

**2023 Post-construction Monitoring Study for the
Bitter Ridge Wind Farm
Jay County, Indiana**

**Final Report
April 1 – October 15, 2023**



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EXECUTIVE SUMMARY

Bitter Ridge Wind Farm, LLC (Bitter Ridge), is operating the Bitter Ridge Wind Farm (Project) in Jay County, Indiana. Bitter Ridge obtained an Incidental Take Permit (ITP; ESPE0014119) for the federally listed Indiana bat and northern long-eared bat (hereafter, Covered Species) from the US Fish and Wildlife Service (USFWS) dated June 15, 2021. This report details the post-construction monitoring (PCM) studies conducted in 2023, consistent with the Project's Habitat Conservation Plan (HCP) and ITP for Covered Species, and the study plan developed for ITP monitoring in 2023.

PCM was completed in accordance with the 2023 study plan. The initial draft of the study plan was submitted to the USFWS on March 20, 2023, and USFWS provided no comments to adjust the study plan. The study plan was designed to achieve a probability of detection, or g , of 0.25. The overall goal of this PCM study was to generate reliable fatality estimates for the Covered Species and to evaluate compliance with the incidental take authorization granted under the Project's ITP. Specifically, the objectives of the study were to estimate Covered Species take using the Evidence of Absence (EoA) framework as outlined in the HCP and determine overall bat fatality rates. This report presents the results of the study conducted within the Project from April 1 – October 15, 2023.

Standardized carcass searches were completed for bats at three plot types: cleared plots, uncleared plots, and road and pad plots. Technicians searched gravel road and pad plots at all 52 turbines out to a distance of 100 meters (m; 328 feet [ft]) from the turbine during the spring study period (April 1 – May 15). During the summer study period (May 16 – July 31), 37 summer risk turbines were searched weekly. A detection-dog team searched cleared plots at eight turbines and soybean plots at seven turbines during the summer, while a technician searched 22 road and pad plots. During the fall study period (August 1 – October 15), all 52 turbines were searched twice per week with a technician searching road and pad plots at 37 turbines and detection-dog teams searching cleared plots at eight turbines and uncleared plots at seven turbines. In both summer and fall, cleared and uncleared plots were searched out to a radius of 70 m (230-ft). Searcher efficiency and carcass persistence trials were also conducted during each season to correct for carcass detection and scavenger removal bias.

The most commonly found bat species were eastern red bat (42.5%), silver-haired bat (27.4%), big brown bat (13.9%), and hoary bat (12.0%). Five carcasses of the state endangered evening bat were recorded at the Project. Species composition recorded at the Project was similar to the first and second year of ITP monitoring conducted in 2021 and 2022. The overall probability of detection (g) distribution for 2023 PCM surveys had a mean of 0.22 (95% Confidence Interval [CI]: 0.20–0.23). During the study, 335 bat fatalities were found. The overall bat fatality rate was 20.17 bats per megawatt (90% CI: 13.98–31.58).

Two Indiana bat carcasses were found during PCM surveys: one on June 20, 2023, at Turbine 21, and one on September 5, 2023, at turbine 3. No northern long-eared bat carcasses were found. Based on the second year of ITP monitoring, cumulative take to-date, M^* at $\alpha = 0.5$ (50th

credible bound), is estimated to be 26 Indiana bats and zero northern long-eared bats. Estimated take for the Covered Species falls below the permitted take level for both species, meaning the Project was in compliance with the ITP. The EoA model estimated the mean annual take rate (λ) at the Project was 10.06 Indiana bats and 0.67 northern long-eared bats. The probability that the annual take rate exceeded the expected annual take rate for Indiana bat (10.41) was greater than 95%, exceeding the short-term adaptive management trigger. Pursuant to HCP section 5.4.3, Bitter Ridge may elect to begin considering adaptive management responses.

CONFIDENTIAL

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INTRODUCTION

Bitter Ridge Wind Farm, LLC (Bitter Ridge), is operating the Bitter Ridge Wind Farm (Project) in Jay County, Indiana. Bitter Ridge obtained an Incidental Take Permit (ITP; ESPER0014119 [US Fish and Wildlife Service (USFWS), dated June 15, 2021]) for the federally listed endangered Indiana bat (*Myotis sodalis* [USFWS 1967]) and northern long-eared bat (*M. septentrionalis* [USFWS 2023]; hereafter Covered Species). The ITP requires the Project to minimize impacts to Covered Species. The ITP also requires monitoring to determine if the level of impact exceeds authorized amounts of take, and to determine if adaptive management is necessary to further reduce impacts.

Western EcoSystems Technology, Inc. (WEST) completed a post-construction monitoring (PCM) study designed to achieve a probability of detection, or g , of 0.25. The objectives of this study were to estimate Covered Species take using the Evidence of Absence (EoA) framework as outlined in the Habitat Conservation Plan (HCP), and determine overall bat fatality rates. This report presents the results of the study conducted within the Project from April 1 – October 15, 2023; the Covered Species take assessment in this report also incorporates the results of the June 21 – October 15, 2021, study (Murray et al. 2022) and the results of the April 1 – October 15, 2022 study (Murray et al. 2023). Bird fatalities were recorded but were not the focus of this ITP study and no analysis of avian fatality rates are included in this report.

STUDY AREA

The Project is located in Jay County, Indiana, on 8,972.0 hectares (22,169.5 acres) of private land approximately nine kilometers (six miles) southwest of Portland, Indiana (Permit Area; Figure 1). Prominent geographic features within the Project include the Platt Nibarger Ditch and the Beason Ditch, both of which flow south to join the Mississinewa River, which roughly parallels the southern boundary of the Project. According to the National Land Cover Database (2021), the primary land cover type within the Project is cultivated crops, which covers 82.1% of the Permit Area, followed by deciduous forest (8.0%), developed open space (4.8%), and hay/pasture (3.6%) of land cover. The remaining land cover types compose less than 1.5% of total land cover (Table 1).

Bitter Ridge became fully operational in September 2020, and consists of 52 General Electric 2.82-megawatt (MW)-127 turbines with a nameplate capacity of 2.82 MW each. All turbines are within the migratory range of the Covered Species. During the 2023 spring (April 1 – May 15) and fall migration (August 1 – October 15) periods, all turbines were feathered from half an hour before sunset to half an hour after sunrise when wind speeds were below 5.0 meters per second (m/s; 16.4 feet per second [ft/s]) and temperatures were above 10 degrees Celsius (°C; 50 °Fahrenheit). The HCP identified 37 turbines within 305 m (1,000 ft) of summer maternity colony habitat for Indiana bat. Bitter Ridge feathered blades at those turbines from half an hour before sunset to half an hour after sunrise when wind speeds were below 5.0 m/s and temperatures were above 10 °C. This was done during the summer maternity season (May 16 – July 31) to minimize impacts to summer maternity colonies. The remaining 15 turbines were feathered below the cut-in speed of 3.0 m/s (9.8 ft/s) during the summer.

