Post-construction Monitoring Study for the Rosewater Wind Farm White County, Indiana

Final Report

April 1 – May 15 and August 1 – October 15, 2023

Prepared for:

Rosewater Wind Farm LLC

801 East 86th Avenue
Merrillville, Indiana 46410

Prepared by:

Meredith Rodriguez, Lucas Voorhees, and Faith Kulzer

Western EcoSystems Technology, Inc.
400 West 7th Street, Suite 200
Bloomington, Indiana 47404

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WEST

Confidential Business Information

EXECUTIVE SUMMARY

Rosewater Wind Farm LLC is operating the Rosewater Wind Farm (Project) in White County, Indiana. The Project became operational in 2020 and consists of 20 4.2-megawatt (MW) Vestas V150 wind turbines that have a 105-meter (m; 344-foot [ft]) hub height and a 150-m (492-ft) rotor diameter, and five 3.6-MW Vestas V136 3.6-MW wind turbines that have a 105-m hub height and a 136-m (446-ft) rotor diameter. This report details the third year of post-construction monitoring studies conducted in 2023, consistent with Section 6.6 of the Project's Habitat Conservation Plan (HCP) and the Incidental Take Permit (ITP; ESPER0003552) for Indiana bats and northern long-eared bats (Covered Species). Turbines were feathered below manufacturer cut-in speed (3.0 m [9.8 ft] per second) March 15–July 31 and October 16–November 15 and below 5.0 m (16.4 ft) per second in the fall (August 1–October 15) sunset to sunrise, when the temperature was above 10 degrees (°) Celsius (50 °Fahrenheit) to minimize direct impacts to Covered Species.

Post-construction monitoring was completed in accordance with the Project's Study Plan, which was approved by the US Fish and Wildlife Service on February 16, 2023. The Study Plan was designed to achieve a probability of detection, or *g*, of 0.20. The overall goal of this post-construction monitoring study was to generate 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 of Covered Species using the Evidence of Absence (EoA) framework and provide the necessary data to determine if adaptive management is triggered, as outlined in the HCP.

Standardized carcass searches were completed for bat carcasses at three plot types: cleared plots, uncleared plots, and roads and pads. Technicians searched all 25 turbines as roads and pads to a distance of 100 m (328 ft) from the turbine, every other week during spring (April 1 – May 15). In the fall (August 1 – October 15), a technician searched 17 turbines as roads and pads to a distance of 100 m from the turbine, weekly. Detection-dog teams searched four turbines as cleared plots with a 70-m (230-ft) radius and four turbines as uncleared plots with a 70-m radius, twice weekly during the fall. Cleared turbine plots were typically located in corn fields and uncleared plots were located in soybean fields. Searcher efficiency and carcass persistence trials were conducted across plot types during each season to correct for detection and scavenger bias.

One Covered Species, a federally listed endangered Indiana bat, was found at the Project on September 7, 2023. Five evening bats, which are state-endangered, were also documented at the Project. Two hundred fifty-six bat carcasses were found during the study. The most commonly found bat species were eastern red bat (125 carcasses; 48.8%) and silver-haired bat (60 carcasses; 23.4%), followed by hoary bat (34 carcasses; 13.3%), and big brown bat (29 carcasses; 11.3%). The overall *g* value for 2023 was 0.318 (95% confidence interval: 0.299–0.336). The EoA model estimated the median annual fatality rate at the Project across 2021–2023 was 1.33 Indiana bats and 0.26 northern long-eared bats. No adaptive management was triggered.

STUDY PARTICIPANTS

Meredith Rodriguez	Project Manager
Lucas Voorhees	Deputy Project Manager, Report Compiler
Jason Ritzert	Senior Reviewer
Anna Ciecka	Detection-dog Coordinator
Ashley Hedrick	Field Coordinator
Meredith Hoggatt	Permitted Bat Biologist
Faith Kulzer	Lead Client Analyst
Simon Weller	Evidence of Absence Analyst and Statistician
Britten Vincent	GIS Technician
Andrea Palochak	Technical Editor
Jessica Elliott	Field Technician
Reagan Muinzer	Field Technician
Joshua Huetterman	Field Technician
Leah Paez	Detection-dog Handler

REPORT REFERENCE

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INTRODUCTION

Rosewater Wind Farm LLC (Rosewater), a subsidiary of Northern Indiana Public Service Company, is operating the Rosewater Wind Farm (Project) in White County, Indiana. Rosewater obtained an Incidental Take Permit (ITP; ESPER0003552) for the federally endangered Indiana bat (*Myotis sodalis*) and northern long-eared bat (*M. septentrionalis*; hereafter Covered Species) from the US Fish and Wildlife Service (USFWS) dated March 8, 2021. Post-construction compliance monitoring is required by the ITP to determine if the level of take of the Covered Species is in compliance with the authorized take and to evaluate the need for adaptive management measures.

Western EcoSystems Technology, Inc. (WEST) completed a post-construction monitoring study designed to achieve a probability of detection, or *g*, of 0.20 consistent with the Project's Habitat Conservation Plan (HCP). The objectives of this study were to: estimate take of Covered Species using the Evidence of Absence (EoA) framework as outlined in the HCP, and provide the necessary data to determine if adaptive management is triggered. This report presents the results of the third year (Year 3) of the post-construction monitoring conducted at the Project from April 1 – May 15 and August 1 – October 15, 2023.

PERMIT AREA

The Project is located in White County, Indiana, 1.6 kilometers (1.0 mile) northwest of Reynolds, Indiana (Figure 1). The Project's Permit Area, defined as the Project's leased lands in which all turbines are located, covers approximately 2,583 hectares (6,381 acres). Approximately 98% of the Permit Area is composed of cultivated cropland and developed areas.

The Project became fully operational in December 2020, and consists of 20 Vestas V150 4.2-megawatt (MW) wind turbines that have a 105-meter (m; 344-foot [ft]) hub height and a 150-m (492-ft) rotor diameter, and five Vestas V136 3.6-MW wind turbines that have a 105-m hub height and a 136-m (446-ft) rotor diameter. All turbines are within the migratory range of the Covered Species. During the spring, summer, and fall, Rosewater adjusted turbine operations to minimize impacts to the Covered Species (Table 1).

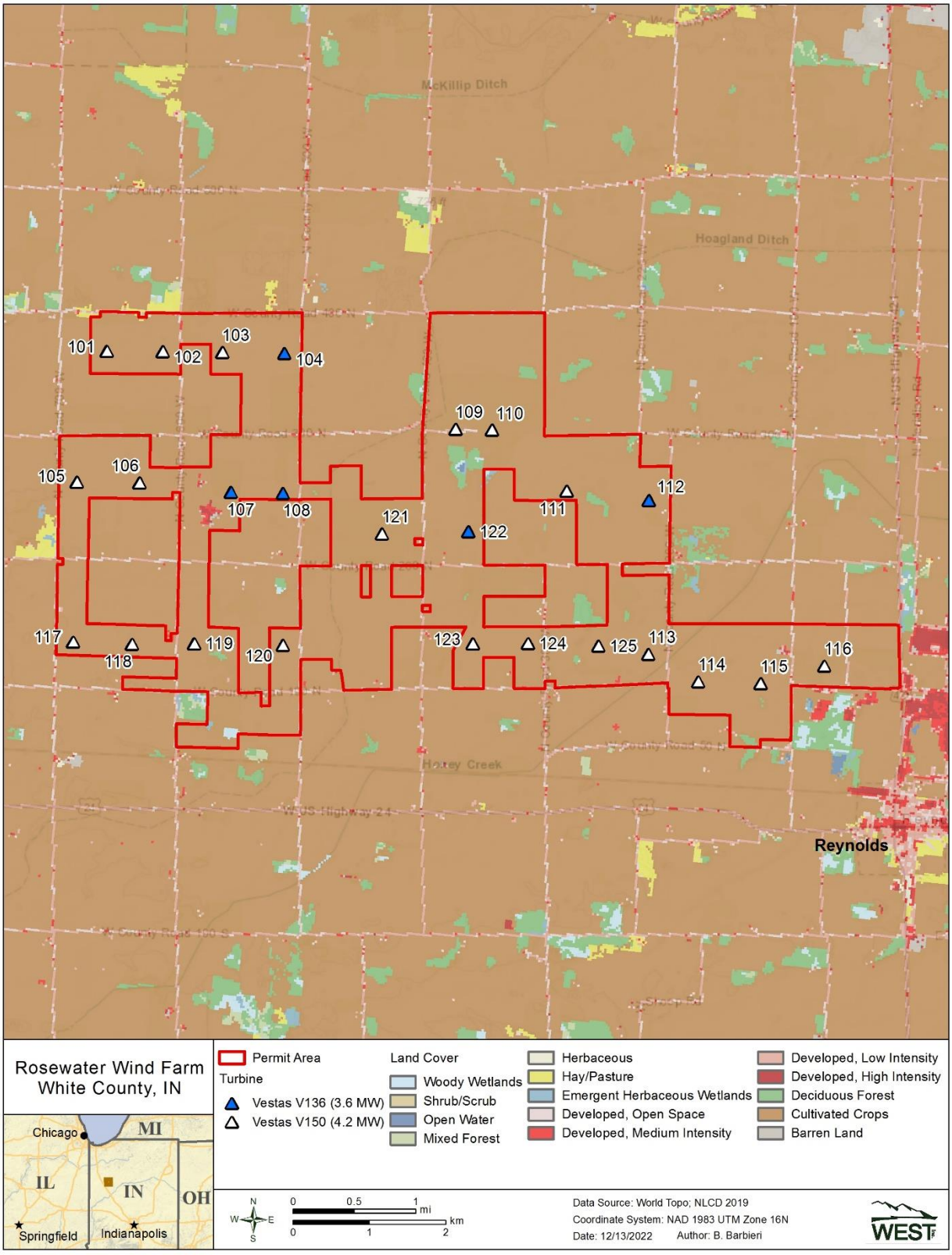

Figure 1. Turbine locations by turbine model at the Rosewater Wind Farm, White County, Indiana.

Table 1. Seasonal curtailment regime at the Rosewater Wind Farm, White County, Indiana.

Season	Turbines	Time of Day	Cut-In Speed	Feathering Below Cut-In[a]?	Temperature Threshold[b]
March 15 – July 31	All	Sunset to sunrise	Manufacturer's rated, minimum of 3.0 m/s (9.8 ft/s)[b]	Yes	10 °C (50 °F)
August 1 – October 15	All	Sunset to sunrise	5.0 m/s (16.4 ft/s)	Yes	10 °C (50 °F)
October 16 – November 15	All	Sunset to sunrise	Manufacturer's rated, minimum of 3.0 m/s (9.8 ft/s)[b]	Yes	10 °C (50 °F)
November 16 – March 14	All	N/A	Manufacturer's setting	No	None

[a] Feathering means that turbine blades will be pitched into the wind such that the blades spin at less than one rotation per minute.

[b] Turbines will be feathered below cut-in when temperatures are above the threshold.

m/s = meters per second; ft/s = feet per second; °C = degrees Celsius; °F = degrees Fahrenheit.

METHODS

To meet the monitoring commitments in the HCP, WEST developed a study plan that targeted a *g* value of 0.20 using values for searcher efficiency, carcass persistence, and area correction from PCM data collected in 2019 from the adjacent Meadow Lake Wind Farm V and from publicly available data from the Headwaters Wind Farm (Rodriguez et al. 2020a, 2020b, 2022). In Year 1 (2021), the study plan achieved a *g* of 0.26 (90% confidence interval [CI]: 0.25–0.28), and in Year 2 the study plan achieved a *g* of 0.311 (95% CI: 0.28–0.35); Rosewater conservatively decided to implement the same study design for Year 3. WEST submitted a study plan to the USFWS on January 30, 2023 (Rodriguez et al. 2023), which was approved by the USFWS on February 16, 2023 (J. Kemnitz, USFWS, pers. comm.).

Standardized Carcass Searches

Number of Turbines Sampled, Search Frequency, and Plot Size

Technicians and detection-dog teams conducted standardized carcass searches from April 1 – May 15 and August 1 – October 15, 2023. Search effort varied by season (Table 2, Figure 2), and was designed to maximize search effort when take of the Covered Species was considered most likely to occur.

Table 2. Search effort by season and plot type at the Rosewater Wind Farm, White County, Indiana.

Season	Plot Type	Search Interval	Number of Turbines	Search Team
Spring (April 1 – May 15)	100-m road and pad	14.0 days	25	Technician
Fall (August 1–October 15)	70-m cleared plot	3.5 days	4	Detection-dog
	70-m uncleared plot	3.5 days	4	Detection-dog
	100-m road and pad	7.0 days	17	Technician

m = meter.

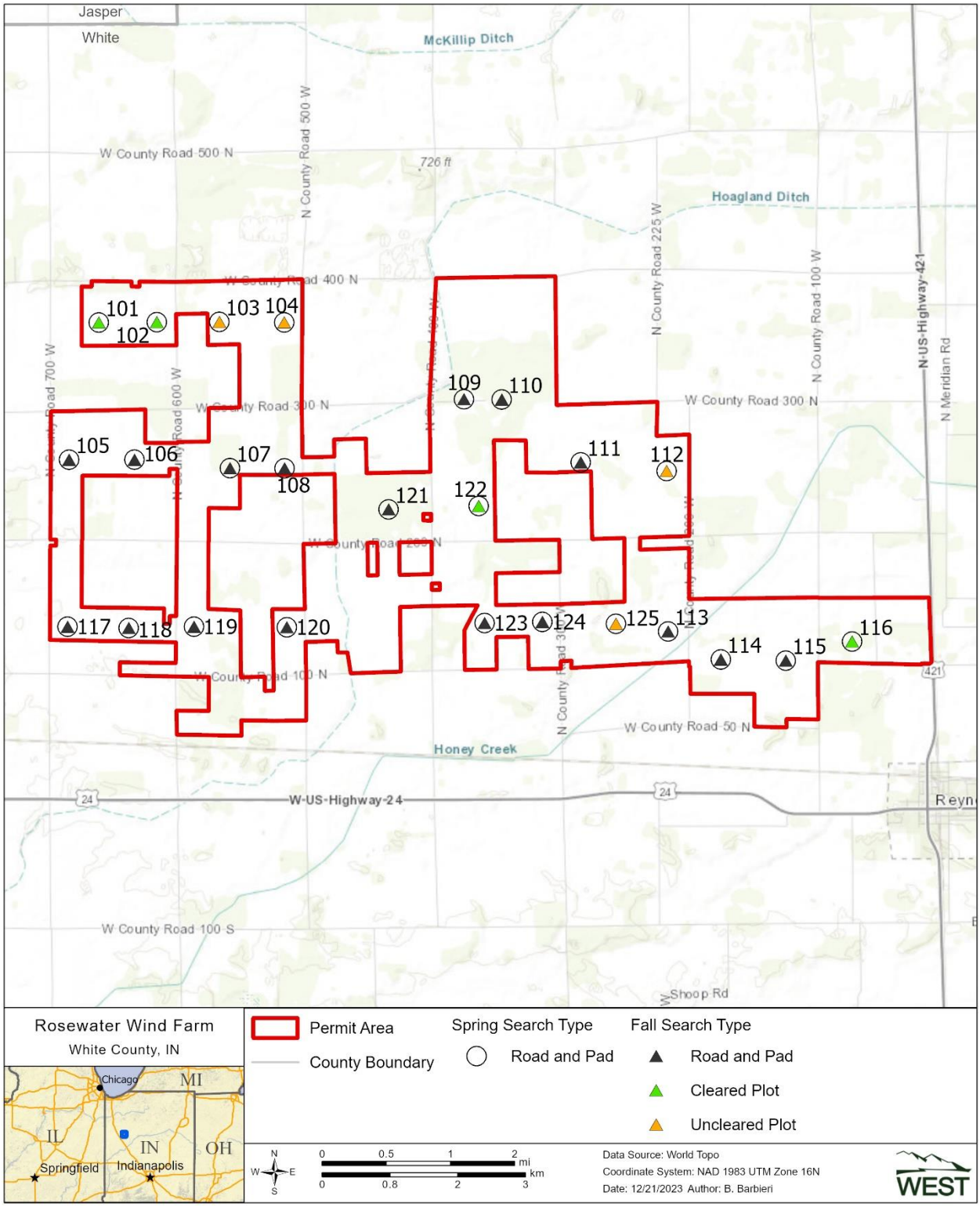

Figure 2. Turbine locations by plot type at the Rosewater Wind Farm, White County, Indiana.

