Post-construction Monitoring Study for the Rosewater Wind Farm

White County, Indiana

Final Report

April 1 – May 15 and August 1 – October 15, 2022

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WEST

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 twenty 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 post-construction monitoring studies conducted in 2022, 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) in the spring (April 1 – May 15), and 5.0 m (16.4 ft) per second in fall (August 1 – October 15) to minimize direct impacts to Covered Species.

Post-construction monitoring was completed in accordance with the study plan, which was approved by the US Fish and Wildlife Service on March 4, 2022. 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 as outlined in the HCP and provide the necessary data to determine if adaptive management is triggered.

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. Dog-handler 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 or alfalfa fields. Searcher efficiency and carcass persistence trials were also conducted during each season to correct for detection and scavenger bias.

No Covered Species were found at the Project during 2022 spring and fall monitoring periods. Two hundred fifty-seven bats were found during the study. The most commonly found bat species were silver-haired bat (43.6%) and eastern red bat (29.2%), big brown bat (13.2%) and hoary bat (12.5%). One *Lasiurus* spp., one Seminole bat, and two evening bats, which are also state-listed as endangered, were documented at the Project on September 9 and 26, 2022. The overall *g* value for 2022 was 0.31 (95% CI: 0.28–0.35). The EoA model estimated the mean annual fatality rate at the Project was 0.872 Indiana bats and 0.872 northern long-eared bats. No adaptive management was triggered.

STUDY PARTICIPANTS

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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 (PCM) 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 second year (Year 2) of the post-construction monitoring conducted at the Project from April 1 – May 15 and August 1 – October 15, 2022.

STUDY 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 2,582 hectares (6,381 acres). Approximately 98% of the Permit Area is composed of cultivated cropland and developed areas (Figure 1).

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).
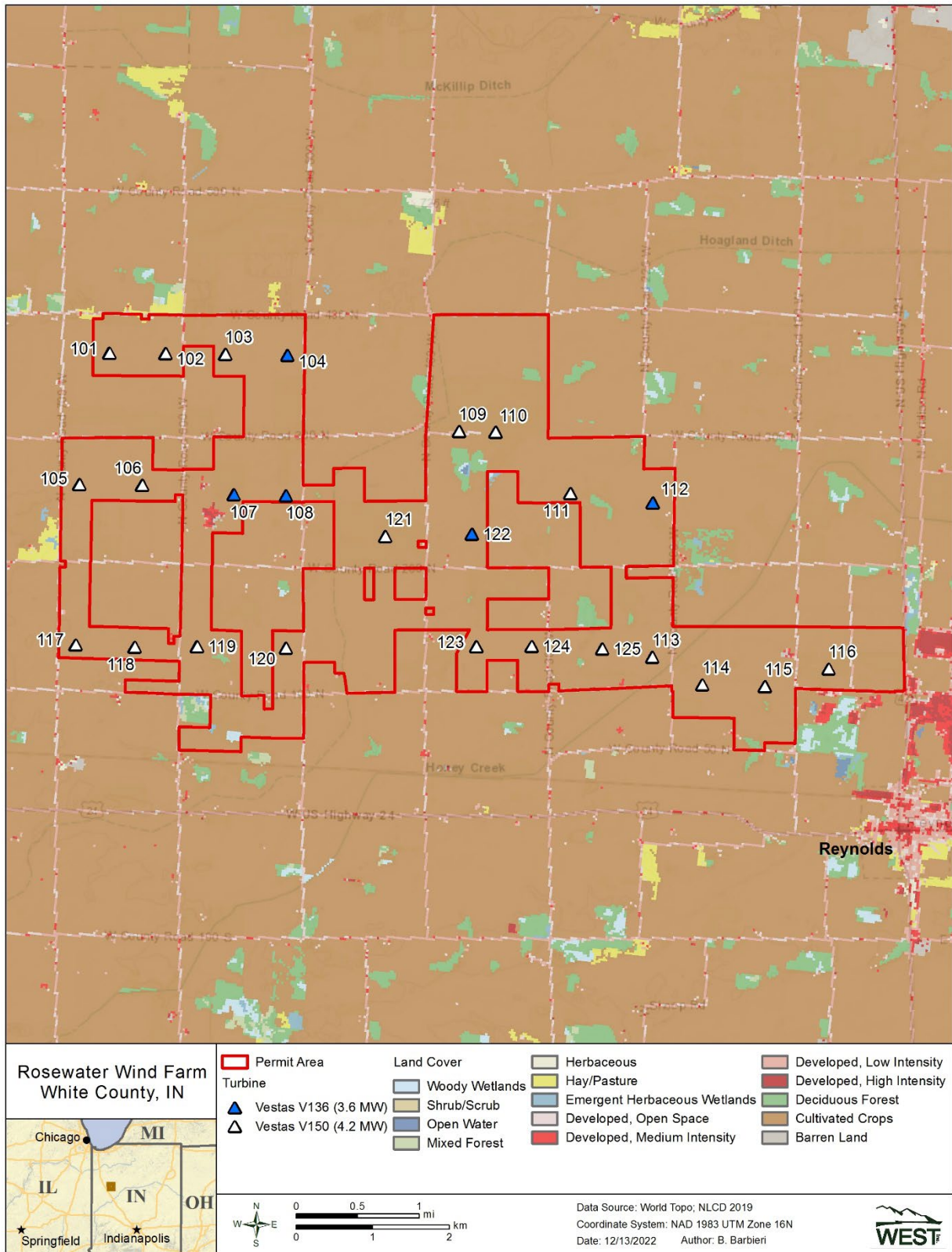
Figure 1. Turbine locations by turbine model and surrounding land cover at the Rosewater Wind Farm, White County, Indiana.

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[1]?	Temperature Threshold[2]
March 15 – July 31	All	Sunset to sunrise	Manufacturer's rated, minimum of 3.0 m/s (9.8 ft/s)[2]	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)[2]	Yes	10° C (50° F)
November 16 – March 14	All	N/A	Manufacturer's setting	No	None

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

[2] 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 0.25, 0.28); Rosewater conservatively decided to implement the same study design for Year 2. WEST submitted a study plan to the USFWS on January 20, 2022 (Rodriguez et al. 2021), which was approved by USFWS on March 4, 2022 (M. Reed, USFWS, pers. comm.).

Standardized Carcass Searches

Number of Turbines Sampled, Search Frequency, and Plot Size

Technicians and dog-handler teams conducted standardized carcass searches from April 1 – May 15 and August 1 – October 15, 2022. Search effort varied by season (Figure 2, Table 2), and was designed to maximize search effort when take of the Covered Species was considered most likely to occur.
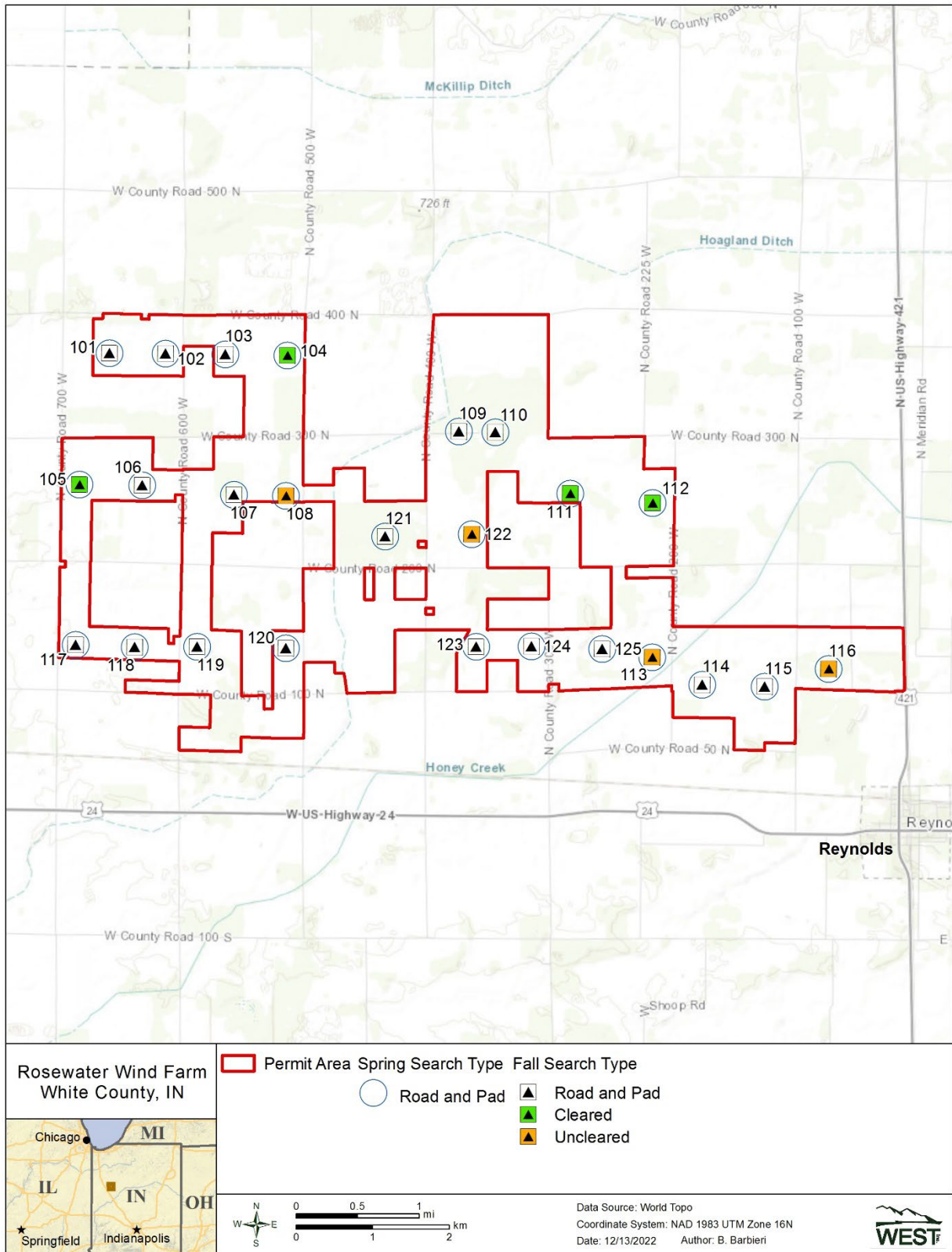
Figure 2. **Turbine locations and search type at the Rosewater Wind Farm, White County, Indiana.**