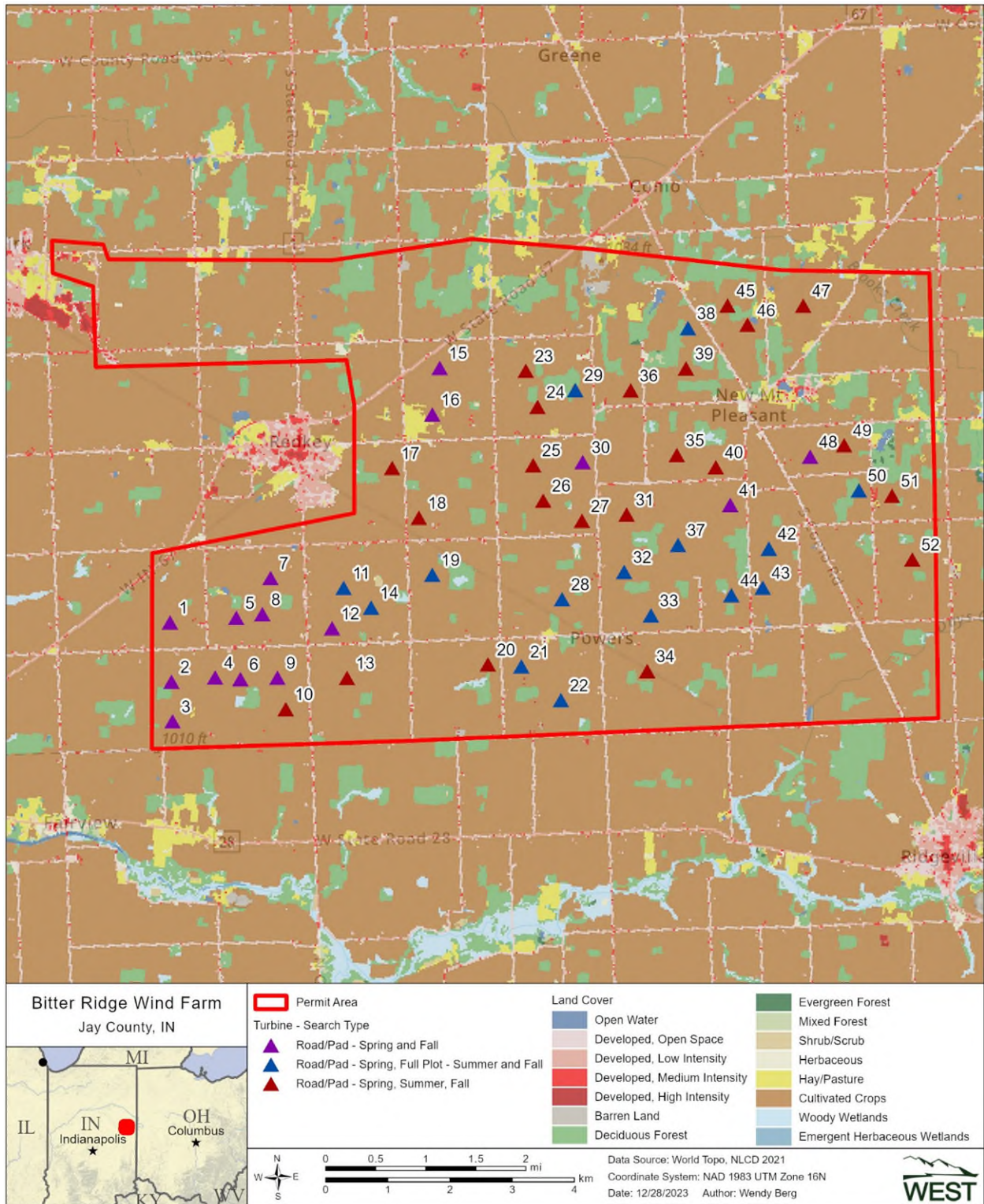


Figure 1. Turbine locations by summer and fall search type and surrounding land cover at the Bitter Ridge Wind Farm, Jay County, Indiana. Road and pad plots were searched for all turbines in spring.

Table 1. National Land Cover Database land cover types and percent (%) composition within the Bitter Ridge Wind Farm Permit Area, Jay County, Indiana.

Habitat	Hectares	Acres	% Composition
Cultivated Crops	7,365.4	18,200.3	82.1
Deciduous Forest	718.5	1,775.4	8.0
Developed, Open Space	435.0	1,074.9	4.8
Hay/Pasture	327.3	808.7	3.6
Herbaceous	52.0	127.5	0.6
Developed, Low Intensity	31.0	76.5	0.3
Open Water	20.0	49.0	0.2
Shrub/Scrub	7.4	18.4	0.1
Woody Wetlands	5.2	12.8	0.1
Emergent Herbaceous Wetlands	5.1	12.7	0.1
Developed, Medium Intensity	4.5	11.2	0.1
Evergreen Forest	0.6	1.6	<0.1
Developed, High Intensity	0.2	0.5	<0.1
Total	8,972.0	22,169.5	100

Data from the National Land Cover Database (2021).

METHODS

WEST used data collected during 2021 and 2022 PCM at Bitter Ridge (Murray et al. 2022, 2023) and public data collected during 2020 PCM at the Headwaters Wind Farm (Rodriguez et al. 2021) to develop a study plan that targeted a g of 0.25 to meet the monitoring commitments in the HCP. The study plan was submitted to the USFWS on March 20, 2023, and USFWS did not provide any comments on the proposed plan (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 (carcass searches) from April 1 – October 15, 2023. Search effort varied by season, and was designed to take advantage of available detection-dog teams and to maximize effort when the greatest number of Covered Species were expected to occur (Table 2).

Table 2. Search effort by season and plot type at Bitter Ridge Wind Farm, Jay County, Indiana.

Season	Plot Type	Search Interval	Number of Turbines	Search Team
Spring (April 1 – May 15)	100-m road and pad plot	Weekly	52	Technician
	100-m road and pad plot	Weekly	22	Technician
Summer (May 16 – July 31)	70-m uncleared plot	Weekly	7	Detection-dog team
	70-m cleared plot	Weekly	8	Detection-dog team
Fall (August 1 – October 15)	100-m road and pad plot	Twice weekly	37	Technician
	70-m uncleared plot	Twice weekly	7	Detection-dog team
	70-m cleared plot	Twice weekly	8	Detection-dog team

m = meter.

All 52 turbines were searched once per week during the spring (Table 2). A technician searched gravel road and pad areas (road and pad plots) under turbines to a distance of 100 m (328 ft) from the turbine.

During the summer study period, 37 summer risk turbines were searched once per week. A technician searched road and pad plots under 22 turbines to a distance of 100 m from the turbine. A detection-dog team searched seven turbines as uncleared plots with a 70-m (230-ft) radius and eight turbines as cleared plots with a 70-m radius (Table 2, Figure 1).

All 52 turbines were searched twice per week during the fall (Table 2). A technician searched 37 turbines as road and pad plots to a distance of 100 m from the turbine (Figure 1). Detection-dog teams searched the eight cleared plots, and the seven uncleared plots originally created in summer, twice a week (Table 2, Figure 1).

During the summer and fall study period, vegetation at cleared plots was mowed and maintained by Project staff within 10 to 15 centimeters (four to six inches) in height to enhance detectability of carcasses. Eight cleared plots were disked once in mid-August and again in early September due to mowing limitations. Uncleared plots were vegetated with soybeans (*Glycine max*).

Search Methods

All personnel were trained to follow the Bitter Ridge search protocol, including proper handling and reporting of carcasses. Carcass searches began at 7:00 AM and ended by 4:00 PM to comply with site safety protocols during the 2023 field season.