During spring (April 1 – May 15; Table 2, Figure 3), a technician searched the gravel roads and pads every other week at all 25 turbines out to a distance of 100 m (328 ft; 100-m roads and pads). During fall (August 1 – October 15), roads and pads were searched weekly by a technician at 17 turbines (Table 2, Figure 2). Detection-dog teams searched plots at four turbines where crops (typically corn fields) were regularly mowed within a 70-m (230-ft) radius (70-m cleared plots; Figure 4) and four plots at turbines that had standing soybean as uncleared plots with a 70-m radius (70-m uncleared plots; Figure 5) twice per week in the fall.

During fall, vegetation at the 70-m cleared plots was mowed by Project staff to enhance detectability of carcasses (Figure 4). Uncleared plots were planted with soybean (Figure 5). A cross pattern approximately 1.5 m (4.9 ft) wide was mowed into the uncleared soy plots to assist detection-dog teams with plot access.

Figure 3. Representative photograph of conditions of a 100-meter road and pad plot at the Rosewater Wind Farm, White County, Indiana.

Figure 4. Representative photograph of vegetation conditions in a 70-meter cleared plot at the Rosewater Wind Farm, White County, Indiana.

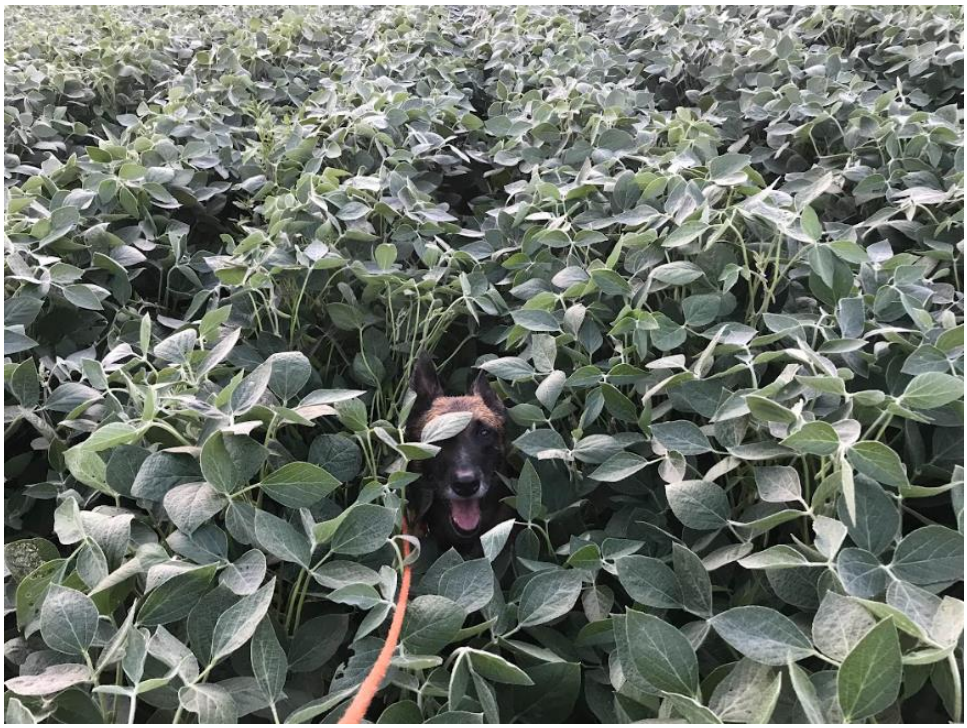

Figure 5. Representative photograph of vegetation conditions in a 70-meter uncleared plot at the Rosewater Wind Farm, White County, Indiana.

Search Methods

WEST used two search methods: a technician search, which was visual, and searches by a detection-dog team, which were olfactory, and where the team consisted of one dog handler and one detection dog. All technicians and dog handlers were trained to follow the Project's study plan, including proper handling and reporting of carcasses. Standardized carcass searches were conducted during the day, beginning as early as first light.

Road and Pad Searches – Technician Searches

During road and pad searches, the technician started at 100 m from the turbine and walked the access road at a rate of approximately 45–60 m per minute (m/min; 148–197 ft/min) 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 road and pad.

70-meter Plot Searches – Detection-dog Team

Detection-dog teams searched 70-m cleared and uncleared plots for carcasses. Prior to each search, dog handlers determined the search start point and the number of transects needed to cover the plot after taking into account wind speed and direction, as well as crop row direction and density (when applicable). Dog handlers oriented the detection dog to start searches perpendicular to the wind to maximize scent detection. Both wind speed and crop density can affect dispersal of the target odor (i.e., bat carcasses) across the plot. To maximize detection rates during an olfactory search, transect width varied with vegetation density, ranging from five to 10 m (16 to 33 ft) apart in densely vegetated areas, to 10 to 15 m (33 to 49 ft) apart in shorter vegetation. Detection dogs were rewarded with either food or a short play session when they correctly alerted their handler to a bird or bat carcass.

Detection-dog Team Evaluation

Detection dogs were considered candidates for standardized carcass searches if they met basic temperament and obedience criteria and demonstrated the trainability to detect bird and/or bat carcasses. Temperament characteristics that are sought after are high-energy dogs, with a high food or toy drive. Prior to conducting searches at the Project, dog handlers trained their detection dogs on the scent of bat carcasses, following methods derived from search and rescue programs and drug detection (Kay 2012, Helfers 2017). Detection dogs were initially trained on cotton scent swabs rubbed on or stored in a container with bat carcasses and progressed to bat carcasses at increasing distances over a period of three to four weeks. Once the detection dog achieved a passing grade of 80% or higher in a scent recognition test, consisting of 10 blind trial lineups using bat carcasses, the detection dog and handler were evaluated in the field to measure the team's performance. The detection-dog coordinator conducted a two-day field evaluation of each detection-dog team. After a detection-dog team achieved a searcher efficiency of 75% or greater for 15–30 bats during evaluation trials, the team was approved to conduct standardized carcass searches. Because the objective of the study was to document bat carcasses, detection dogs were not explicitly trained on native bird carcasses; however, all detection dogs alerted their handler when they found birds in the field, and handlers rewarded bird finds in the field to

encourage future alerts to bird carcasses. The breed used at the Project as a detection dog was a Belgian Malinois.

Data Collection

Technicians and dog handlers recorded the date, search start and end times, technician or dog handler name, turbine number, type of search and if any carcasses were found during each scheduled search. When a bird or bat carcass was found, a flag was placed near it and the search continued. After searching the entire plot, the technician or dog handler returned to record information for each carcass on a carcass information form, including the date and time the carcass was found, species (or best possible field identification), sex and age (when possible), technician or dog handler name, turbine number, measured distance from turbine (m), azimuth from turbine, location of the carcass as latitude and longitude, habitat surrounding the carcass, carcass condition, and estimated time of death (e.g., less than one day, two days).

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

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

For bird carcasses, the following category was also used:

- Feather spot—Ten or more feathers (excluding down), or two or more primary feathers found at one location (i.e., one square m [10 square ft]), indicating predation or scavenging of a bird carcass.

Digital photographs were taken of each carcass, 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 (ESPER0003552), WEST's Federal Native Endangered and Threatened Species Recovery Permit (ES23412), and WEST's Special Purpose Salvage Permit (2263). Technicians or dog handlers 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. Live, injured bats were recorded and considered fatalities for analysis purposes when observed in search areas and were 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 analysis.

Carcass Identification and Agency Notification

Field identification of bird carcasses were reviewed by biologists with extensive field experience in identification of Midwestern birds and feathers. A federally permitted bat biologist (ESPER0039249) identified all bat carcasses via photographs or in hand. Bat carcasses that were heavily scavenged but did not have potential to be a Covered Species (i.e., fur was present on the wing and/or forearms measured greater than 41 millimeters) were identified to the closest genus or group possible and were not sent off for further identification. In accordance with the Project's ITP and WEST's state and federal salvage permits, the USFWS was notified within 24 hours of positive identification of federally listed species, and the Indiana Department of Natural Resources (IDNR) was notified within three working days of positive identification of state-listed species. Fur and tissue samples were delivered to the USFWS Indiana Field Office at the end of the study, and all bat carcasses were submitted to the USFWS Indiana Field Office or Illinois Natural History Survey repository, in accordance with permits.

Tissue samples were collected from heavily scavenged or decomposed bat carcasses that could not be positively identified and had potential to be a Covered Species based on available identifiable characteristics and were submitted to a USFWS-approved laboratory, East Stroudsburg University Wildlife Genetics Institute, for identification on September 20 and October 24, 2023.

Bias Trials

Searcher Efficiency Trials

The objective of searcher efficiency trials was to estimate the probability that a carcass was found by a technician or detection dog. Searcher efficiency trials were conducted in the same areas where standardized carcass searches occurred. Technicians or detection-dog teams conducting standardized carcass searches 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*), big brown bats (*Eptesicus fuscus*), and silver-haired bats (*Lasionycteris noctivagans*) that had previously been found at the Project. In accordance with the study plan, brown and black house mice (*Mus musculus*) were used for 25 trials in the spring when sufficient bat carcasses were not available. Eighty-five carcasses were placed across all seasons and plot types to account for differences in search conditions by plot type and season.

Multiple trials were conducted in each season 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 trial carcass after it was found. Carcasses were dropped from waist-height or higher and allowed to land in a random posture. The trial administrator walked in a meandering path and dropped trials for detection-dog

teams the day prior to the next search to allow time for the scent to pool and disperse prior to scheduled searches.

Searchers 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 during each search was determined immediately after each trial by the trial administrator.

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. A minimum of 15 trial carcasses were placed in each season and plot type to incorporate the effects of varying weather and scavenger densities on carcass persistence. No more than three trial carcasses were placed on a plot at a time to avoid potential over-seeding and attracting scavengers. Thirty-eight searcher efficiency trial carcasses were left in place and used for carcass persistence trials, and an additional 22 trial carcasses were dropped, for a total of 60 trial carcasses placed across all seasons and plot types.

Technicians monitored the trial carcasses over a 14-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, and 14. In the spring, due to the longer search interval, trial carcasses were monitored over a 28-day period, with two additional checks on days 21 and 28. Trial carcasses were monitored until they were completely removed or the trial period ended, whichever occurred first. At the end of the 14 or 28-day period, any remaining carcasses were removed. Detection-dog teams were used on the 70-m plots to determine when carcasses were removed, while technicians determined the status of carcasses placed on 100-m roads and pads.

Search Area Mapping

Technicians recorded the boundaries of 70-m cleared plots using a Trimble sub-meter Global Positioning System unit. Unsearchable areas within plot boundaries were also mapped. 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 search areas. A 72-m (236-ft) radius projection was applied to 70-m uncleared plots. The additional 2.0 m (6.6 ft) were added to the radius to account for the width of the turbine tower. Road and pad boundaries mapped in Year 1 (2021) were used for spatial verification of carcasses found on 100-m roads and pads.

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 searches, 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 search 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. Data used in the EoA model included number of found Covered Species carcasses, fatality spatial data from all bats found during searches, and the results of searcher efficiency and carcass persistence trials.

Searcher Efficiency Estimation

Searcher efficiency was estimated separately for technicians and detection-dog teams to account for different modes of detection (i.e., technicians use sight while dogs use scent). EoA uses raw searcher efficiency data (e.g., number of found and available trial carcasses) to inform overall probability of detection. However, to determine if searcher efficiency data should be pooled, or separated by strata such as season and/or plot type, searcher efficiency was modeled using logistic regression. Season was included as a potential covariate for the technician model, and plot type was included as a potential covariate for the detection-dog team model. For both the technician and detection-dog models, selection was completed using an information theoretic approach known as AICc, or corrected Akaike Information Criterion (Burnham and Anderson 2002). The best-supported model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value. Searcher efficiency values were input into the EoA software according to the model selection results.

The change in searcher efficiency 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 searcher efficiency 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 estimates for the Covered Species in EoA.

Carcass Persistence Rate Estimation

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 or detection-dog team. 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, loglogistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Dalthorp et al. 2018). As with searcher efficiency, carcass persistence models were estimated separately by search team (i.e., plots searched by technicians vs. plots searched by detection-dog teams) to account for different modes of detection. Season was included as a potential covariate for the technician model, and plot type was included as a potential covariate for the detection-dog team model. The best-supported 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 (shape and scale, including the 95% CI of scale) were used as inputs in the EoA Single Class Module.

Search 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 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 weight-based probability of detection and the proportion of area searched in each 1.0-m annulus around the turbine. Although the spring and fall seasons have the potential to have different carcass density distributions due to differences in turbine operation, there was insufficient sample size in the spring to examine these effects. Therefore, the models pooled data from both turbine operation regimes and seasons. Due to the variation in turbine sizes (blade lengths range from 136–150 m in diameter), carcass-density distribution models were fit for each turbine type separately and compared to models fit data pooled across all turbine types. Distributions considered were normal, gamma, Gompertz, and Weibull (parameterized according to R Development Core Team (2016) and Yee (2010). The best-supported model was selected using AICc.

Carcasses Excluded from Fatality Estimates

Fatalities were excluded from the area adjustment used in EoA when the carcass was discovered outside of the spatial and temporal scope of the study 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 prior to the start of searches (e.g., a carcass found on a plot in the summer that was not searched until the fall) 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 searches. If a fatality of a Covered Species had been found outside of the spatial or temporal scope of the study design, it would have been 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 mean annual take rate (λ) for the Covered Species and the probability of detection (*g*). Estimates were calculated using the EoA method (Dalthorp et al. 2017), using the Single Class, Multiple Class, and Multiple Years modules of EoA.

The probability of detection (*g*) was estimated using the bias corrections for searcher efficiency, carcass persistence, and area searched, as well as the assumed seasonality of risk for the Covered Species, which was 11% in spring and 89% in fall per the Project's study plan. The EoA Single Class Module was used to estimate the distribution of detection probability in each search stratum. This resulted in alpha and 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 within a season, with weights for each class defined by the sampling fraction for each plot type. The Multiple Class Module was used again to combine the strata across seasons using arrival proportions to define the weights for each class to get a single annual Beta distribution. The Beta distribution from years 2021 – 2023 were then combined using the EoA Multiple Years Module.

For this study, cross-season relative turbine operations were calculated as the number of operational nights in each season, during which turbines were operating, divided by the total number of operational nights in each season. Given that nominal turbine operations at the Project includes downtime for regular maintenance, operations were considered normal unless the proportion of operational turbine-nights was less than 90% of total turbine-nights during the study period. Cross-season relative turbine operations and the arrival proportions were multiplied and then re-scaled to sum to one across seasons. These values defined the weights for combining the Beta distribution parameters across seasons. Furthermore, the Multiple Years Module was used to combine detection probabilities across years. The Multiple Years Module requires the input ρ, which weights the years appropriately for combining Beta distribution parameters. The proportion of operational-turbine nights was greater than 0.9, so ρ was set to 1 for the 2023 study.

Adaptive Management Trigger

Table 6.5 in the HCP outlines several conditions for adaptive management at the Project. Two conditions are based on bats in hand (i.e., either two or more Indiana bat or northern-long eared bat carcasses found in Years 1–2, or a single Indiana bat or northern long-eared bat carcass found in either the spring or the summer of any year). The remaining conditions for adaptive management are based on EoA Estimates. The estimates from the EoA analysis were used to test the adaptive management triggers that the median (50^{th} credible bound) annual take rates (λ) were between one and three bats per year, or greater than three bats per year at Year 3, per the HCP. Outcomes for meeting individual adaptive management triggers would be followed in accordance with the actions outlined in Table 6.5 of the Project's HCP. The adaptive management triggers were tested and reviewed individually for each of the Covered Species. Three years of data were used in this analysis, 2021–2023.