Table 2.   **Search effort by season and plot type at 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)	100-m road and pad	7.0 days	17	Technician
	70-m cleared plot	3.5 days	4	Dog-handler
	70-m uncleared plot	3.5 days	4	Dog-handler

m = meter.

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). Dog-handler 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 soybeans as uncleared plots with a 70-m radius (70-m uncleared plots; Figure 5) twice per week in the fall.

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

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

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

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

Search Methods

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

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 search area.

70-meter Plot Searches – Dog-handler Team

Dog-handler 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 windspeed 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 (16–33 ft) apart in densely vegetated areas, to 10–15 m (33–49 ft) 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.

Dog-handler Team Evaluation

Detection dogs were considered candidates for 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, 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 that had been 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 ten blind trial lineups using bat carcasses, the dog and handler were evaluated in the field to measure their performance. The detection dog coordinator conducted a two day field evaluation of each dog-handler team; after teams achieved a searcher efficiency of 75% or greater for 15–30 bats during evaluation trials, the teams were 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 on birds in the field, and handlers rewarded bird finds in the field to encourage future alerts to bird carcasses. Breeds

used at the Project as detection dogs included a shepherd mix and a border collie/Australian shepherd mix.

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 fatalities were found for each scheduled search. When a bird or bat fatality was found, technicians placed a flag near it and continued the search. After searching the entire plot, the technician or dog-handler returned to record information for each fatality 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, azimuth from turbine (m), location of carcass as latitude and longitude, habitat surrounding 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 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, etc.), 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—Ten or more feathers (excluding down), or two or more primary feathers at one location indicating predation or scavenging of a bird carcass.

Digital photographs were taken of each fatality, including any visible injuries, and surrounding habitat. No bird carcasses were collected, but a marker was placed next to each bird carcass to avoid duplicate counting. Bat carcasses were collected under the Project's ITP (ESPER0003552), WEST's Federal Native Endangered and Threatened Species Recovery Permit (TE234121-9), and WEST's Special Purpose Salvage Permit (2229). 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 in hand at the end of the searches. 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 would have been notified within 24 hours of positive identification a federally listed species, and the IDNR was notified within three working days of positive identification of state-listed species. At the end of the searches, bat carcasses and fur and tissue samples were delivered to the USFWS Indiana Field Office in Bloomington, Indiana, on December 29, 2022.

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 22 and October 27, 2022.

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 carcass searches occurred. Technicians conducting 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 on site or provided by Indiana State University (ISU). Additionally, one hoary bat (*Lasiurus cinereus)* provided by ISU was placed in the spring. Ninety-four 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 dog-handler 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 for detection during each search was determined immediately after each trial by the trial administrator. Following searches, any carcasses that were not detected were checked to confirm availability. Fifty-one trials of the 94 placed 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. 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.

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-day period, any remaining carcasses were removed. Dog-handler 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 (QA/QC) 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 Evidence of Absence (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 dog-handler 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, we modeled searcher efficiency 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 dog-handler model. For both the technician and dog-handler team 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 dog-handler 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, log-logistic, 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 dog-handler 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 dog-handler 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. 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. Distributions considered were normal, gamma, Gompertz, and Weibull (parameterized according to R Development Core Team [2016] and Yee [2010]). 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 only models considered were those that pooled data from both turbine operation regimes and seasons. The best-supported model was selected using AICc. 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.

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 still be excluded from the area correction estimate, but would be included in the EoA fatality estimate following Dalthorp et al. 2020.

Covered Species Take and Detection Probability Estimates

EoA was used to estimate the 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 and Multiple Class 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, and area adjustment was included in the Single Class module for each 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 and 2022 were then combined using the EoA Multiple Years module. Per the HCP, adaptive management triggers will not be evaluated using EoA until Year 3.

RESULTS

Standardized Carcass Searches

Ninety-seven searches were completed in the spring, and 404 searches were completed in the fall. Six searches (1.2%) were missed due to turbine maintenance, weather constraints, and/or safety hazards. Two hundred fifty-seven bat carcasses and 64 bird carcasses were found during searches and incidentally (Appendix A). No Covered Species were found. Two evening bats (*Nycticeius humeralis*), a state-listed endangered species, were documented at the Project at turbines 122 and 112, on September 9 and 26, respectively. IDNR was notified within three working days (on September 9 and 29, 2022). No other state- or federally listed species were recorded during the ITP monitoring effort.

Five bats were found in the spring and 252 bats were found in the fall (Appendix A). The most commonly found bat species were silver-haired bat (112 carcasses; 43.6%) and eastern red bat (75 carcasses; 29.2%), followed by big brown bat (34 carcasses; 13.2%) and hoary bat (32 carcasses; 12.5%). Two evening bats (0.8%), one Seminole bat (0.4%), and one unidentified *Lasiurus* spp. (0.4%) were also found (Appendices A and B). Over the course of the monitoring period, four heavily scavenged bats (e.g., wing membrane only, bones, or partial carcasses) were sent off for identification via deoxyribonucleic acid (DNA) analysis; they were identified as three silver-haired bats, and one big brown bat. The majority of bat carcasses were recorded on 70-m plots searched by dog-handler teams (Appendix A).

Statistical Analysis

Bias Trials

Searcher Efficiency Trials

Ninety-four bats were placed for searcher efficiency trials on 11 separate dates across all plot types and months of the study; 82 were available for search teams to find. The best-supported model for searcher efficiency on 70-m plots 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 70.7% on 70-m plots to 95.1% on roads and pads (Table 3).

Table 3. Searcher efficiency results by plot type at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Plot Type	Number Placed	Number Available	Number Found	% Found
100-meter Roads and Pads	41	41	39	95.1
70-meter Plots	53	41	29	70.7

