Post-construction Monitoring Study for the California Ridge Wind Farm Champaign and Vermilion Counties, Illinois

Year 3 Final Report

August 22 – October 13, 2023

Prepared for:

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January 30, 2024

WEST

EXECUTIVE SUMMARY

California Ridge Wind Energy, LLC, is operating the California Ridge Wind Farm (Project) in Champaign and Vermilion counties, Illinois. The Project became operational in 2012 and consists of 134 turbines, each with a capacity of 1.6 megawatts (MW) that have a 100-meter (m; 328-foot [ft]) hub height and a 50-m (164-ft) blade length. This report details the post-construction monitoring (PCM) studies conducted in fall 2023, consistent with Section 7.3 of the Project's Habitat Conservation Plan (HCP), United States Fish and Wildlife Service (USFWS) Incidental Take Permit (ITP; ESPER0018464) and Illinois Department of Natural Resources (IDNR) Incidental Take Authorization (ITA; ITA222) for the Indiana bat, northern long-eared bat[1], little brown bat and tricolored bat[2] (collectively, Covered Species). Note that the state permit only covers the Indiana bat and northern long-eared bat at this time given that neither the tricolored bat or little brown bat are listed in the state of Illinois.

Western EcoSystems Technology, Inc. (WEST), followed PCM methods outlined in the Project's HCP, which targeted a probability of detection (*g*) of 0.061 for Indiana bats and northern long-eared bats and 0.043 for little brown bats and tricolored bats. The objectives of this study were to produce estimates of bat mortality as outlined in the HCP, and to evaluate the need for adaptive management measures.

The third-year year PCM was completed by WEST from August 22 – October 13, 2023[3]. Standardized carcass searches were completed for bat carcasses at road and pad plots. Across fall, technicians searched road and pad plots at all 134 turbines out to 95 m (311 ft) from each turbine once per week. Searcher efficiency and carcass persistence trials were also conducted to correct for detection and scavenger bias.

No Covered Species were found during the 2023 searches. The most commonly found species were eastern red bat (75.6%) and silver-haired bat (9.8%), followed by hoary bat (7.3%) and big brown bat (7.3%). The overall bat fatality rate, calculated using a generalized estimator of fatality (commonly, GenEst), was 9.86 bats per MW.

The overall *g* was 0.013 (90% CI: 0.011–0.015) for Indiana bat and northern long-eared bat and 0.009 (90% CI: 0.080–0.010) for little brown bat and tricolored bat. No adaptive management triggers were met under the ITP.

[1] On November 29, 2022, the USFWS published the final rule to list the northern long-eared bat as endangered under the Endangered Species Act. The effective date of the final rule took effect March 31, 2023.

[2] On September 14, 2022, the USFWS proposed to list the tricolored bat as endangered under the Endangered Species Act. The final listing decision is expected in 2024.

[3] Searches began August 22 rather than on August 1 due to unforeseen project delays.

STUDY PARTICIPANTS

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REPORT REFERENCE

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INTRODUCTION

California Ridge Wind Energy, LLC (California Ridge) is operating the California Ridge Wind Farm (Project) in Champaign and Vermilion counties, Illinois. The Project became operational in 2012 and consists of 134 General Electric 1.6-megawatts (MW) wind turbines that have a 100-meter (m; 328-foot [ft]) hub height and a 50-m (164-ft) blade length. California Ridge obtained a United States Fish and Wildlife Service (USFWS) Incidental Take Permit (ITP; ESPER0018464) for the federally listed as endangered Indiana bat (*Myotis sodalis*), federally listed as endangered northern long-eared bat[4] (*M. septentrionalis*), as well as two species that were not protected by the federal Endangered Species Act at the time of the ITP issuance; little brown bat (*M. lucifugus*) and tricolored bat[5] (*Perimyotis subflavus*; collectively, Covered Species) dated August 6, 2021. California Ridge also obtained Incidental Take Authorization (ITA) from the Illinois Department of Natural Resources (IDNR) for Indiana and northern long-eared bat on January 20, 2022. Both the USFWS ITP and IDNR ITA require the Project to minimize impacts to Covered Species and conduct post-construction monitoring (PCM).

Western EcoSystems Technology, Inc. (WEST) completed the third-year annual PCM in accordance with Section 7.3 of the Project's Habitat Conservation Plan (HCP; Stantec Consulting Services, Inc. 2021). The objectives of this study were to produce estimates of bat mortality and evaluate the need for adaptive management measures. This report presents the results of the 2023 year of monitoring conducted at the Project from August 22 – October 13.

STUDY AREA

According to the National Land Cover Dataset (2021), the primary land cover type within the Permit Area (a 1.0-kilometer [0.6-mile] buffer around the outermost turbines) is cultivated crops (95.2%), followed by developed areas (4.2%; Figure 1). The remaining land cover types make up less than 1.0% of the area individually.

All turbines are within the migratory range of the Indiana bat, northern long-eared bat, little brown bat, and tricolored bat. California Ridge adjusted turbine operations during the fall (August 1 – October 15) to minimize impacts to the Covered Species (Table 1).

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[4] On November 29, 2022, the USFWS published the final rule to list the northern long-eared bat as endangered under the Endangered Species Act. The status change took effect on January 30, 2023.

[5] On September 14, 2022, the USFWS proposed to list the tricolored bat as endangered under the Endangered Species Act. The final listing decision is expected in late 2024.

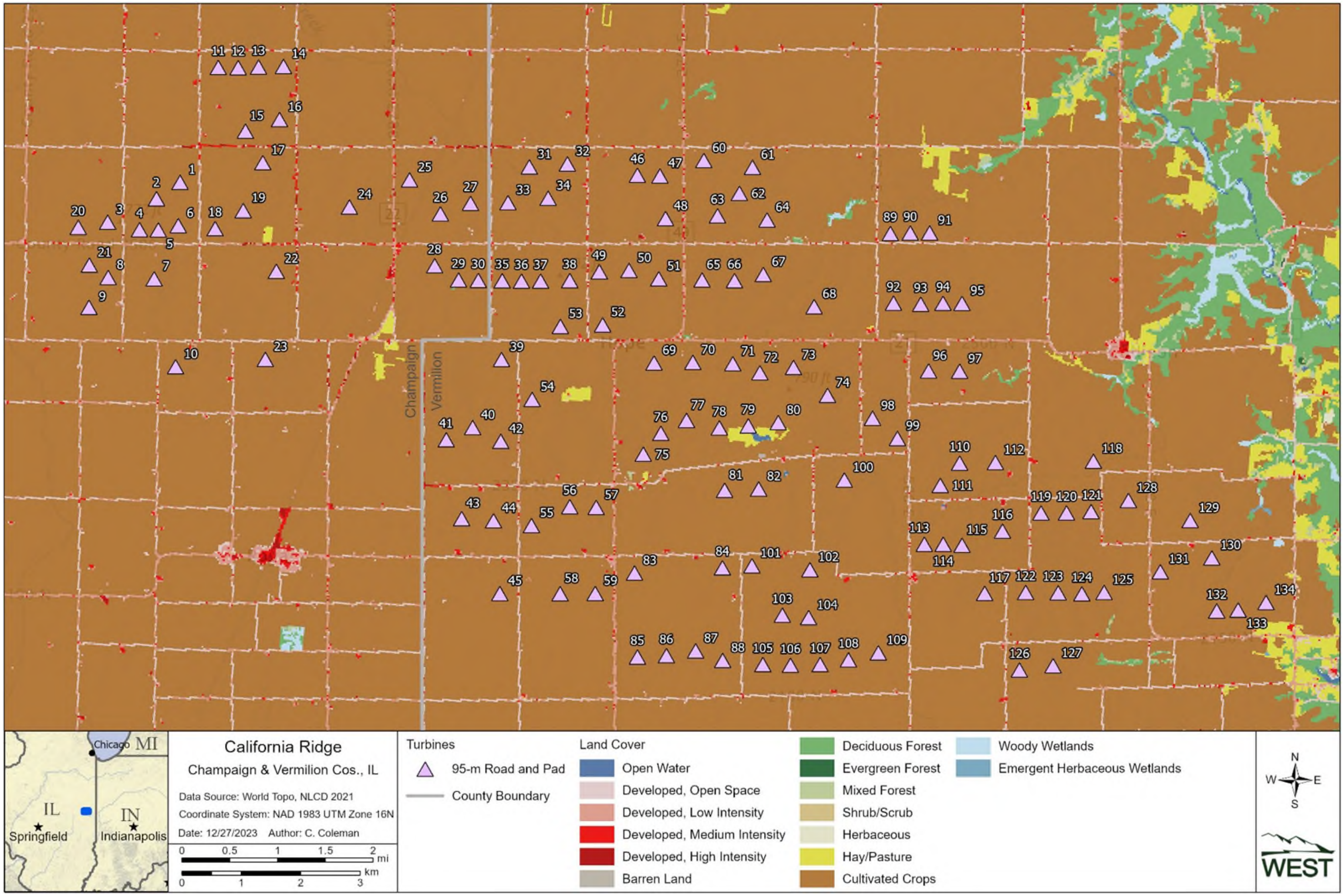


Figure 1. Turbines by plot type and surrounding land cover at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

Table 1. Seasonal curtailment regime at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

Season	Turbines	Time of Day	Cut-In Speed[1]	Feathering Below Cut-In[2]?	Temperature Threshold[3]
Fall: August 1 – October 15	All	Sunset to sunrise	5.0 m/s	Yes	Above 10°C (50°F)

1. The manufacturer's cut-in wind speed is 3.0 meters per second (m/s; 9.8 feet/s) across the Project turbines.
2. Feathering means that turbine blades will be pitched into the wind such that they spin at less than one rotation per minute.
3. Turbines will be feathered below cut-in when temperatures are above the threshold.

°C = degrees Celsius; °F = degrees Fahrenheit.

METHODS

WEST followed PCM methods outlined in the Project's HCP, which targeted a probability of detection (*g*) of 0.061 for Indiana bats and northern long-eared bats and 0.043 for little brown bats and tricolored bats to meet the monitoring commitments.

Standardized Carcass Searches

Number of Turbines Sampled, Search Frequency, and Plot Size

Standardized carcass searches were completed once weekly on roads and pads at all turbines from August 22 – October 13, 2023. The HCP defines the fall bat migratory period as August 1 – October 15 yearly. Searches began August 22 due to unforeseen project delays. Road and pad searches at all 134 Project turbines included searching the entire gravel road and pad area within a 95-m (311-ft) radius of the turbine base once per week (Table 2). If vegetation (weeds, grass, and/or crops) was present, vegetation was maintained by operations and maintenance staff. Areas of dense and high vegetation were noted on carcass search forms.

Table 2. Search effort at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

Season	Search Team	Plot Type	Number of Plots	Search Interval
Fall	Technicians	Road and pads – 95 m	134	Once weekly

m = meters.

Search Methods

All personnel were trained to follow search methodology from the Project's HCP, including proper handling and reporting of carcasses. Carcass searches were conducted during the day, beginning as early as first light.

During 95-m road and pad searches, the technician started at 95 m from the turbine and walked the access road at a rate of approximately 45–60 m (148–197 ft) per minute toward the turbine, around the turbine along the gravel pad, and back towards their vehicle. The technician searched out to 2.5 m (8.2 ft) on each side as they walked until the entire road/access pad was searched to ensure full visual coverage of each search area (Figure 2).

Figure 2. Representative photo of conditions of a 95-meter road and pad plot.

Data Collection

Technicians recorded the date, search start and end times, technician name, turbine number, type of search, and if any carcasses were found during 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 data sheet, including the date and time, species, technician name, turbine number, measured distance from turbine, azimuth from turbine, location of carcass as Universal Transverse Mercator coordinates, habitat surrounding carcass, carcass condition, and estimated time of death (i.e., 0–1 days, 2–3 days, 4–7 days, 8–14 days, 15–30 days, or more than 30 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 (i.e., scattered within a 1.0-m radius) indicating predation or scavenging of a bird carcass.