Technician Searches

The technicians walked transects spaced five m (16 ft) apart at a rate of approximately 45–60 m per minute (m/min; 148–197 ft/min) on all gravel road and pad areas within 100 m of the turbine. The technicians scanned the area for fatalities on both sides of the transects out to approximately 2.5 m (8.2 ft) to ensure full visual coverage of each search area.

Detection-dog Teams

Detection-dog teams searched cleared and uncleared plots for bat carcasses. Detection dogs were considered candidates for carcass searches if the dogs met temperament, basic obedience, and requirements towards the ability to detect bat carcasses. Temperament characteristics that are sought after are high-energy dogs, with a high food or toy drive, and eagerness to please the handler. Prior to conducting searches at Bitter Ridge, handlers trained the detection dogs on the scent of bat carcasses derived from search and rescue programs and drug detection (Kay 2012, Helfers 2017). 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 dog achieved a passing grade of 80% or higher in a scent recognition test, consisting of 10 blind trial lineups using bat carcasses, the dog and handler were evaluated in the field to measure performance. The detection-dog coordinator conducted a 2-day field evaluation of each detection-dog team; after teams achieved a searcher efficiency of 75% or greater for 30 bats during evaluation trials, the teams were approved to conduct carcass

searches. Because the objective of the study was to document bat carcasses, 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. Detection dogs used at Bitter Ridge included a German shepherd and two golden retrievers.

Prior to each search, handlers determined the survey start points and the number of transects needed to cover the plot after considering wind speed and direction, as well as crop row direction and density (when applicable). Handlers oriented dogs to start searches perpendicular to the wind to maximize scent detection. Both wind speed and crop density can affect scent dispersal across the search area. Transect width varied by plot type to maximize detection and ranged from 5–10 m (16–33 ft) in uncleared plots, and 10–15 m (33–49 ft) in cleared plots. The handler placed a marker by the carcass and rewarded the dog with either a food reward or a short play session when a detection dog correctly alerted to a bird or bat carcass.

Data Collection

For each scheduled search, technicians and/or handlers recorded the date, start and end times, technician name, turbine number, type of search, and if any fatalities were found. When a fatality was found, technicians placed a flag near the carcass and continued the search. After searching the entire plot, the technician returned to record information for each fatality on a fatality data sheet, including the date and time, species, sex and age (when possible), technician name, turbine number, measured distance from turbine (with range finder), azimuth from turbine, location of carcass as Global Positioning System (GPS) coordinates (latitude and longitude), ground cover surrounding carcass, condition of carcass (i.e., intact, scavenged, dismembered, feather spot [for birds only], injured), and estimated time of death (e.g., less than one day, two days). Technicians took digital photographs of each fatality, including any visible injuries, and surrounding habitat. Carcasses found in non-search areas (e.g., outside of a plot boundary) and those recorded as incidental discoveries (found outside of a scheduled search) were documented following the same protocol for those found during standard searches, but these carcasses were not included in analysis.

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

- Intact—a complete carcass, that was 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—an entire 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—10 or more feathers (excluding down) or two or more primary feathers that were found at one location, indicating predation or scavenging of a bird carcass.

Bat carcasses were collected under the Project's ITP (ESPER0014119), WEST's Federal Native Endangered and Threatened Species Recovery Permit (ES234121), and WEST's Indiana Special Purpose Salvage Permit (2263). Technicians placed all bat carcasses in a re-sealable plastic bag labeled with the unique carcass identification number, turbine number, and date, for storage in a freezer on site. Leather and latex/nitrile gloves were used to handle all bat carcasses to reduce the risk of transmission of rabies or other diseases. Bird carcasses were recorded but were left in place. Injured bats were not taken to rehabilitation facilities or euthanized but were left in place after data was safely collected.

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. These samples were submitted to a USFWS-approved laboratory, the Dr. Jane Huffman Wildlife Genetics Institute for identification associated with East Stroudsburg University. Bat carcasses that were heavily scavenged but did not have potential to be a Covered Species (i.e., fur was present on the wing or the forearms measured over 41 millimeters [1.6 inches] long) were identified to the closest genus or type possible and were not sent off for further identification.

Carcass Identification and Agency Notification

Identification of bird carcasses were verified by biologists with significant field experience in identification of birds and feathers. A federally permitted bat biologist (Meredith Hoggatt [ESPER0039249]) identified all bat carcasses either via photographs or in person. The USFWS and the Indiana Department of Natural Resources (IDNR) were notified within 24 hours of positive identification of any species listed as endangered or threatened under the Endangered Species Act of 1973, or any state-listed threatened or endangered species. An additional permitted bat biologist (Kevin Murray [ES234121-10]) verified the identifications of sensitive bat species carcasses in hand. Bat carcasses are planned to be delivered to the bat repository with the Illinois Natural History Survey at University of Illinois Urbana-Champaign in February 2024, as directed by the USFWS Indiana Ecological Services Field Office in Bloomington, Indiana.

Bias Trials

Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the probability searchers found a bat carcass. Searcher efficiency trials were conducted in the same areas where carcass searches occurred. Personnel conducting carcass surveys did not know when searcher efficiency trials were being conducted or the location of the trial carcasses. Trial carcasses consisted of eastern red bats (*Lasiurus borealis*), big brown bats (*Eptesicus fuscus*), hoary bats (*Lasiurus cinereus*), and silver-haired bats (*Lasionycteris noctivagans*) that had previously been found on site. A minimum of 20 bat carcasses were placed and confirmed available per plot type in the spring,

summer, and fall. 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 around the upper forelimb for identification as a study carcass after it was found. Carcasses were dropped from waist-height or higher and allowed to land in a random posture. The 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 person responsible for distributing the carcasses. Searchers (technicians or detection-dogs) had one chance to locate trial carcasses during the first search after carcass placement. The trial administrator walked in a meandering path and dropped trials for detection dogs the night prior to the next search to allow time for the scent to pool and disperse prior to scheduled searches. Following searches, any carcasses that were not detected were checked to confirm availability. One hundred five trial carcasses were left in place and used for carcass persistence trials (CPT).

Carcass Persistence Trials

The objective of CPT 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 plot type per season to incorporate the effects of varying weather and climatic conditions on carcass persistence. Trials were conducted across all plot types to incorporate the effects of varying weather and scavenger densities. No more than three trial carcasses were placed on a plot to avoid potential over-seeding and attracting scavengers.

Technicians monitored the trial carcasses over a 30-day period according to the following schedule, as closely as possible. Carcasses were checked daily for the first four days, then on days 7, 10, 14, 21, and 30. Trial carcasses were monitored until the carcasses were completely removed or the trial period ended. Detection dogs were used on the cleared and uncleared plots to determine when carcasses were removed.

Search Area Mapping

Technicians recorded the boundaries of all cleared plots using a Juniper Systems Geode submeter GPS unit. Soy plot boundaries were mapped via desktop geographic information system (GIS) software based on turbine location and size of plot, and road and pad plot boundaries, recorded during previous search years were used. Unsearchable areas within plot boundaries were also mapped. The plot boundaries were used to verify if carcasses were found inside the search areas, and to inform the distribution of carcasses around turbines to estimate the number of carcasses that fell inside or outside of search areas.