Carcass Persistence Trials

Sixty carcasses were placed to estimate carcass persistence. The best-fit model for carcass persistence rates on plots searched by dog-handlers had a Weibull distribution and did not include any covariates, which suggests carcass persistence rates did not vary by plot type (Appendix B). The best-fit model for carcass persistence rates on 100-m roads and pad searched by technicians had an exponential distribution and did not include any covariates, meaning that carcass persistence on roads and pads did not vary by season (Appendix B). Estimated median carcass persistence times were 12.03 days on 70-m and 7.12 days on roads and pads (Figure 6; Appendix B).
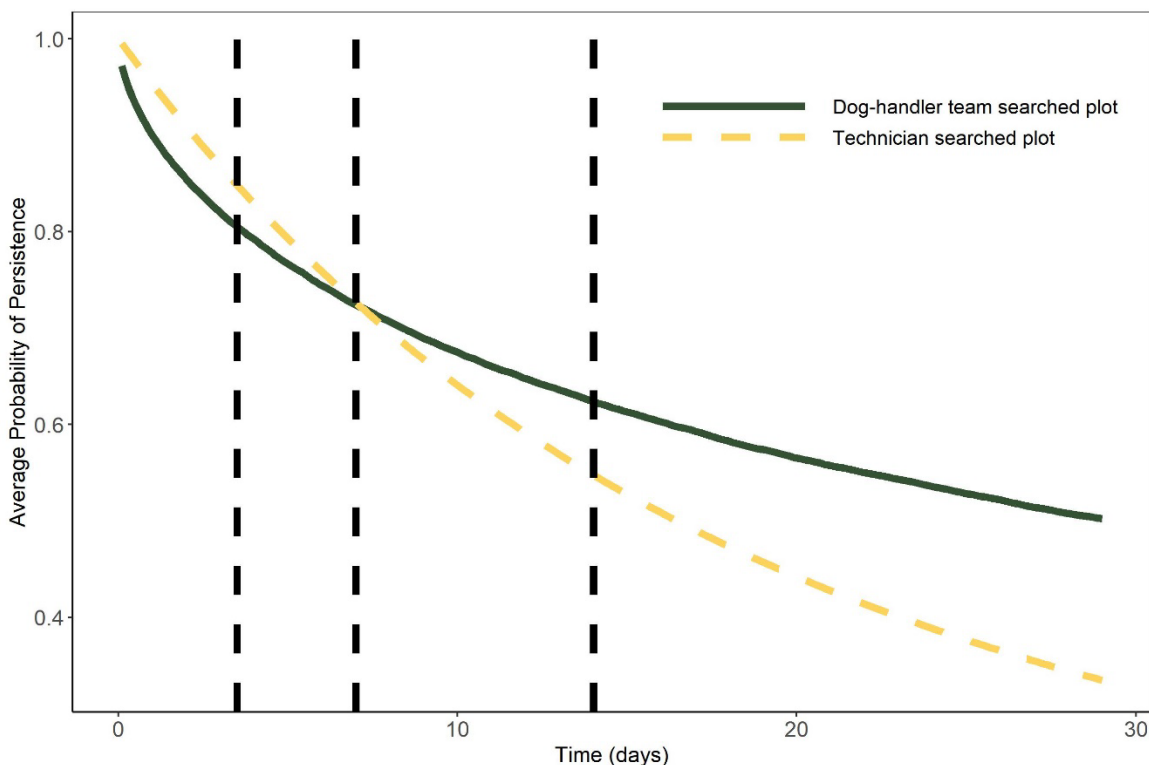
Figure 6.   The average probability of persistence of bats on over time (in days) at Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Note: The vertical dashed lines indicate the 3, 5, 7, and 14 day search intervals used in this study.

Area Adjustment

Ten of the 257 bats found were excluded from modeling the carcass-density distribution for EoA. Five bat carcasses were excluded from analysis because they were found off plot. Another five bats were excluded because their estimated time of death was prior to the start of searches (Appendix A).

The best-fit model for the distribution of bats with respect to distance from turbine base was a normal distribution (Appendix B). The estimated TWL area adjustment for bats was 0.22 for 100-m roads and pads (Appendix B; Figure 7). The estimated TWL area adjustment for bats was 0.98 for 70-m plots (Appendix B; Figure 7).
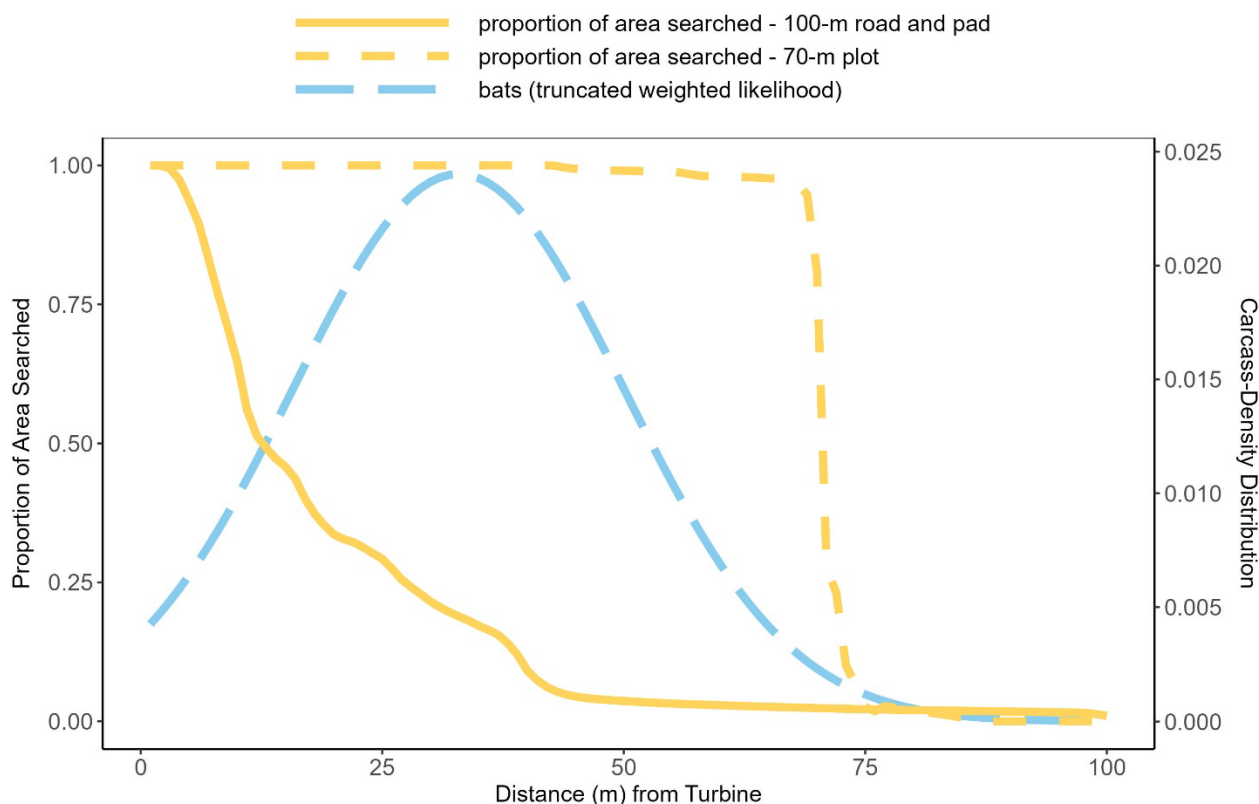
Figure 7. Density of bat carcasses per area searched at all plots at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15, 2022, and August 1 – October 15, 2022.

Indiana Bat and Northern Long-eared Bat Take Estimates

Evidence of Absence Framework

No Covered Species carcasses were found during the study, thus, the adaptive management trigger for Years 1–2 was not met and no adaptive management is necessary. The overall *g* achieved for the 2022 monitoring period had a mean of 0.311 (95% CI: 0.277–0.346). The average overall *g* achieved for the 2021 and 2022 monitoring years had a mean of 0.287 (95% CI: 0.268–0.306). Mean annual take rates were estimated to be 0.872 (95% CI: 0.001–4.384) Indiana bats or northern long-eared bats per year. 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.

CONCLUSIONS

The overall *g* achieved for the 2022 monitoring period keeps the Project on track to exceed the minimum average g of 0.2 for Years 1–3. The ITP compliance monitoring completed during 2022 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 will not be formally evaluated using the EoA results until Year 3; however, no adaptive management actions were triggered this year because no Covered Species were found.

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Appendix A. Carcasses Found during the 2022 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, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
Bat carcasses							
4/25/2022	silver-haired bat	120	incidental	100-m road and pad	intact	40.77001	-86.97011
4/29/2022	hoary bat	117	carcass search	100-m road and pad	intact	40.76989	-87.00276
5/13/2022	eastern red bat	125	carcass search	100-m road and pad	intact	40.77028	-86.92110
5/13/2022	hoary bat	124	carcass search	100-m road and pad	scavenged	40.77067	-86.93171
5/13/2022	silver-haired bat	120	carcass search	100-m road and pad	scavenged	40.76997	-86.96989
8/1/2022	big brown bat	116	carcass search	70-m uncleared plot	intact	40.76836	-86.88561
8/1/2022	eastern red bat	116	incidental	70-m uncleared plot	intact	40.76801	-86.88618
8/1/2022	hoary bat	116	carcass search	70-m uncleared plot	intact	40.76803	-86.88613
8/2/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78759	-86.91352
8/2/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78754	-86.91390
8/2/2022	big brown bat	122	carcass search	70-m uncleared plot	intact	40.78375	-86.94189
8/2/2022	hoary bat	105	carcass search	70-m cleared plot	intact	40.78874	-87.00214
8/2/2022	hoary bat	108	carcass search	70-m uncleared plot	intact	40.78760	-86.97060
8/2/2022	hoary bat	111	carcass search	70-m cleared plot	intact	40.78872	-86.92686
8/3/2022	big brown bat	113	carcass search	70-m uncleared plot	intact	40.76969	-86.91402
8/4/2022	big brown bat	102	carcass search	100-m road and pad	scavenged	40.80438	-86.98922
8/4/2022	big brown bat	124	carcass search	100-m road and pad	scavenged	40.77054	-86.93195
8/4/2022	eastern red bat	102	carcass search	100-m road and pad	scavenged	40.80430	-86.98919
8/4/2022	eastern red bat	125	carcass search	100-m road and pad	scavenged	40.77022	-86.92132
8/4/2022	hoary bat	118	carcass search	100-m road and pad	scavenged	40.76986	-86.99380
8/5/2022	eastern red bat	122	carcass search	70-m uncleared plot	intact	40.78361	-86.94165
8/8/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78722	-86.91341
8/8/2022	hoary bat	111	carcass search	70-m cleared plot	scavenged	40.78869	-86.92662
8/8/2022	hoary bat	113	incidental[2]	70-m uncleared plot	scavenged	40.76959	-86.91257
8/9/2022	big brown bat	105	carcass search	70-m cleared plot	scavenged	40.78875	-87.00218
8/9/2022	eastern red bat	104	carcass search	70-m cleared plot	scavenged	40.80420	-86.97019
8/9/2022	eastern red bat	108	carcass search	70-m uncleared plot	scavenged	40.78835	-86.97049
8/9/2022	hoary bat	108	carcass search	70-m uncleared plot	scavenged	40.78792	-86.97078
8/11/2022	big brown bat	111	carcass search	70-m cleared plot	scavenged	40.78803	-86.92714
8/11/2022	big brown bat	115	carcass search	100-m road and pad	scavenged	40.76597	-86.89584
8/11/2022	big brown bat	116	carcass search	70-m uncleared plot	scavenged	40.76833	-86.88645
8/11/2022	big brown bat	119	carcass search	100-m road and pad	scavenged	40.76992	-86.98421
8/11/2022	eastern red bat	111	carcass search	70-m cleared plot	intact	40.78818	-86.92700
8/11/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78861	-86.92715
8/11/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78859	-86.92676

