FP	0.03	0	74.60	64.58	0.536	[0.453, 0.618]
75-m blade FP	0.05	0	83.07	77.32	0.5179	[0.441, 0.595]
50-m blade RP	0.31	0	143.41	913.81	0.1356	[0.116, 0.157]
57-m blade RP	0.28	0	137.26	741.21	0.1562	[0.133, 0.181]
68-m blade RP	0.02	0	139.69	985.60	0.1241	[0.106, 0.144]
75-m blade RP	0.13	0	150.85	1114.18	0.1192	[0.102, 0.138]

Estimated detection probability (g) for multiple classes

File Edit

Summary statistics for multiple class estimate

Input: Detection probability, by search class

Search coverage = 0.99

Class	DWP	X	Ba	Bb	ghat	95% CI
unsearched	0.01	0	---	---	0	[0, 0]
50-m blade FP	0.1	0	73.53	59.29	0.554	[0.469, 0.637]
57-m blade FP	0.07	0	79.57	70.74	0.529	[0.450, 0.608]
68-m blade FP	0.03	0	74.6	64.58	0.536	[0.453, 0.618]
75-m blade FP	0.05	0	83.07	77.32	0.518	[0.441, 0.595]
50-m blade RP	0.31	0	143.4	913.8	0.136	[0.116, 0.157]
57-m blade RP	0.28	0	137.3	741.2	0.156	[0.133, 0.181]
68-m blade RP	0.02	0	139.7	985.6	0.124	[0.106, 0.144]
75-m blade RP	0.13	0	150.8	1114	0.119	[0.102, 0.138]

Results for full site

Detection probability

Estimated g = 0.238, 95% CI = [0.224, 0.253]

Fitted beta distribution parameters for estimated g: Ba = 773.7095, Bb = 2474.7375

Mortality

Test of assumed relative weights (rho)

Class	Assumed	Fitted (95% CI)
unsearched	0.010	NA
50-m blade FP	0.100	[0.000, 0.294]
57-m blade FP	0.070	[0.000, 0.309]
68-m blade FP	0.030	[0.000, 0.299]
75-m blade FP	0.050	[0.000, 0.340]
50-m blade RP	0.310	[0.001, 0.701]
57-m blade RP	0.280	[0.001, 0.645]
68-m blade RP	0.020	[0.001, 0.728]
75-m blade RP	0.130	[0.001, 0.707]

p = 1 for likelihood ratio test of H0: assumed rho = true rho

**Appendix D12. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for spring 2023 stratified by plot type and turbine type, searches at 133 turbines, searched at a 3.5-day interval.**

EoA, v2.0.7 - Multiple Class Module

Edit Help

Options

Overall

☐ Estimate total mortality (M)

Credibility level ( $1 - \alpha$ )

☒ One-sided CI ( $M^*$ )

☐ Two-sided CI

☒ Estimate overall detection probability (g)

Individual classes

☐ Calculate g parameters from monitoring data

☒ Enter g parameters manually

Actions

Add class Calculate Clear Close

Class	dwp	X	Ba	Bb	$\hat{g}$	95% CI
unsearched	0	0	---	---	0	[0, 0]
spring	1	0	777.24	2543.25	0.2341	[0.22, 0.249]

Estimated detection probability (g) for multiple classes

File Edit

Summary statistics for multiple class estimate

Input: Detection probability, by search class

Search coverage = 1

Class	DWP	X	Ba	Bb	ghat	95% CI
unsearched	0	0	---	---	0	[0, 0]
spring	1	0	777.2	2543	0.234	[0.220, 0.249]

Results for full site

Detection probability

Estimated  $g = 0.234$ , 95% CI = [0.22, 0.249]

Fitted beta distribution parameters for estimated  $g$ :  $Ba = 777.24$ ,  $Bb = 2543.25$

Mortality

Test of assumed relative weights ( $\rho$ )

Class	Assumed	Fitted (95% CI)
unsearched	0.000	NA
spring	1.000	[1.000, 1.000]

$p = 1$  for likelihood ratio test of  $H_0$ : assumed  $\rho = \text{true } \rho$

**Appendix D13. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for spring 2023, searches at 133 turbines, searched at a 3.5- day interval.**