Quality Assurance and Quality Control

Quality assurance and quality control measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, technicians were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data were identified using a series of database queries. Irregular codes or

data suspected as questionable were discussed with the technician and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes and measures were implemented. A Microsoft® SQL database was developed to store, organize, and retrieve survey data. All data forms and electronic data files were retained for reference.

Statistical Analysis

The EoA (Dalthorp et al. 2017) modeling framework was used to estimate take of Covered Species. EoA was used with data collected in the field to estimate the overall probability of detecting a bat carcass, the take rate of Covered Species, and the number of Covered Species fatalities that occurred. Data used in the EoA model included number of Covered Species fatalities, fatality spatial data from all bats found during surveys, and the results of searcher efficiency and carcass persistence trials, the seasonal arrival distribution of bats, and the detection reduction factor (k ; described below).

Fatality Rate Estimation

Carcasses included in the fatality rate estimation were found within the search plots and had an estimated time of death within the study period. Fatality estimates were calculated for bats by season using GenEst (a generalized estimator of fatality; Dalthorp et al. 2018, Simonis et al. 2018). To obtain an overall estimate of fatality, each carcass included in the analysis was adjusted to account for searcher efficiency, carcass persistence, a detection reduction factor (also referred to as “ k ”; see below), and search area adjustment. Estimates and 90% confidence intervals (CI) were calculated using a parametric bootstrap (Dalthorp et al. 2018).

Searcher Efficiency Estimation

Data collected during searcher efficiency trials were used to estimate the probability that bat carcasses were detected by searchers. Estimates of searcher efficiency were used to adjust carcass counts for detection bias. Searcher efficiency is the probability of a carcass being detected by a searcher given the carcass was available to be found. 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, while accounting for the detection reduction factor k (Dalthorp et al. 2018). Searcher efficiency was estimated separately for technicians and detection-dog teams to account for different modes of detection (i.e., technicians use sight, whereas dogs use scent). Covariates for these logit regression models included plot type (for detection-dog teams only) and season and the interactions between these variables. For both sets of 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 (i.e., model with the fewest parameters) 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 0, it implies a carcass that was missed on the first search would never be found on subsequent searches. A k of 1 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 bat fatality estimates using EoA per the HCP.

Carcass Persistence Estimation

Data collected during carcass persistence trials were used to estimate the amount of time, in days, that carcasses remained available to be located by the searcher. Models of carcass persistence were used to adjust carcass counts for removal bias by estimating the average probability a carcass persisted through the search interval (i.e., the time between scheduled searches). The persistence of a carcass was modeled using an interval-censored survival regression for each size class using 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 versus plots searched by detection-dog teams) to account for different modes of detection. Season was included as a potential covariate for the technician model while season and plot type (road and pad plot, cleared plot, and uncleared plot) were included as potential covariates for the detection-dog model. The best-supported model was selected as the most parsimonious model (i.e., model with the fewest parameters) within two AICc units of the model with the lowest AICc value. The parameter estimates of the selected model (α [shape] and β [scale], including the 95% CI of β) 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 0 to 1. For example, a search area adjustment of 0.75 meant that an estimated 75% of carcasses fell within the search plots. The search area adjustment was estimated by multiplying the predicted proportion of carcasses occurring within each 1-m (3-ft) annulus around the base of the turbine (according to the carcass-density distribution) and the proportion of area searched within that 1-m annulus. The product of these two components for each annulus was summed over all 1-m annuli from the turbine base to the maximum predicted fall distance.

Unsearched areas were due to survey obstacles such as ground cover (e.g., tall crops) or terrain, or areas where carcasses fell outside the search plots (e.g., a carcass landed 80 m [262 ft] away from the turbine on a plot searched out to 70 m from the turbine base). The proportion of area searched was calculated in a GIS program as the amount of area searched divided by the total area searched at each 1-m annulus around the turbine.

The carcass-density distribution predicts the likelihood a carcass fell a given distance from the turbine base and can be estimated using a number of analysis methods. 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. Truncation accounts for

carcasses beyond the search radius and weights account for unequal search effort. Weights were based on probability of detection and the proportion of area searched in each 1-m annulus around the turbine. Distributions considered were normal, gamma, Gompertz, and Weibull (parameterized according to R Development Core Team [2016], Yee and Moler 2020)]. The best-supported model was selected as the most parsimonious model (i.e., model with the fewest parameters) within two AICc units of the model with the lowest AICc value.

Carcasses Excluded from Area Adjustment Calculations

Fatalities were excluded from the area adjustment used in both the EoA and the all-bat fatality estimates when the carcass was discovered outside of the spatial and temporal scope of the survey design. For example, carcasses found outside a designated plot were not included in the analysis because the area adjustment accounts for the carcass by adjusting for unsearched areas. Carcasses found prior to the start of surveys (e.g., a carcass found on a plot in the summer that is not searched until the fall) were also excluded because the carcass occurred outside of the study period. Note that carcasses found incidentally on a plot were included in the analysis if that plot had a scheduled search in the future. If a fatality of a Covered Species had been found outside of the spatial or temporal scope of the survey design, it would still be excluded from the area correction estimate but would be included in the EoA fatality estimate, following Dalthorp et al. (2020).

Indiana Bat and Northern Long-eared Bat Take and Detection Probability Estimates

Evidence of Absence

EoA was used to estimate the median cumulative take to-date (M^*), the mean annual take rate (λ), and evaluate the probability that the estimated annual take rate (λ) exceeded the expected annual take rate (τ) for Indiana bat and northern long-eared bat. Estimates were calculated using the Single Class, Multiple Class, and Multiple Years modules of EoA (Dalthorp et al. 2017).

The probability of detection (g) was estimated using the bias corrections for searcher efficiency, carcass persistence, the area adjustment, the fraction by which searcher efficiency was reduced with each successive search (k), and the phenology of bat fatalities (i.e., proportion of fatalities expected to occur during each season). Searcher efficiency, carcass persistence probability, and the search area adjustment (“area correction” in EoA) were estimated as described above. The fraction to which searcher efficiency was reduced with each successive search, or k , will be 0.67, as assumed in the HCP. The *Myotis* arrival proportions were set to 0.07 in spring, 0.36 in summer, and 0.57 in fall, as described in the Project’s study plan.

The EoA Single Class module was used to estimate the 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 area correction for each stratum was included in the Single Class Module as the “Spatial Coverage (a)” input. The EoA Multiple Class module was then used to combine detection probability distributions across strata (cleared plots, uncleared plots, and road and pad plots), with weights for each class (density-weighted proportion, or “DWP” in the EoA software) defined by the within-season sampling fraction. The EoA Multiple Years Module was then used to estimate the site-wide, cumulative detection probability for monitoring periods in

2021, 2022 and 2023. The results from the Multiple Years module (Ba and Bb parameters for the detection probability to date) were used to estimate M^* (the median cumulative take over the life of the permit), and mean annual take rate λ and its 95% CI. The mean annual take rate λ was used to evaluate the short-term adaptive management trigger and the cumulative take estimate M^* was used to evaluate the long-term adaptive management trigger (see *Adaptive Management Triggers* section below). Appendix C shows detailed inputs needed if using the EoA Graphical User Interface.