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
8/11/2022	eastern red bat	116	carcass search	70-m uncleared plot	scavenged	40.76869	-86.88631
8/11/2022	hoary bat	102	carcass search	100-m road and pad	scavenged	40.80449	-86.98923
8/12/2022	big brown bat	122	carcass search	70-m uncleared plot	intact	40.78360	-86.94172
8/12/2022	eastern red bat	122	carcass search	70-m uncleared plot	scavenged	40.78296	-86.94139
8/13/2022	eastern red bat	105	incidental	70-m cleared plot	intact	40.78849	-87.00253
8/13/2022	eastern red bat	105	incidental	70-m cleared plot	intact	40.78886	-87.00265
8/15/2022	big brown bat	116	incidental	70-m uncleared plot	scavenged	40.76816	-86.88598
8/15/2022	big brown bat	116	carcass search	70-m uncleared plot	scavenged	40.76827	-86.88591
8/15/2022	hoary bat	112	carcass search	70-m cleared plot	intact	40.78760	-86.91403
8/16/2022	eastern red bat	105	carcass search	70-m cleared plot	scavenged	40.78881	-87.00225
8/16/2022	eastern red bat	108	carcass search	70-m uncleared plot	scavenged	40.78759	-86.97091
8/16/2022	eastern red bat	122	carcass search	70-m uncleared plot	intact	40.78353	-86.94137
8/16/2022	eastern red bat	122	incidental	70-m uncleared plot	intact	40.78348	-86.94193
8/16/2022	hoary bat	122	carcass search	70-m uncleared plot	intact	40.78381	-86.94200
8/16/2022	hoary bat	122	carcass search	70-m uncleared plot	scavenged	40.78318	-86.94133
8/18/2022	big brown bat	110	carcass search	100-m road and pad	intact	40.79547	-86.93874
8/18/2022	big brown bat	112	carcass search	70-m cleared plot	scavenged	40.78744	-86.91402
8/18/2022	big brown bat	112	carcass search	70-m cleared plot	scavenged	40.78743	-86.91413
8/18/2022	big brown bat	116	carcass search	70-m uncleared plot	scavenged	40.76828	-86.88614
8/18/2022	eastern red bat	101	carcass search	100-m road and pad	scavenged	40.80427	-86.99768
8/18/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78802	-86.92608
8/18/2022	eastern red bat	115	carcass search	100-m road and pad	scavenged	40.76607	-86.89566
8/18/2022	eastern red bat	117	carcass search	100-m road and pad	scavenged	40.76986	-87.00265
8/18/2022	eastern red bat	120	carcass search	100-m road and pad	scavenged	40.77002	-86.97033
8/18/2022	eastern red bat	123	carcass search	100-m road and pad	scavenged	40.77042	-86.94024
8/18/2022	eastern red bat	123	carcass search	100-m road and pad	scavenged	40.77039	-86.94086
8/18/2022	hoary bat	112	carcass search	70-m cleared plot	scavenged	40.78741	-86.91413
8/18/2022	hoary bat	115	carcass search	100-m road and pad	scavenged	40.76597	-86.89605
8/24/2022	big brown bat	105	carcass search	70-m cleared plot	scavenged	40.78844	-87.00307
8/24/2022	eastern red bat	105	carcass search	70-m cleared plot	scavenged	40.78878	-87.00284
8/25/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78751	-86.91401
8/25/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78710	-86.91396
8/25/2022	big brown bat	114	carcass search	100-m road and pad	scavenged	40.76605	-86.90554
8/25/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78847	-86.92637
8/25/2022	silver-haired bat	113	carcass search	70-m uncleared plot	scavenged	40.76961	-86.91356
8/26/2022	big brown bat	108	carcass search	70-m uncleared plot	scavenged	40.78780	-86.97044
8/27/2022	hoary bat	122	carcass search	70-m uncleared plot	scavenged	40.78346	-86.94130

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
8/29/2022	big brown bat	111	carcass search	70-m cleared plot	scavenged	40.78809	-86.92676
8/29/2022	big brown bat	113	carcass search	70-m uncleared plot	scavenged	40.76924	-86.91372
8/29/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78823	-86.92588
8/29/2022	eastern red bat	111	carcass search[2]	70-m cleared plot	scavenged	40.78790	-86.92703
8/29/2022	eastern red bat	112	carcass search	70-m cleared plot	scavenged	40.78730	-86.91385
8/29/2022	eastern red bat	112	carcass search	70-m cleared plot	scavenged	40.78756	-86.91378
8/29/2022	eastern red bat	113	carcass search	70-m uncleared plot	scavenged	40.76893	-86.91360
8/29/2022	hoary bat	111	carcass search	70-m cleared plot	scavenged	40.78792	-86.92637
8/29/2022	hoary bat	112	carcass search	70-m cleared plot	intact	40.78753	-86.91374
8/30/2022	eastern red bat	104	carcass search	70-m cleared plot	scavenged	40.80423	-86.97050
8/30/2022	eastern red bat	105	carcass search	70-m cleared plot	intact	40.78890	-87.00230
8/30/2022	eastern red bat	122	carcass search	70-m uncleared plot	scavenged	40.78340	-86.94205
9/1/2022	eastern red bat	106	carcass search	100-m road and pad	scavenged	40.78887	-86.99239
9/1/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78802	-86.92676
9/1/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78819	-86.92639
9/1/2022	eastern red bat	112	carcass search	70-m cleared plot	scavenged	40.78763	-86.91365
9/1/2022	eastern red bat	112	carcass search	70-m cleared plot	scavenged	40.78738	-86.91455
9/1/2022	eastern red bat	116	carcass search	70-m uncleared plot	intact	40.76822	-86.88626
9/1/2022	eastern red bat	124	carcass search	100-m road and pad	intact	40.77064	-86.93177
9/1/2022	hoary bat	115	carcass search	100-m road and pad	scavenged	40.76599	-86.89606
9/1/2022	hoary bat	121	carcass search	100-m road and pad	scavenged	40.78322	-86.95509
9/1/2022	hoary bat	125	carcass search	100-m road and pad	scavenged	40.77020	-86.92097
9/1/2022	silver-haired bat	101	carcass search	100-m road and pad	scavenged	40.80433	-86.99785
9/1/2022	silver-haired bat	102	carcass search	100-m road and pad	scavenged	40.80444	-86.98901
9/1/2022	silver-haired bat	102	carcass search	100-m road and pad	scavenged	40.80440	-86.98922
9/1/2022	silver-haired bat	106	carcass search	100-m road and pad	intact	40.78886	-86.99245
9/1/2022	silver-haired bat	106	carcass search	100-m road and pad	scavenged	40.78887	-86.99239
9/1/2022	silver-haired bat	106	carcass search	100-m road and pad	intact	40.78882	-86.99258
9/1/2022	silver-haired bat	109	carcass search	100-m road and pad	intact	40.79550	-86.94388
9/1/2022	silver-haired bat	111	carcass search	70-m cleared plot	intact	40.78857	-86.92652
9/1/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78788	-86.91371
9/1/2022	silver-haired bat	114	carcass search	100-m road and pad	intact	40.76614	-86.90565
9/1/2022	silver-haired bat	115	carcass search	100-m road and pad	intact	40.76593	-86.89578
9/1/2022	silver-haired bat	117	carcass search	100-m road and pad	scavenged	40.76994	-87.00255
9/1/2022	silver-haired bat	120	carcass search	100-m road and pad	dismembered	40.76990	-86.97016
9/1/2022	silver-haired bat	120	carcass search	100-m road and pad	intact	40.77002	-86.97027
9/1/2022	silver-haired bat	123	carcass search	100-m road and pad	intact	40.77047	-86.94060