RESULTS

Standardized Carcass Searches

Seventy-five searches were completed in the spring, and 349 searches were completed in the fall. Six searches (1.7%) were missed due to turbine maintenance, weather constraints, and/or safety hazards. Two hundred fifty-six bat carcasses and 74 bird carcasses were found during searches and incidentally (Appendix A). One Covered Species, an Indiana bat, was found at Turbine 111 on September 7, 2023. Five evening bats (*Nycticeius humeralis*), a state-listed endangered species, were documented at the Project at turbines 112 (two carcasses), 116, and 122 (two carcasses; Table 3, Figure 6). The USFWS and/or IDNR were notified within 24 hours or three business days of positive identification, respectively (on August 16 and 23; September 8,

12, and 20; and November 20, 2023). No other state- or federally listed species were recorded during the ITP monitoring effort.

Table 3. Listed bat species found at the Rosewater Wind Farm, White County, Indiana, from April 1 – May 15 and August 1 – October 15, 2023.

Species	Sex	Date Found	Estimated Time of Death	Location	Turbine
evening bat	unknown	8/14/23	0–1 days	40.78720, -86.91354	112
evening bat	unknown	8/21/23	2–3 days	40.76853, -86.88680	116
evening bat	unknown	9/4/23	2–3 days	40.78727, -86.91333	112
Indiana bat	unknown	9/7/23	4–7 days	40.78847, -86.92637	111
evening bat	unknown	9/19/23	0–1 days	40.78331, -86.94115	122
evening bat	unknown	10/12/23	2–3 days	40.78391, -86.94146	122

One bat was found in the spring and 255 bats were found in the fall (Appendix A). The most commonly found bat species were eastern red bat (125 carcasses; 48.8%) and silver-haired bat (60 carcasses; 23.4%) followed by hoary bat (*Lasiurus cinereus*; 34 carcasses; 13.3%), big brown bat (29 carcasses; 11.3%), and evening bats (five carcasses; 2.0%). Two eastern red bat or Seminole bat (*Lasiurus seminolus*; 0.8%) and one Indiana bat (0.4%) were also found (Appendices A and B). Over the course of the monitoring period, six heavily scavenged bats (e.g., wing membrane only, bones, or partial carcasses) were sent off for identification via deoxyribonucleic acid (DNA) analysis and were identified as three big brown bats, one evening bat, one hoary bat, and one silver-haired bat. The majority of bat carcasses were recorded on 70-m plots searched by detection-dog teams (Appendix A).

Statistical Analysis

Bias Trials

Searcher Efficiency Trials

Eighty-five bats were placed for searcher efficiency trials on 17 separate dates across all plot types and months of the study and 83 were available for search teams to find. The best-supported model for searcher efficiency for detection-dog teams did not support the inclusion of plot type as a covariate, meaning there was not a substantial difference between searcher efficiency rates on 70-m cleared and uncleared plots. The best-supported model for searcher efficiency on roads and pads did not support the inclusion of season as a covariate, meaning there was not a substantial difference in searcher efficiency rates for roads and pads between seasons. Searcher efficiency rates ranged from 85.7% on 70-m plots to 87.8% on roads and pads (Table 4).

Table 4. Searcher efficiency results by plot type at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Plot Type	Number Placed	Number Available	Number Found	% Found
70-meter plots	43	42	36	85.7
100-meter roads and pads	42	41	36	87.8

Carcass Persistence Trials

Sixty carcasses were placed during the study period to estimate carcass persistence. The best-fit model for carcass persistence rates on 70-m plots had an exponential distribution and did not include any covariates, which suggests carcass persistence rates did not vary by 70-m plot type (Figure 6; Appendix B). The best-fit model for carcass persistence rates on 100-m roads and pads had an exponential distribution and did not include any covariates, meaning that carcass persistence on roads and pads did not vary by season (Figure 6; Appendix B). Estimated median carcass persistence times were 12.15 days on 70-m plots and 6.34 days on roads and pads (Appendix B).

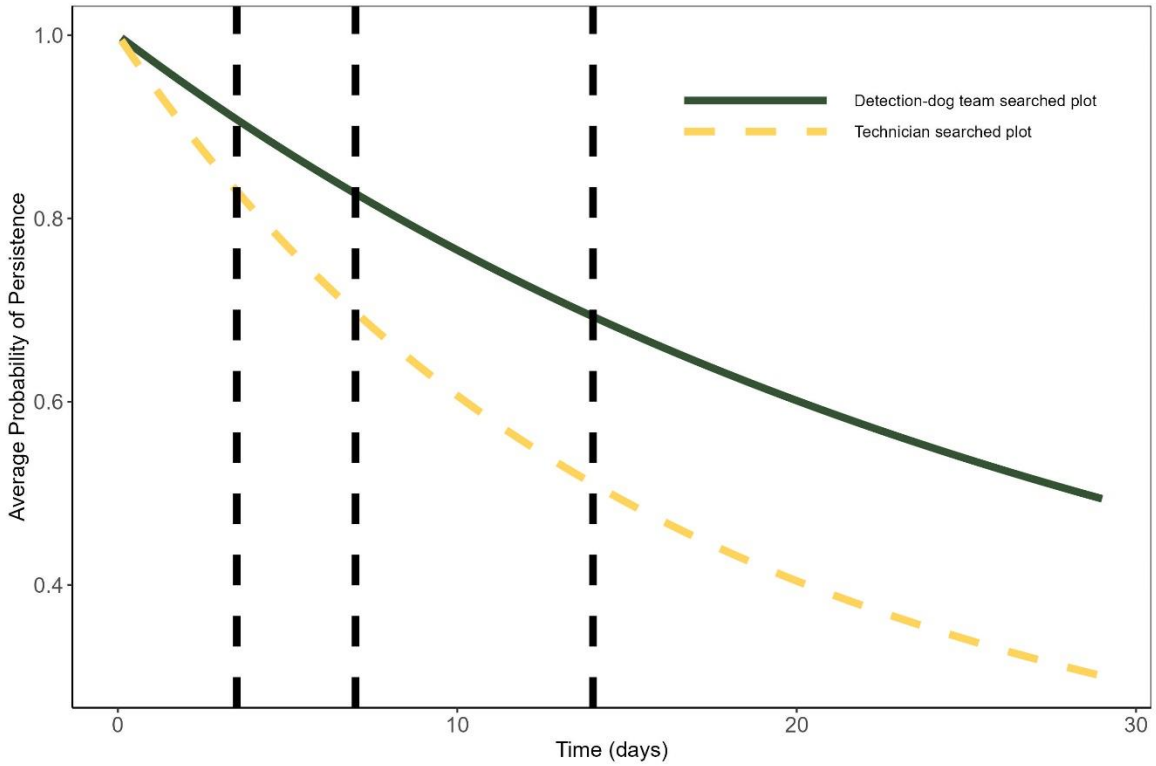

Figure 6. The average probability of persistence of bats on over time (in days) at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Note: The vertical dashed lines indicate the 3.5, 7, and 14 day search intervals used in this study.

Search Area Adjustment

Thirty of the 256 bats found were excluded from modeling the carcass-density distribution for EoA. Six bat carcasses were excluded from analysis because they were found off plot. Another 24 bats were excluded because their estimated time of death was prior to the start of the monitoring season (Appendices A and B).

The best-fit model for the distribution of bats with respect to distance from turbine base was a Gompertz distribution stratified by turbine model (Appendix B). The estimated TWL area adjustment for bats was 0.08 and 0.20 for 100-m roads and pads on 3.6-MW and 4.2-MW

turbines, respectively, and 0.97 and 1.00 for 70-m plots on 4.2-MW and 3.6-MW turbines, respectively (Appendix B; Figures 7 and 8).

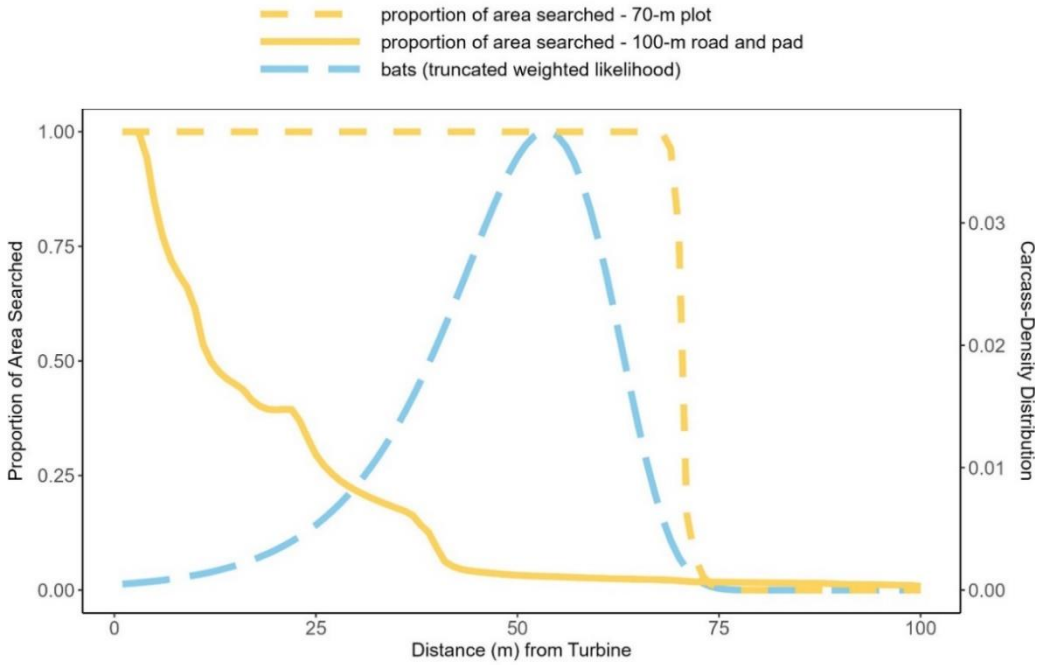

Figure 7. Density of bat carcasses per area searched at all plot types at 3.6-megawatt turbines at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15, and August 1 – October 15, 2023.

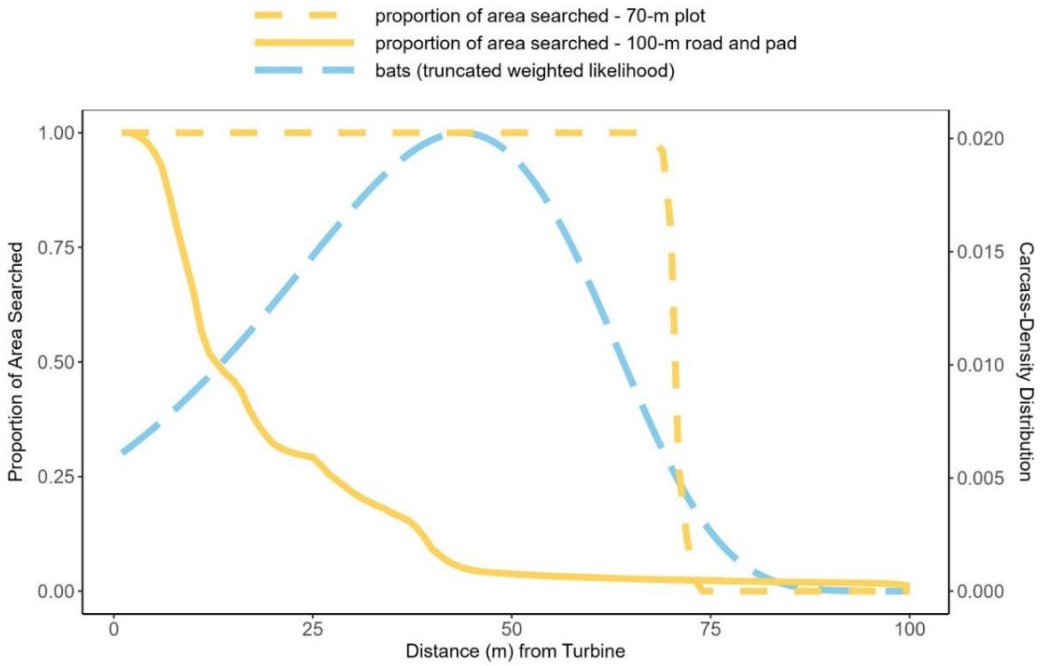

Figure 8. Density of bat carcasses per area searched at all plot types at 4.2 megawatt turbines at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15, and August 1 – October 15, 2023.

Covered Species Take Estimates

One Covered Species carcass, an Indiana bat, was found during the 2023 study period; no other Indiana bats have been found to date. No northern long-eared bats have been found to date under the ITP. The overall *g* achieved for the 2023 monitoring period had a mean of 0.318 (95% CI: 0.299–0.336). The average overall *g* achieved for the 2021–2023 monitoring years was a mean of 0.297 (95% CI: 0.283–0.311; Table 5); this average overall g value was used to estimate the median annual take rate for Years 1-3.

Table 5. Probability of detection (*g*), Ba, and Bb for the Rosewater Wind Farm, White County, Indiana, from 2021–2023.

Year	Ba*	Bb*	*g*	95% CI
2021	825.190	2,304.680	0.264	0.248–0.279
2022	214.050	475.260	0.311	0.277–0.346
2023	771.332	1,657.162	0.318	0.299–0.336
Overall	**1,211.062**	**2,862.952**	**0.297**	**0.283–0.311**

* 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.

CI = confidence interval

Evidence of Absence Framework

The median annual take rate from 2021–2023 was estimated to be 1.33 (95% CI: 0.12–5.25) Indiana bats and 0.26 (95% CI. 0.00–2.82) northern long-eared bats (Table 6; Figure 10). 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 C.

Adaptive management criteria were assessed using the median annual take rate from Years 1–3. The estimated annual take rate must be greater than or equal to one to trigger adaptive management. The estimated take rate for Indiana bat exceeded one, indicating the criteria for adaptive management was met (Table 6). In this case, per Table 6.5 in the HCP, the Project will continue operational minimization as planned and continue to monitor at *g* = 0.08 for the remaining three years of the ITP. The estimated take rate required a mitigation true-up if up-front mitigation does not cover the projected six year take estimate; however, the Project mitigated for the full amount of authorized take up front, and therefore no additional mitigation is needed. The estimated take rate for northern long-eared bat did not meet or exceed one, indicating that criteria for adaptive management were not met for this species and no adaptive management actions are necessary at this time (Table 6). Neither species' estimated take rate exceeded the authorized take rate.

Table 6. Estimated median fatality rate (λ) for the Covered Species based on studies conducted at the Rosewater Wind Farm, White County, Indiana, ~~ITP~~Incidental Take Permit Years 1–3 (2021–2023).

Species	Carcass Count	Median λ (95% CI)	Expected Take Rate	Authorized Take Rate
Indiana bat	1	1.33 (0.12–5.25)	1	3
Northern long-eared bat	0	0.26 (0.00–2.82)	1	3

CONCLUSIONS

The overall *g* achieved for the first three years of monitoring exceeded the target average *g* of 0.2 for Years 1–3. One Indiana bat carcass was found during the study; however, the ITP compliance monitoring completed during 2023 provided evidence that the rate of take of Covered Species is compatible with ITP compliance over the duration of the permit term. Adaptive management triggers were evaluated using the EoA results and due to the average annual take of Indiana bats being between one and three bats per year at Year 3, operational minimization will continue as planned (Rosewater 2021).