The EoA Multiple Years Module requires the input rho (ρ), which weights the years for combining Beta distribution parameters based on relative risk to a given species. Risk is informed by facility operations (i.e., temporal gaps in turbine operations) or changes in operation characteristics (e.g., changes to cut-in speeds). In 2021, the Project ITP was issued part way through the summer season. To account for the incomplete summer season, the 2021 ρ was calculated using adjusted seasonal arrival proportions. The full summer arrival proportion (0.36) was adjusted to reflect the proportion of the summer that was searched. The adjusted summer arrival proportion (0.19) was combined with the full fall arrival proportion (0.57) to yield a ρ of 0.76 for 2021. This means that 76% of total annual risk was observed in monitoring data from 2021. In 2022 and 2023, the Project was fully operational for all seasons, so ρ was set to 1.

Adaptive Management Triggers

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

Evidence of Absence Short-term Trigger

The EoA short-term trigger is designed as an early warning signal that the Project may be on the path to exceeding permitted take (T) by the end of the permit term. The short-term trigger is designed to determine if an adaptive management response is needed to prevent the cumulative take estimate from actuating a response to the long-term trigger test. The short-term trigger tests if the estimated annual take rate (λ) exceeded the expected take rate ($\tau = T \div \text{years in permit}$) at a confidence level of $\alpha = 0.05$, per the HCP. Data from three monitoring periods were used in this analysis (2021, 2022, and 2023) along with the values of ρ listed above (0.76, 1.0 and 1.0 respectively). For estimates of λ , it was necessary to rescale the EoA-produced estimates to represent three full years of operation and monitoring using the sum of these ρ values due to limitations with the EoA graphical user interface. It was necessary to scale the annual rate threshold (τ) to represent the level of risk in the moving average estimate of λ for adaptive management triggers associated with λ .

The Project's short-term trigger is designed to evaluate a rolling window of seven years of PCM data. The short-term trigger would be met if within any 7-year rolling window the estimated take rate exceeds the expected take rate with 95% confidence. If the short-term trigger is met, HCP section 5.4.3 sets forth adaptive management responses to be considered prior to the next monitoring cycle.

Evidence of Absence Long-term Trigger

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

RESULTS

Standardized Carcass Searches

Between spring, summer, and fall monitoring, 1,821 searches were conducted (Table 3). Thirty searches (less than 2.0%) were missed due to turbine maintenance, weather constraints, and/or safety hazards. Three hundred thirty-five bat carcasses and 78 bird carcasses were found during surveys and incidentally (Appendix A). Appendix A documents the birds that were recorded during this survey; the remainder of the results focuses on the bat-related study.

Table 3. Number of searches per plot type at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Season	Plot Type	Search Interval	Number of Searches
Spring (April 1 – May 15)	100-m road and pad plot	Weekly	309
	100-m road and pad plot	Weekly	240
Summer (May 16 – July 31)	70-m cleared plot	Weekly	84
	70-m uncleared plot	Weekly	77
Fall (August 1 – October 15)	100-m road and pad plot	Twice weekly	791
	70-m cleared plot	Twice weekly	175
	70-m uncleared plot	Twice weekly	145

m = meter.

Species Composition

The most commonly found bat species were eastern red bat (146 carcasses; 43.6%) and silver-haired bat (91; 27.2%), followed by big brown bat (45; 13.4%) and hoary bat (39; 11.6%). The remaining species composed less than 5.0% of the total bats found. (Table 4, Appendix A). Species composition recorded at the Project was similar to ITP monitoring conducted in 2021 and 2022. Six bats were found in spring, 74 bats were found in the summer, and 255 bats were found in the fall (Appendix A). Nine heavily scavenged bats (e.g., wing membrane only, bones, or partial carcasses) were sent for identification via DNA analysis; DNA analysis identified these as three big brown bats, three eastern red bats, one hoary bat, one evening bat (*Nycticeius humeralis*), and one Indiana bat. The majority of bat carcasses were recorded on plots searched by detection-dog teams (Tables 5a, 5b, 5c).

Table 4. Number and percent (%) of bat carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Species	Included in Area Correction		Outside Search Area*		Outside Study Period*		Total	
	Total	%	Total	%	Total	%	Total	%
eastern red bat	138	42.5	4	66.7	4	100	146	43.6
silver-haired bat	89	27.4	2	33.3	0	0	91	27.2
big brown bat	45	13.8	0	0	0	0	45	13.4
hoary bat	39	12.0	0	0	0	0	39	11.6
evening bat	5	1.5	0	0	0	0	5	1.5
unidentified <i>Lasiurus</i> bat	3	0.9	0	0	0	0	3	0.9
Indiana bat	2	0.6	0	0	0	0	2	0.6
Seminole bat	2	0.6	0	0	0	0	2	0.6
unidentified non- <i>Myotis</i>	2	0.6	0	0	0	0	2	0.6
Total	325	100	6	100	4	100	335	100

* Carcasses not included in analysis.

Sums may not equal total values shown due to rounding.

Table 5a. Species composition on 100-meter road and pad plot by season for bat carcasses* found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Species	Spring		Summer		Fall	
	# of Carcasses	%	# of Carcasses	%	# of Carcasses	%
eastern red bat	1	16.7	4	44.4	26	40.6
silver-haired bat	5	83.3	2	22.2	18	28.1
big brown bat	0	0	1	11.1	10	15.6
hoary bat	0	0	1	11.1	5	7.8
Seminole bat	0	0	0	0	2	3.1
evening bat	0	0	1	11.1	0	0
Indiana bat	0	0	0	0	1	1.6
unidentified non- <i>Myotis</i>	0	0	0	0	1	1.6
unidentified <i>Lasiurus</i> bat	0	0	0	0	1	1.6
Total	6	100	9	100	64	100

* This table only includes bat carcasses included in the area correction calculation.

Sums may not equal total values shown due to rounding.

Table 5b. Species composition on 70-meter cleared plot by season for bat carcasses* found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Species	Summer		Fall	
	# of Carcasses	%	# of Carcasses	%
eastern red bat	20	69.0	34	28.8
silver-haired bat	2	6.9	38	32.2
big brown bat	1	3.4	24	20.3
hoary bat	4	13.8	19	16.1
Seminole bat	0	0	0	0
evening bat	1	3.4	1	0.8
Indiana bat	1	3.4	0	0
unidentified <i>Lasiurus</i> bat	0	0	2	1.7
Total	29	100	118	100

* This table only includes bat carcasses included in the area correction calculation.

Sums may not equal total values shown due to rounding.

Table 5c. Species composition on 70-meter uncleared plot by season for bat carcasses* found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Species	Summer		Fall	
	# of Carcasses	%	# of Carcasses	%
eastern red bat	21	65.6	32	47.8
silver-haired bat	5	15.6	19	28.4
big brown bat	1	3.1	8	11.9
hoary bat	4	12.5	6	9.0
Seminole bat	0	0	0	0
evening bat	1	3.1	1	1.5
Indiana bat	0	0	0	0
unidentified non- <i>Myotis</i>	0	0	1	1.5
Total	32	100	67	100

* This table only includes bat carcasses included in the area correction calculation.

Sums may not equal total values shown due to rounding.