## Past monitoring and operations data

Year	p	X	Ba	Bb	$\hat{g}$	95% CI
2020	0.89	0	323.42	1417.48	0.1858	[0.168, 0.204]
2021	1	0	2365.45	4863.69	0.3272	[0.316, 0.338]
2022	1	0	903.02	2673.21	0.2525	[0.238, 0.267]
2023	0.11	0	777.24	2543.25	0.2341	[0.22, 0.249]

## Options

## Fatalities

☒ Estimate M Credibility level (1 -  $\alpha$ ) 0.5

☒ Total mortality

☒ One-sided CI ( $M^*$ )

☐ Two-sided CI

## Project parameters

Total years in project 4

Mortality threshold (T) 60

☐ Track past mortality

☐ Projection of future mortality and estimates

Future monitoring and operations

☒ g and p unchanged from most recent year

☐ g and p constant, different from most recent year

g 0.08 95% CI: 0.07 0.09 p 1

☐ g and p vary among future years

## Average Rate

☒ Estimate average annual fatality rate ( $\lambda$ )
Annual rate threshold ( $\tau$ ) 2.5
☐ Credibility level for CI (1 -  $\alpha$ ) 0.9

☒ Short-term rate ( $\lambda > \tau$ ) Term: 4  $\alpha$  0.05

☐ Reversion test ( $\lambda < p\tau$ ) p 0.6  $\alpha$  0.1

## Actions

Calculate

Close

## Mortality over 4 years

File Edit

## Summary statistics for total mortality through 4 years

## Results

 $M^* = 0$  for  $1 - \alpha = 0.5$ , i.e.,  $P(M \leq 0) \geq 50\%$ 

 Estimated overall detection probability:  $g = 0.257$ , 95% CI = [0.249, 0.265]  
 Ba = 2891.9, Bb = 8363.5

 Estimated baseline fatality rate:  $\lambda = 0.6488$ , 95% CI = [0.000644, 3.26]
Test of assumed relative weights ( $\rho$ ) and potential biasFitted  $\rho$ 

Assumed $\rho$	95% CI
0.89	[0.006, 2.604]
1	[0.002, 2.373]
1	[0.004, 2.612]
0.11	[0.006, 2.648]

 $p = 1$  for likelihood ratio test of  $H_0$ : assumed  $\rho$  = true  $\rho$ 

Quick test of relative bias: 0.934

## Posterior distribution of M

m	$p(M = m)$	$p(M > m)$
0	0.5481	0.4519
1	0.1687	0.2832
2	0.0962	0.1870
3	0.0603	0.1268
4	0.0395	0.0873
5	0.0265	0.0608
6	0.0181	0.0427
7	0.0125	0.0302
8	0.0087	0.0214
9	0.0061	0.0153
10	0.0043	0.0109
11	0.0031	0.0078
12	0.0022	0.0056
13	0.0016	0.0041
14	0.0011	0.0029
15	0.0008	0.0021
16	0.0006	0.0015

**Appendix D14. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Years Module inputs 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, v2.0.7 - Multiple Years Module

Edit Help

Past monitoring and operations data

Year	p	X	Ba	Bb	$\hat{g}$	95% CI
2020	0.89	0	323.42	1417.48	0.1858	[0.168, 0.204]
2021	1	0	2365.45	4863.69	0.3272	[0.316, 0.338]
2022	1	0	903.02	2673.21	0.2525	[0.238, 0.267]
2023	0.11	0	777.24	2543.25	0.2341	[0.22, 0.249]

Options

Fatalities

☒ Estimate M Credibility level (1 -  $\alpha$ ) 0.5

☒ Total mortality ☒ One-sided CI ( $M^*$ )

☐ Two-sided CI

Project parameters

Total years in project 4

Mortality threshold (T) 60

☐ Track past mortality

☐ Projection of future mortality and estimates

Future monitoring and operations

☒ g and p unchanged from most recent year

☐ g and p constant, different from most recent year

g 0.08 95% CI: 0.07 0.09 p 1

☐ g and p vary among future years

Average Rate

☐ Estimate average annual fatality rate ( $\lambda$ )