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Appendix A. Carcasses Found during the 2023 Post-construction Monitoring Searches at the Rosewater Wind Farm

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
Bat Carcasses							
04/24/2023	silver-haired bat	106	carcass search	100-m road and pad	scavenged	40.78879	-86.99271
08/01/2023	big brown bat	122	carcass search	70-m cleared	scavenged	40.78328	-86.94132
08/01/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76843	-86.88564
08/01/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78339	-86.94148
08/01/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.7702	-86.92105
08/01/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.77085	-86.92128
08/01/2023	hoary bat	125	carcass search	70-m uncleared	scavenged	40.77054	-86.92109
08/01/2023	hoary bat	125	carcass search	70-m uncleared	scavenged	40.77038	-86.92126
08/02/2023	big brown bat	104	carcass search	70-m uncleared	scavenged	40.80416	-86.97016
08/02/2023	big brown bat	104	carcass search	70-m uncleared	scavenged	40.80423	-86.97066
08/02/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80416	-86.99008
08/02/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80439	-86.98945
08/02/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80395	-86.98071
08/02/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80452	-86.98
08/02/2023	eastern red bat	104	carcass search	70-m uncleared	scavenged	40.80419	-86.97067
08/02/2023	eastern red bat	104	carcass search	70-m uncleared	scavenged	40.80445	-86.9704
08/02/2023	eastern red bat	104	carcass search	70-m uncleared	scavenged	40.80469	-86.97009
08/02/2023	hoary bat	101	carcass search	70-m cleared	scavenged	40.80416	-86.99859
08/02/2023	hoary bat	101	carcass search	70-m cleared	scavenged	40.80462	-86.99817
08/02/2023	hoary bat	102	carcass search	70-m cleared	scavenged	40.80444	-86.98923
08/02/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80417	-86.9799
08/02/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.8042	-86.98037
08/02/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80441	-86.97979
08/04/2023	big brown bat	123	carcass search	100-m road and pad	scavenged	40.77033	-86.94042
08/04/2023	eastern red bat	111	carcass search	100-m road and pad	scavenged	40.78845	-86.92645
08/04/2023	eastern red bat	119	carcass search	100-m road and pad	scavenged	40.769847	-86.98458
08/04/2023	hoary bat	114	carcass search	100-m road and pad	scavenged	40.76601	-86.90566
08/04/2023	hoary bat	118	carcass search	100-m road and pad	scavenged	40.76993	-86.99386
08/07/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.787523	-86.91426
08/08/2023	big brown bat	101	carcass search	70-m cleared	scavenged	40.80449	-86.99783
08/08/2023	big brown bat	102	carcass search	70-m cleared	scavenged	40.8044	-86.98974
08/08/2023	big brown bat	104	carcass search	70-m uncleared	scavenged	40.80419	-86.97074
08/08/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80383	-86.99856
08/08/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80433	-86.98996
08/08/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80416	-86.98071

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
08/08/2023	hoary bat	101	carcass search	70-m cleared	scavenged	40.803639	-86.99791
08/08/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80416	-86.98021
08/10/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76801	-86.88593
08/10/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78336	-86.94208
08/10/2023	hoary bat	125	carcass search	70-m uncleared	scavenged	40.77032	-86.9214
08/11/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80406	-86.99759
08/11/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80397	-86.9888
08/11/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80441	-86.98928
08/11/2023	eastern red bat	103	carcass search**	70-m uncleared	scavenged	40.80383	-86.98095
08/11/2023	eastern red bat	106	carcass search	100-m road and pad	intact	40.78898	-86.99264
08/11/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80387	-86.98056
08/14/2023	big brown bat	101	carcass search	70-m cleared	scavenged	40.80459	-86.99783
08/14/2023	big brown bat	122	carcass search	70-m cleared	scavenged	40.78356	-86.94169
08/14/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80467	-86.99757
08/14/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80438	-86.99801
08/14/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.8041	-86.98919
08/14/2023	eastern red bat	102	carcass search	70-m cleared	unknown	*	*
08/14/2023	eastern red bat	102	carcass search	70-m cleared	unknown	*	*
08/14/2023	eastern red bat	102	carcass search	70-m cleared	unknown	*	*
08/14/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.78721	-86.91357
08/14/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.78748	-86.91375
08/14/2023	eastern red bat	112	carcass search	70-m uncleared	intact	40.78702	-86.91373
08/14/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76817	-86.8859
08/14/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78349	-86.94138
08/14/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78363	-86.94204
08/14/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78387	-86.94196
08/14/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.77022	-86.9206
08/14/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.77058	-86.92104
08/14/2023	evening bat	112	carcass search	70-m uncleared	scavenged	40.7872	-86.91354
08/14/2023	hoary bat	101	carcass search	70-m cleared	scavenged	40.80421	-86.99833
08/14/2023	hoary bat	102	carcass search	70-m cleared	unknown	*	*
08/14/2023	hoary bat	122	carcass search	70-m cleared	intact	40.78326	-86.94145
08/17/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.7873	-86.91333
08/17/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.78737	-86.91352
08/17/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76781	-86.88554
08/17/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76806	-86.88549

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
08/17/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78331	-86.94212
08/18/2023	big brown bat	119	carcass search	100-m road and pad	scavenged	40.76994	-86.98399
08/18/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80432	-86.99819
08/18/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80429	-86.98017
08/18/2023	eastern red bat	104	carcass search	70-m uncleared	intact	40.80418	-86.9703
08/18/2023	eastern red bat	104	carcass search	70-m uncleared	scavenged	40.80412	-86.97079
08/18/2023	eastern red bat	105	carcass search	100-m road and pad	intact	40.78887	-87.00208
08/18/2023	eastern red bat	110	carcass search	100-m road and pad	scavenged	40.79554	-86.93835
08/18/2023	eastern red bat	119	carcass search	100-m road and pad	scavenged	40.76991	-86.98399
08/18/2023	eastern red bat	123	carcass search	100-m road and pad	scavenged	40.77036	-86.94056
08/18/2023	silver-haired bat	103	carcass search	70-m uncleared	scavenged	40.80448	-86.98083
08/21/2023	eastern red bat	112	carcass search**	70-m uncleared	scavenged	40.78737	-86.91454
08/21/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.77032	-86.92162
08/21/2023	evening bat	116	carcass search	70-m cleared	scavenged	40.76853	-86.8868
08/22/2023	big brown bat	103	carcass search	70-m uncleared	scavenged	40.80439	-86.98029
08/22/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80416	-86.9987
08/22/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80461	-86.99011
08/22/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.8042	-86.97996
08/22/2023	hoary bat	102	carcass search	70-m cleared	scavenged	40.80454	-86.98903
08/22/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80423	-86.99827
08/22/2023	silver-haired bat	102	carcass search	70-m cleared	scavenged	40.80429	-86.98952
08/22/2023	silver-haired bat	102	carcass search	70-m cleared	scavenged	40.80455	-86.98974
08/24/2023	big brown bat	114	carcass search	100-m road and pad	scavenged	40.76619	-86.90536
08/24/2023	big brown bat	125	carcass search	70-m uncleared	scavenged	40.77034	-86.92088
08/24/2023	eastern red bat	104	carcass search	70-m uncleared	scavenged	40.804360	-86.97054
08/24/2023	eastern red bat	112	carcass search	70-m uncleared	intact	40.78772	-86.91321
08/24/2023	eastern red bat	114	carcass search	100-m road and pad	scavenged	40.76622	-86.90574
08/24/2023	eastern red bat	119	carcass search	100-m road and pad	scavenged	40.76996	-86.98427
08/24/2023	eastern red bat or Seminole bat	124	carcass search	100-m road and pad	scavenged	40.77043	-86.932
08/24/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77012	-86.92133
08/25/2023	big brown bat	102	carcass search	70-m cleared	scavenged	40.80468	-86.98948
08/25/2023	eastern red bat	101	carcass search**	70-m cleared	scavenged	40.80518	-86.99855
08/25/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.803670	-86.98969
08/25/2023	eastern red bat	102	carcass search	70-m cleared	intact	40.80408	-86.98907
08/25/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80462	-86.98955

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
08/25/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.8043	-86.98919
08/25/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80462	-86.98995
08/25/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80425	-86.98001
08/25/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80432	-86.98057
08/25/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80418	-86.98042
08/25/2023	hoary bat	102	carcass search	70-m cleared	dismembered	40.80472	-86.98932
08/25/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80434	-86.98007
08/25/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80441	-86.98056
08/26/2023	big brown bat	116	carcass search	70-m cleared	scavenged	40.76794	-86.88631
08/26/2023	eastern red bat	116	carcass search	70-m cleared	intact	40.76789	-86.88627
08/26/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76782	-86.88645
08/26/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76838	-86.88566
08/26/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.767967	-86.88570
08/26/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78362	-86.94241
08/26/2023	eastern red bat	122	carcass search	70-m cleared	scavenged	40.78356	-86.94203
08/26/2023	eastern red bat	122	carcass search	70-m cleared	intact	40.78346	-86.94139
08/26/2023	hoary bat	116	carcass search	70-m cleared	scavenged	40.76835	-86.88599
08/28/2023	big brown bat	122	carcass search	70-m cleared	scavenged	40.78356	-86.94194
08/28/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76809	-86.8858
08/28/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76815	-86.88606
08/28/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.768	-86.88635
08/28/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76797	-86.8865
08/28/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76828	-86.88696
08/28/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.77034	-86.92076
08/28/2023	eastern red bat	125	carcass search	70-m uncleared	intact	40.77052	-86.92083
08/29/2023	big brown bat	101	carcass search	70-m cleared	scavenged	40.80426	-86.99817
08/29/2023	big brown bat	103	carcass search	70-m uncleared	scavenged	40.80421	-86.98007
08/29/2023	big brown bat	103	carcass search	70-m uncleared	scavenged	40.80383	-86.98001
08/29/2023	eastern red bat	102	carcass search	70-m cleared	intact	40.80431	-86.98968
08/29/2023	eastern red bat	102	carcass search	70-m cleared	intact	40.80379	-86.98989
08/29/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80387	-86.98966
08/29/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80457	-86.98024
08/29/2023	eastern red bat	104	carcass search	70-m uncleared	scavenged	40.80407	-86.97002
08/29/2023	hoary bat	102	carcass search	70-m cleared	scavenged	40.80398	-86.98975
08/29/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80396	-86.98074
08/29/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80421	-86.99783

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
08/29/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80413	-86.99795
08/29/2023	silver-haired bat	103	carcass search	70-m uncleared	scavenged	40.804014	-86.98091
08/31/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76817	-86.88541
08/31/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76821	-86.88628
08/31/2023	eastern red bat	125	carcass search	70-m uncleared	intact	40.77016	-86.92111
08/31/2023	eastern red bat or Seminole bat	116	carcass search	70-m cleared	scavenged	40.76782	-86.88583
08/31/2023	silver-haired bat	119	carcass search	100-m road and pad	intact	40.76991	-86.98415
08/31/2023	silver-haired bat	119	carcass search	100-m road and pad	intact	40.76992	-86.98394
08/31/2023	silver-haired bat	120	carcass search	100-m road and pad	scavenged	40.76993	-86.96997
09/01/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.8041	-86.98889
09/01/2023	hoary bat	103	carcass search	70-m uncleared	intact	40.80471	-86.98088
09/01/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80453	-86.9807
09/04/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.78719	-86.91298
09/04/2023	evening bat	112	carcass search	70-m uncleared	scavenged	40.78727	-86.91333
09/04/2023	hoary bat	112	carcass search	70-m uncleared	scavenged	40.78757	-86.91403
09/04/2023	hoary bat	125	carcass search	70-m uncleared	scavenged	40.76994	-86.92068
09/04/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.7679	-86.88614
09/04/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.76822	-86.88638
09/05/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.804	-86.99871
09/05/2023	eastern red bat	101	carcass search	70-m cleared	intact	40.80448	-86.99854
09/05/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80469	-86.99822
09/05/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80462	-86.98976
09/05/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80438	-86.97977
09/05/2023	eastern red bat	103	carcass search	70-m uncleared	scavenged	40.80469	-86.98009
09/05/2023	hoary bat	103	carcass search	70-m uncleared	scavenged	40.80428	-86.97956
09/05/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.8048	-86.99833
09/05/2023	silver-haired bat	102	carcass search	70-m cleared	scavenged	40.80476	-86.98958
09/05/2023	silver-haired bat	103	carcass search	70-m uncleared	scavenged	40.80422	-86.98067
09/06/2023	silver-haired bat	122	carcass search	70-m cleared	scavenged	40.78302	-86.9421
09/07/2023	Indiana bat	111	carcass search	100-m road and pad	scavenged	40.78847	-86.92637
09/07/2023	eastern red bat	106	carcass search	100-m road and pad	intact	40.78902	-86.9925
09/07/2023	eastern red bat	107	carcass search	100-m road and pad	injured	40.78764	-86.97796
09/07/2023	eastern red bat	112	carcass search	70-m uncleared	intact	40.78791	-86.91349
09/07/2023	eastern red bat	121	carcass search	100-m road and pad	intact	40.78324	-86.95427
09/07/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.77051	-86.92055

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
09/07/2023	eastern red bat	125	carcass search**	70-m uncleared	scavenged	40.77083	-86.92187
09/07/2023	hoary bat	105	carcass search	100-m road and pad	scavenged	40.78887	-87.00221
09/07/2023	hoary bat	107	carcass search	100-m road and pad	scavenged	40.78779	-86.97879
09/07/2023	silver-haired bat	105	carcass search	100-m road and pad	scavenged	40.78879	-87.0025
09/07/2023	silver-haired bat	114	carcass search	100-m road and pad	scavenged	40.76617	-86.90572
09/07/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.76852	-86.88642
09/08/2023	eastern red bat	101	carcass search	70-m cleared	intact	40.80429	-86.99808
09/08/2023	silver-haired bat	103	carcass search	70-m uncleared	scavenged	40.80451	-86.98027
09/08/2023	silver-haired bat	103	carcass search	70-m uncleared	scavenged	40.80423	-86.98022
09/11/2023	big brown bat	116	carcass search	70-m cleared	scavenged	40.76824	-86.88563
09/11/2023	big brown bat	116	carcass search	70-m cleared	scavenged	40.76782	-86.88578
09/11/2023	eastern red bat	112	carcass search	70-m uncleared	scavenged	40.78718	-86.91308
09/11/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76858	-86.88659
09/11/2023	silver-haired bat	112	carcass search	70-m uncleared	scavenged	40.78733	-86.91343
09/11/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.76791	-86.8858
09/12/2023	big brown bat	102	carcass search	70-m cleared	scavenged	40.80392	-86.98928
09/12/2023	big brown bat	103	carcass search	70-m uncleared	scavenged	40.80409	-86.9805
09/12/2023	big brown bat	125	carcass search**	70-m uncleared	scavenged	40.76995	-86.92226
09/12/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80425	-86.9976
09/12/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80398	-86.98975
09/12/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.8043	-86.98999
09/12/2023	hoary bat	101	carcass search	70-m cleared	scavenged	40.80419	-86.99873
09/12/2023	silver-haired bat	102	carcass search	70-m cleared	scavenged	40.80403	-86.98981
09/12/2023	silver-haired bat	103	carcass search	70-m uncleared	scavenged	40.80444	-86.98035
09/12/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77017	-86.92112
09/14/2023	big brown bat	116	carcass search	70-m cleared	scavenged	40.76792	-86.88657
09/14/2023	eastern red bat	109	carcass search	100-m road and pad	scavenged	40.79552	-86.94414
09/14/2023	eastern red bat	116	carcass search	70-m cleared	intact	40.76837	-86.88647
09/14/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76802	-86.8867
09/14/2023	silver-haired bat	113	carcass search	100-m road and pad	scavenged	40.769325	-86.91331
09/14/2023	silver-haired bat	114	carcass search	100-m road and pad	scavenged	40.76608	-86.90577
09/14/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77004	-86.92067
09/14/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77005	-86.92185
09/14/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77072	-86.92094
09/15/2023	big brown bat	102	carcass search	70-m cleared	scavenged	40.8043	-86.9892
09/15/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.8041	-86.98962