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
9/1/2022	silver-haired bat	124	carcass search	100-m road and pad	scavenged	40.77055	-86.93221
9/2/2022	eastern red bat	105	carcass search	70-m cleared plot	scavenged	40.78902	-87.00309
9/2/2022	eastern red bat	108	carcass search	70-m uncleared plot	scavenged	40.78756	-86.97018
9/2/2022	eastern red bat	108	carcass search	70-m uncleared plot	scavenged	40.78775	-86.97049
9/2/2022	hoary bat	108	carcass search	70-m uncleared plot	scavenged	40.78786	-86.97065
9/2/2022	hoary bat	108	carcass search	70-m uncleared plot	scavenged	40.78761	-86.97100
9/2/2022	silver-haired bat	104	carcass search	70-m cleared plot	scavenged	40.80420	-86.97014
9/2/2022	silver-haired bat	104	carcass search	70-m cleared plot	scavenged	40.80413	-86.97016
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78855	-87.00219
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78928	-87.00231
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	intact	40.78844	-87.00220
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	intact	40.78915	-87.00233
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78864	-87.00187
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78869	-87.00191
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	intact	40.78889	-87.00247
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	intact	40.78876	-87.00254
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78838	-87.00246
9/2/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78897	-87.00217
9/5/2022	hoary bat	116	carcass search	70-m uncleared plot	scavenged	40.76833	-86.88553
9/5/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78834	-86.92626
9/5/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78833	-86.92595
9/5/2022	silver-haired bat	112	carcass search	70-m cleared plot	intact	40.78741	-86.91367
9/5/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78737	-86.91314
9/5/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78858	-86.92670
9/5/2022	big brown bat	116	carcass search	70-m uncleared plot	scavenged	40.76797	-86.88592
9/6/2022	big brown bat	105	carcass search	70-m cleared plot	intact	40.78864	-87.00267
9/6/2022	eastern red bat	105	carcass search	70-m cleared plot	intact	40.78913	-87.00270
9/6/2022	eastern red bat	105	carcass search	70-m cleared plot	scavenged	40.78870	-87.00180
9/6/2022	eastern red bat	108	carcass search	70-m uncleared plot	intact	40.78766	-86.97104
9/6/2022	eastern red bat	122	carcass search	70-m uncleared plot	intact	40.78331	-86.94161
9/6/2022	hoary bat	105	carcass search	70-m cleared plot	scavenged	40.78850	-87.00181
9/6/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78879	-87.00198
9/6/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78881	-87.00186
9/6/2022	silver-haired bat	108	carcass search	70-m uncleared plot	scavenged	40.78783	-86.97034
9/6/2022	silver-haired bat	108	carcass search	70-m uncleared plot	scavenged	40.78783	-86.97028
9/8/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78756	-86.91366
9/8/2022	big brown bat	112	carcass search	70-m cleared plot	intact	40.78762	-86.91429

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
9/8/2022	eastern red bat	107	carcass search	100-m road and pad	scavenged	40.78785	-86.97854
9/8/2022	eastern red bat	112	carcass search	70-m cleared plot	intact	40.78751	-86.91429
9/8/2022	silver-haired bat	105	incidental	70-m cleared plot	scavenged	40.78885	-87.00237
9/8/2022	silver-haired bat	106	incidental	100-m road and pad	intact	40.78875	-86.99280
9/9/2022	eastern red bat	122	carcass search	70-m uncleared plot	scavenged	40.78360	-86.94211
9/9/2022	evening bat	122	carcass search	70-m uncleared plot	scavenged	40.78373	-86.94190
9/9/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78881	-87.00231
9/9/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78816	-87.00233
9/9/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78869	-87.00293
9/12/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78817	-86.92644
9/12/2022	eastern red bat	113	carcass search	70-m uncleared plot	scavenged	40.76949	-86.91409
9/12/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78846	-86.92653
9/12/2022	silver-haired bat	113	carcass search	70-m uncleared plot	intact	40.76945	-86.91356
9/15/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78861	-86.92644
9/15/2022	eastern red bat	112	carcass search	70-m cleared plot	scavenged	40.78704	-86.91372
9/15/2022	eastern red bat	114	carcass search	100-m road and pad	scavenged	40.76609	-86.90570
9/15/2022	eastern red bat	121	carcass search	100-m road and pad	scavenged	40.78331	-86.95493
9/15/2022	eastern red bat	124	carcass search	100-m road and pad	intact	40.77055	-86.93223
9/15/2022	hoary bat	113	carcass search	70-m uncleared plot	scavenged	40.76950	-86.91387
9/15/2022	silver-haired bat	103	carcass search	100-m road and pad	scavenged	40.80457	-86.98021
9/15/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78796	-86.92627
9/15/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78824	-86.92613
9/15/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78772	-86.91367
9/15/2022	silver-haired bat	112	carcass search	70-m cleared plot	intact	40.78738	-86.91379
9/15/2022	silver-haired bat	118	carcass search	100-m road and pad	scavenged	40.76992	-86.99368
9/15/2022	silver-haired bat	120	carcass search	100-m road and pad	scavenged	40.76996	-86.96986
9/15/2022	silver-haired bat	123	carcass search	100-m road and pad	intact	40.77038	-86.94080
9/15/2022	silver-haired bat	123	carcass search	100-m road and pad	scavenged	40.77044	-86.94065
9/16/2022	eastern red bat	108	carcass search	70-m uncleared plot	intact	40.78783	-86.97084
9/16/2022	silver-haired bat	105	carcass search	70-m cleared plot	intact	40.78862	-87.00255
9/16/2022	silver-haired bat	122	carcass search	70-m uncleared plot	intact	40.78350	-86.94160
9/16/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78368	-86.94169
9/18/2022	big brown bat	111	carcass search	70-m cleared plot	scavenged	40.78787	-86.92654
9/18/2022	eastern red bat	116	carcass search	70-m uncleared plot	intact	40.76833	-86.88637
9/18/2022	silver-haired bat	111	carcass search	70-m cleared plot	injured	40.78859	-86.92653
9/18/2022	silver-haired bat	111	carcass search	70-m cleared plot	intact	40.78857	-86.92635

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
9/18/2022	silver-haired bat	116	carcass search	70-m uncleared plot	intact	40.76825	-86.88594
9/19/2022	eastern red bat	122	carcass search	70-m uncleared plot	scavenged	40.78360	-86.94214
9/19/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78905	-87.00279
9/19/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78382	-86.94193
9/19/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78372	-86.94198
9/19/2022	silver-haired bat	122	carcass search	70-m uncleared plot	intact	40.78361	-86.94169
9/19/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78364	-86.94220
9/19/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78382	-86.94197
9/21/2022	eastern red bat	111	carcass search	70-m cleared plot	scavenged	40.78838	-86.92635
9/21/2022	eastern red bat	112	carcass search	70-m cleared plot	intact	40.78728	-86.91337
9/21/2022	eastern red bat	113	carcass search	70-m uncleared plot	scavenged	40.76881	-86.91358
9/21/2022	hoary bat	112	carcass search	70-m cleared plot	scavenged	40.78791	-86.91433
9/21/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78829	-86.92581
9/21/2022	silver-haired bat	111	carcass search	70-m cleared plot	intact	40.78845	-86.92705
9/21/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78758	-86.91391
9/21/2022	silver-haired bat	112	carcass search	70-m cleared plot	dismembered	40.78765	-86.91351
9/21/2022	silver-haired bat	113	carcass search	70-m uncleared plot	scavenged	40.76995	-86.91354
9/22/2022	eastern red bat	102	carcass search	100-m road and pad	scavenged	40.80430	-86.98917
9/22/2022	eastern red bat	106	incidental	100-m road and pad	scavenged	40.78891	-86.99283
9/22/2022	eastern red bat	109	carcass search	100-m road and pad	intact	40.79543	-86.94422
9/22/2022	eastern red bat	122	carcass search	70-m uncleared plot	scavenged	40.78348	-86.94151
9/22/2022	eastern red bat	122	carcass search	70-m uncleared plot	scavenged	40.78389	-86.94103
9/22/2022	hoary bat	105	carcass search	70-m cleared plot	scavenged	40.78900	-87.00299
9/22/2022	hoary bat	120	carcass search	100-m road and pad	scavenged	40.76991	-86.97013
9/22/2022	hoary bat	122	carcass search	70-m uncleared plot	scavenged	40.78392	-86.94179
9/22/2022	silver-haired bat	101	carcass search	100-m road and pad	intact	40.80427	-86.99783
9/22/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78877	-87.00315
9/22/2022	silver-haired bat	117	carcass search	100-m road and pad	scavenged	40.77008	-87.00241
9/22/2022	silver-haired bat	117	carcass search	100-m road and pad	intact	40.76992	-87.00251
9/22/2022	silver-haired bat	120	carcass search	100-m road and pad	intact	40.76988	-86.96996
9/26/2022	eastern red bat	112	carcass search	70-m cleared plot	scavenged	40.78700	-86.91352
9/26/2022	eastern red bat	116	carcass search	70-m uncleared plot	scavenged	40.76805	-86.88565
9/26/2022	eastern red bat	116	carcass search	70-m uncleared plot	scavenged	40.76817	-86.88569
9/26/2022	evening bat	112	carcass search	70-m cleared plot	intact	40.78701	-86.91362
9/26/2022	silver-haired bat	111	carcass search	70-m cleared plot	intact	40.78851	-86.92656
9/26/2022	silver-haired bat	111	carcass search	70-m cleared plot	intact	40.78831	-86.92614