Technicians took digital photographs of each carcass, including any visible injuries, and surrounding habitat. No bird carcasses were collected. Bat carcasses were collected under the Project's USFWS ITP ESPER0018464, WEST's Federal Native Endangered and Threatened Species Recovery Permit ES234121, WEST's State Endangered and Threatened Species Scientific Permit 16988, and individual state salvage permits: NH23.7024, NH23.6419, NH23.6968, NH23.6689, and NH23.6426. 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 and rubber gloves were used to handle all bat carcasses to eliminate possible transmission of rabies or other diseases. Protocols were for any live, injured bats to be recorded and considered fatalities for analysis purposes if observed in search areas and handled in accordance with permit conditions (left in place).

Bird and bat 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 statistical analysis.

Carcass Identification and Agency Notification

Field identification of bird carcasses were verified by WEST biologists with extensive field experience in identification of birds and their feathers. A WEST federally permitted bat biologist (Meredith Hoggatt ESPER0039249; Pallavi Sirajuddin TE62046D-0) identified all bat carcasses via photos and/or in hand at the end of the surveys. The USFWS and the IDNR were notified within 24 hours of positive identification any state- or federally listed species.

If any fragments or highly decomposed bat carcasses were found that could not be identified, tissue samples were collected and submitted to the East Stroudsburg University Wildlife Genetics Institute for identification via deoxyribonucleic acid (DNA) analysis.

Bias Trials

Searcher Efficiency Trials

The objective of searcher efficiency trials was to estimate the probability that a carcass was found by technicians. Searcher efficiency trials were conducted in the same areas where carcass searches occurred. Technicians conducting carcass surveys did not know when searcher efficiency trials were being conducted or the location of the trial carcasses. Trial carcasses consisted of eastern red bats (*Lasiurus borealis*), hoary bats (*L. cinereus*), big brown bats (*Eptesicus fuscus*), evening bats (*Nycticeius humeralis*), and silver-haired bats (*Lasionycteris noctivagans*) that had previously been found on site. Forty carcasses were placed within search areas during the fall season.

Multiple trials were conducted to measure potential changes in plot conditions on searcher efficiency over time. Each trial carcass was discreetly marked with a black zip-tie and/or a piece of electrical tape around the upper forelimb for identification as a study carcass after it is found. Carcasses were dropped from waist-height or higher and allowed to land in a random posture.

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 subsequent search were recorded, and the number of trial carcasses available for detection during each search was determined immediately after each trial by the trial administrator responsible for distributing the carcasses. Following searches, any carcasses that were not detected were checked to confirm availability. The forty trial carcasses were left in place and used for carcass persistence trials.

Carcass Persistence Trials

The objective of carcass persistence trials was to estimate the length of time (in days) a carcass would persist, or be available for detection, in the field. Carcasses could be removed by scavenging or rendered undetectable by typical farming activities. Only one carcass was placed at a turbine during each trial to avoid potential over seeding or attracting an increased number of 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 7 days, then on days 10, 14, 21, and 30. Trial carcasses were monitored by technicians until they were completely removed or the trial period ended and they were then picked up. Due to time constraints of the study, carcasses placed during the final persistence trial were not left out for the full 30 days.

Search Area Mapping

During studies on site in 2022, technicians recorded the boundaries of 95-m road and pads using a Trimble R1 GNSS Receiver 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 to estimate the number of carcasses that fell inside or outside of search areas. Due to no changes to the road and pads since 2022, last year’s search area mapping was used for the 2023 study.

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 Evidence of Absence (EoA; Dalthorp et al. 2017) modeling framework was used to estimate the probability of detecting each Covered Species. Additionally, per the Project's HCP, the all-bat fatality estimate was calculated using GenEst (a generalized estimator of fatality; Dalthorp et al. 2018, Simonis et al. 2018).

Bias Trials

<u>Searcher Efficiency Estimation</u>

Searcher efficiency was modeled using logistic regression, while accounting for the detection reduction factor (*k*; Dalthorp et al. 2018).

The results of searcher efficiency model selection are used differently in GenEst and EoA. The logistic regression model was used with GenEst to estimate the all-bat fatality rate. EoA uses raw searcher efficiency data (e.g., number of found and available trial carcasses) to inform overall probability of detection.

Detection Reduction Factor

The change in searcher efficiency between successive searches was defined by a parameter called the detection reduction factor (*k*) that ranged from zero to one. When *k* is zero it implied that a carcass missed on the first search would never be found. A *k* of one implied searcher efficiency remained constant no matter how many times a carcass is missed. The detection reduction factor was a required parameter for GenEst; however, data were not collected to estimate *k*. A value for *k* of 0.8 was assumed for bats per the HCP.

<u>Carcass Persistence Rate Estimation</u>

Data collected during carcass persistence trials were used to estimate the amount of time, in days, carcasses remained available to be located by the technician. The average probability a carcass persisted through the search interval (i.e., the time between scheduled searches) was estimated using an interval-censored survival regression with four potential distributions: exponential, log-logistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Dalthorp et al. 2018). Selection was completed using an information theoretic approach known as AICc, or corrected Akaike Information Criterion (Burnham and Anderson 2002). The best-supported model for EoA and the all-bat fatality estimate 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 (α [shape] and β [scale], including the 90% Confidence Interval [CI] of β) were used as inputs in the EoA Single Class module.

Search Area Adjustment/Density Weighted Proportion

The search area adjustment accounted for unsearched areas beneath turbines and was calculated as a probability that ranged from zero to one. For example, an area adjustment of 0.75 meant that an estimated 75% of carcasses fell within the search area. Unsearched areas were due to survey obstacles such as terrain, or areas where carcasses fell outside the search area (e.g., a carcass landed within the agricultural land off the searched road and pad area). The area adjustment was estimated as the product of the relative proportion of searched area around each turbine and a carcass-density distribution. The carcass-density distribution predicts the likelihood a carcass fell a given distance from the turbine base.

The method used to estimate the carcass-density distribution was specified in Section 7.3.3.3 of the HCP which states:

> "GenEst does not currently have a module for estimating the area adjustment, but it may become available during the permit term. Meanwhile, the area adjustment will be calculated using density-weighted proportions, placing each carcass found into a 10-meter distance band, and calculating the percent of each distance band that was searched site-wide, and the weighted searcher efficiency for that distance band. If other methods for modeling search area adjustment become available during the permit term, California Ridge will seek written USFWS approval to use them in fatality estimates."

The method outlined above corresponds to an adaptation of the "Cake Method" described in Maurer et al. (2020) in which the number of fatalities found in a 10-m (33-ft) concentric annulus around the turbine is divided by the probability of detection and the proportion of area searched in each 10-m annulus to develop an "effective number of carcasses" within each annulus (Maurer et al. 2020). The effective number of carcasses within each annulus is divided by the sum of effective number of carcasses in all annuli to calculate the relative carcass density within each 10-m annulus. This method is not able to account for carcasses that may occur beyond the maximum search radius. Although the HCP specifies that a 'weighted searcher efficiency,' will be used in the calculation of density weighted proportion, the quantity that is relevant to the effective number of carcasses is actually the carcass detection probability (which includes the searcher efficiency as a component). For this study, the detection probability for each carcass was multiplied by the proportion of searched area within each annulus and used as the overall probability of detection as in Maurer et al. (2020).

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-m annulus around the turbine. The area adjustment was estimated by combining the carcass-density for each 10-m annulus with the proportion of area searched for each 10-m annulus for each plot type across the search area and summarizing across the distances.

In EoA, the search area adjustment is the aggregate of this across all 134 turbines; for GenEst, each turbine is assigned a turbine-specific Density Weighted Proportion (DWP) based on the specific road and pad layout at that turbine.

Carcasses Excluded from Area Correction Calculations

Fatalities were excluded from the area correction estimate 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 area adjustment accounts for the carcass by adjusting for unsearched areas. Carcasses found with an estimated time of death before August 1 were also excluded because the carcass occurred outside of the study period. Note that carcasses found on a plot incidentally were included in the analysis if that plot had a scheduled search during the next round of surveys.

Detection Probability Estimates

Estimates of the probability of detecting each Covered Species were calculated using EoA using the Single Class, Multiple Class, and Multiple Years modules. Appendix A shows details on how the detection probabilities were calculated using the EoA Graphical User Interface, which are also summarized below.[6]

The probability of detection (*g*) was estimated using the bias corrections for searcher efficiency, carcass persistence, and area searched, and the assumed seasonality of risk for the Covered Species. The seasonality of risk (expressed as relative proportion of the species arriving at the Project in each season) per the HCP, was 0.017 in the spring, zero in the summer, and 0.983 in the fall for Indiana bat and northern long-eared bat, and 0.065 in the spring, 0.255 in the summer, and 0.680 in the fall for little brown bat and tricolored bat. Within the fall period, a seasonality of 28.8% was assigned to August 1 – August 21 and a seasonality of 71.2% was assigned to August 22 – October 13 based on the number of days within each period. This assumed that the risk within the fall period was uniform throughout that period.

The EoA Single Class module was used to estimate detection probability for the second part of fall. Based on the bias correction data input, an alpha (α, defined Ba in EoA) and beta (β, defined Bb in EoA) parameters are estimated that define the beta distribution of detection probability. A beta distribution with parameters set to Ba = 0.01 and Bb = 1,000 was used to indicate the unsearched time periods of spring, summer, and the first part of fall (August 1 – August 21).

The EoA Multiple Class module was then used to combine detection probability distributions across strata (95-m roads and pads in the second part of fall and unsearched plots during the rest of the year), with weights for each class defined by the sampling fraction and seasonality of risk. The Multiple Years module was used to estimate the cumulative beta distribution of detection probability for all years at the project (Ba and Bb parameters for the detection probability to date). The Multiple Years module requires the beta distribution parameters for detection probability in each year and weights (ρ), which were all assumed to be one because there were no changes in facility operations (such as cut-in speed) between years that would have resulted in different weights.

[6] 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.

Fatality Rate Estimation

Carcasses included in the fatality rate estimation were found within the search areas (plots) and had an estimated time of death within the study period. Fatality estimates were calculated for all bats. To obtain an overall estimate of fatality, each carcass included in the analysis was adjusted for searcher efficiency, carcass persistence, a detection reduction factor (also referred to as "*k*"; see above), and a search area adjustment. Estimates and 90% CIs were calculated using a parametric bootstrap (Dalthorp et al. 2018).

Assessment of Adaptive Management Triggers

As specified in the Project's HCP, the need for adaptive management during the initial five years of the ITP is based upon the number of Covered Species carcasses found during compliance monitoring. Adaptive management would only be triggered by discovery of two or more Indiana bat carcasses, four or more northern long-eared bat carcasses, nine or more little brown bat carcasses, or 13 or more tricolored bat carcasses during the first five years of PCM.

Covered Species Take Estimates

Section 7.3.3.5 of the Project's HCP specifies Covered Species take estimates to be calculated and reported using the Multiple Years Module; however, these estimates are not used to assess compliance during the initial five years of the ITP. These estimates include the median cumulative take to-date (M^*), the median cumulative take within the current monitoring year (M^*_{2022}), the projected mortality ($M_{Projected}$), and the mean annual take rate (λ) for each of the Covered Species and are presented in Appendix B.

RESULTS

Standardized Carcass Searches

Overall, 1,056 searches were completed during the study period. Forty-eight searches (4.5%) were missed due to turbine maintenance, weather constraints, and/or safety hazards. No surveys were completed prior to August 22, 2023; however, the statistical analysis accounted for the missed surveys.

Overall Carcasses

Thirty-nine bat carcasses were found during carcass searches (Appendix C). An additional bat carcass was found outside the search area and another was determined to have died prior to the study period; these two were not included in analysis (Table 3). Thirteen bird carcasses were found during surveys (Appendix C); however, no birds were included in the analysis.

Species Composition

Four bat species were recorded during carcass searches (Table 3; Appendix C). The most commonly found species were eastern red bat (31 carcasses; 75.6%) and silver-haired bat (four carcasses; 9.8%), followed by hoary bat (three carcasses; 7.3%), and big brown bat (three carcasses; 7.3%; Appendix C). No DNA analysis was necessary to identify the carcasses found. Additionally, no carcasses of Covered Species were discovered during the fall 2023 study.

Table 3. Number and percent (%) of carcasses by species included and excluded from analysis at the California Ridge Wind Farm, Champaign and Vermillion counties, Illinois, from August 22 – October 13, 2023.