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
09/15/2023	hoary bat	102	carcass search	70-m cleared	scavenged	40.80439	-86.98945
09/18/2023	silver-haired bat	102	carcass search	70-m cleared	scavenged	40.80441	-86.98876
09/18/2023	silver-haired bat	102	carcass search	70-m cleared	intact	40.80423	-86.98906
09/19/2023	big brown bat	112	carcass search	70-m uncleared	scavenged	40.78706	-86.91376
09/19/2023	big brown bat	116	carcass search	70-m cleared	scavenged	40.76829	-86.88701
09/19/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76815	-86.88671
09/19/2023	eastern red bat	125	carcass search	70-m uncleared	scavenged	40.7702	-86.92126
09/19/2023	evening bat	122	carcass search	70-m cleared	scavenged	40.78331	-86.94115
09/19/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.76812	-86.88602
09/19/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77014	-86.92103
09/19/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.77017	-86.92149
09/21/2023	silver-haired bat	119	carcass search	100-m road and pad	intact	40.76981	-86.98423
09/21/2023	silver-haired bat	125	carcass search	70-m uncleared	scavenged	40.76969	-86.92131
09/22/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80379	-86.99759
09/22/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80461	-86.99865
09/25/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.76814	-86.88583
09/26/2023	eastern red bat	101	carcass search	70-m cleared	scavenged	40.80477	-86.99826
09/26/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80383	-86.9897
09/28/2023	big brown bat	125	carcass search	70-m cleared	scavenged	40.77042	-86.92172
09/28/2023	eastern red bat	116	carcass search	70-m cleared	scavenged	40.76793	-86.88654
09/28/2023	silver-haired bat	113	carcass search	100-m road and pad	scavenged	40.76936	-86.9131
09/28/2023	silver-haired bat	122	carcass search	70-m cleared	scavenged	40.7836	-86.94194
10/03/2023	hoary bat	102	carcass search	70-m cleared	scavenged	40.80391	-86.9895
10/06/2023	eastern red bat	102	carcass search	70-m cleared	intact	40.80448	-86.98871
10/06/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80407	-86.99803
10/09/2023	eastern red bat	125	carcass search	70-m cleared	intact	40.76998	-86.92062
10/09/2023	silver-haired bat	112	carcass search	70-m uncleared	intact	40.78709	-86.91344
10/09/2023	silver-haired bat	116	carcass search	70-m cleared	scavenged	40.76825	-86.88583
10/09/2023	silver-haired bat	116	carcass search	70-m cleared	intact	40.76811	-86.88601
10/09/2023	silver-haired bat	125	carcass search	70-m cleared	scavenged	40.7698	-86.92132
10/10/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80448	-86.99744
10/10/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80405	-86.9977
10/10/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80478	-86.99771
10/10/2023	silver-haired bat	102	carcass search	70-m cleared	scavenged	40.80459	-86.98877
10/10/2023	silver-haired bat	108	carcass search	100-m road and pad	scavenged	40.787574	-86.97051
10/12/2023	evening bat	122	carcass search	70-m cleared	scavenged	40.78391	-86.94146

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Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
10/12/2023	silver-haired bat	118	carcass search	100-m road and pad	intact	40.76976	-86.99383
10/12/2023	silver-haired bat	112	carcass search	70-m cleared	scavenged	40.787	-86.91349
10/13/2023	eastern red bat	102	carcass search	70-m cleared	scavenged	40.80488	-86.9899
10/13/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80416	-86.99813
10/13/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80439	-86.9987
10/13/2023	silver-haired bat	101	carcass search	70-m cleared	scavenged	40.80439	-86.99743
10/13/2023	silver-haired bat	102	carcass search**	70-m cleared	scavenged	40.80378	-86.98895
Bird Carcasses							
08/01/2023	barn swallow	122	carcass search	70-m cleared	scavenged	40.78359	-86.94208
08/01/2023	killdeer	125	carcass search	70-m uncleared	scavenged	40.77015	-86.92124
08/01/2023	unidentified small bird	122	carcass search	70-m cleared	scavenged	40.78389	-86.94141
08/02/2023	killdeer	102	carcass search	70-m cleared	feather spot	40.80481	-86.98935
08/02/2023	unidentified small bird	101	carcass search	70-m cleared	scavenged	40.80464	-86.99791
08/04/2023	killdeer	108	carcass search	100-m road and pad	feather spot	40.7877	-86.97059
08/04/2023	unidentified small bird	117	carcass search	100-m road and pad	scavenged	40.77	-87.00262
08/07/2023	unidentified small bird	112	carcass search	70-m uncleared	scavenged	40.78741	-86.91384
08/10/2023	turkey vulture	122	carcass search	70-m cleared	scavenged	40.78396	-86.94141
08/14/2023	eastern kingbird	116	carcass search	70-m cleared	intact	40.76816	-86.88626
08/14/2023	unidentified small bird	125	carcass search	70-m uncleared	scavenged	40.77064	-86.92193
08/18/2023	horned lark	102	carcass search	70-m cleared	scavenged	40.80417	-86.98958
08/21/2023	chimney swift	122	carcass search	70-m cleared	scavenged	40.78404	-86.94161
08/21/2023	horned lark	122	carcass search	70-m cleared	scavenged	40.78361	-86.94156
08/21/2023	killdeer	116	carcass search	70-m cleared	scavenged	40.76796	-86.88642
08/21/2023	unidentified small bird	112	carcass search	70-m uncleared	scavenged	40.7872	-86.91427
08/22/2023	horned lark	102	carcass search	70-m cleared	scavenged	40.80449	-86.98967
08/24/2023	Blackburnian warbler	125	carcass search	70-m uncleared	scavenged	40.77041	-86.92157
08/24/2023	black-and-white warbler	104	carcass search	70-m uncleared	scavenged	40.804517	-86.97111
08/26/2023	killdeer	116	carcass search	70-m cleared	scavenged	40.76843	-86.88624
08/28/2023	European starling	125	carcass search	70-m uncleared	intact	40.76982	-86.92071
08/28/2023	cliff swallow	125	carcass search	70-m uncleared	scavenged	40.76998	-86.9213
08/29/2023	unidentified warbler	103	carcass search	70-m uncleared	scavenged	40.80447	-86.98063
08/29/2023	yellow-rumped warbler	102	carcass search	70-m cleared	intact	40.80427	-86.98909
08/31/2023	horned lark	116	carcass search	70-m cleared	scavenged	40.76803	-86.88589
08/31/2023	unidentified small bird	116	carcass search	70-m cleared	scavenged	40.76765	-86.88646
08/31/2023	unidentified small bird	125	carcass search	70-m uncleared	scavenged	40.77044	-86.92177
09/01/2023	horned lark	102	carcass search	70-m cleared	scavenged	40.80409	-86.98966

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
09/01/2023	killdeer	103	carcass search	70-m uncleared	intact	40.80464	-86.97992
09/07/2023	Tennessee warbler	125	carcass search	70-m uncleared	intact	40.77037	-86.92079
09/07/2023	northern parula	123	carcass search	100-m road and pad	scavenged	40.77031	-86.94039
09/07/2023	warbling vireo	122	carcass search	70-m cleared	intact	40.78318	-86.94149
09/08/2023	Tennessee warbler	102	carcass search	70-m cleared	scavenged	40.80394	-86.98891
09/08/2023	horned lark	102	carcass search	70-m cleared	intact	40.80433	-86.98933
09/11/2023	American redstart	116	carcass search	70-m cleared	scavenged	40.76785	-86.88683
09/11/2023	killdeer	116	carcass search	70-m cleared	scavenged	40.7683	-86.8856
09/11/2023	unidentified small bird	116	carcass search	70-m cleared	scavenged	40.76809	-86.88604
09/11/2023	unidentified small bird	116	carcass search**	70-m cleared	scavenged	40.76752	-86.88642
09/11/2023	unidentified small bird	122	carcass search	70-m cleared	feather spot	40.78332	-86.94246
09/12/2023	Tennessee warbler	101	carcass search	70-m cleared	scavenged	40.80398	-86.9977
09/14/2023	horned lark	116	carcass search	70-m cleared	scavenged	40.76834	-86.88637
09/14/2023	horned lark	116	carcass search	70-m cleared	scavenged	40.7684	-86.88633
09/14/2023	unidentified small bird	125	carcass search	70-m uncleared	scavenged	40.76978	-86.92092
09/14/2023	unidentified warbler	116	carcass search	70-m cleared	scavenged	40.76786	-86.88593
09/14/2023	unidentified warbler	116	carcass search	70-m cleared	scavenged	40.76805	-86.88682
09/18/2023	unidentified small bird	101	carcass search	70-m cleared	scavenged	40.80471	-86.99763
09/21/2023	unidentified small bird	116	carcass search	70-m cleared	feather spot	40.7678	-86.88595
09/22/2023	mourning dove	102	carcass search	70-m cleared	intact	40.80405	-86.98995
09/22/2023	turkey vulture	102	carcass search	70-m cleared	scavenged	40.80416	-86.99002
09/22/2023	unidentified passerine	101	carcass search**	70-m cleared	scavenged	40.80475	-86.99746
09/25/2023	unidentified small bird	116	carcass search	70-m cleared	scavenged	40.76862	-86.88658
09/25/2023	unidentified small bird	122	carcass search	70-m cleared	feather spot	40.78333	-86.94223
09/28/2023	horned lark	116	carcass search	70-m cleared	scavenged	40.76817	-86.88622
10/02/2023	killdeer	125	carcass search	70-m cleared	scavenged	40.77018	-86.92193
10/05/2023	red-eyed vireo	125	carcass search	70-m cleared	intact	40.77049	-86.92187
10/05/2023	red-tailed hawk	116	carcass search	70-m cleared	scavenged	40.76811	-86.88546
10/09/2023	Tennessee warbler	112	carcass search	70-m uncleared	intact	40.78751	-86.91334
10/09/2023	golden-crowned kinglet	112	carcass search	70-m uncleared	scavenged	40.78729	-86.91347
10/09/2023	killdeer	116	carcass search	70-m cleared	scavenged	40.76806	-86.8858
10/09/2023	ruby-crowned kinglet	112	carcass search	70-m uncleared	intact	40.7871	-86.91339
10/09/2023	turkey vulture	112	carcass search	70-m uncleared	scavenged	40.78796	-86.91346
10/09/2023	unidentified small bird	125	carcass search**	70-m cleared	scavenged	40.77084	-86.92164
10/10/2023	brown creeper	102	carcass search	70-m cleared	scavenged	40.80394	-86.98916
10/10/2023	golden-crowned kinglet	101	carcass search	70-m cleared	scavenged	40.80402	-86.99808

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Latitude	Longitude
10/10/2023	golden-crowned kinglet	102	carcass search	70-m cleared	scavenged	40.80454	-86.98886
10/10/2023	unidentified small bird	101	carcass search	70-m cleared	scavenged	40.80397	-86.99789
10/10/2023	winter wren	122	carcass search	70-m cleared	intact	40.78371	-86.94099
10/10/2023	yellow-bellied sapsucker	101	carcass search	70-m cleared	scavenged	40.80441	-86.99731
10/12/2023	golden-crowned kinglet	122	carcass search	70-m cleared	intact	40.7832	-86.94113
10/12/2023	horned lark	122	carcass search	70-m cleared	intact	40.78346	-86.94187
10/13/2023	golden-crowned kinglet	102	carcass search	70-m cleared	scavenged	40.80469	-86.98901
10/13/2023	golden-crowned kinglet	102	carcass search	70-m cleared	scavenged	40.8046	-86.99022
10/13/2023	ruby-crowned kinglet	101	carcass search	70-m cleared	scavenged	40.80388	-86.9981
10/13/2023	ruby-crowned kinglet	102	carcass search	70-m cleared	scavenged	40.80408	-86.98974

* Coordinates were not collected for this carcass due to technological failure.

** Carcass was found outside the search area.

m = meters.

Appendix B. Searcher Efficiency, Carcass Persistence, and Truncated Weighted Likelihood Area Adjustment Estimate Model Fitting Results

Appendix B1. Searcher efficiency models for 70-meter plots at the Rosewater Wind Farm, White County, Indiana, August 1 – October 15, 2023.

Covariates	*k* Value	AICc	Delta AICc
Plot type	0.67	36.40	0
No covariates	0.67	36.55	0.15*

* Selected model.

AICc is corrected Akaike Information Criterion; Delta AICc is the difference between the AICc of a given model and the lowest AICc value.

Appendix B2. Searcher efficiency models for 100-meter roads and pads at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Covariates	*k* Value	AICc	Delta AICc
Season	0.67	32.37	0
No covariates	0.67	32.51	0.14*

* Selected model.

AICc is corrected Akaike Information Criterion; Delta AICc is the difference between the AICc of a given model and the lowest AICc value.

Appendix B3. Carcass persistence models with covariates and distributions for 70-meter plots at the Rosewater Wind Farm, White County, Indiana, August 1 – October 15, 2023.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Plot type	–	exponential	101.64	0
No covariates	–	exponential	101.76	0.12*
No covariates	Plot type	lognormal	103.27	1.63
No covariates	No covariates	loglogistic	103.51	1.87
Plot type	Plot type	lognormal	103.61	1.97
No covariates	No covariates	lognormal	103.65	2.01
No covariates	Plot type	loglogistic	103.68	2.04
Plot type	Plot type	loglogistic	103.75	2.11
No covariates	No covariates	Weibull	103.76	2.12
Plot type	No covariates	Weibull	103.98	2.34
Plot type	No covariates	loglogistic	104.22	2.58
Plot type	Plot type	Weibull	104.85	3.21
Plot type	No covariates	lognormal	105.25	3.61
No covariates	Plot type	Weibull	105.78	4.14

* Selected model.

AICc is corrected Akaike Information Criterion; Delta AICc is the difference between the AICc of a given model and the lowest AICc value.

Appendix B4. Carcass persistence top models with covariates, distributions, and model parameters for the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Plot Type	Distribution*	Estimated Median Removal Times (days)	Parameter 1**
70-meter cleared plots	exponential	12.15	0.0570
100-meter roads and pads	exponential	6.34	0.1093

* Parameterization follows the base R parameterization for this distribution.

** Parameter 1 for the exponential distribution is rate.

Appendix B5. Carcass persistence models with covariates and distributions for 100-meter roads and pads at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	–	exponential	136.53	0
No covariates	–	exponential	137.85	1.32*
Season	No covariates	Weibull	138.89	2.36
No covariates	No covariates	Weibull	139.52	2.99
Season	Season	Weibull	141.48	4.95
No covariates	Season	Weibull	141.98	5.45
No covariates	No covariates	loglogistic	142.78	6.25
Season	No covariates	loglogistic	142.87	6.34
Season	No covariates	lognormal	143.26	6.73
No covariates	No covariates	lognormal	143.39	6.86
No covariates	Season	loglogistic	145.20	8.67
Season	Season	loglogistic	145.39	8.86
No covariates	Season	lognormal	145.81	9.28
Season	Season	lognormal	145.85	9.32

* Selected model.

AICc is corrected Akaike Information Criterion; Delta AICc is the difference between the AICc of a given model and the lowest AICc value.

Appendix B6. Number and percent (%) of bat carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

	Included in Area Correction		Outside Search Area*		Outside Study Period*		Total	
Species	Total	%	Total	%	Total	%	Total	%
eastern red bat	111	49.1	4	66.7	10	41.7	125	48.8
silver-haired bat	58	25.7	1	16.7	1	4.2	60	23.4
hoary bat	24	10.6	0	0	10	41.7	34	13.3
big brown bat	25	11.1	1	16.7	3	12.5	29	11.3
evening bat	5	2.2	0	0	0	0	5	2.0
eastern red bat or Seminole bat	2	0.9	0	0	0	0	2	0.8
Indiana bat	1	0.4	0	0	0	0	1	0.4
Total	**226**	**100**	**6**	**100**	**24**	**100**	**256**	**100**

* Carcasses not included in analysis.