Two Indiana bat carcasses were found during PCM surveys: one on June 20, 2023, at Turbine 21, and one on September 5, 2023, at Turbine 3 (Figure 2). The Indiana bats were identified by a permitted bat biologist (ES234121-10) and reported to the USFWS and IDNR on June 20 and September 11, 2023. The carcass found at Turbine 3 on September 5 was originally identified as an unidentified *Myotis* and a sample was sent for deoxyribonucleic acid (commonly, DNA) testing for verification of species. Verification of Indiana bat DNA was received from Dr. Jane Huffman of the Wildlife Genetics Institute on October 20, 2023. The estimated time of death of both Indiana bats found was zero to one days prior to discovery. Scavenging and decomposition of the carcasses prior to finding the carcasses prevented assignment of sex. DNA analysis identified the Indiana bat carcass found on June 20 at Turbine 21 as a male and the Indiana bat carcass found on September 5 at Turbine 3 as female.

No northern long-eared bat carcasses were found during the study. No tri-colored bats or little brown bats were found in 2023. Five state-listed endangered evening bat were also found during summer and fall surveys. One evening bat was found at Turbine 11 on May 16, one was found at Turbine 27 on May 24, one was found at Turbine 38 on June 1, one was found at Turbine 32 on October 10, and one was found at Turbine 33 on October 13, 2023 (Figure 2).

Carcasses for Area Adjustment Analysis

Ten of the 335 bats found during monitoring season were excluded from modeling the area correction; six bat carcasses were excluded from analysis because the carcasses were found off plot. Another four bats were excluded because the estimated time of death was prior to the start of the surveys (Table 4).

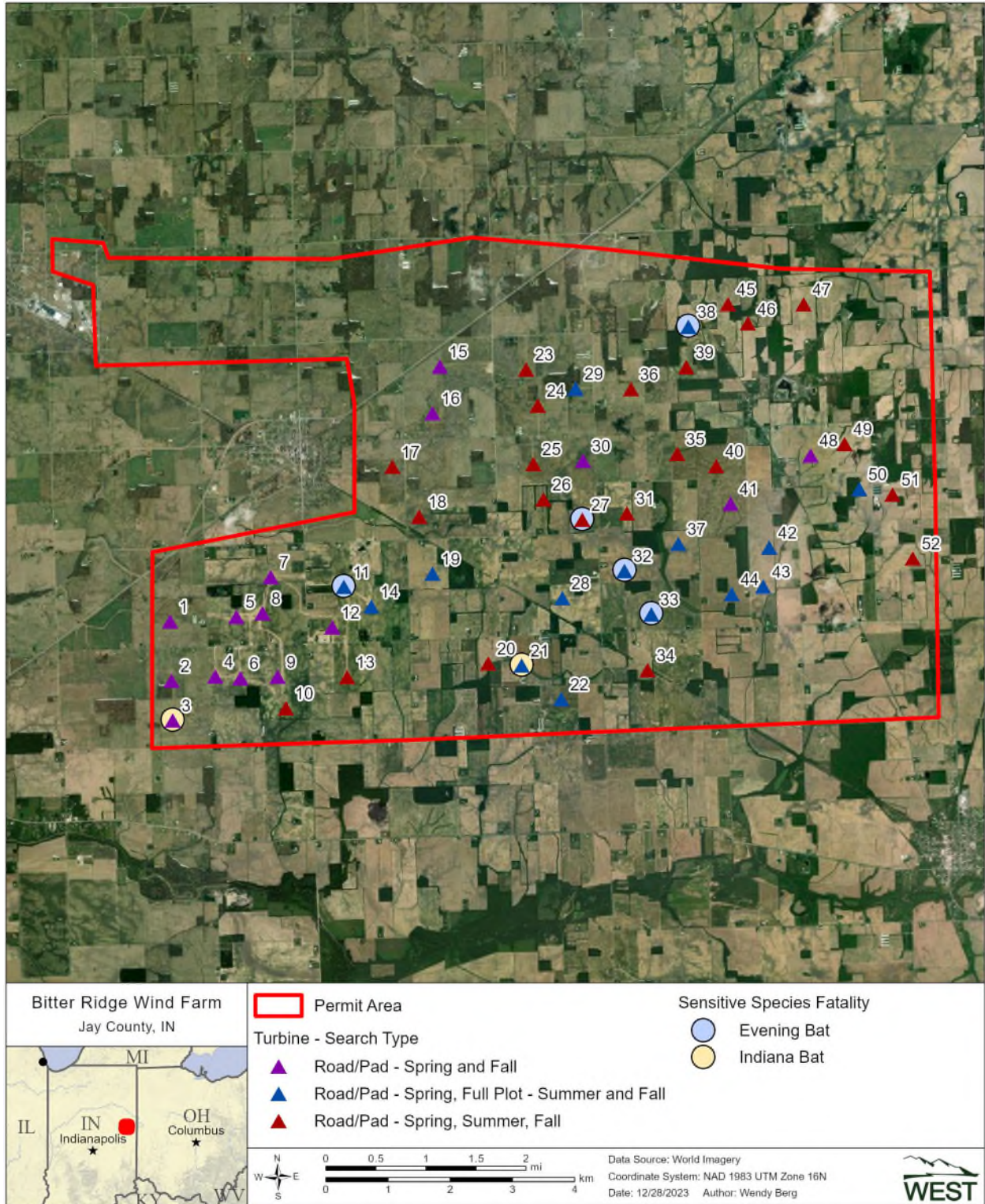


Figure 2. Location of state- and federally listed bat carcasses in relation to turbines at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Bias Trials

Searcher Efficiency Trials

One hundred fifty-six bats were placed for searcher efficiency trials on 18 separate dates (April 4 and 10; May 31; June 1, 13 and 26; July 10, 17, 18, 20, and 28; August 7 and 21; September 11 and 21; and October 5, 9 and 11, 2023), and 136 bats were available for search teams to find across all plot types. Overall searcher efficiency rates ranged from 76.3% on 70-m cleared plots searched by dog teams to 83.3% on road and pad plots searched by technicians (Table 6). The best-fit 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 uncleared and cleared plots. The best-fit model for searcher efficiency on 70-m plots did support the inclusion of season as a covariate, meaning there was a substantial difference between searcher efficiency rates between seasons (Table 7). The best-fit model for searcher efficiency on 100-m road and pad plots did not support the inclusion of season as a covariate (Table 8). Thus, the total number of available and found searcher efficiency trials were summed across seasons for road and pad plots. The inputs for the 70-m plots were 39 available carcasses and 35 found carcasses for summer and were 37 available carcasses and 24 found carcasses for fall. The inputs for road and pad plots were 60 available carcasses and 50 found carcasses for all seasons (Table 6).

Table 6. Searcher efficiency results by plot type at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Season	Plot Type	Number Placed	Number Available	Number Found	% Found
Spring	100-m road and pad plot	20	20	18	90.0
	70-m cleared plot*	22	19	16	84.2
Summer	70-m uncleared plot*	20	20	19	95.0
	100-m road and pad plot	20	20	15	75.0
Fall	70-m cleared plot*	28	19	13	84.2
	70-m uncleared plot*	23	18	11	61.1
	100-m road and pad plot	23	20	17	85.0
Overall 70-m cleared plot*		50	38	29	76.3
Overall 70-m uncleared plot*		43	38	30	79.0
Overall 100-m road and pad plot		63	60	50	83.3
Overall		156	136	109	80.1

m = meter.

* = Detection-dog teams searched 70-m plots

Table 7. Searcher efficiency models for 70-meter detection-dog searched plots at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Covariates	k Value	AICc	Delta AICc
Season	k fixed at 0.67	77.93	0*
No Covariates	k fixed at 0.67	82.85	4.92

* Selected model.