Annual rate threshold ( $\tau$ ) 2.5

☐ Credibility level for CI (1 -  $\alpha$ ) 0.9

☒ Short-term rate ( $\lambda > \tau$ ) Term: 4  $\alpha$  0.05

☐ Reversion test ( $\lambda < \rho \tau$ )  $\rho$  0.6  $\alpha$  0.1

Actions

Calculate Close

Mortality over 4 years

File Edit

Summary statistics for total mortality through 4 years

-----

Results

$M^* = 0$  for  $1 - \alpha = 0.5$ , i.e.,  $P(M \leq 0) \geq 50\%$

Estimated overall detection probability:  $g = 0.257$ , 95% CI = [0.249, 0.265]

Ba = 2891.9, Bb = 8363.5

Estimated baseline fatality rate:  $\lambda = 0.6488$ , 95% CI = [0.000644, 3.26]

Test of assumed relative weights ( $\rho$ ) and potential bias

Assumed $\rho$	95% CI	Fitted $\rho$
0.89	[0.006, 2.604]	
1	[0.002, 2.373]	
1	[0.004, 2.612]	
0.11	[0.006, 2.648]	

$p = 1$  for likelihood ratio test of  $H_0$ : assumed  $\rho$  = true  $\rho$

Quick test of relative bias: 0.934

Posterior distribution of M

m	$p(M = m)$	$p(M > m)$
0	0.5481	0.4519
1	0.1687	0.2832
2	0.0962	0.1870
3	0.0603	0.1268
4	0.0395	0.0873
5	0.0265	0.0608
6	0.0181	0.0427
7	0.0125	0.0302
8	0.0087	0.0214
9	0.0061	0.0153
10	0.0043	0.0109
11	0.0031	0.0078
12	0.0022	0.0056
13	0.0016	0.0041
14	0.0011	0.0029
15	0.0008	0.0021
16	0.0006	0.0015

**Appendix D15. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Years Module inputs 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, v2.0.7 - Multiple Years Module
Edit Help

Past monitoring and operations data

Year	p	X	Ba	Bb	g	95% CI
2020	0.89	0	323.42	1417.48	0.1858	[0.168, 0.204]
2021	1	0	2365.45	4863.69	0.3272	[0.316, 0.338]
2022	1	0	903.02	2673.21	0.2525	[0.238, 0.267]
2023	0.11	0	777.24	2543.25	0.2341	[0.22, 0.249]

Options

Fatalities

☒ Estimate M
Credibility level (1 -  $\alpha$ ) 0.5

☒ Total mortality
☒ One-sided CI (M\*)
☐ Two-sided CI

Project parameters
Total years in project 30
Mortality threshold (T) 60
☐ Track past mortality
☒ Projection of future mortality and estimates

Future monitoring and operations
☒ g and p unchanged from most recent year
☐ g and p constant, different from most recent year

g 0.08 95% CI: 0.07 0.09 p 1
☐ g and p vary among future years

Average Rate
☒ Estimate average annual fatality rate ( $\lambda$ )
Annual rate threshold ( $\tau$ ) 2.5
☐ Credibility level for CI (1 -  $\alpha$ ) 0.9
☒ Short-term rate ( $\lambda > \tau$ )
Term: 4  $\alpha$  0.05
☐ Reversion test ( $\lambda < \rho \tau$ )
p 0.6  $\alpha$  0.1

Actions

Calculate Close

Short-term Trigger
File Edit

Short-term trigger: Test of average fatality rate ( $\lambda$ ) over 4 years  
Years: 2020 - 2023  
=====
Results  
Estimated overall detection probability: g = 0.257, 95% CI = [0.249, 0.265]  
Ba = 2891.9, Bb = 8363.5  
  
Estimated annual fatality rate over the past 4 years:  $\lambda = 0.4866$ , 95% CI = [0.000483, 2.45]  
P( $\lambda > 2.5$ ) = 0.0234  
Compliance: Cannot infer  $\lambda > 2.5$  with 95% credibility  
  


---

Input  
Threshold for short-term rate ( $\tau$ ) = 2.5 per year  
  

Period	rel_wt	X	Ba	Bb	ghat	95% CI
2020	0.890	0	323.4	1417	0.186	[0.168, 0.204]
2021	1.000	0	2365	4864	0.327	[0.316, 0.338]
2022	1.000	0	903	2673	0.253	[0.238, 0.267]
2023	0.110	0	777.2	2543	0.234	[0.220, 0.249]

**Appendix D16. Screen shot of Evidence of Absence (v2.0.7) graphical user interface (EoA GUI), Multiple Years 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.**