Sums may not equal totals shown due to rounding.

Appendix B7. Stratified search area adjustment models for bats from the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

3.6-MW Turbines	4.2-MW Turbines	Pooled	AICc	DeltaAICc
Gompertz	Gompertz	–	5,357.14	0*
Gompertz	normal	–	5,369.72	12.58
Weibull	Gompertz	–	5,397.62	40.48
normal	Gompertz	–	5,400.93	43.80
–	–	Gompertz	5,401.29	44.16
Gompertz	Weibull	–	5,406.93	49.79
Weibull	normal	–	5,410.20	53.06
normal	normal	–	5,413.51	56.38
gamma	Gompertz	–	5,438.86	81.72
–	–	normal	5,440.06	82.92

* Selected model.

AICc is corrected Akaike Information Criterion; Delta AICc is the difference between the AICc of a given model and the lowest AICc value.

MW = megawatt.

Note: Model output is clipped to display the top ten selected models.

Appendix B8. Truncated weighted maximum likelihood search area adjustment estimates for the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Plot Type	Turbine MW	Area Correction	Distribution	Parameter 1	Parameter 2
100-m road and pad	3.6	0.08	Gompertz	0.1014	0.0004
100-m road and pad	4.2	0.20	Gompertz	0.0486	0.0058
70-m plot	3.6	1.00	Gompertz	0.1014	0.0004
70-m plot	4.2	0.97	Gompertz	0.0486	0.0058

MW = megawatt; m =meter.

The number of bats informing this model is 247.

Appendix C. Inputs for Single Class and Multiple Class Modules in Evidence of Absence

Appendix C1. Inputs needed to run Evidence of Absence (EoA): Single Class Module for the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Season	Plot Type	Turbine MW	Search Interval (*I*)	Number of searches[b]	Spatial Coverage (*a*)	Searcher Efficiency		Carcass Persistence[a]			
						Carcasses Available	Carcasses Found	Shape (α)	Scale (β)	Scale Lower Limit (β)	Scale Upper Limit (β)
spring	100-m road and pad	3.6	14.5	4	0.08	41	36	–	9.15	6.31	13.28
spring	100-m road and pad	4.2	14.5	4	0.2	41	36	–	9.15	6.31	13.28
fall	70-m plots	3.6	3.5	21	1	42	36	–	17.53	10.74	28.65
fall	70-m plots	4.2	3.5	21	0.97	42	36	–	17.53	10.74	28.65
fall	100-m road and pad	3.6	7	12	0.08	41	36	–	9.15	6.31	13.28
fall	100-m road and pad	4.2	7	12	0.2	41	36	–	9.15	6.31	13.28

[a] An exponential distribution was used for the road and pad and cleared and uncleared plot carcass persistence distribution.

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

Note: Values for temporal coverage (*v*) were set to 1, and arrival proportions were accounted for in the Multiple Class Module.

m = meters, MW = megawatt.

Appendix C2. Inputs needed to run Evidence of Absence: Multiple Class Module for fall plot types at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Season	Plot Type	Turbine MW	Ba	Bb	Within-season Sampling Fraction	Within Season Weights (ρ)
spring	road and pad	3.6	62.55	1,715.93	0.2	0.2
spring	road and pad	4.2	59.09	599.39	0.8	0.8
fall	full plot	3.6	82.42	15.22	0.12	0.12
fall	full plot	4.2	93.13	19.85	0.2	0.2
fall	road and pad	3.6	135.91	2,568.36	0.08	0.08
fall	road and pad	4.2	124.98	849.54	0.6	0.6

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.

MW = megawatt.

Appendix C3. Inputs needed to run Evidence of Absence: Multiple Class Module for seasonal detection probabilities at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2023.

Season	Plot Type	Ba	Bb	Sampling Fraction	Temporal Coverage (*v*)	Weights (ρ)
spring	100-m road and pad	71.438	834.803	1	0.11	0.11
fall	100-m road and pad and 70-m plots	705.834	1,327.504	1	0.89	0.89

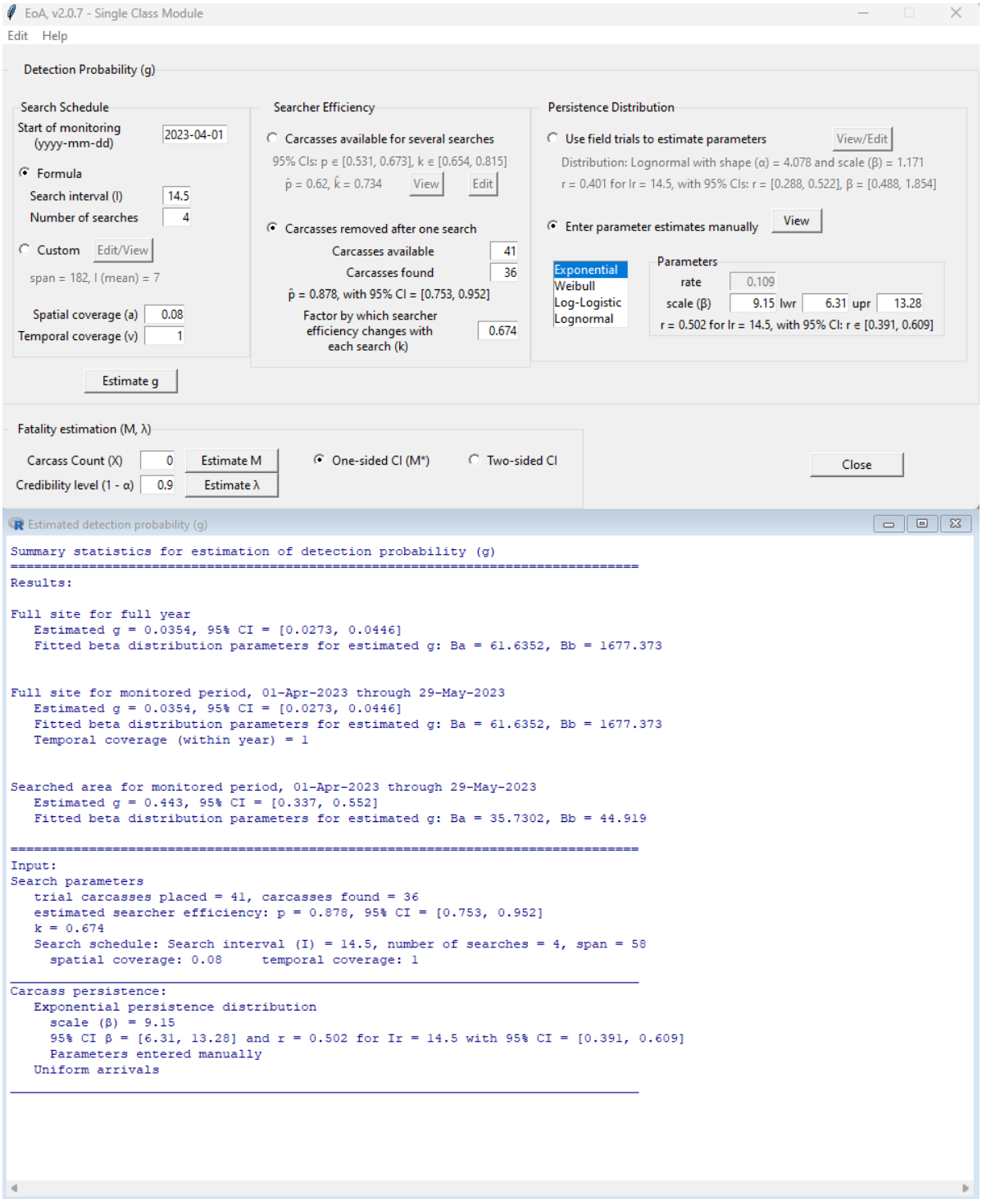
Ba and Bb are the parameters for the beta distribution used to characterize the probability of detection. The *g* value is the mean of that distribution.

m = meter.

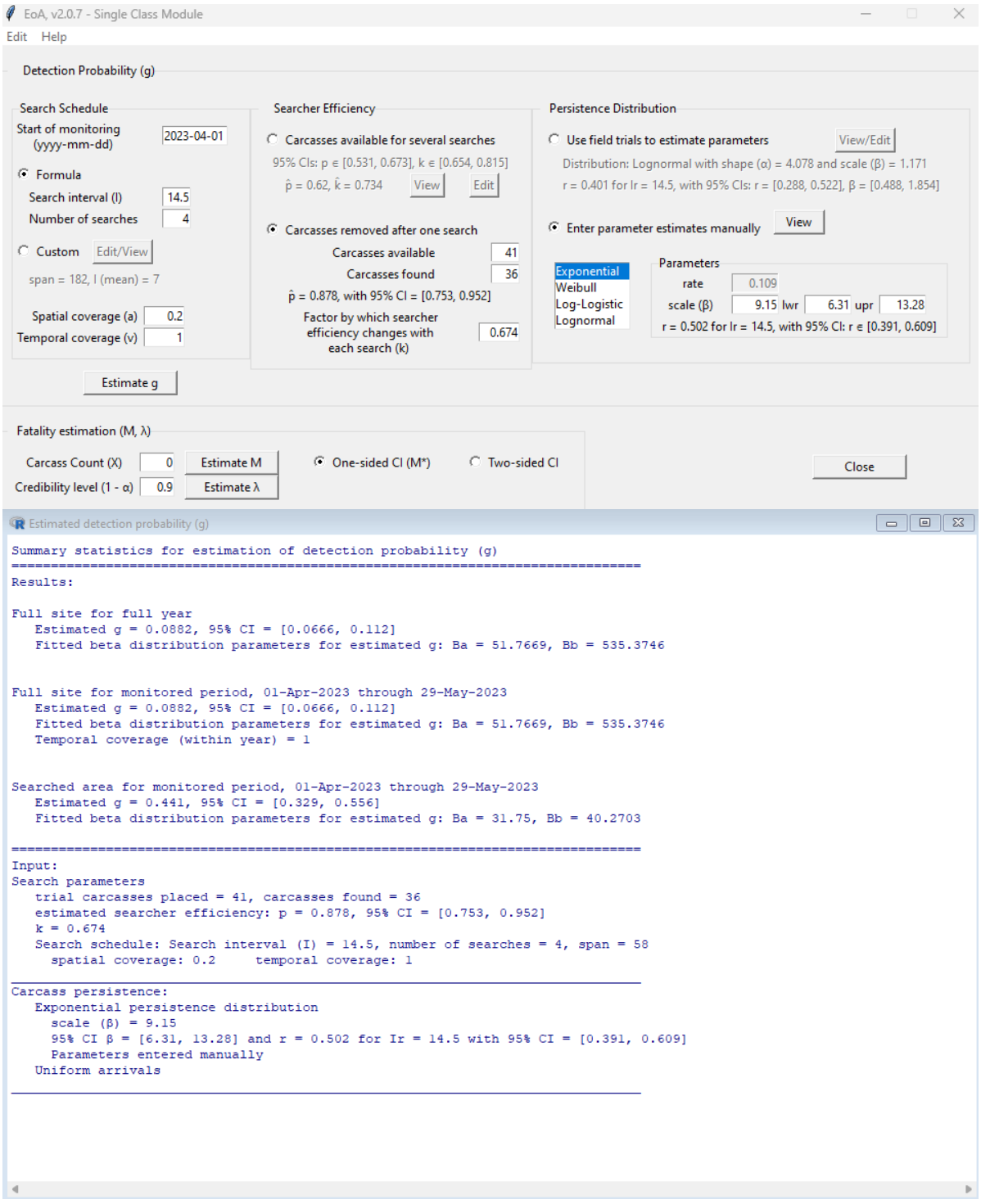
Appendix C4. Inputs needed to run Evidence of Absence: Multiple Years Module for the Rosewater Wind Farm, White County, Indiana, from 2021–2023.

Year	*g*	95% Confidence Interval	Ba	Bb	Weights (ρ)
2021	0.264	0.248–0.279	825.190	2,304.680	1.0
2022	0.311	0.277–0.346	214.048	475.256	1.0
2023	0.318	0.299–0.336	771.332	1,657.162	1.0
Overall	**0.297**	**0.283–0.311**	**1,211.062**	**2,862.952**	

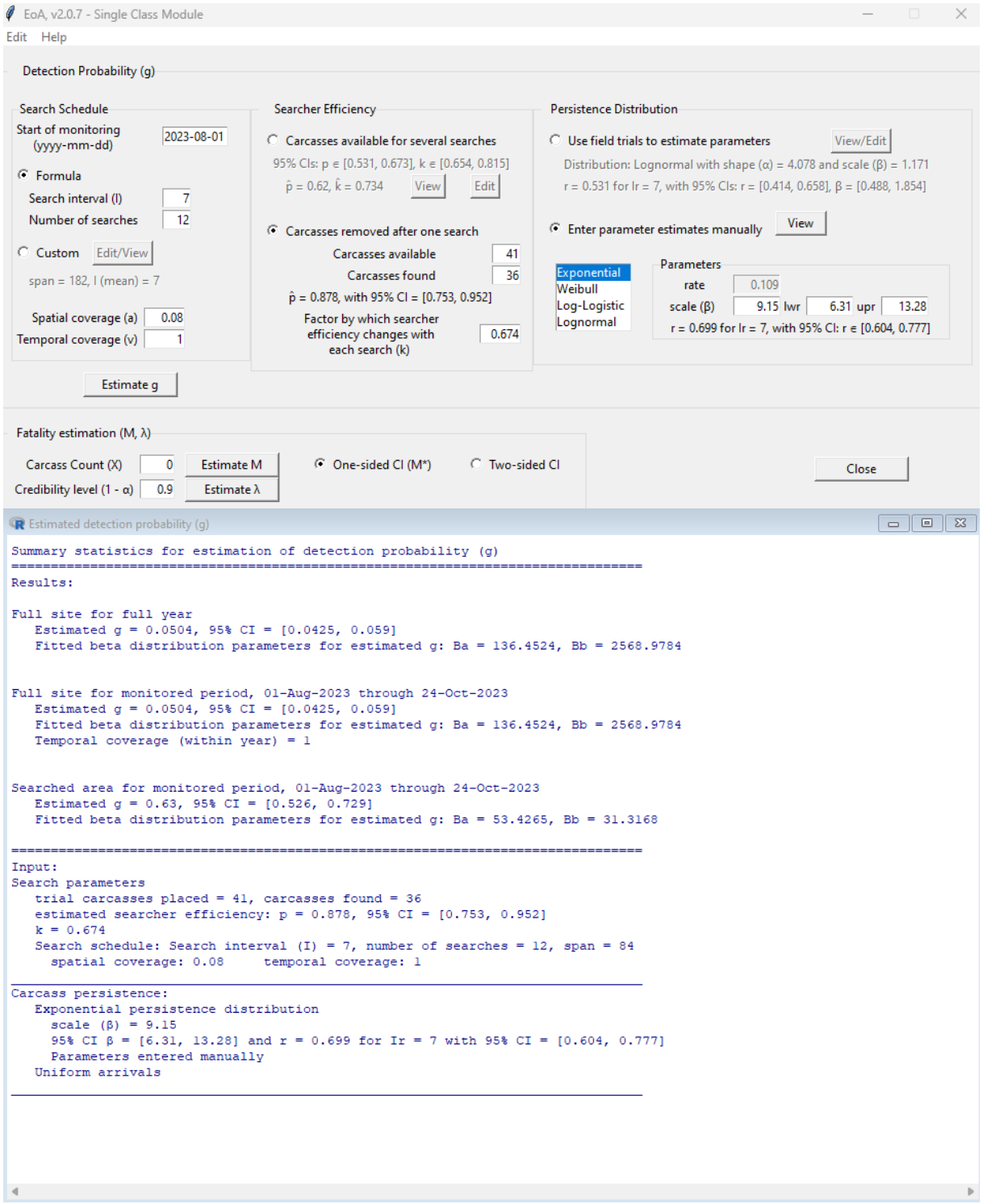
Ba and Bb are the parameters for the beta distribution used to characterize the probability of detection.