AICc = Corrected Akaike Information Criterion, Delta AICc = Change in AICc.

n = 76.

Table 8. Searcher efficiency models for 100-meter technician searched road and pad plots at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Covariates	k Value	AICc	Delta AICc
No covariates	0.67	56.14	0*
Season	0.67	58.83	2.69

* Selected model.

AICc = corrected Akaike Information Criterion, Delta AICc = Change in AICc.

n = 60.

Carcass Persistence Trials

Forty-two carcasses were placed to estimate carcass persistence on road and pad plots searched by a technician and 55 carcasses were placed to estimate carcass persistence on detection-dog searched cleared and uncleared plots combined. The best-fit model for carcass persistence rates on road and pad plots included season with a lognormal distribution and suggests bat carcass persistence rates on road and pad plots did vary by season (Table 9). The best-fit model for carcass persistence rates on detection-dog searched plots had no covariates with a Weibull distribution and suggests bat carcass persistence rates did not vary by season (Table 10). The estimated median carcass persistence times ranged from 3.7–17.1 days on 100-m road and pad plots and 10.1 days on 70-m plots (Table 11). The average probability a carcass persisted through a 7.2-day average search interval on 100-m road and pad plots ranged from 0.79 (90% CI: 0.64–0.90) in the summer to 0.87 (90% CI: 0.76–0.94) in the spring. The average probability that a carcass persisted through a 3.5-day average search interval on 100-m road and pad plots in the fall was 0.73 (90% CI: 0.59 – 0.85). The average probability a carcass persisted through a 7.2-day average search interval was 0.73 (90% CI: 0.66 – 0.81) at cleared and uncleared plots in the summer, and the average probability a carcass persisted through a 3.5-day search average interval was 0.83 (90% CI: 0.76 – 0.89) on 70-m cleared and uncleared plots in the fall (Table 12, Figures 3 and 4).

Table 9. Carcass persistence models with covariates and distributions for technician searched road and pad plots at the Bitter Ridge Wind Energy Project, Jay County, Indiana, from April 1 – October 15, 2023.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	No Covariates	lognormal	186.68	0*
Season	No Covariates	loglogistic	187.86	1.18
No Covariates	No Covariates	loglogistic	189.61	2.93
No Covariates	No Covariates	lognormal	189.87	3.19
Season	–	exponential	190.42	3.74
Season	No Covariates	Weibull	190.60	3.92
Season	Season	lognormal	191.14	4.46
No Covariates	No Covariates	Weibull	191.84	5.16
Season	Season	loglogistic	192.51	5.83
No Covariates	Season	loglogistic	192.52	5.84
No Covariates	Season	loglogistic	193.10	6.42
No Covariates	–	exponential	193.18	6.50
Season	Season	Weibull	194.81	8.13
No Covariates	Season	Weibull	195.16	8.48

* Selected model.

AICc = Corrected Akaike Information Criterion, Delta AICc = Change in AICc.
 n = 42.

Table 10. Carcass persistence models with covariates and distributions for detection-dog searched plots at the Bitter Ridge Wind Energy Project, Jay County, Indiana, from April 1 – October 15, 2023.

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	No Covariates	Weibull	245.68	0*
Season	No Covariates	Weibull	246.98	1.30
No Covariates	Season	Weibull	247.79	2.11
Season	Season	Weibull	249.21	3.53
No Covariates	–	exponential	250.02	4.34
Season	–	exponential	250.74	5.06
No Covariates	No Covariates	loglogistic	253.26	7.58
Season	No Covariates	loglogistic	254.52	8.84
No Covariates	Season	loglogistic	254.71	9.03
No Covariates	No Covariates	lognormal	255.86	10.18
Season	Season	loglogistic	256.17	10.49
No Covariates	Season	lognormal	256.54	10.86
Season	No Covariates	lognormal	257.79	12.11
Season	Season	lognormal	258.54	12.86

* Selected model.

AICc = Corrected Akaike Information Criterion, Delta AICc = Change in AICc.
 n = 55.

Table 11. Carcass persistence top models with covariates, distributions, and model parameters for the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Plot Search Type	Season	Distribution	Estimated Median Removal		
			Times (days)	Parameter 1	Parameter 2
70-m plot**	All	Weibull*	10.05	shape=0.7037	scale=1.675
100-m road and pad plot	Fall	lognormal*	3.73	meanlog = 1.317	sdlog=1.397
100-m road and pad plot	Spring	lognormal*	17.05	meanlog=2.836	sdlog = 1.397
100-m road and pad plot	Summer	lognormal*	10.15	meanlog=2.317	sdlog=1.397

* Parameterization follows the base R parameterization for this distribution.

** Searched by detection-dog teams

m = meter.

Table 12. Probability a carcass would persist through the search interval for the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Season	Plot Type	Search Interval (days)	Average Probability of Persistence Through Search Interval	
			Average Probability of Persistence Through Search Interval	90% Confidence Interval
Spring	100-m road and pad plot	Weekly (7.2)	0.87	0.76–0.94
Summer	100-m road and pad plot	Weekly (7.2)	0.79	0.64–0.90
	70-m plot*	Weekly (7.2)	0.73	0.66–0.81
Fall	100-m road and pad plot	Twice Weekly (3.5)	0.73	0.59–0.85
	70-m plot*	Twice Weekly(3.5)	0.83	0.76–0.89

m = meter.

* 70-m plots searched by detection-dog team.

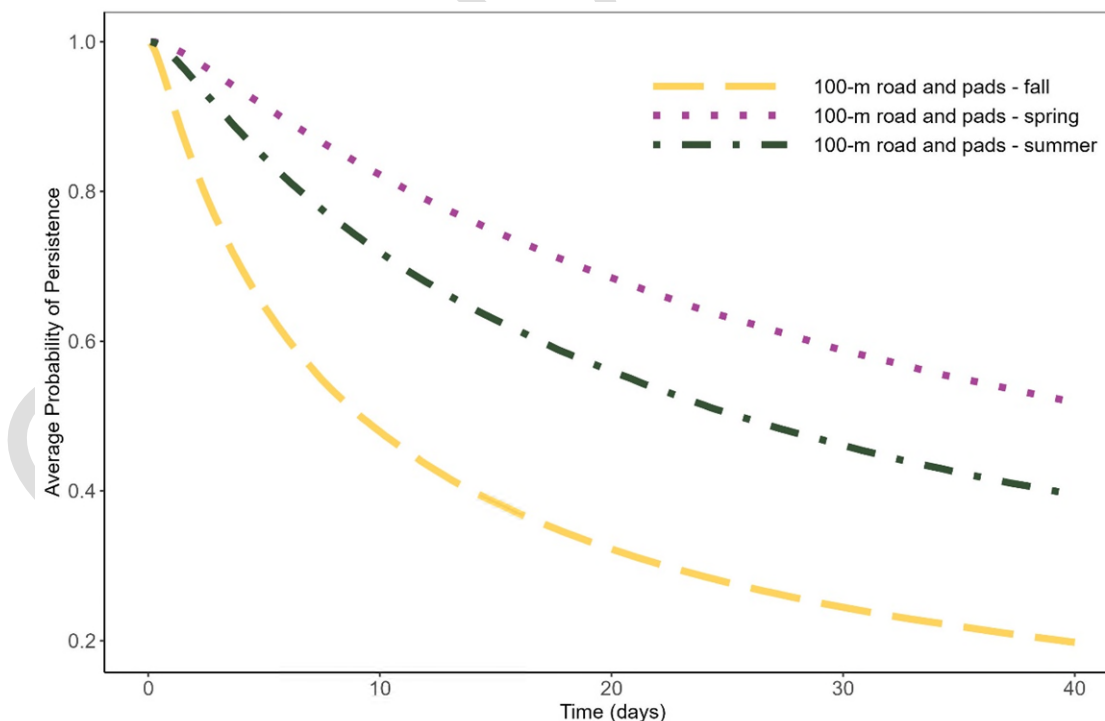


Figure 3. The average probability of persistence for 100-meter road and pad plots, in days, at Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