	Included in Fatality Estimate		Outside Search Area*		Outside Study Period*		Other*		Total	
Species	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
eastern red bat	30	76.92	1	100	0	0	0	0	31	75.6
silver-haired bat	4	10.26	0	0	0	0	0	0	4	9.8
big brown bat	3	7.69	0	0	0	0	0	0	3	7.3
hoary bat	2	5.13	0	0	1	100	0	0	3	7.3
Overall Bats	**39**	**100**	**1**	**100**	**1**	**100**	**0**	**0**	**41**	**100**

* Carcasses not included in analysis/excluded from fatality estimate.

Timing and Distribution of Bat Carcasses

Most bat carcasses were found between August 22 and September 8 (Figure 3; Appendix C). Thirty-five bats (85% of casualties) were found between August 22 and September 8, with most bats found between September 5 and September 8, 2023 (Figure 3).

Bat carcasses were found at 36 of the 134 study turbines. Turbines 20, 44,52, and 82 had two casualties found at each search location, while 31 other turbines each had one bat carcass found within their search areas (Figure 4).

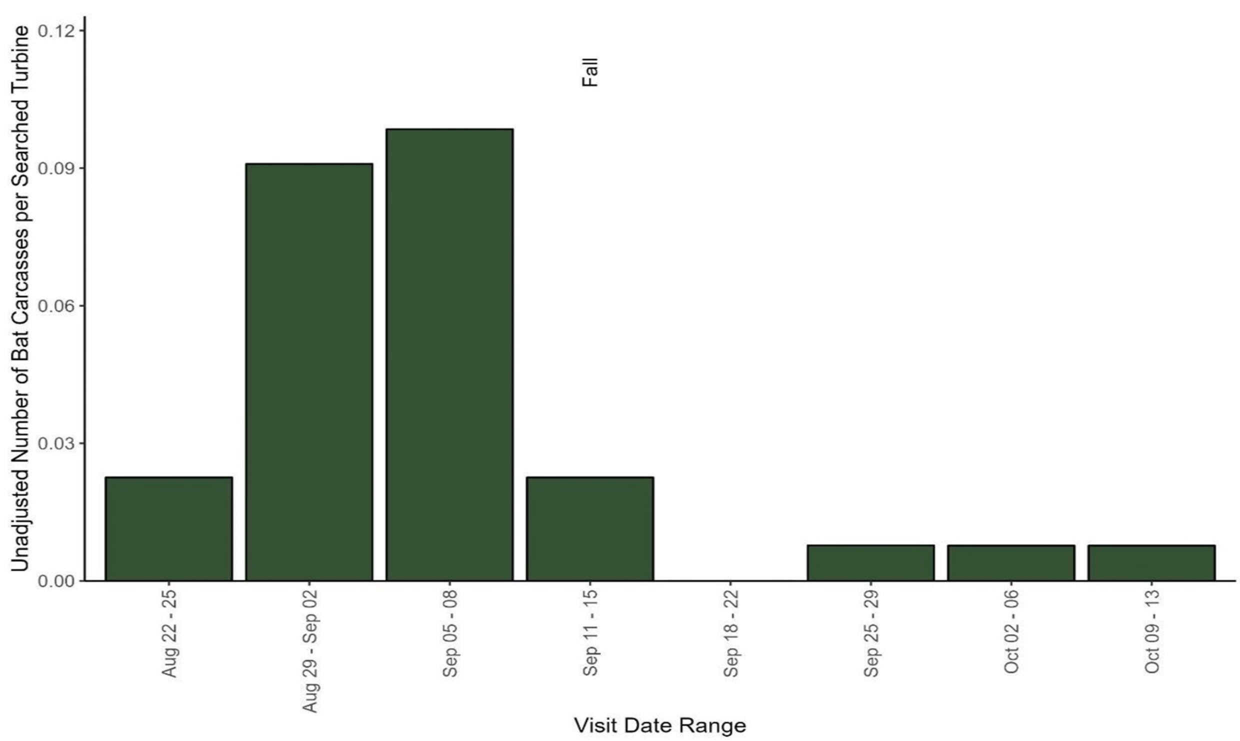


Figure 3. Timing of bat carcasses found on roads and pads for carcasses included in the GenEst fatality estimates at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

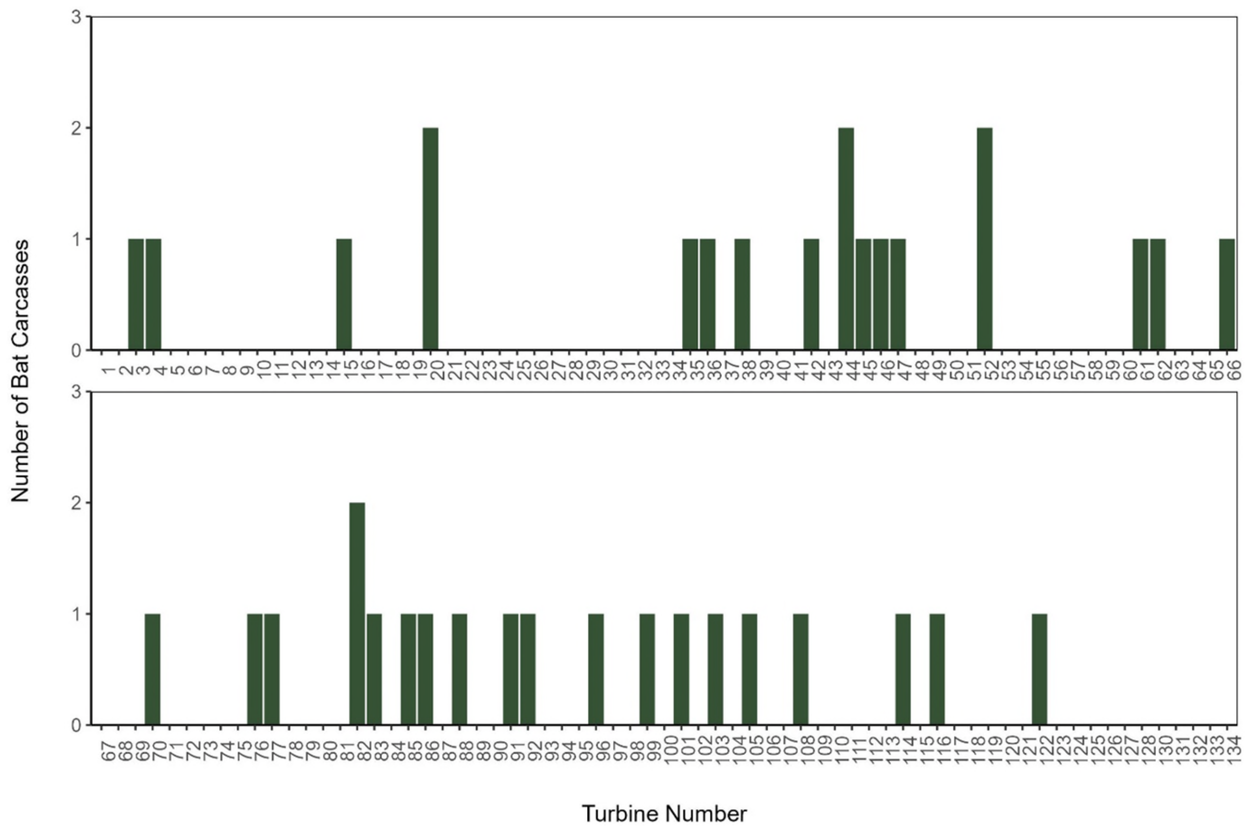


Figure 4. Number of bat carcasses found per turbine at the California Ridge Wind Farm, Champaign and Vermillion counties, Illinois, from August 22 – October 13, 2023.

Statistical Analysis

Bias Trials

Searcher Efficiency Trials

Forty bats were placed for searcher efficiency trials on three separate dates, and 32 were available for searchers to find. The overall searcher efficiency rate was 71.9% (Table 4). Searcher efficiency decay was modeled with a *k* value of 0.8.

Table 4. Searcher efficiency results at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

Plot Type	Number Placed	Number Available	Number Found	% Found
95-meter road and pad	40	32	23	71.9

Carcass Persistence Trials

The same forty carcasses used for searcher efficiency trials were also monitored to estimate carcass persistence. The best-fit model for carcass persistence had an exponential distribution The average probability of a carcass persisting through the 7.0-day search interval was 0.77 (90%

CI: 0.70–0.82) (Figure 5). Estimated median carcass persistence times for the 7-day search interval was 8.86 days (Figure 5; Appendix D).

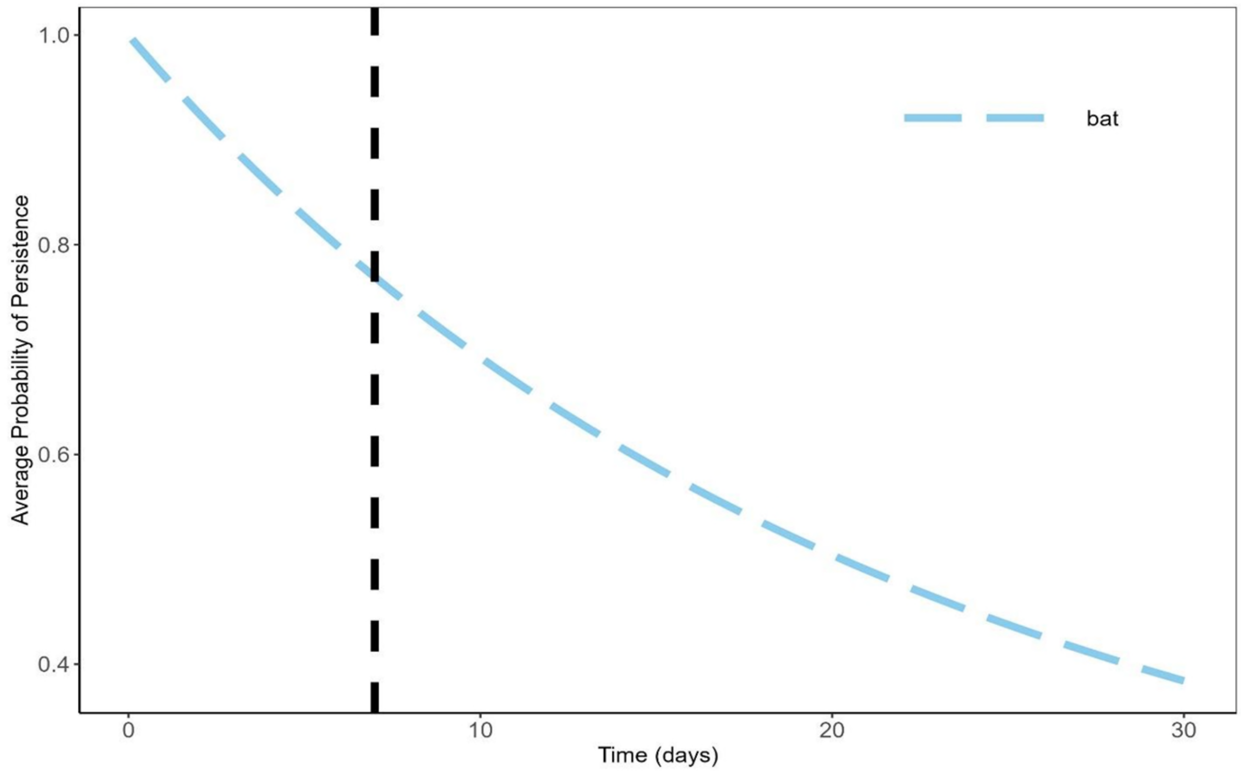


Figure 5. Average probability of carcass persistence as a function of time (days) for bat carcasses placed at the California Ridge Wind Farm, Champaign and Vermillion counties, Illinois, from August 22 – October 13, 2023. Average search interval was seven days and represented by a vertical line on the figure.

Search Area Adjustment

Two of the 41 bats found were excluded from modeling the carcass-density because one was found outside of the search area and the other had an estimated time of death prior to the start of carcasses searches. All fatalities included fell within 95 m of the base of the turbine (Table 5). The mean area adjustment was 0.03 for roads and pads (Table 6, Figure 6), meaning that an estimated 3% of bats fell within the search areas of the roads and pads.