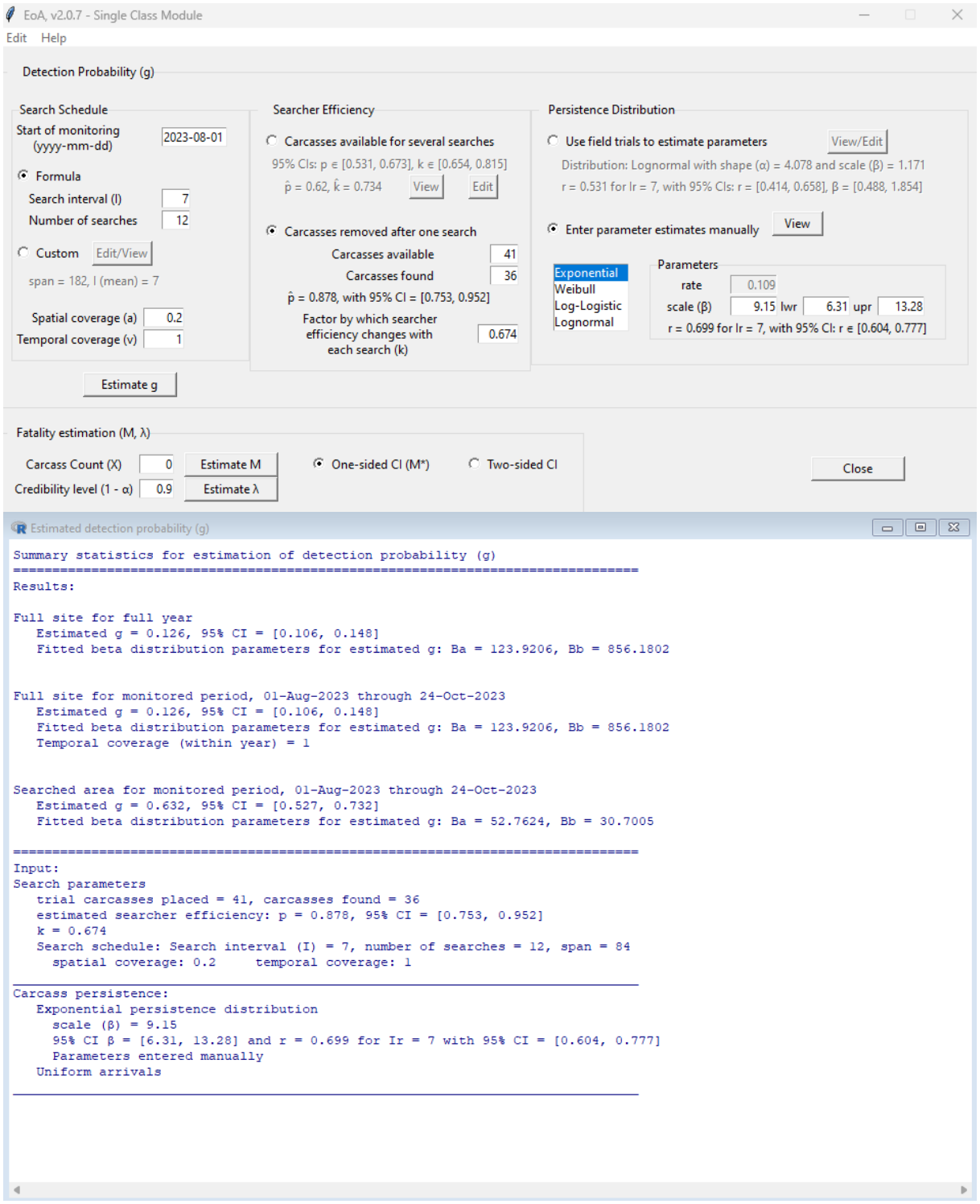
Appendix C5. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Spring 2023, 100-meter road and pad searches at five 3.6 megawatt turbines, searched at a 14-day interval.



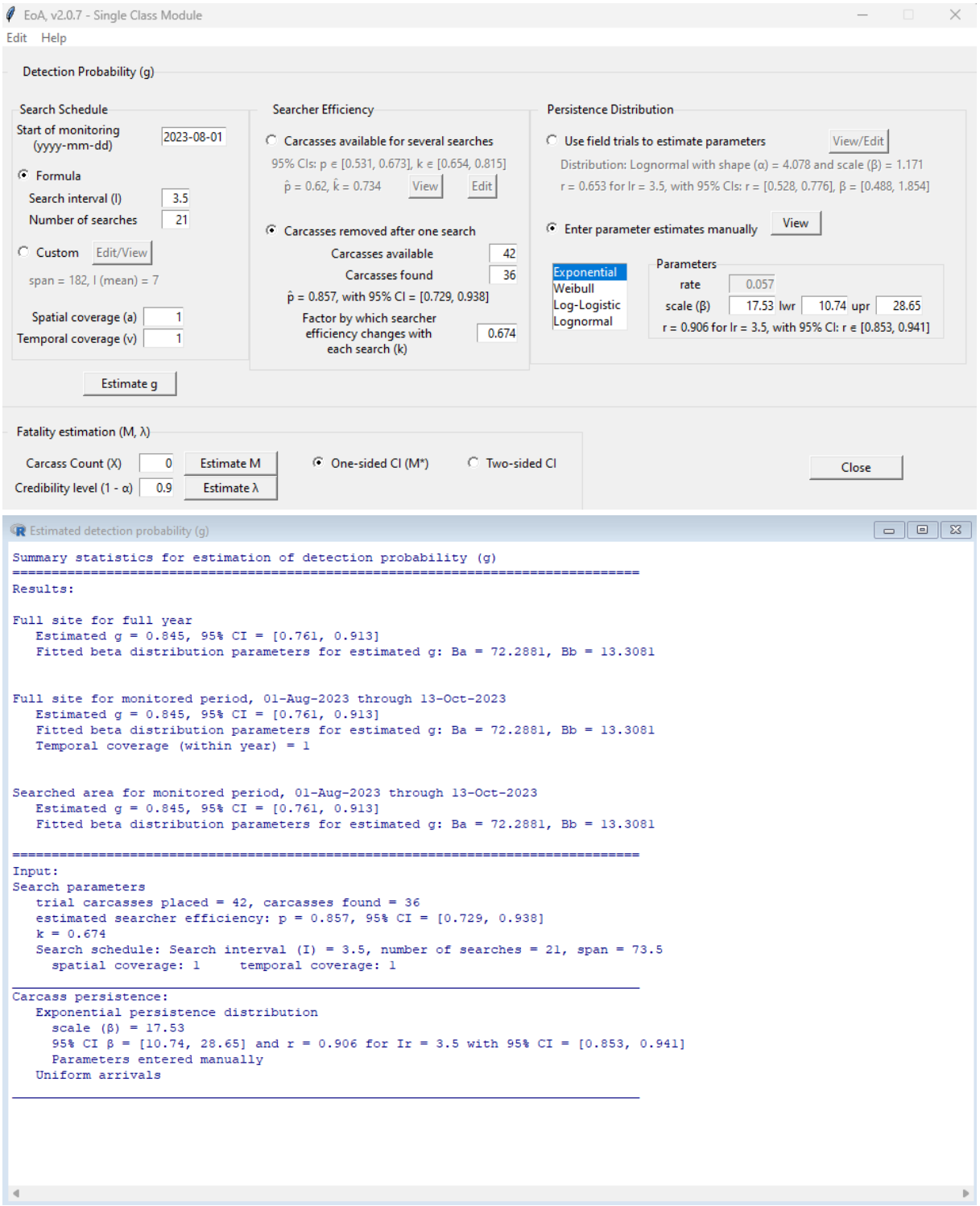
Appendix C6. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Spring 2023, 100-meter road and pad searches at 20 4.2-megawatt turbines, searched at a 14-day interval.



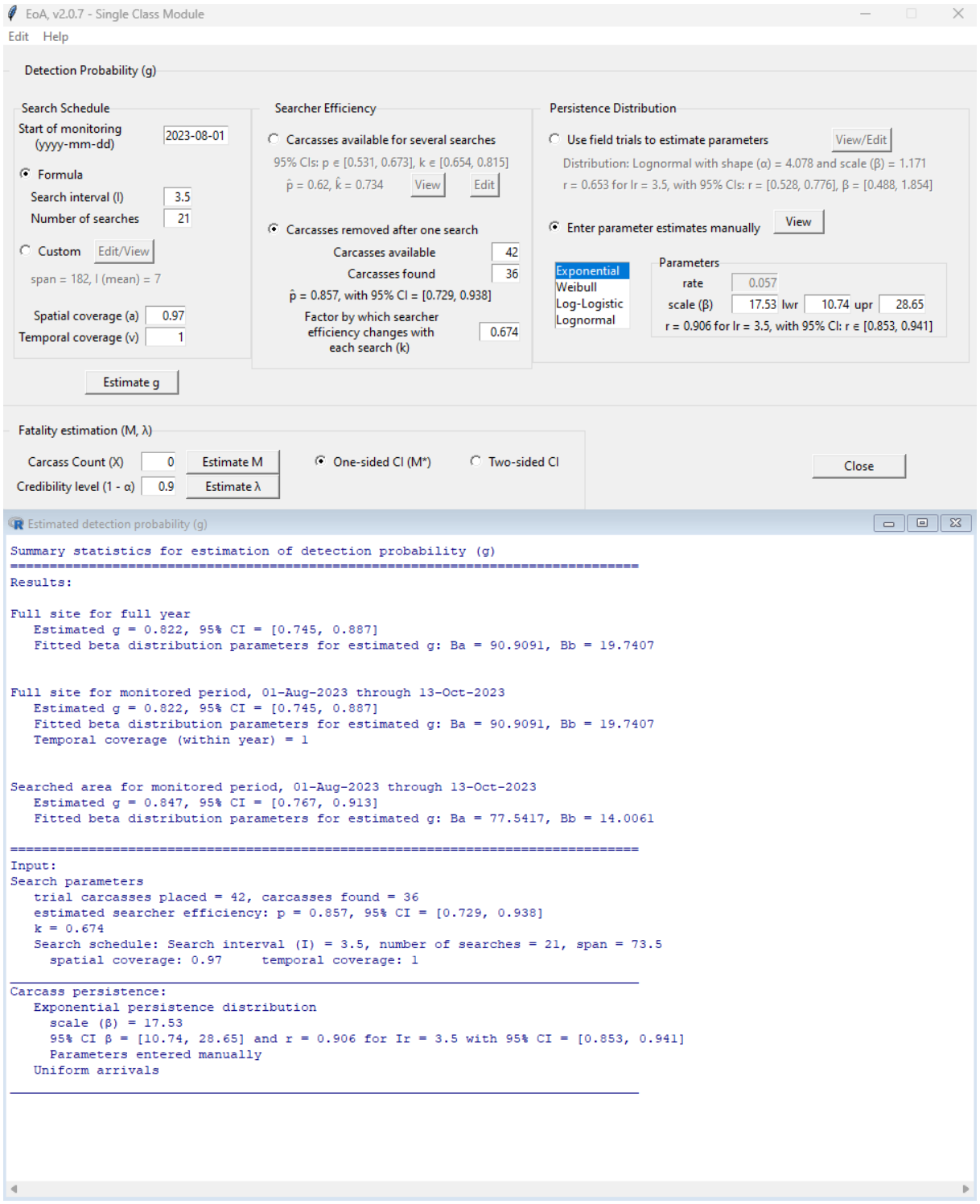
Appendix C7. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for fall 2023, 100-meter road and pad searches at two 3.6-megawatt turbines searched at a 7-day interval.



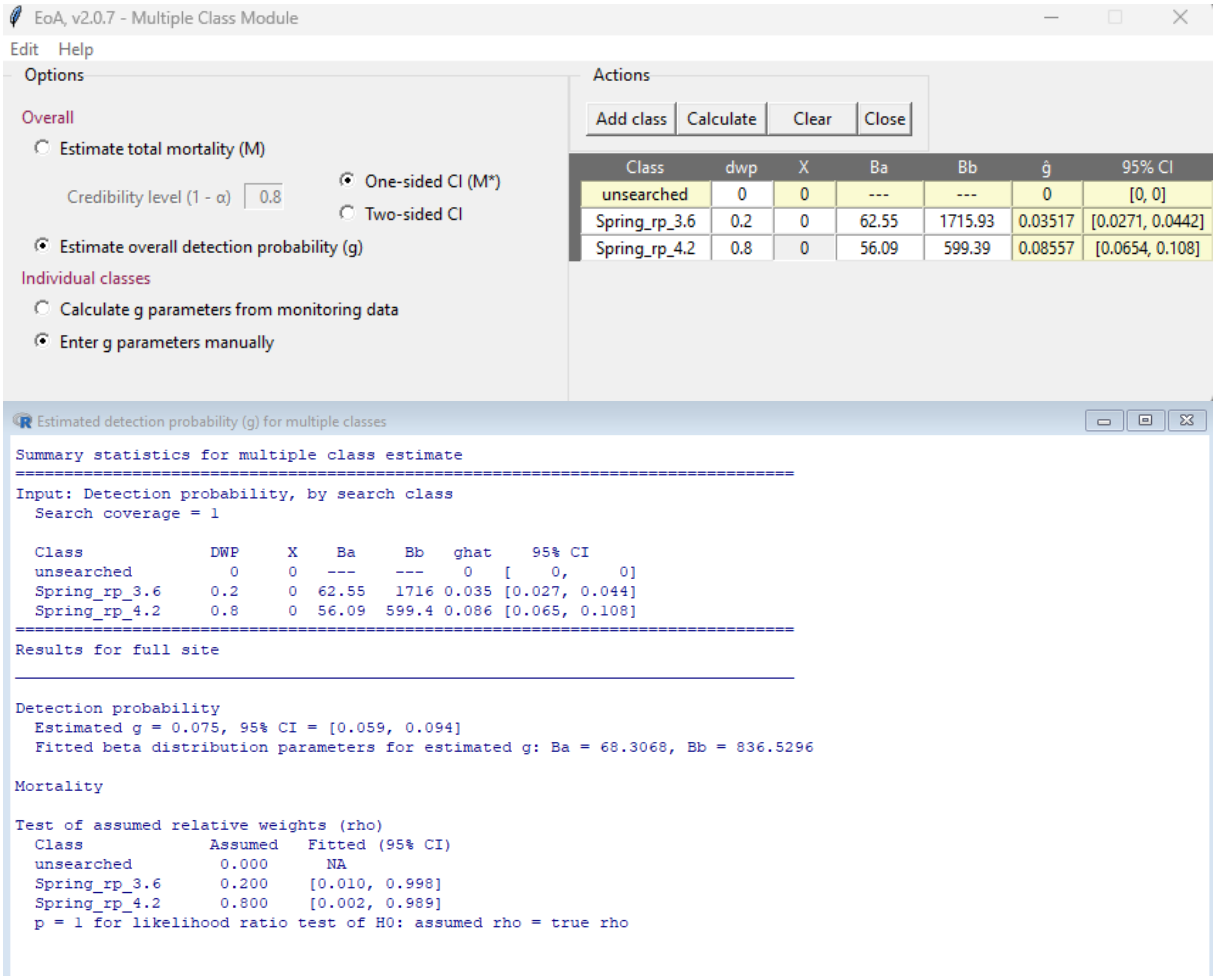
Appendix C8. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for fall 2023, 100-meter road and pad searches at 15 4.2-megawatt turbines searched at a 7-day interval.