Note: although the weight ( $\rho$ ) column of the Multiple Years Module sums to 3, the EoA GUI produces a “year-adjusted  $\lambda$ ” by calculating the average  $\lambda$  over the number of input rows (years) in the multi-year module of the GUI. Because the  $\rho$  values associated with each year in the GUI are scaled so that a “ $\rho$ ” of 1.0 is equivalent to a typical operations year for the wind farm (but 2020 and 2023 were only surveyed for portions of the year), we would like to calculate the “ $\rho$ -adjusted  $\lambda$ ” but the GUI does not accommodate that calculation. Therefore, the “ $\rho$ -adjusted  $\lambda$ ”, 0.65, is equivalent to the “year-adjusted  $\lambda$ ” (0.4866) as seen in the output above) divided by the sum of  $\rho$  (3) multiplied by the number of years (4).

EoA, v2.0.7 - Multiple Years Module
Edit Help

Past monitoring and operations data

Year	$p$	$X$	$Ba$	$Bb$	$\hat{g}$	95% CI
2020	0.89	1	323.42	1417.48	0.1858	[0.168, 0.204]
2021	1	0	2365.45	4863.69	0.3272	[0.316, 0.338]
2022	1	0	903.02	2673.21	0.2525	[0.238, 0.267]
2023	0.11	0	777.24	2543.25	0.2341	[0.22, 0.249]

Options

Fatalities

☒ Estimate M
Credibility level ( $1 - \alpha$ )

☒ Total mortality
☒ One-sided CI ( $M^*$ )
☐ Two-sided CI

Project parameters

Total years in project 
Mortality threshold ( $T$ )

☐ Track past mortality
☐ Projection of future mortality and estimates

Future monitoring and operations

☒  $g$  and  $p$  unchanged from most recent year
☐  $g$  and  $p$  constant, different from most recent year
☐  $g$  and  $p$  vary among future years

Average Rate

☒ Estimate average annual fatality rate ( $\lambda$ )

Annual rate threshold ( $\tau$ )

☐ Credibility level for CI ( $1 - \alpha$ )

☒ Short-term rate ( $\lambda > \tau$ )
Term:   $\alpha$

☐ Reversion test ( $\lambda < p \tau$ )

$p$    $\alpha$

Actions

Short-term Trigger
File Edit

Short-term trigger: Test of average fatality rate ( $\lambda$ ) over 4 years  
Years: 2020 - 2023  
=====

Results

Estimated overall detection probability:  $g = 0.257$ , 95% CI = [0.249, 0.265]  
 $Ba = 2891.9$ ,  $Bb = 8363.5$

Estimated annual fatality rate over the past 4 years:  $\lambda = 1.46$ , 95% CI = [0.105, 4.55]  
 $P(\lambda > 10.8) = 0$   
Compliance: Cannot infer  $\lambda > 10.8$  with 95% credibility

Input

Threshold for short-term rate ( $\tau$ ) = 10.8 per year

Period	rel_wt	$X$	$Ba$	$Bb$	$\hat{g}$	95% CI
2020	0.890	1	323.4	1417	0.186	[0.168, 0.204]
2021	1.000	0	2365	4864	0.327	[0.316, 0.338]
2022	1.000	0	903	2673	0.253	[0.238, 0.267]
2023	0.110	0	777.2	2543	0.234	[0.220, 0.249]

# Appendix D17. Screen shot of Evidence of Absence (v2.0.7) graphical user interface (EoA GUI), Multiple Years Module for estimation of Indiana bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text.

Note that although the weight ( $p$ ) column of the Multiple Years Module sums to 3, the EoA GUI produces a “year-adjusted  $\lambda$ ” by calculating the average  $\lambda$  over the number of input rows (years) in the multi-year module of the GUI. Because the  $p$  values associated with each year in the GUI are scaled so that a “ $p$ ” of 1.0 is equivalent to a typical operations year for the wind farm (but 2020 and 2023 were only surveyed for portions of the year), we would like to calculate the “ $p$ -adjusted  $\lambda$ ” but the GUI does not accommodate that calculation. Therefore, the “ $p$ -adjusted  $\lambda$ ”, 1.95, is equivalent to the “year-adjusted  $\lambda$ ” (1.46 as seen in the output above) divided by the sum of  $p$  (3) multiplied by the number of years (4).