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
9/26/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78808	-86.92615
9/26/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78715	-86.91369
9/26/2022	silver-haired bat	116	carcass search	70-m uncleared plot	scavenged	40.76813	-86.88655
9/26/2022	silver-haired bat	113	carcass search	70-m uncleared plot	scavenged	40.76945	-86.91291
9/27/2022	eastern red bat	106	incidental	100-m road and pad	scavenged	40.78901	-86.99233
9/27/2022	silver-haired bat	103	incidental	100-m road and pad	intact	40.80447	-86.97988
9/27/2022	silver-haired bat	103	incidental	100-m road and pad	intact	40.80453	-86.98014
9/27/2022	silver-haired bat	105	carcass search	70-m cleared plot	scavenged	40.78875	-87.00228
9/27/2022	silver-haired bat	106	incidental	100-m road and pad	intact	40.78903	-86.99209
9/27/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78362	-86.94196
9/29/2022	silver-haired bat	101	carcass search	100-m road and pad	intact	40.80425	-86.99786
9/29/2022	silver-haired bat	102	carcass search	100-m road and pad	scavenged	40.80437	-86.98910
9/29/2022	silver-haired bat	107	carcass search	100-m road and pad	scavenged	40.78761	-86.97812
9/29/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78797	-86.92657
9/29/2022	silver-haired bat	111	carcass search[2]	70-m cleared plot	scavenged	40.78777	-86.92626
9/29/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78734	-86.91346
9/29/2022	silver-haired bat	113	carcass search	70-m uncleared plot	scavenged	40.76975	-86.91354
9/29/2022	silver-haired bat	123	carcass search	100-m road and pad	intact	40.77028	-86.94070
9/29/2022	silver-haired bat	125	carcass search	100-m road and pad	scavenged	40.77029	-86.92106
9/30/2022	silver-haired bat	105	carcass search	70-m cleared plot	intact	40.78844	-87.00195
10/3/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78855	-86.92690
10/4/2022	eastern red bat	105	carcass search	70-m cleared plot	scavenged	40.78904	-87.00245
10/4/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78384	-86.94212
10/4/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78327	-86.94133
10/6/2022	hoary bat	110	carcass search	100-m road and pad	scavenged	40.79551	-86.93826
10/6/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78824	-86.92687
10/6/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78809	-86.92628
10/6/2022	silver-haired bat	111	carcass search	70-m cleared plot	scavenged	40.78877	-86.92622
10/7/2022	big brown bat	122	carcass search	70-m uncleared plot	scavenged	40.78329	-86.94142
10/7/2022	silver-haired bat	122	carcass search	70-m uncleared plot	scavenged	40.78311	-86.94185
10/10/2022	silver-haired bat	112	carcass search	70-m cleared plot	scavenged	40.78782	-86.91367
10/11/2022	big brown bat	108	carcass search	70-m uncleared plot	scavenged	40.78753	-86.97115
10/11/2022	eastern red bat	108	carcass search	70-m uncleared plot	scavenged	40.78756	-86.97124
10/11/2022	silver-haired bat	108	carcass search	70-m uncleared plot	intact	40.78800	-86.97071
10/11/2022	silver-haired bat	108	carcass search	70-m uncleared plot	scavenged	40.78756	-86.97124
10/11/2022	unidentified lasiurus bat	108	carcass search[2]	70-m uncleared plot	scavenged	40.78716	-86.97037

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
10/14/2022	eastern red bat	105	carcass search	70-m cleared plot	scavenged	40.78859	-87.00325
10/14/2022	silver-haired bat	102	carcass search	100-m road and pad	scavenged	40.80443	-86.98929
10/14/2022	silver-haired bat	122	carcass search[2]	70-m uncleared plot	scavenged	40.78299	-86.94109
Bird Carcasses							
4/15/2022	brown thrasher	124	carcass search[2]	100-m road and pad	intact	40.77077	-86.93150
5/13/2022	blue-winged warbler	102	carcass search	100-m road and pad	intact	40.80450	-86.98948
8/4/2022	downy woodpecker	106	carcass search	100-m road and pad	scavenged	40.78874	-86.99278
8/8/2022	killdeer	116	carcass search	70-m uncleared plot	scavenged	40.76822	-86.88582
8/11/2022	semipalmated sandpiper	106	carcass search	100-m road and pad	intact	40.78900	-86.99230
8/11/2022	unidentified small bird	102	carcass search	100-m road and pad	dismembered	40.80446	-86.98903
8/15/2022	horned lark	111	incidental	70-m cleared plot	intact	40.78789	-86.92668
8/18/2022	killdeer	119	carcass search[2]	100-m road and pad	feather spot	40.76980	-86.98524
8/19/2022	horned lark	105	carcass search	70-m cleared plot	scavenged	40.78875	-87.00233
8/26/2022	horned lark	105	carcass search	70-m cleared plot	intact	40.78881	-87.00230
8/26/2022	red-headed woodpecker	107	carcass search	100-m road and pad	feather spot	40.78765	-86.97888
8/29/2022	horned lark	111	carcass search	70-m cleared plot	scavenged	40.78852	-86.92682
8/29/2022	horned lark	113	carcass search	70-m uncleared plot	scavenged	40.76941	-86.91355
8/30/2022	horned lark	105	carcass search	70-m cleared plot	scavenged	40.78881	-87.00233
8/30/2022	horned lark	105	carcass search	70-m cleared plot	scavenged	40.78887	-87.00263
9/1/2022	horned lark	112	carcass search	70-m cleared plot	scavenged	40.78770	-86.91347
9/1/2022	magnolia warbler	102	carcass search	100-m road and pad	scavenged	40.80424	-86.98918
9/1/2022	magnolia warbler	109	carcass search	100-m road and pad	scavenged	40.79557	-86.94389
9/12/2022	horned lark	111	carcass search	70-m cleared plot	feather spot	40.78821	-86.92637
9/13/2022	horned lark	122	carcass search[2]	70-m uncleared plot	feather spot	40.78344	-86.94253
9/15/2022	horned lark	112	carcass search	70-m cleared plot	dismembered	40.78730	-86.91373
9/16/2022	horned lark	105	carcass search	70-m cleared plot	scavenged	40.78869	-87.00289
9/18/2022	horned lark	112	carcass search	70-m cleared plot	scavenged	40.78776	-86.91331
9/18/2022	horned lark	113	carcass search	70-m uncleared plot	scavenged	40.76972	-86.91409
9/21/2022	killdeer	111	carcass search	70-m cleared plot	intact	40.78844	-86.92646
9/21/2022	magnolia warbler	112	carcass search	70-m cleared plot	intact	40.78721	-86.91421
9/22/2022	killdeer	114	carcass search	100-m road and pad	feather spot	40.76606	-86.90577
9/22/2022	red-breasted nuthatch	115	carcass search	100-m road and pad	intact	40.76580	-86.89491
9/22/2022	unidentified warbler	104	carcass search	70-m cleared plot	scavenged	40.80384	-86.97099
9/26/2022	unidentified warbler	111	carcass search	70-m cleared plot	scavenged	40.78797	-86.92595
9/27/2022	red-eyed vireo	105	carcass search	70-m cleared plot	scavenged	40.78827	-87.00253
9/29/2022	black-throated blue warbler	111	carcass search	70-m cleared plot	scavenged	40.78799	-86.92619