Table 5. Results of relative carcass-density estimation using the using the "Cake Method" (Maurer et al. 2020), at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

10-meter (m) Annulus	Number of Carcasses	Average Detection Probability	Proportion of 10-m Annulus Searched	Relative Carcass Density
10	7	0.639	0.590	0.009
20	5	0.624	0.081	0.048
30	6	0.624	0.037	0.126
40	6	0.631	0.028	0.165
50	8	0.627	0.023	0.263
60	2	0.633	0.017	0.087

Table 5. Results of relative carcass-density estimation using the using the "Cake Method" (Maurer et al. 2020), at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

10-meter (m) Annulus	Number of Carcasses	Average Detection Probability	Proportion of 10-m Annulus Searched	Relative Carcass Density
70	1	0.660	0.016	0.047
80	2	0.637	0.012	0.122
90	2	0.653	0.011	0.133
100	0	0	0.008	0

Table 6. Area adjustment estimate for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023. Estimate was calculated using the "Cake Method" (Maurer et al. 2020).

Size Class	Search Area Type	Area Adjustment
Bat	Road and pad	0.03

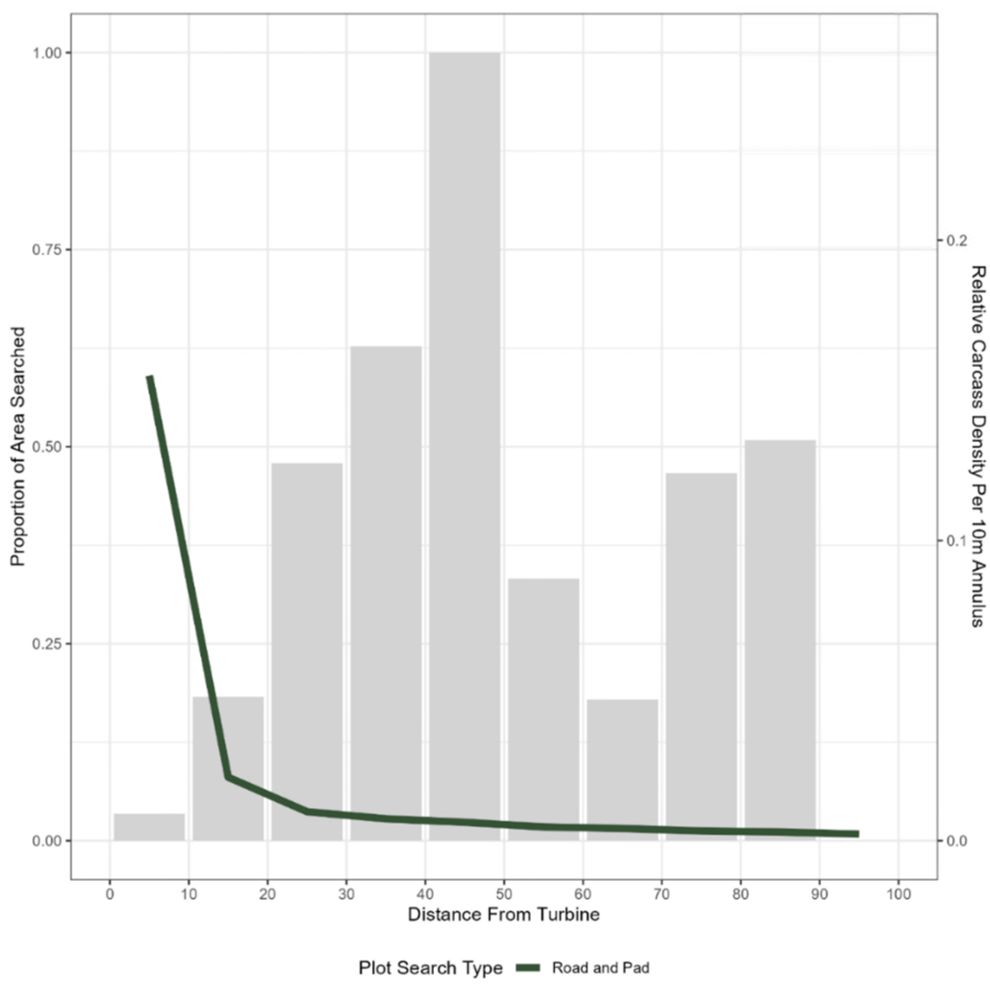


Figure 6. Density of bat carcasses per area searched at all 95-meter road and pads at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

Detection Probability Estimates – Evidence of Absence

The overall probability of detection achieved for the 2023 monitoring period was 0.013 (90% CI: 0.011–0.015) for Indiana bat and northern long-eared bat and 0.009 (90% CI: 0.008–0.010) for little brown bat and tricolored bat (Table 7). The cumulative *g* over the past three years of monitoring was 0.073 (90% CI: 0.070–0.076) for Indiana bat and northern long-eared bat and 0.069 (90% CI: 0.067–0.071) for little brown bat and tricolored bat (Table 7). Differences in the arrival proportions used for Indiana bat/northern long-eared bat and little brown bat/tricolored bat (see *Methods*) resulted in slightly different *g* distributions for these species. Inputs required to run the EoA Single Class module and stratum-specific *g* distribution values and inputs required for the Multiple Class and Multiple Years modules are described in Appendix A.

Table 7. Probability of detection (*g*), Ba, and Bb for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from July 19 – October 14, 2021, April 1 – October 15, 2022, and August 22 – October 13, 2023.

Year	Species Group	Ba*	Bb*	*g*	90% CI
2021	INBA/NLEB	29.295	2,295.992	0.013	0.009–0.017
	LBBA/TRBA	27.782	3,157.140	0.009	0.006–0.012
2022	INBA/NLEB	1,200.049	4,992.981	0.194	0.186–0.202
	LBBA/TRBA	2,547.059	10,889.440	0.190	0.184–0.195
2023	INBA/NLEB	117.607	8,967.292	0.013	0.011–0.015
	LBBA/TRBA	118.046	13,059.497	0.009	0.008–0.010
Cumulative for ITP monitoring to date	INBA/NLEB	1,394.23	17,677.14	0.073	0.070–0.076
	LBBA/TRBA	2,697.73	36,353.84	0.069	0.067–0.071

CI = Confidence Interval; ITP = Incidental Take Permit; INBA = Indiana bat; NLEB = northern long-eared bat; LBBA = little brown bat; TRBA = tricolored bat.

* = α and β parameters of beta distribution describing detection probability as defined in Evidence of Absence.

Adjusted Overall Bat Fatality Estimates – GenEst

The overall bat fatality estimate for the 2023 study was 9.86 bats per MW (90% CI: 7.08–13.41; Table 8). Inputs used to calculate fatality estimates are presented in Appendix E.

Table 8. Seasonal and overall bat fatality rates per turbine and megawatt (MW) using GenEst for studies conducted at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 15, 2023.

Season	Bat Fatality Estimate per Turbine	90% Confidence Interval	Bat Fatality Estimate per MW	90% Confidence Interval
Fall	15.78	11.32–21.46	9.86	7.08–13.41

Assessment of Adaptive Management Triggers

During year three of PCM, no Covered Species were recorded. During the previous two years of PCM, a single Indiana bat and single little brown bat carcass have been found. No northern long-eared bat or tricolored bat carcasses have been recorded under the ITP or ITA. No adaptive management triggers have been met as the number of carcasses recorded were below the adaptive management triggers for the initial five years of the ITP for all Covered Species (Table 9).

Table 9. Summary of adaptive management evaluations based upon the results from the first three years of compliance monitoring at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

Compliance Metric	Species	Adaptive Management Trigger	Number of Carcasses Discovered (2021 – 2023)	Adaptive Managemen t Required?
Number of Covered Species found during initial five years	Indiana bat	2	1	No
	northern long-eared bat	4	0	No
	little brown bat	9	1	No
	tricolored bat	13	0	No

CONCLUSIONS

One Indiana bat carcass and one little brown bat carcass, both HCP Covered Species, were recorded in 2022 and no additional covered species were found during 2023 monitoring (and none were found in 2021). Although Covered Species carcasses have been found at the Project, the number of Covered Species carcasses found during the initial three years of ITP monitoring were below the levels that would trigger adaptive management, and thus no adaptive management actions were triggered. Annual monitoring will occur again during the fall 2024 season, and no changes are proposed to the protocols at this time.

REFERENCES

Burnham, K. P. and D. R. Anderson. 2002. Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. Second Edition. Springer, New York, New York.

Dalthorp, D., M. M. P. Huso, and D. Dail. 2017. Evidence of Absence (V2.0) Software User Guide. US Geological Survey (USGS) Data Series 1055. USGS, Reston, Virginia. 109 pp. doi: 10.3133/ds1055. Available online: https://pubs.usgs.gov/ds/1055/ds1055.pdf

Dalthorp, D. H., L. Madsen, M. M. Huso, P. Rabie, R. Wolpert, J. Studyvin, J. Simonis, and J. M. Mintz. 2018. GenEst Statistical Models—a Generalized Estimator of Mortality. US Geological Survey Techniques and Methods, Volume 7, Chapter A2. 13 pp. doi: 10.3133/tm7A2. Available online : https ://pubs.usgs.gov/tm/7a2/tm7a2.pdf

Esri. 2023. World Imagery and Aerial Photos (World Topo). ArcGIS Resource Center. Environmental Systems Research Institute (Esri), producers of ArcGIS software, Redlands, California. Accessed December 2023. Available online: https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=10df2279f9684e4a9f6a7f08febac2a9

Kalbfleisch, J. D. and R. L. Prentice. 2002. The Statistical Analysis of Failure Time Data. John Wiley & Sons, Hoboken, New Jersey.

Maurer, J. D., M. Huso, D. Dalthorp, L. Madsen, and C. Fuentes. 2020. Comparing Methods to Estimate the Proportion of Turbine-Induced Bird and Bat Mortality in the Search Area under a Road and Pad Search Protocol. Environmental and Ecological Statistics 27: 769-801. doi: 10.1007/s10651-020-00466-0.

National Land Cover Database (NLCD). 2021. National Land Cover Database 2021 - Landcover & Imperviousness (Nlcd2021). Available online: https://www.mrlc.gov/data. As cited includes:

Dewitz, J. 2023. National Land Cover Database (NLCD) 2021 Products. US Geological Survey data release. doi: 10.5066/P9JZ7AO3.

Simonis, J., D. H. Dalthorp, M. M. Huso, J. M. Mintz, L. Madsen, P. Rabie, and J. Studyvin. 2018. GenEst User Guide—Software for a Generalized Estimator of Mortality. US Geological Survey Techniques and Methods, Volume 7, Chapter C19, 72 pp. doi: 10.3133/tm7C19. Available online: https://pubs.usgs.gov/tm/7c19/tm7c19.pdf

Stantec Consulting Services, Inc. (Stantec). 2021. California Ridge Wind Energy Project Final Habitat Conservation Plan for Indiana Bat, Northern Long-Eared Bat, Little Brown Bat, and Tricolored Bat. Prepared for California Ridge Wind Energy, LLC. Prepared by Stantec, Independence, Iowa. July 31, 2021.

Appendix A. Inputs for Single Class, Multiple Class, and Multiple Year Modules in Evidence of Absence for the 2023 Post-construction Monitoring at the California Ridge Wind Farm, Champaign and Vermilion Counties, Illinois, from August 22 – October 13, 2023

Appendix A1. Inputs needed to run Evidence of Absence (EoA): Single Class Module for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.[1]

Species Group	Season	Plot Type	Search Interval (I)	Number of Searches[2]	Spatial Coverage (a)	Searcher Efficiency		Carcass Persistence[3]	
						Carcasses Available	Carcasses Found	Shape (α)	Scale (β)
INBA/NLEB	Fall	95-m road and pad	7	8	0.03	32	23	NA	12.78
LBBA/TRBA	Fall	95-m road and pad	7	8	0.03	32	23	NA	12.78

[1] Inputs in each row apply to both species identified.

[2] Includes one additional search beyond what was conducted in the field to account for the EoA graphical use interface assumption that a clearing search is included in the number of searches.

[3] An exponential distribution was used for carcass persistence distribution.