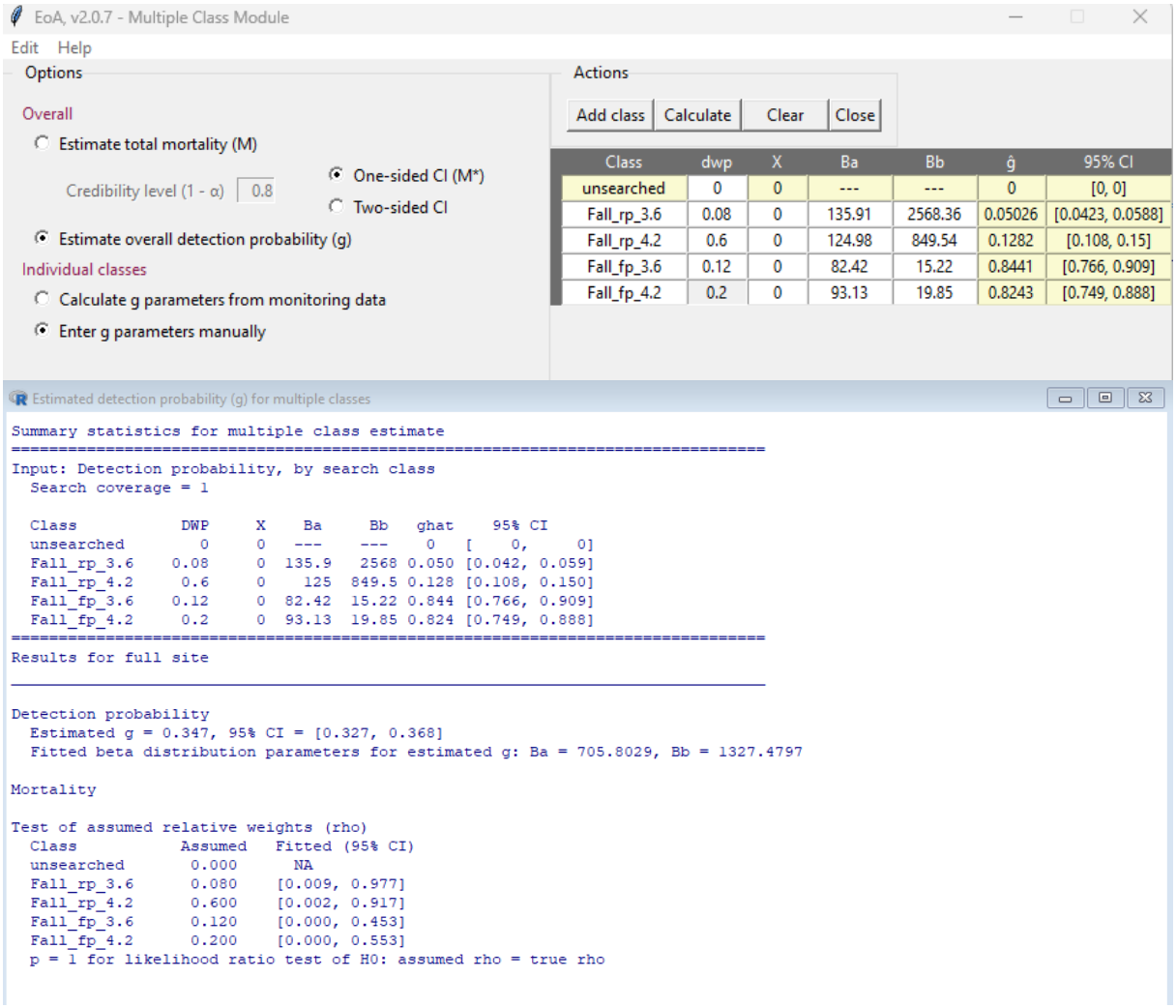
Appendix C9. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for fall 2023, 70-meter plot searches at three 3.6-megawatt turbines searched at a 3.5-day interval.



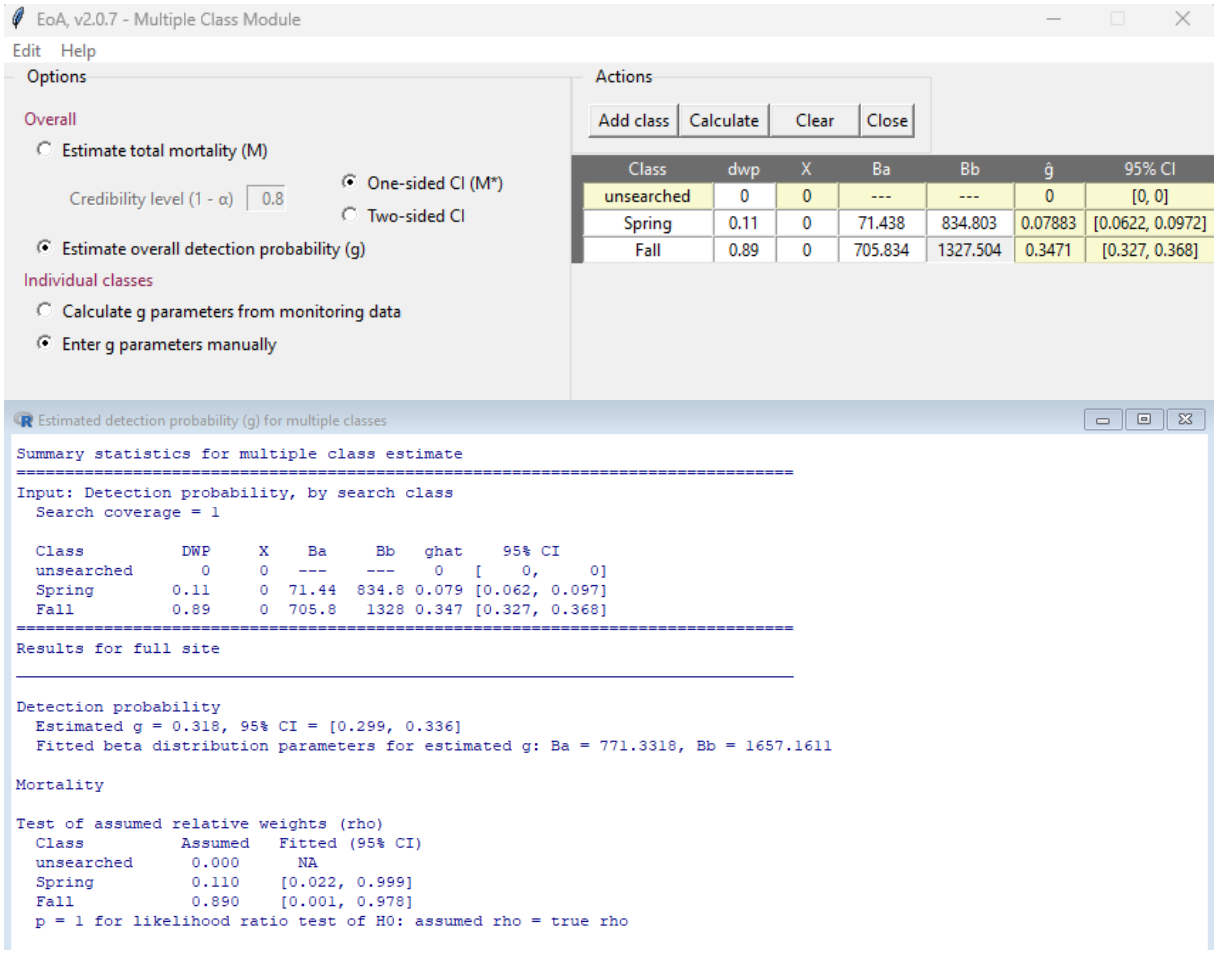
Appendix C10. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for fall 2023, 70-meter plot searches at five 4.2-megawatt turbines searched at a 3.5-day interval.



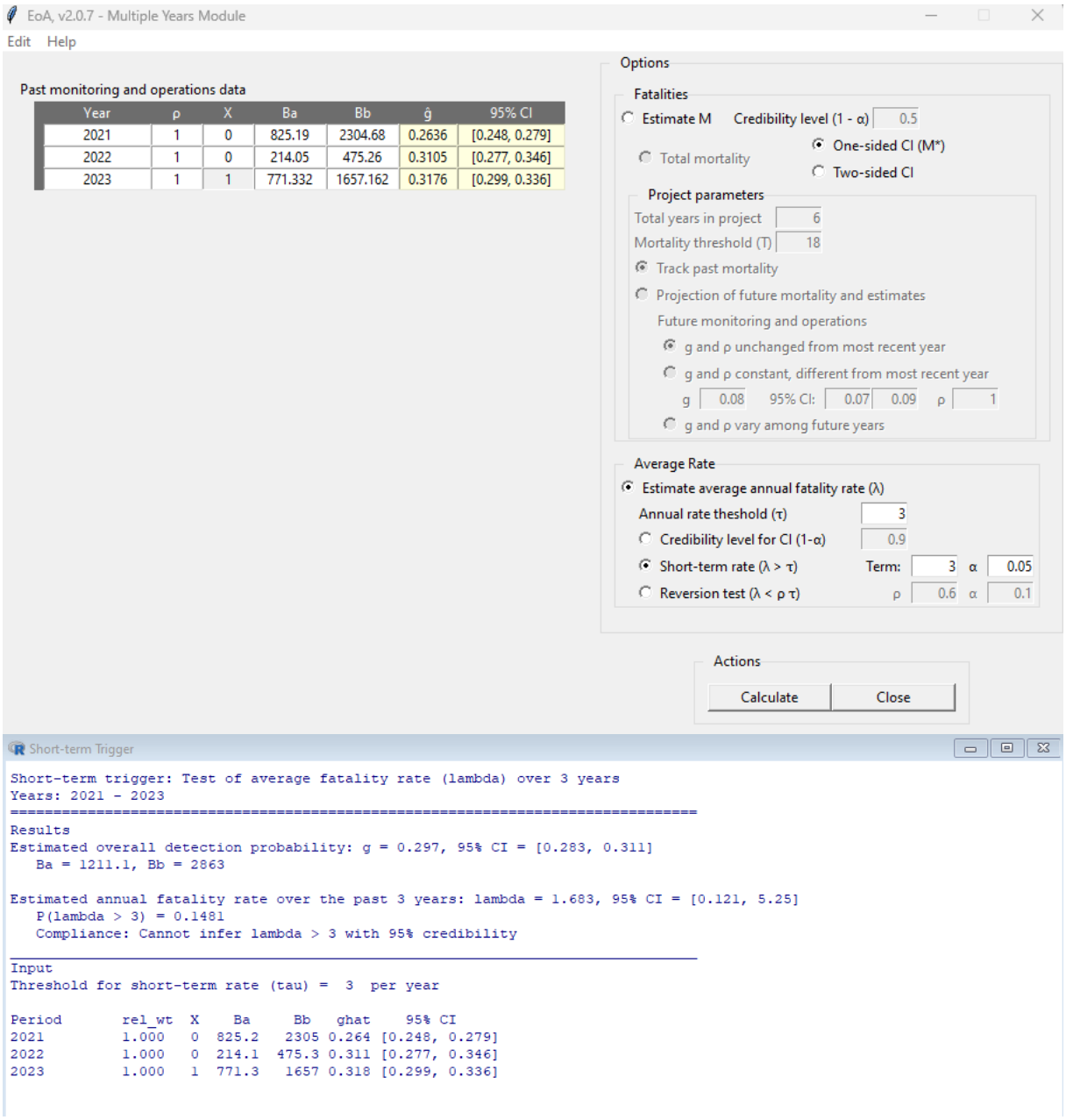
Appendix C11. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for spring 2023 turbine types (n = 25) searched at a 7-day interval.



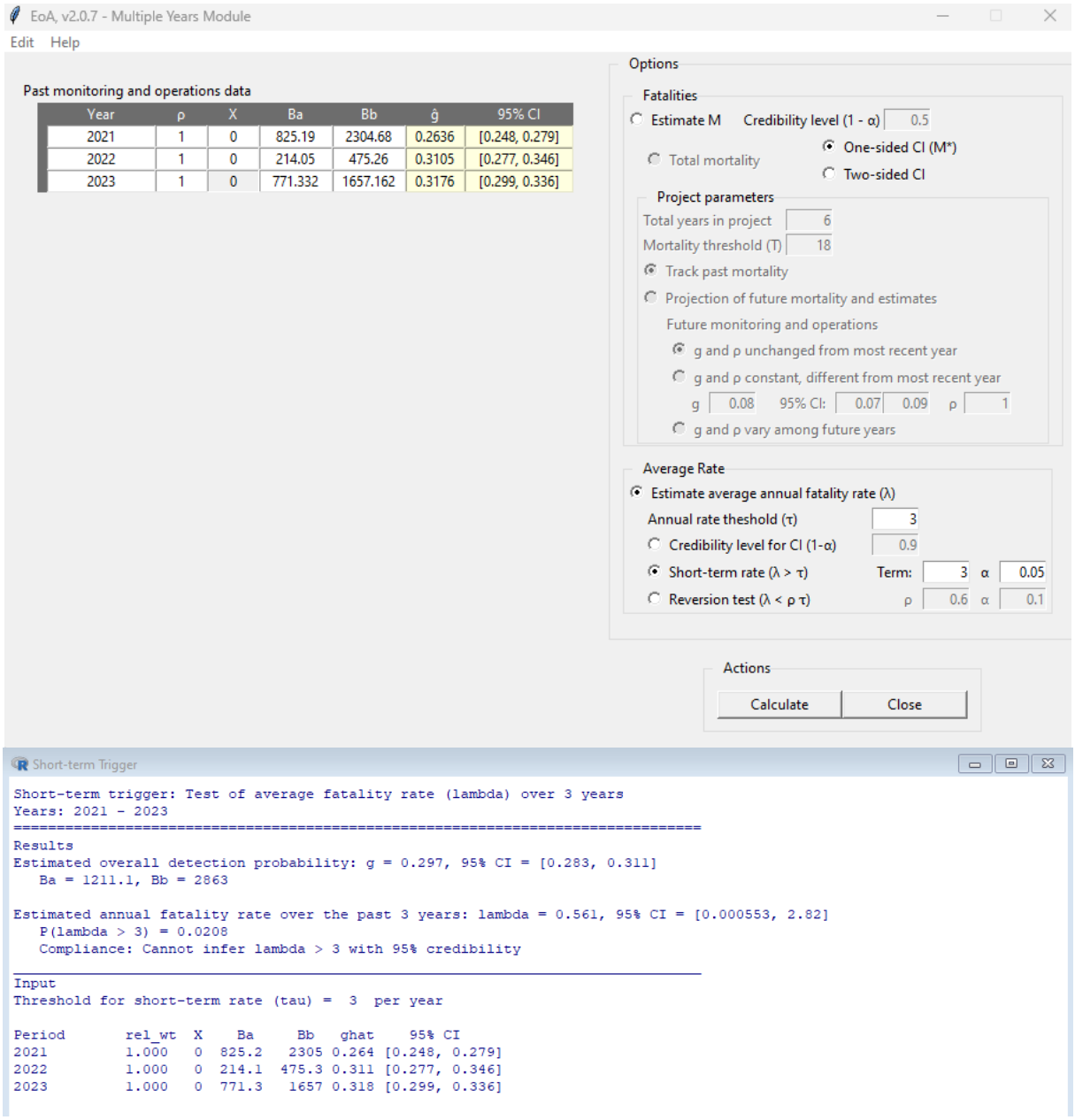
Appendix C12. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for fall 2023 plot types and turbine types (n = 25) searched at a 7-day interval for 100-meter roads and pads, and a 3.5-day interval for 70-meter plots.



Appendix C13. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for seasonal detection probabilities 2023 (n = 25 turbines in spring, 25 in fall) searched at a 14-day interval in the spring, a 7-day interval in the fall for 100-meter roads and pads, and a 3.5-day interval in the fall for 70-meter plots.



Appendix C14. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Years Module inputs for estimation of annual fatality rate (λ) for Indiana bats for 2021–2023.



Appendix C15. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Years Module inputs for estimation of annual fatality rate (λ) for northern long-eared bats for 2021–2023.