Appendix A. Carcasses found at the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Found Date	Common Name	Turbine	Search Type	Plot Type	Physical Condition	Longitude[1]	Latitude[1]
9/29/2022	horned lark	112	carcass search	70-m cleared plot	scavenged	40.78717	-86.91326
9/29/2022	unidentified warbler	114	carcass search	100-m road and pad	scavenged	40.76621	-86.90536
9/30/2022	red-breasted nuthatch	105	carcass search	70-m cleared plot	intact	40.78837	-87.00221
10/3/2022	golden-crowned kinglet	111	carcass search	70-m cleared plot	scavenged	40.78854	-86.92732
10/3/2022	golden-crowned kinglet	111	carcass search	70-m cleared plot	scavenged	40.78786	-86.92661
10/3/2022	golden-crowned kinglet	112	carcass search	70-m cleared plot	intact	40.78733	-86.91414
10/3/2022	golden-crowned kinglet	116	carcass search	70-m uncleared plot	scavenged	40.76807	-86.88612
10/3/2022	killdeer	116	carcass search	70-m uncleared plot	feather spot	40.76874	-86.88622
10/4/2022	golden-crowned kinglet	108	carcass search	70-m uncleared plot	scavenged	40.78808	-86.97094
10/6/2022	brown creeper	103	carcass search	100-m road and pad	intact	40.80455	-86.98043
10/6/2022	golden-crowned kinglet	107	carcass search	100-m road and pad	intact	40.78786	-86.97874
10/6/2022	killdeer	111	carcass search	70-m cleared plot	feather spot	40.78825	-86.92624
10/6/2022	killdeer	116	carcass search	70-m uncleared plot	scavenged	40.76790	-86.88589
10/6/2022	pine warbler	112	carcass search	70-m cleared plot	scavenged	40.78713	-86.91437
10/6/2022	unidentified passerine	119	carcass search	100-m road and pad	scavenged	40.76988	-86.98412
10/7/2022	American redstart	105	carcass search	70-m cleared plot	scavenged	40.78852	-87.00217
10/7/2022	golden-crowned kinglet	122	carcass search	70-m uncleared plot	scavenged	40.78306	-86.94173
10/7/2022	unidentified kinglet	105	carcass search	70-m cleared plot	scavenged	40.78835	-87.00250
10/7/2022	unidentified vireo	104	carcass search	70-m cleared plot	scavenged	40.80415	-86.97109
10/10/2022	golden-crowned kinglet	113	carcass search	70-m uncleared plot	scavenged	40.76935	-86.91420
10/10/2022	golden-crowned kinglet	113	carcass search	70-m uncleared plot	scavenged	40.76944	-86.91358
10/10/2022	killdeer	116	carcass search	70-m uncleared plot	scavenged	40.76833	-86.88640
10/10/2022	unidentified kinglet	113	carcass search	70-m uncleared plot	feather spot	40.76958	-86.91409
10/10/2022	unidentified small bird	111	carcass search[2]	70-m cleared plot	feather spot	40.78794	-86.92715
10/11/2022	golden-crowned kinglet	122	carcass search	70-m uncleared plot	dismembered	40.78380	-86.94218
10/11/2022	golden-crowned kinglet	122	carcass search	70-m uncleared plot	intact	40.78353	-86.94205
10/11/2022	golden-crowned kinglet	122	carcass search	70-m uncleared plot	scavenged	40.78328	-86.94103
10/14/2022	golden-crowned kinglet	108	carcass search	70-m uncleared plot	scavenged	40.78733	-86.97059
10/14/2022	ruby-throated hummingbird	105	carcass search	70-m cleared plot	scavenged	40.78872	-87.00207
10/14/2022	turkey vulture	107	carcass search[2]	100-m road and pad	scavenged	40.78791	-86.97880
10/14/2022	unidentified flycatcher	108	carcass search	70-m uncleared plot	scavenged	40.78804	-86.97020
10/14/2022	unidentified kinglet	108	carcass search	70-m uncleared plot	scavenged	40.78722	-86.97045

[1] These coordinates were collected in WGS84.

[2] 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, 2022.

Covariates	k Value	AICc	Delta AICc
No covariates	0.67	51.67	0*
Plot type	0.67	53.63	1.96

* 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, 2022.

Covariates	k Value	AICc	Delta AICc
No covariates	0.67	18.09	0*
Season	0.67	20.30	2.21

* 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, 2022.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	No Covariates	Weibull	102.85	0*
No Covariates	No Covariates	loglogistic	103.13	0.28
No Covariates	No Covariates	lognormal	103.38	0.53
No Covariates	PlotSearchTypeBT	Weibull	103.60	0.75
No Covariates	PlotSearchTypeBT	loglogistic	104.22	1.37
No Covariates	PlotSearchTypeBT	lognormal	104.32	1.47
PlotSearchTypeBT	No Covariates	loglogistic	104.43	1.58
PlotSearchTypeBT	No Covariates	Weibull	104.45	1.60
PlotSearchTypeBT	No Covariates	lognormal	104.46	1.61
No Covariates	-	exponential	105.68	2.83
PlotSearchTypeBT	PlotSearchTypeBT	Weibull	106.11	3.26
PlotSearchTypeBT	PlotSearchTypeBT	loglogistic	106.31	3.46
PlotSearchTypeBT	PlotSearchTypeBT	lognormal	106.42	3.57
PlotSearchTypeBT	-	exponential	106.94	4.09

* 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, 2021.

Plot Search Type	Distribution[1]	Estimated Median Removal Times (days)	Parameter 1[2]	Parameter 2
70-meter cleared plots	Weibull	12.03	0.5741	22.7827
100-meter roads and pads	exponential	7.12	0.0974	--

[1] Parameterization follows the base R parameterization for this distribution.

[2] Parameters 1 and 2 for the Weibull distribution are shape and scale, respectively. 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, 2022.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	-	exponential	130.34	0
No Covariates	-	exponential	131.48	1.14*
Season	No Covariates	Weibull	132.27	1.93
No Covariates	No Covariates	Weibull	132.43	2.09
Season	Season	Weibull	133.43	3.09
No Covariates	Season	Weibull	133.46	3.12
Season	No Covariates	loglogistic	134.05	3.71
Season	No Covariates	lognormal	134.06	3.72
Season	Season	loglogistic	134.52	4.18
No Covariates	No Covariates	loglogistic	134.74	4.40
Season	Season	lognormal	134.88	4.54
No Covariates	Season	loglogistic	134.89	4.55
No Covariates	No Covariates	lognormal	135.31	4.97
No Covariates	Season	lognormal	135.67	5.33

* 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, 2022.

Species	Included in Area Correction Total	%	Outside Search Area* Total	%	Outside Study Period* Total	%	Total	%
silver-haired bat	110	44.5	2	40	0	0	112	43.6
eastern red bat	74	30.0	1	20	0	0	75	29.2
big brown bat	32	13.0	0	0	2	40	34	13.2
hoary bat	28	11.3	1	20	3	60	32	12.5
evening bat	2	0.8	0	0	0	0	2	0.8
Seminole bat	1	0.4	0	0	0	0	1	0.4
unidentified *Lasiurus* spp.	0	0	1	20	0	0	1	0.4
Total	**247**	**100**	**5**	**100**	**5**	**100**	**257**	**100**

* Carcasses not included in analysis.

Sums may not equal totals shown due to rounding.

Appendix B7. Search area adjustment models for bats from the Rosewater Wind Farm, White County, Indiana, April 1 – May 15 and August 1 – October 15, 2022.

Distribution	AICc	Delta AICc
normal	7,049.77	0*
Gompertz	7,061.62	11.84
Weibull	7,095.27	45.50
gamma	7,194.08	144.31

* Selected model.

AICc = corrected Akaike Information Criterion.

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, 2022.

Plot Type	Area Correction
70-m plots	0.98
100-m road and pad	0.22

The carcass density followed a truncated normal distribution with the following parameters: 32.8457 (Parameter 1) and 17.1255 (Parameter 2) and a left-truncation bound at zero meters (m).

n = 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, 2022.

Season	Plot Type	Search interval (l)	Number of searches[2]	Spatial Coverage (a)	Searcher Efficiency Carcasses available	Searcher Efficiency Carcasses found	Shape (α)	Scale (β)	Scale Lower Limit (β)	Scale Upper Limit (β)
spring	100-m road and pad	14.0	5	0.225	38	36	-	10.268	6.980	15.105
fall	100-m road and pad	7.0	12	0.225	38	36	-	10.268	6.980	15.105
fall	70-m plots	3.5	22	0.982	38	30	0.574	22.783	8.793	59.027

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

[2] 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.

m = meters.

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, 2022.

Season	Plot Type	Ba	Bb	Within-Season Sampling Fraction	Temporal Coverage (v)	Within Season Weights (ρ)
spring*	100-m road and pad	70.846	536.783	1	1	1
fall	100-m road and pad	170.349	926.342	0.68	1	0.68
fall	70-m plots	43.987	17.514	0.32	1	0.32

* The spring season had a single plot type, and no combination of detection probabilities was required during this step for the spring. The spring road and pad strata information is included for transparency.

m = meter.