INBA = Indiana Bat; NLEB = northern long-eared bat; LBBA = little brown bat; TRBA = tricolored bat; m = meter.

Appendix A2. Indiana bat/northern long-eared bat and little brown bat/tricolored bat species group inputs needed to run Evidence of Absence: Multiple Class Module[1] for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.[2]

Species Group	Season	Plot Type	Ba	Bb	Within-season Sampling Fraction	Within-season Risk Fraction	DWP
INBA/NLEB	Spring	Unsearched	0.01	1,000	1.000	1.000	1.0
LBBA/TRBA	Spring	Unsearched	0.01	1,000	1.000	1.000	1.0
INBA/NLEB	Summer	Unsearched	0.01	1,000	1.000	1.000	1.0
LBBA/TRBA	Summer	Unsearched	0.01	1,000	1.000	1.000	1.0
INBA/NLEB	Fall	Unsearched	0.01	1,000	1.000	0.303	0.3
LBBA/TRBA	Fall	Unsearched	0.01	1,000	1.000	0.303	0.3
INBA/NLEB	Fall	Road and pad	116.919	6,101.647	0.993	0.712	0.7
LBBA/TRBA	Fall	Road and pad	116.919	6,101.647	0.993	0.712	0.7

[1] Module was run twice, once using the Indiana bat/northern long-eared bat (INBA/NLEB) inputs and once using the little brown bat/tricolored bat (LBBA/TRBA) inputs.

[2] The inputs in each row apply to both species identified.

m = meters.

Appendix A3. Indiana bat/northern long-eared (INBA/NLEB) and little brown bat/tricolored bat (LBBA/TRBA) species groups inputs needed to run Evidence of Absence: Multiple Class Module for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

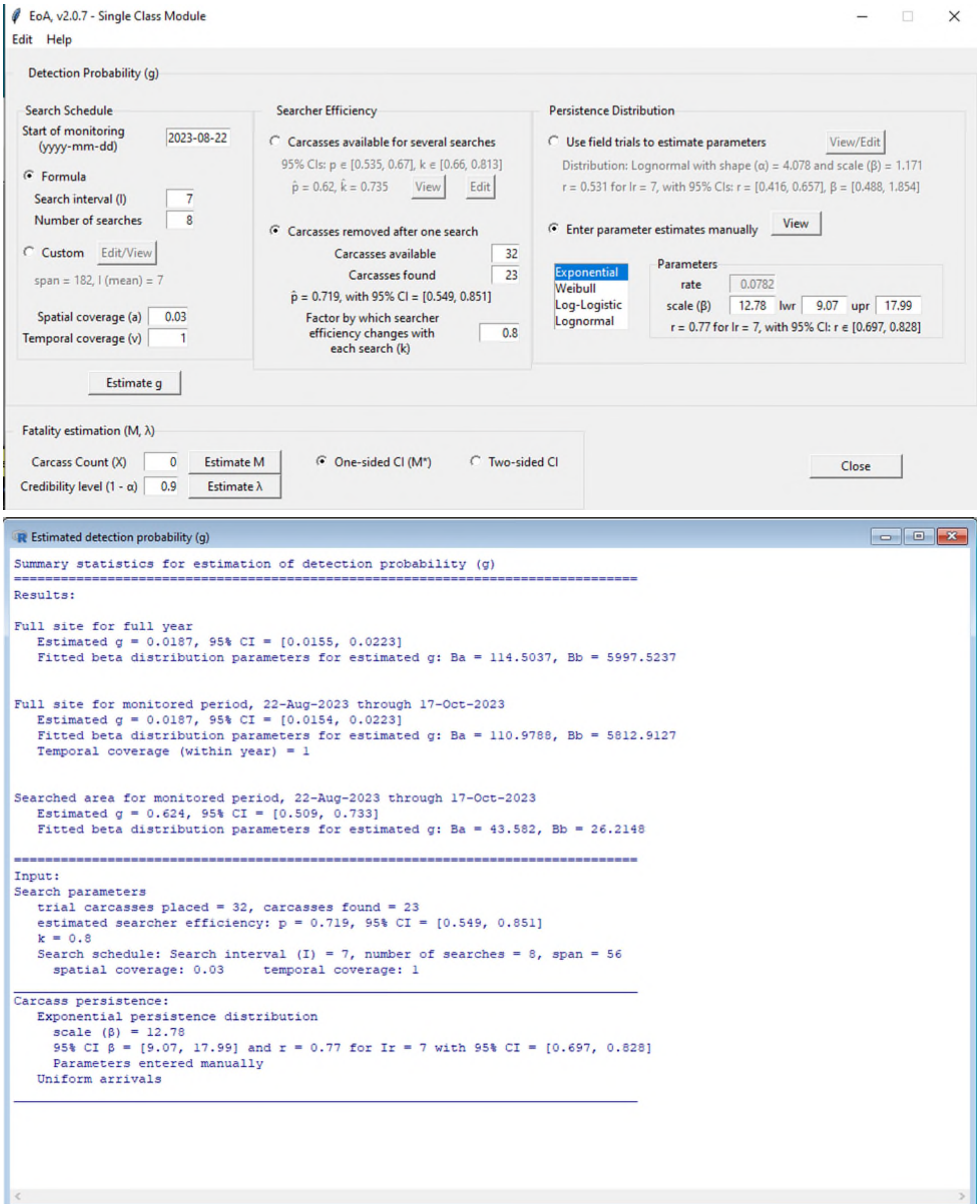
Season	Species Group	Ba	Bb	Weights (DWP)
Spring	INBA/NLEB	0.010	1,000	0.017
	LBBA/TRBA	0.010	1,000	0.065
Summer	INBA/NLEB	0.010	1,000	0
	LBBA/TRBA	0.010	1,000	0.255
Fall	INBA/NLEB	117.577	8,810.738	0.983
	LBBA/TRBA	117.577	8,810.738	0.680

Appendix A4. Indiana bat/northern long-eared bat species group inputs needed to run Evidence of Absence: Multiple Years Module for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

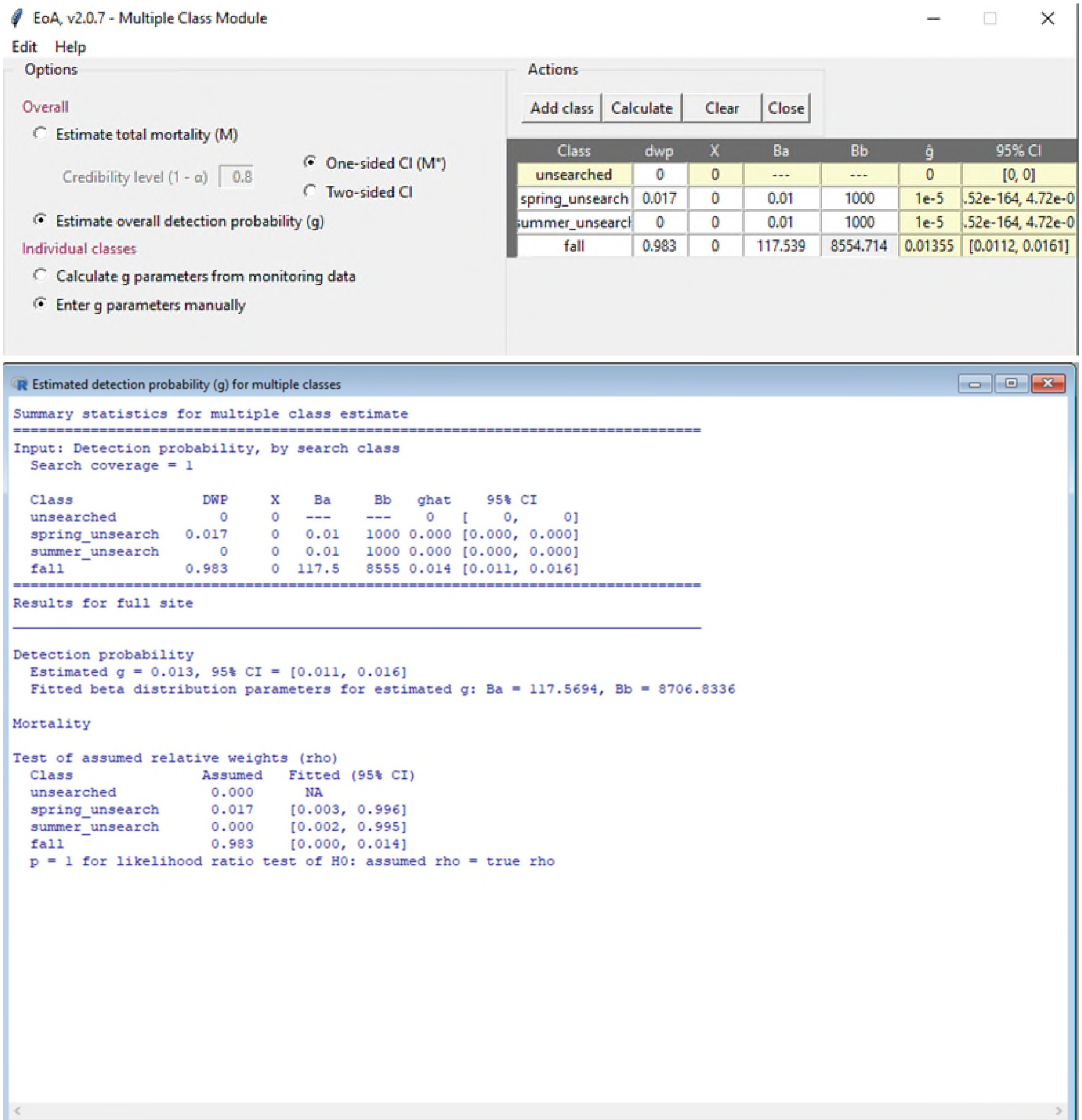
Year	*g*	90% Confidence Interval	Ba	Bb	Weights (ρ)
2021	0.0130	(0.009–0.017)	29.295	2,295.992	1.0
2022	0.1940	(0.186–0.202)	1,200.049	4,992.981	1.0
2023	0.0129	(0.011–0.015)	117.607	8,967.292	1.0

Appendix A5. Little brown bat/tricolored bat species group inputs needed to run Evidence of Absence: Multiple Years Module for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

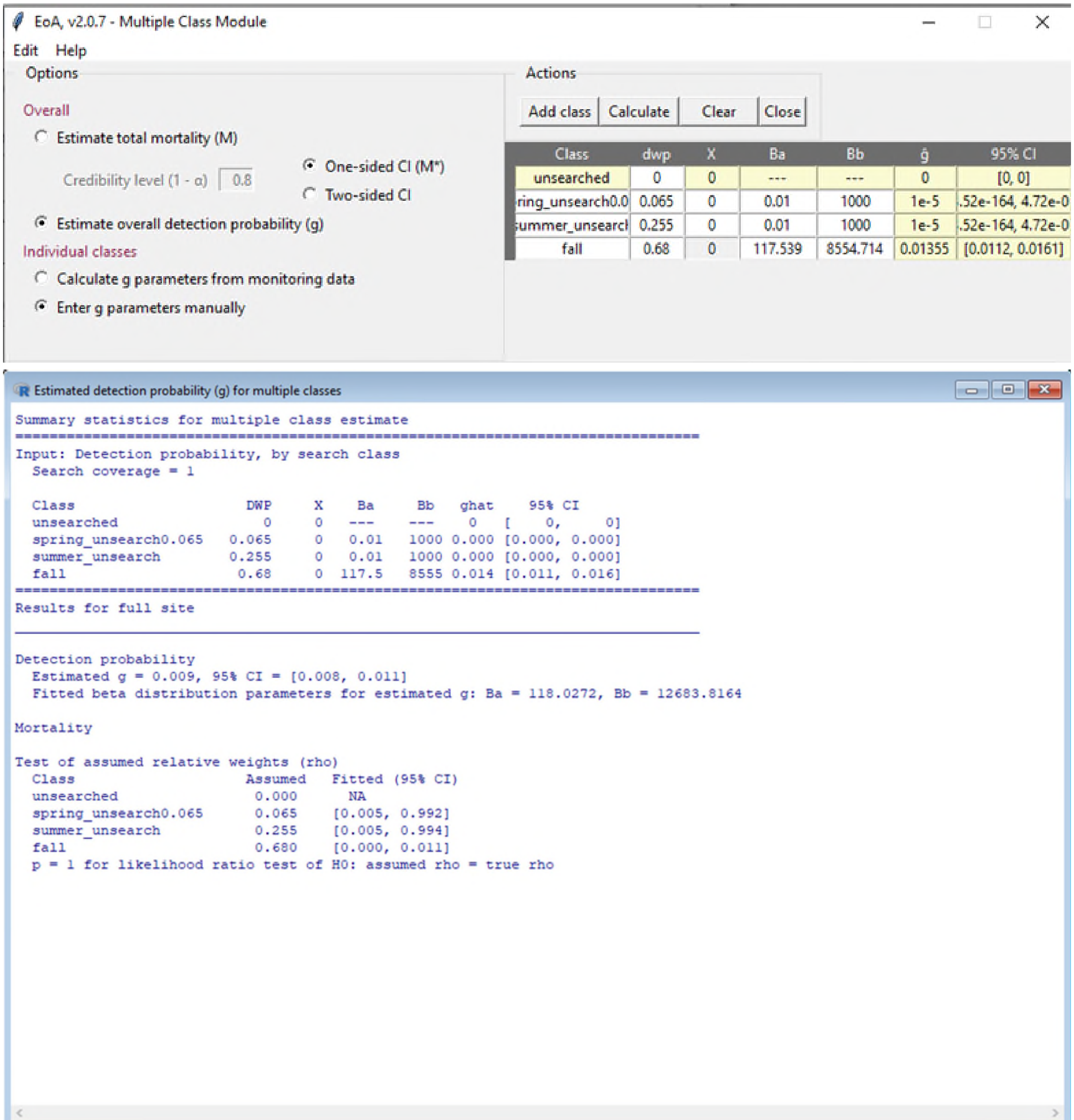
Year	*g*	90% Confidence Interval	Ba	Bb	Weights (ρ)
2021	0.009	(0.006–0.012)	27.782	3,157.140	1.0
2022	0.190	(0.184–0.195)	2,547.059	10,889.440	1.0
2023	0.009	(0.008–0.010)	118.046	13,059.497	1.0



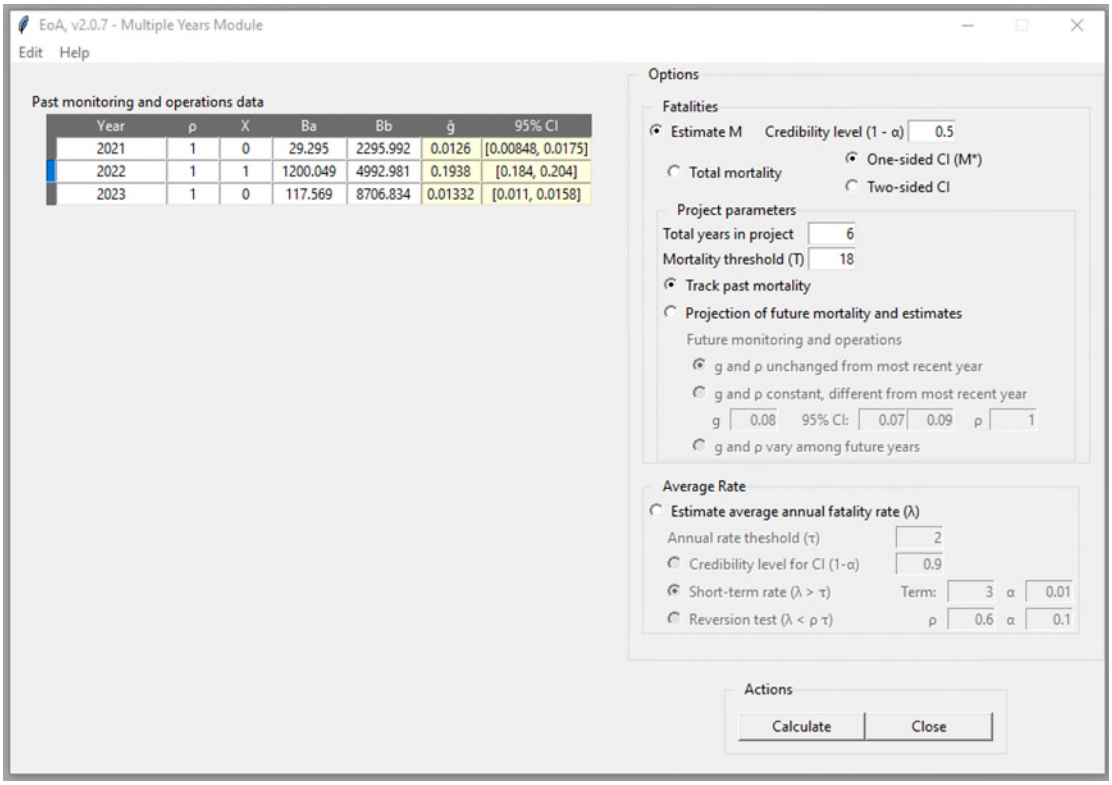
Appendix A6. Screenshot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs and output for fall 2023, road and pad searches.

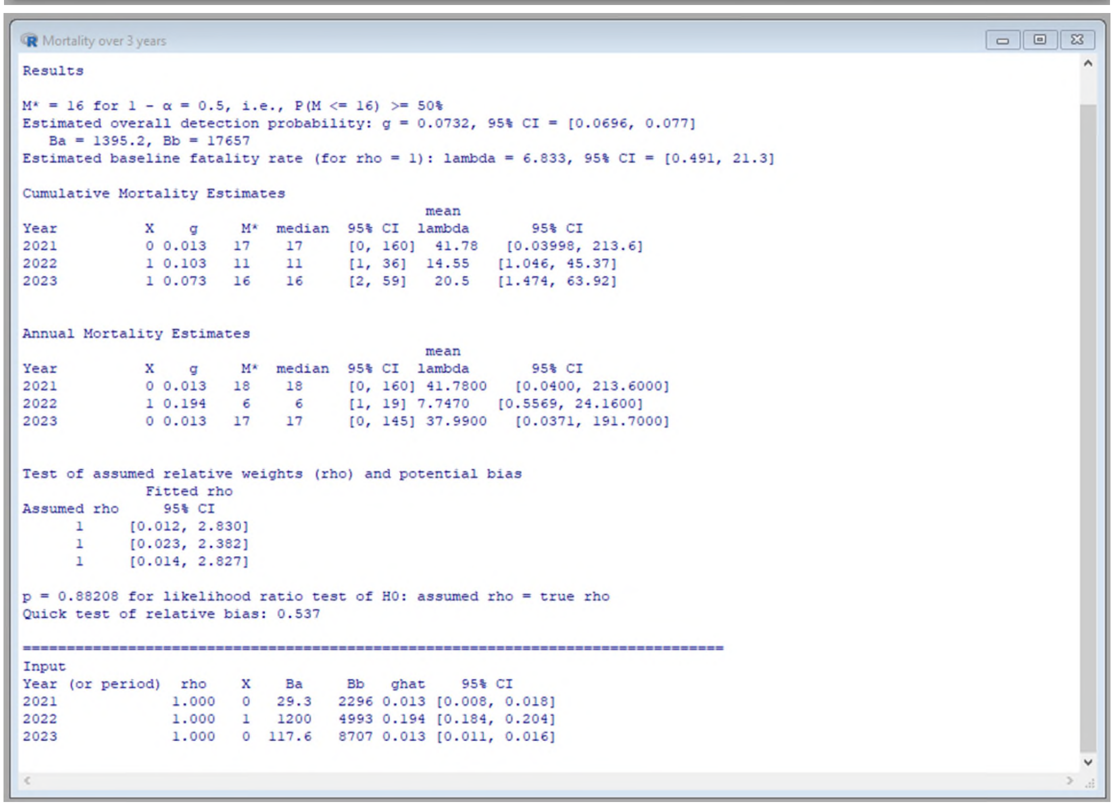


Appendix A7. Screenshot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for 2023 for Indiana and northern long-eared bats.

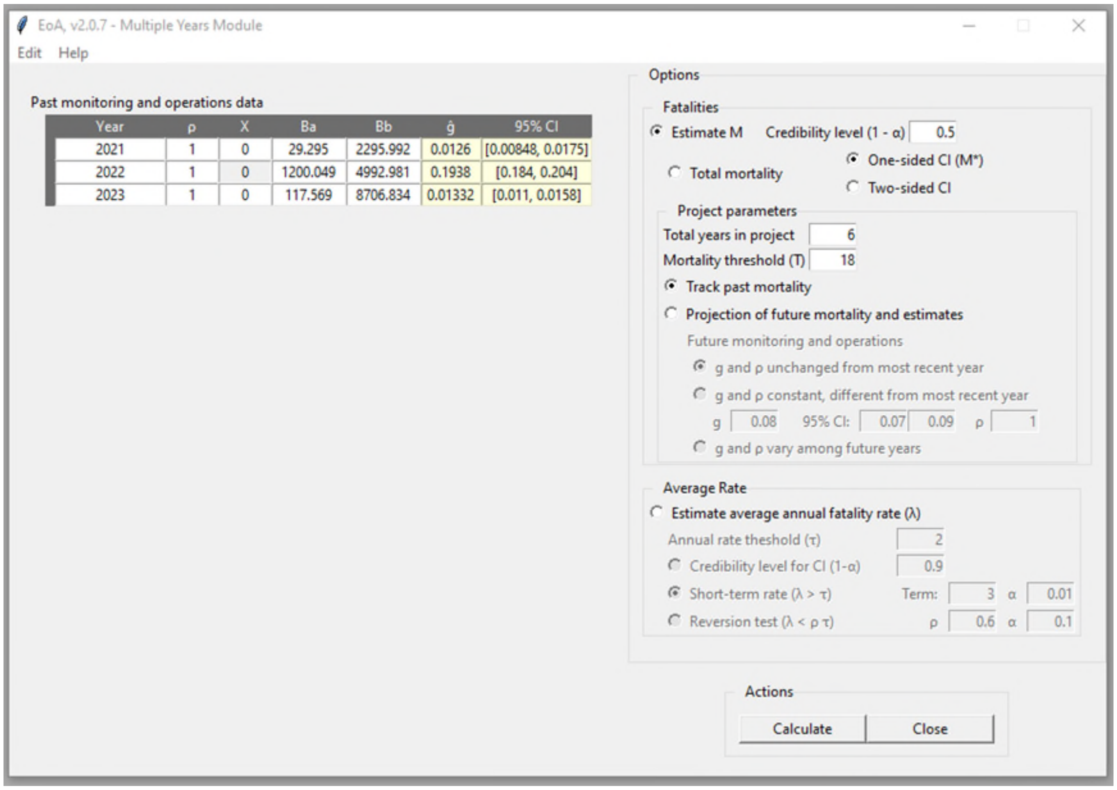


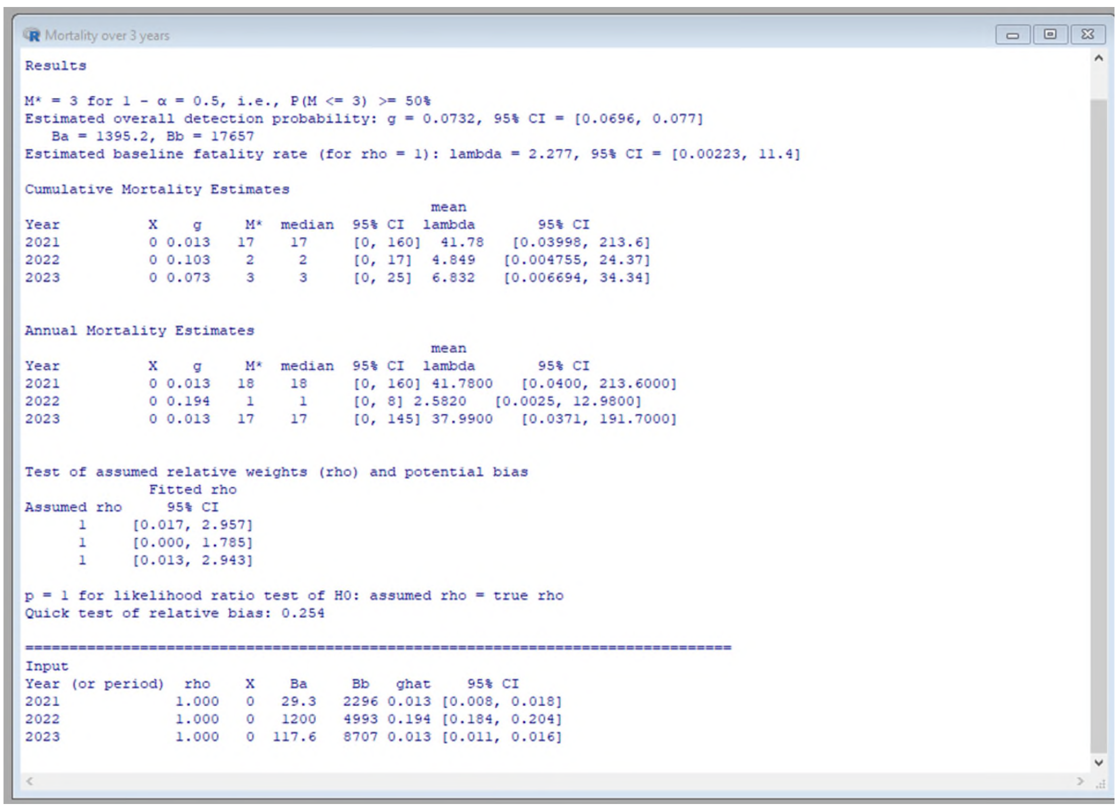
Appendix A8. Screenshot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for 2023 for little brown bats and tricolored bats.