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, 2022.

Season	Plot Type	Ba	Bb	Sampling Fraction	Temporal Coverage (v)	Weights (ρ)
spring	100-m road and pad	70.846	536.783	1	0.11	0.11
fall	100-m road and pad and 70-m plots	191.097	380.201	1	0.89	0.89

m = meter.

Appendix C4. Inputs needed to run Evidence of Absence: Multiple Years Module for the Rosewater Wind Farm, White County, Indiana, from 2022.

Year	g	95% Confidence Interval	Ba	Bb	Weights (ρ)
2021	0.264	0.248–0.279	825.190	2304.680	1.0
2022	0.311	0.277–0.346	214.048	475.256	1.0
Overall	**0.287**	**0.268–0.306**	**631.246**	**1567.539**	**2.0**

EoA, v2.0.7 - Single Class Module

Edit   Help

Detection Probability (g)

Search Schedule

Start of monitoring (yyyy-mm-dd): 2022-04-01

● Formula

Search interval (I): 14

Number of searches: 5

○ Custom   Edit/View

span = 182, I (mean) = 7

Spatial coverage (a): 0.23

Temporal coverage (v): .11

Estimate g

Searcher Efficiency

○ Carcasses available for several searches

95% CIs: p ∈ [0.535, 0.676], k ∈ [0.655, 0.813]

$\hat{p}$ = 0.62, $\hat{k}$ = 0.736   View   Edit

● Carcasses removed after one search

Carcasses available: 38

Carcasses found: 36

$\hat{p}$ = 0.947, with 95% CI = [0.842, 0.989]

Factor by which searcher efficiency changes with each search (k): 0.67

Persistence Distribution

○ Use field trials to estimate parameters   View/Edit

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

r = 0.407 for Ir = 14, with 95% CIs: r = [0.3, 0.526], β = [0.488, 1.854]

● Enter parameter estimates manually   View

Exponential	Parameters		
Weibull	rate	0.0974	
Log-Logistic	scale (β)	10.27 lwr 6.98 upr	15.11
Lognormal			

r = 0.546 for Ir = 14, with 95% CI: r ∈ [0.431, 0.652]

Estimated detection probability (g)

```
Summary statistics for estimation of detection probability (g)
==============================================================================
Results:


Full site for full year
    Estimated g = 0.0129, 95% CI = [0.0102, 0.016]
    Fitted beta distribution parameters for estimated g: Ba = 74.156, Bb = 5656.3279


Full site for monitored period, 01-Apr-2022 through 10-Jun-2022
    Estimated g = 0.118, 95% CI = [0.0922, 0.146]
    Fitted beta distribution parameters for estimated g: Ba = 65.5481, Bb = 491.6414
    Temporal coverage (within year) = 0.11


Searched area for monitored period, 01-Apr-2022 through 10-Jun-2022
    Estimated g = 0.512, 95% CI = [0.396, 0.626]
    Fitted beta distribution parameters for estimated g: Ba = 36.1975, Bb = 34.5697


==============================================================================
Input:
Search parameters
    trial carcasses placed = 38, carcasses found = 36
    estimated searcher efficiency: p = 0.947, 95% CI = [0.842, 0.989]
    k = 0.67
    Search schedule: Search interval (I) = 14, number of searches = 5, span = 70
      spatial coverage: 0.23    temporal coverage: .11
_____
Carcass persistence:
    Exponential persistence distribution
      scale (ß) = 10.27
      95% CI ß = [6.98, 15.11] and r = 0.546 for Ir = 14 with 95% CI = [0.431, 0.652]
      Parameters entered manually
    Uniform arrivals
_____
```

Appendix C5. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Spring 2022, 100-meter road and pad searches at 25 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 Fall 2022, 100-meter road and pad searches at 17 turbines searched at a 7-day interval.

EoA, v2.0.7 - Single Class Module

Edit Help

Detection Probability (g)

Search Schedule

Start of monitoring (yyyy-mm-dd): 2022-08-01

⦿ Formula

Search interval (I): 3.5

Number of searches: 22

○ Custom [Edit/View]

span = 182, I (mean) = 7

Spatial coverage (a): 0.98

Temporal coverage (v): .89

[Estimate g]

Searcher Efficiency

○ Carcasses available for several searches

95% CIs: $p \in$ [0.535, 0.676], $k \in$ [0.655, 0.813]

$\hat{p}$ = 0.62, $\hat{k}$ = 0.736 [View] [Edit]

⦿ Carcasses removed after one search

Carcasses available: 38

Carcasses found: 30

$\hat{p}$ = 0.789, with 95% CI = [0.642, 0.895]

Factor by which searcher efficiency changes with each search (k): 0.67

Persistence Distribution

○ Use field trials to estimate parameters [View/Edit]

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

r = 0.653 for Ir = 3.5, with 95% CIs: r = [0.546, 0.78], β = [0.488, 1.854]

⦿ Enter parameter estimates manually [View]

Exponential
Weibull
Log-Logistic
Lognormal

Parameters

shape (α): 0.57

scale (β): 22.78 lwr 8.79 upr 59.03

r = 0.806 for Ir = 3.5, with 95% CI: $r \in$ [0.694, 0.882]

® Estimated detection probability (g)

```
Summary statistics for estimation of detection probability (g)
==============================================================================
Results:

Full site for full year
    Estimated g = 0.632, 95% CI = [0.53, 0.728]
    Fitted beta distribution parameters for estimated g: Ba = 56.4031, Bb = 32.8744


Full site for monitored period, 01-Aug-2022 through 17-Oct-2022
    Estimated g = 0.71, 95% CI = [0.592, 0.815]
    Fitted beta distribution parameters for estimated g: Ba = 44.4043, Bb = 18.1491
    Temporal coverage (within year) = 0.89


Searched area for monitored period, 01-Aug-2022 through 17-Oct-2022
    Estimated g = 0.724, 95% CI = [0.604, 0.83]
    Fitted beta distribution parameters for estimated g: Ba = 42.1142, Bb = 16.0261


==============================================================================
Input:
Search parameters
    trial carcasses placed = 38, carcasses found = 30
    estimated searcher efficiency: p = 0.789, 95% CI = [0.642, 0.895]
    k = 0.67
    Search schedule: Search interval (I) = 3.5, number of searches = 22, span = 77
      spatial coverage: 0.98     temporal coverage: .89

Carcass persistence:
    Weibull persistence distribution
      shape (a) = 0.57 and scale (ß) = 22.78
      95% CI ß = [8.79, 59.03]
      r = 0.806 for Ir = 3.5 with 95% CI = [0.694, 0.882]
    Parameters entered manually
    Uniform arrivals
```

Appendix C7. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Fall 2022, 70-meter plot searches at eight turbines searched at a 3.5-day interval.

Appendix C8. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for fall plot types 2022, (n = 25), searched at a 7-day interval for 100-meter roads and pads, and a 3.5-day interval for 70-meter plots.

EoA, v2.0.7 - Multiple Class Module

Edit   Help

Options

Overall

○ Estimate total mortality (M)

Credibility level (1 - α) `0.8`

● One-sided CI (M*)
○ Two-sided CI

● Estimate overall detection probability (g)

Individual classes

○ Calculate g parameters from monitoring data
● Enter g parameters manually

Actions

| Add class | Calculate | Clear | Close |

Class	dwp	X	Ba	Bb	ĝ	95% CI
unsearched	0	0	---	---	0	[0, 0]
Spring	0.11	0	70.845	536.782	0.1166	[0.0923, 0.143]
Fall	0.89	0	191.0972	380.200	0.3345	[0.296, 0.374]

Estimated detection probability (g) for multiple classes

```
Summary statistics for multiple class estimate
==============================================================================
Input: Detection probability, by search class
  Search coverage = 1

  Class          DWP     X     Ba      Bb    ghat     95% CI
  unsearched       0     0    ---     ---       0  [    0,      0]
  Spring        0.11     0  70.84   536.8   0.117  [0.092, 0.143]
  Fall          0.89     0  191.1   380.2   0.334  [0.296, 0.374]
==============================================================================
Results for full site
_____

Detection probability
  Estimated g = 0.311, 95% CI = [0.277, 0.346]
  Fitted beta distribution parameters for estimated g: Ba = 214.0475, Bb = 475.2553

Mortality

Test of assumed relative weights (rho)
  Class          Assumed    Fitted (95% CI)
  unsearched       0.000       NA
  Spring           0.110     [0.011, 0.998]
  Fall             0.890     [0.002, 0.989]
  p = 1 for likelihood ratio test of H0: assumed rho = true rho
```

Appendix C9. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs for seasonal detection probabilities 2022, (n = 25 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 C10. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Years Module inputs for estimation of annual fatality rate (lambda) for 2021 and 2022.