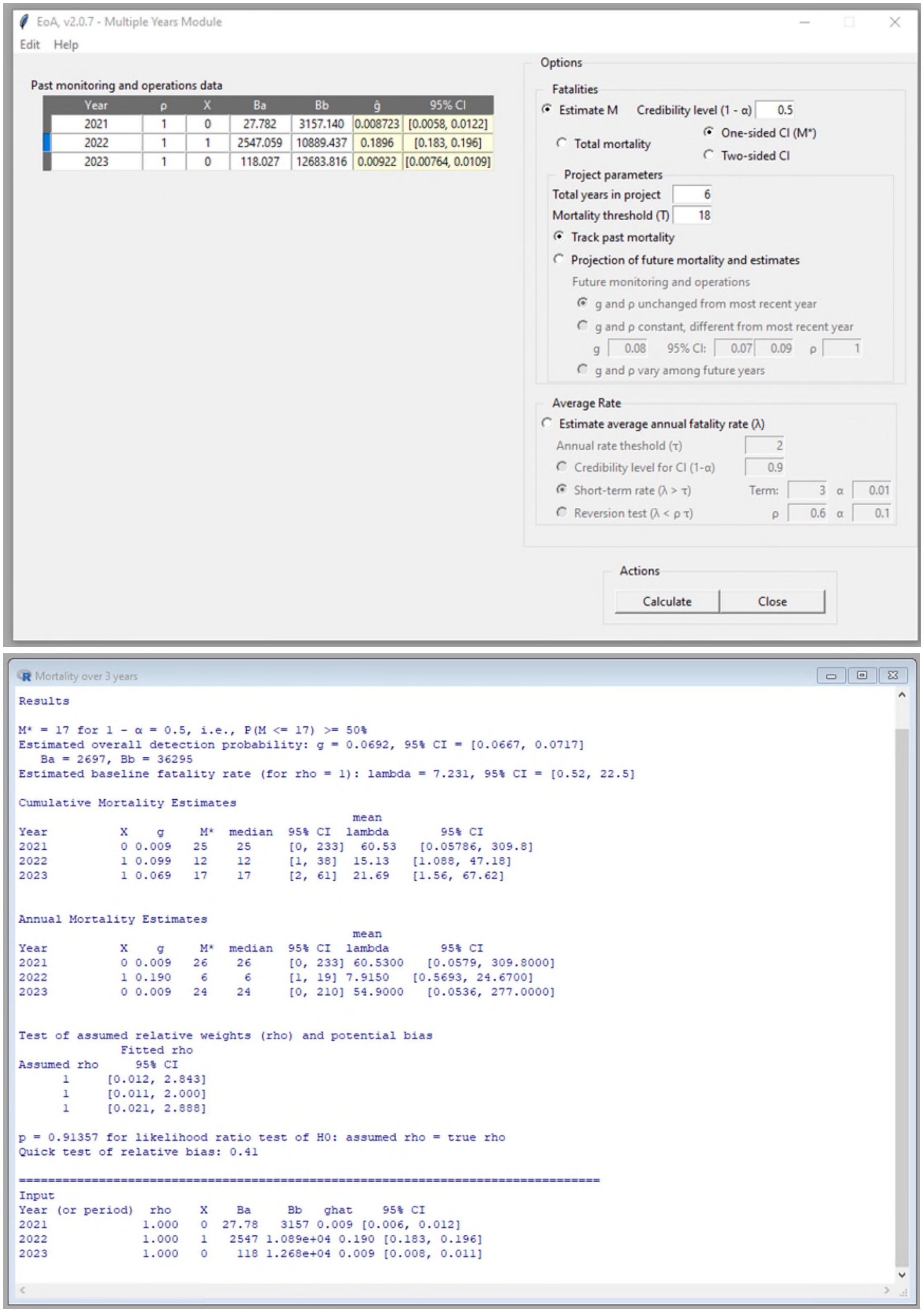


Appendix A9. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module inputs for estimation of cumulative detection probability, annual fatality rate (λ), cumulative mortality (*M) for 2021, 2022, and 2023 for Indiana bats.**

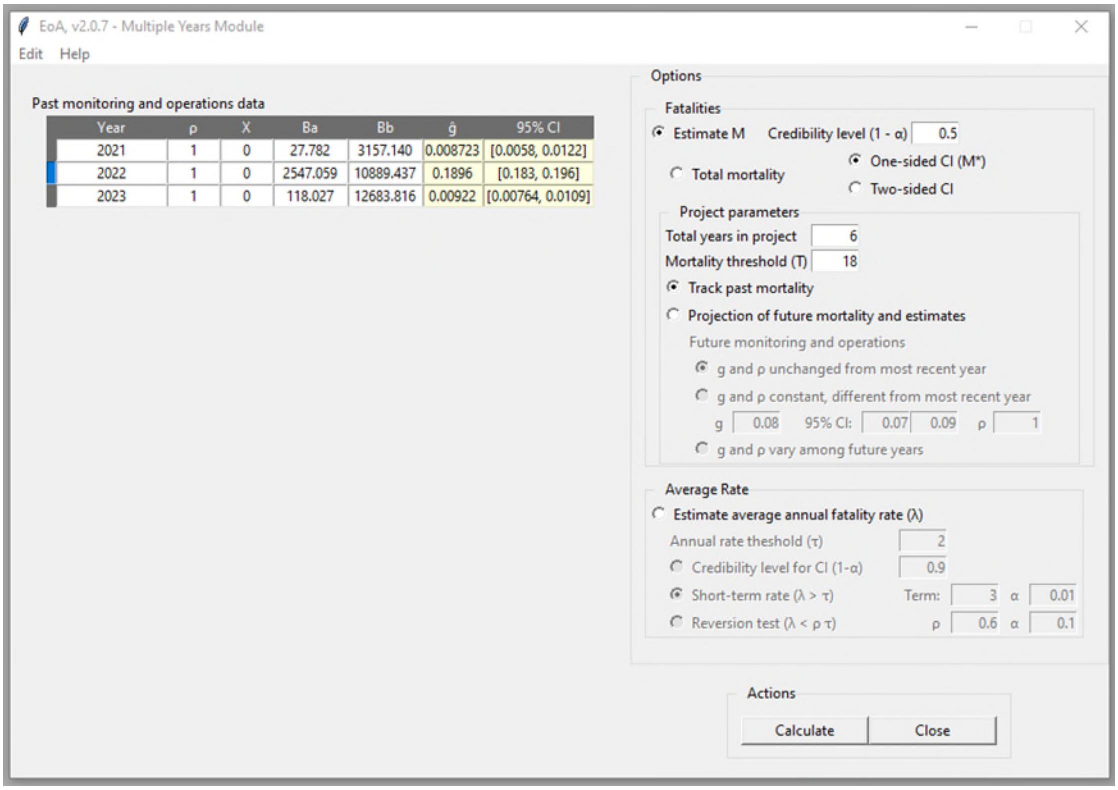


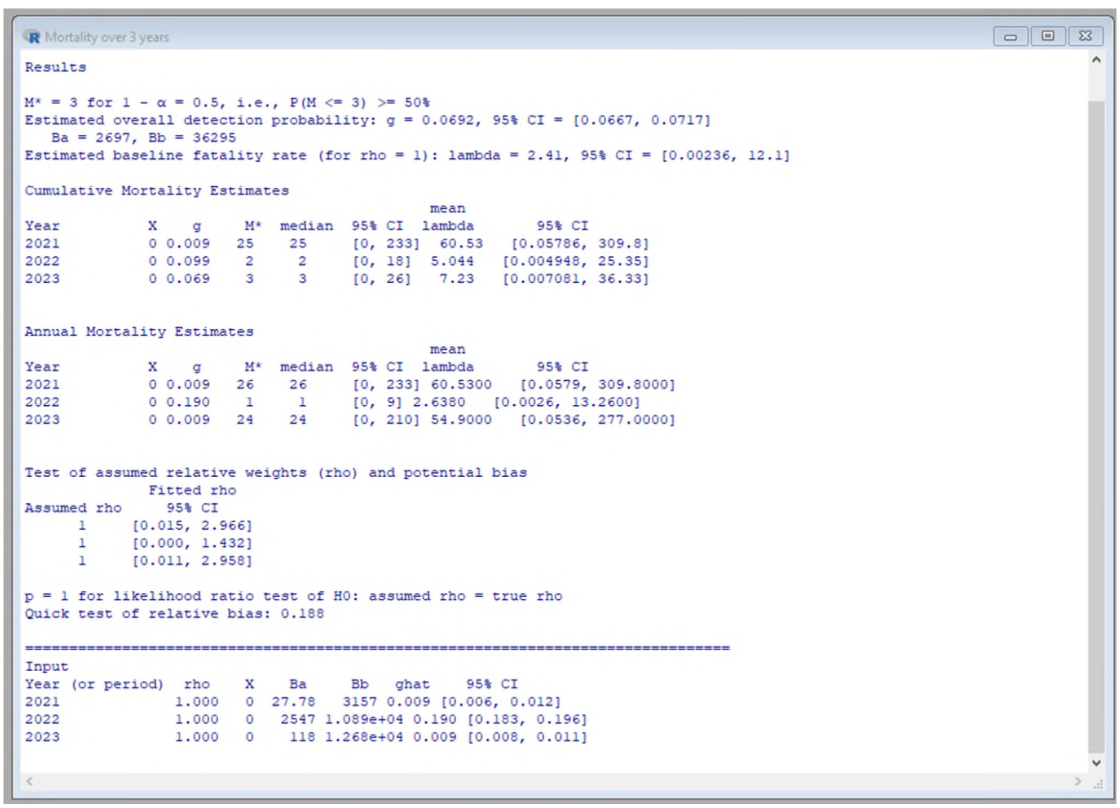


Appendix A10. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module inputs for estimation of cumulative detection probability, annual fatality rate (λ), cumulative mortality (*M) for 2021, 2022, and 2023 for northern long-eared bats.**



Appendix A11. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module inputs for estimation of cumulative detection probability, annual fatality rate (λ), cumulative mortality (*M) for 2021, 2022, and 2023 for little brown bats.**





Appendix A12. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module inputs for estimation of cumulative detection probability, annual fatality rate (λ), cumulative mortality (*M) for 2021, 2022, and 2023 for tricolored bats.**

Appendix B. Covered Species Evidence of Absence Take Estimates for the California Ridge Wind Farm, Champaign and Vermilion Counties, Illinois

INTRODUCTION

Although the adaptive management triggers during the initial five years of the ITP are based solely on the number of Covered Species carcasses found, EoA was used to estimate additional metrics related to take of Covered Species as specified in Section 7.3.3.5 of the HCP, including the mean annual take rate (λ), the median cumulative take to-date (M^*), the median cumulative take within the current monitoring year (M^*_{2023}), and the projected mortality ($M_{\text{projected}}$) for each of the Covered Species.

METHODS

The EoA Multiple Years Module was used with the number of fatalities to-date and the probability of detection to-date (i.e., from 2021, 2022, and 2023) for each Covered Species to compute the mean annual take rate (λ) and cumulative take to-date (M^*). The Multiple Years Module was used with the number of fatalities and the probability of detection specific to the 2023 monitoring year for each Covered Species to estimate cumulative annual take (M^*_{2023}). Per the HCP, M^*_{2023} and M^* were estimated at a confidence level of $\alpha = 0.5$ (using the median, or 50th credible bound, of the posterior distribution of estimated mortality).

The EoA Multiple Years Module was used in a Monte Carlo simulation approach to project future cumulative mortality ($M_{Projected}$) based on data collected to date. Current estimated take was simulated as 1,000 samples from the posterior distribution for cumulative take to date (M^* from EoA). Future take was simulated using 1,000 samples from the posterior distribution of the annual take rate that was estimated using the previous three years of data (2021–2023). Each of the 1,000 annual take rate samples were extrapolated to the remaining 17 years of the permit term and mortality in each year was sampled from a Poisson distribution with the annual take rate specified as the rate parameter. Simulated mortality in each year were summed over the 17 projected years, resulting in 1,000 realizations of projected mortality from year 2023 to the end of the permit term. The vector of current take estimate samples and the vector of projected mortality samples were summed element-wise to generate a 1,000 sample distribution of cumulative mortality at the end of the permit term. The median of this distribution was reported as the estimate of projected mortality.

RESULTS

Mean annual take rates were estimated to be 10.27 Indiana bats (90% CI: 1.20–26.76), 3.42 northern long-eared bats (90% CI: 0.01–13.15), 10.86 little brown bats (90% CI: 1.27–28.30), and 3.62 tricolored bats (90% CI: 0.01–13.91) per year (Appendix B1). Cumulative take to-date, M^* at $\alpha = 0.5$ (50th credible bound), was estimated to be 16 Indiana bats, 17 little brown bats, 3 northern long-eared bats, and 3 tricolored bats (Appendix B2). Annual take, M^*_{2023} at $\alpha = 0.5$ (50th credible bound), was estimated to be 17 Indiana bats, 17 northern long-eared bat, 25 little brown bats, and 25 tricolored bats (Appendix B3).

The cumulative median 20-year mortality projection at a 50% credible interval was 115 Indiana bat fatalities, 25 northern long-eared bat fatalities, 126 little brown bat fatalities and 28 tricolored bat fatalities (Appendix B4), which are below the permitted take of individuals of each of these Covered Species described within the Project's HCP.

Appendix B1. Estimated annual take rates for studies conducted at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, Incidental Take Permit Years 1–3 (2021–2023).

Species	Mean Annual Take Rate λ (90% CI)
Indiana bat	10.27 (1.20–26.76)
northern long-eared bat	3.42 (0.01–13.15)
little brown bat	10.86 (1.27–28.30)
tricolored bat	3.62 (0.01–13.91)

CI = Confidence Interval.

Appendix B2. Cumulative take estimate using Evidence of Absence for studies conducted within the Incidental Take Permit (ITP) term, to date, at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, ITP Years 1–3 (2021–2023).

Species	Cumulative take (M^*)	Permitted take (T)
Indiana bat	16	100
northern long-eared bat	3	280
little brown bat	17	460
tricolored bat	3	240

Appendix B3. Cumulative take estimate for studies conducted within the 2023 monitoring period using Evidence of Absence for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

Species	Annual take (M^*_{2023})	Permitted take (T)
Indiana bat	17	100
northern long-eared bat	17	280
little brown bat	25	460
tricolored bat	25	240

The cumulative median 20-year mortality projection at a 50% credible interval was 25 northern long-eared bat fatalities, 126 little brown bat fatalities and 28 tricolored bat fatalities (Appendix B4), which are below the permitted take of individuals of each of these three species described within the Project's HCP. The cumulative median 20-year mortality projection for the Indiana bat was 115 Indiana bat fatalities, which was greater than the permitted take of 100 Indiana bats. However, note that this projection is based off of only three years of PCM, and the projection will be monitored going forward to ensure that take remains within permitted levels.

Appendix B4. Cumulative median 20-year projected bat mortalities using Evidence of Absence (EoA; α = 0.5) for studies conducted at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois.

Species	Carcass Count	Permitted Take (T)	Cumulative Median Projected Mortalities (20 years; $M_{projected}$)
Indiana bat	1	100	115
northern long-eared bat	0	280	25
little brown bat	1	460	126
tricolored bat	0	240	28

Appendix C. Carcasses Found during the 2023 Post-construction Monitoring at the California Ridge Wind Farm, Champaign and Vermilion Counties, Illinois, from August 22 – October 13, 2023

Appendix C. Complete listing of carcasses found at the California Ridge Wind Farm, Champaign and Vermillion counties, Illinois, from August 22 – October 13, 2023.

Found Date	Species	Distance from Turbine (meters)	Turbine	Search Type	Search Area Type	Physical Condition
Bat						
08/22/2023	big brown bat	1	20	carcass search	road and pad	scavenged
08/22/2023	eastern red bat	49	20	carcass search	road and pad	scavenged
08/22/2023	eastern red bat	40	66	carcass search	road and pad	scavenged
08/22/2023	eastern red bat	72	82	carcass search	road and pad	scavenged
08/22/2023	hoary bat	5	17	carcass search	road and pad	scavenged
08/23/2023	eastern red bat	104	83	incidental*	road and pad	scavenged
08/23/2023	eastern red bat	25	83	carcass search	road and pad	scavenged
08/23/2023	eastern red bat	22	86	carcass search	road and pad	intact
08/25/2023	big brown bat	45	122	carcass search	road and pad	intact
08/25/2023	eastern red bat	40	116	carcass search	road and pad	intact
08/29/2023	eastern red bat	31	3	carcass search	road and pad	intact
08/29/2023	eastern red bat	38	70	carcass search	road and pad	scavenged
08/29/2023	eastern red bat	2	82	incidental	road and pad	scavenged
08/29/2023	eastern red bat	35	91	carcass search	road and pad	intact
08/29/2023	eastern red bat	53	99	carcass search	road and pad	intact
08/31/2023	eastern red bat	73	46	carcass search	road and pad	intact
09/01/2023	eastern red bat	40	52	carcass search	road and pad	intact
09/01/2023	eastern red bat	17	52	carcass search	road and pad	scavenged
09/01/2023	hoary bat	24	77	carcass search	road and pad	scavenged
09/01/2023	silver-haired bat	43	61	carcass search	road and pad	scavenged
09/02/2023	eastern red bat	10	101	carcass search	road and pad	dismembered
09/02/2023	eastern red bat	22	85	carcass search	road and pad	scavenged
09/02/2023	silver-haired bat	48	88	carcass search	road and pad	intact
09/05/2023	big brown bat	18	47	carcass search	road and pad	scavenged
09/05/2023	eastern red bat	22	35	carcass search	road and pad	intact
09/05/2023	eastern red bat	5	38	carcass search	road and pad	scavenged
09/05/2023	eastern red bat	42	92	carcass search	road and pad	intact
09/06/2023	eastern red bat	5	15	carcass search	road and pad	scavenged
09/07/2023	eastern red bat	50	114	carcass search	road and pad	intact
09/07/2023	eastern red bat	87	42	carcass search	road and pad	scavenged
09/07/2023	eastern red bat	19	76	carcass search	road and pad	scavenged
09/08/2023	eastern red bat	1	103	carcass search	road and pad	intact
09/08/2023	eastern red bat	84	44	carcass search	road and pad	scavenged
09/08/2023	eastern red bat	50	44	carcass search	road and pad	dismembered

Appendix C. Complete listing of carcasses found at the California Ridge Wind Farm, Champaign and Vermillion counties, Illinois, from August 22 – October 13, 2023.

Found Date	Species	Distance from Turbine (meters)	Turbine	Search Type	Search Area Type	Physical Condition
09/08/2023	silver-haired bat	6	108	carcass search	road and pad	scavenged
09/12/2023	hoary bat	18	96	carcass search	road and pad	intact
09/14/2023	eastern red bat	24	45	incidental	road and pad	intact
09/14/2023	eastern red bat	66	62	carcass search	road and pad	scavenged
09/26/2023	eastern red bat	43	36	carcass search	road and pad	scavenged
10/06/2023	eastern red bat	55	105	carcass search	road and pad	scavenged
10/09/2023	silver-haired bat	14	4	carcass search	road and pad	scavenged
Bird						
08/29/2023	cliff swallow	2	15	carcass search	road and pad	intact
08/30/2023	tree swallow	3	125	carcass search	road and pad	dismembered
09/07/2023	killdeer	73	76	carcass search	road and pad	scavenged
09/08/2023	killdeer	59	44	carcass search	road and pad	feather spot
09/12/2023	killdeer	64	47	carcass search	road and pad	feather spot
09/14/2023	killdeer	61	76	carcass search	road and pad	feather spot
09/19/2023	mourning dove	1	46	carcass search	road and pad	intact
09/19/2023	northern parula	83	38	carcass search	road and pad	intact
09/19/2023	red-winged blackbird	8	70	carcass search	road and pad	dismembered
09/22/2023	ring-necked pheasant	3	134	carcass search	road and pad	feather spot
10/06/2023	dickcissel	92	113	carcass search	road and pad	scavenged
10/09/2023	chimney swift	20	3	carcass search	road and pad	intact
10/12/2023	mourning dove	14	53	carcass search	road and pad	feather spot

* Carcass was found outside the search area.

Appendix D. Searcher Efficiency and Carcass Persistence Model Fitting Results for the 2023 Post-construction Monitoring at the California Ridge Wind Farm, Champaign and Vermilion Counties, Illinois, from August 22 – October 13, 2023

Appendix D1. Searcher efficiency models for 95-meter road and pads at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023 (n = 32).

Covariates	*k* Value	AICc	Delta AICc
No Covariates	*k* fixed at 0.8	40.16	0*

* Selected model.

AICc = Corrected Akaike Information Criterion.

Delta AICc = Change in AICc.

Appendix D2. Carcass persistence models with covariates and distributions for 95-meter road and pads at the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023 (n = 40).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	No Covariates	Weibull	188.54	0
No Covariates	–	exponential	190.06	1.52*
No Covariates	No Covariates	loglogistic	192.03	3.49
No Covariates	No Covariates	lognormal	192.68	4.14

* Selected model.

AICc = Corrected Akaike Information Criterion.

Delta AICc = Change in AICc.

Appendix D3. Carcass persistence top models with covariates, distributions, and model parameters for the California Ridge Wind Farm, Champaign and Vermilion counties, Illinois, from August 22 – October 13, 2023.

Plot Search Type	Distribution	Estimated Median Removal Times (days)	Parameter 1	Parameter 2
95-meter road and pad	exponential*	8.86	rate_R = 0.0782	–

* Parameterization follows the base R parameterization for this distribution.

Appendix E. Bat Fatality Rates and Adjustment Factors Table for the California Ridge Wind Farm, Champaign and Vermilion Counties, Illinois, from August 22 – October13, 2023

Appendix E. Estimated fatality rates and adjustment factors, with 90% Confidence Intervals (CI) for bats on road and pad plots search areas for studies conducted at the California Ridge Wind Farm, Champaign and Vermillion counties, Illinois, from August 22 – October 13, 2023.

	Estimate	90% CI
Search Area Adjustment		
Bat	0.03	0.03–0.03
Searcher Efficiency		
Bat	0.72	0.57–0.83
Average Probability of a Carcass Persisting Through the Search Interval*		
Bat	0.77	0.70–0.82
Probability of Available and Detected		
Bat	0.62	0.52–0.71
Estimated Fatality Rates (Fatalities/Turbine/Seasons(s))		
Bat	15.78	11.32–21.46
Estimated Fatality Rates (Fatalities/Megawatt/Seasons(s))		
Bat	9.86	7.08–13.41

* The search interval was weekly.