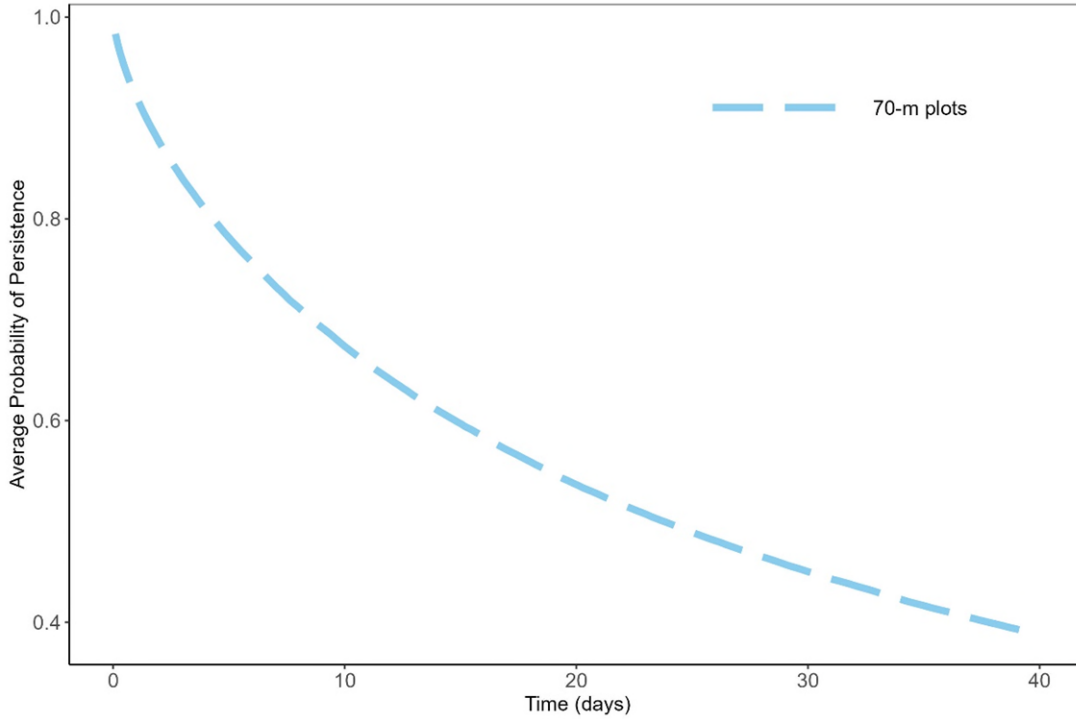


Figure 4. The average probability of persistence for 70-meter plots searched by detection-dog teams, in days, at Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Statistical Analysis

Area Correction

The best-fit model for the distribution of bats with respect to distance from turbine base was a Gompertz distribution (Appendix B1). The TWL area correction for bats was estimated to be 0.92 for 70-m plots, and 0.05 for 100-m road and pad plots (Appendix B2; Figure 5).

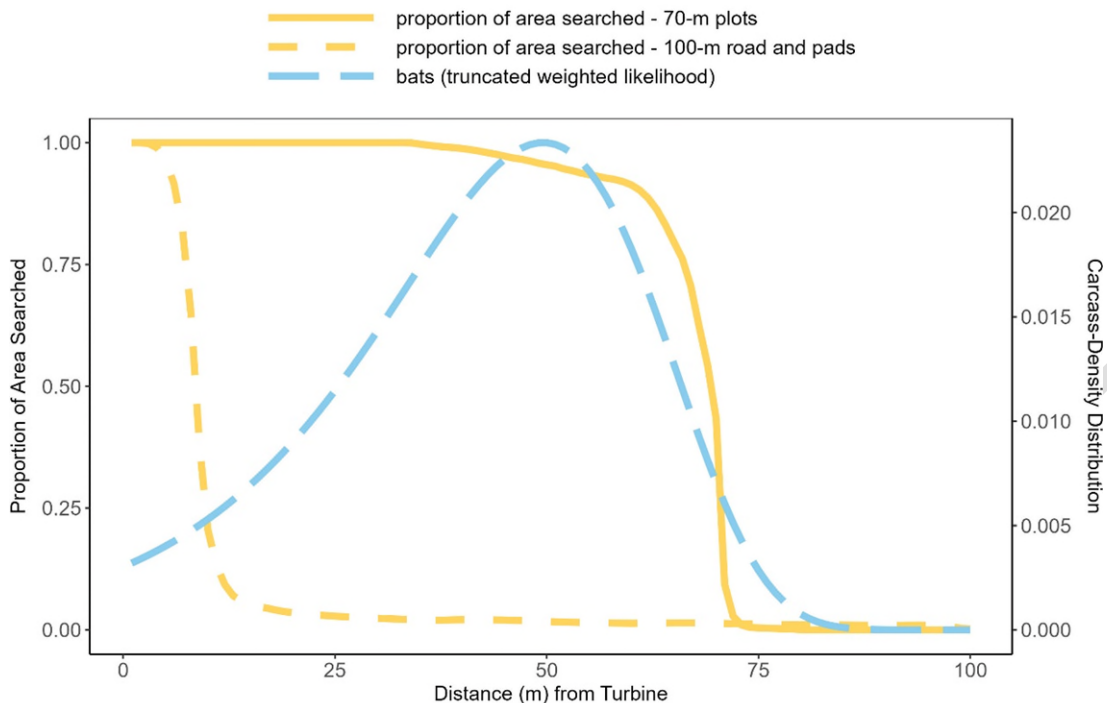


Figure 5. Density of bat carcasses per area searched at all road and pad plots, cleared plots, and uncleared plots at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Adjusted Overall Bat Fatality Estimates

Bat fatality estimates were calculated for the year, per the HCP. Fatality estimates were highest in the fall, and the overall estimate for the study was 20.17 bats per MW (90% CI: 13.98–31.58; Table 13).

Table 13. Overall bat fatality rates per turbine and megawatt using GenEst for studies conducted at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Season	Bat Fatality Estimate per Turbine	90% Confidence Limits	Bat Fatality Estimate per Megawatt	90% Confidence Limits
Spring	2.93	1.16–6.14	1.04	0.41–2.18
Summer	9.03	5.36–15.18	3.20	1.90–5.38
Fall	44.17	30.24–71.51	15.66	10.72–25.36
Overall	56.89	39.44–89.05	20.17	13.98–31.58

* Confidence interval not calculated because the observed carcass count is less than 5.

Indiana Bat and Northern Long-eared Bat Take Estimates

Evidence of Absence Framework

Two Indiana bats and zero northern long-eared bat carcasses were found during the study. The overall probability of detection distribution achieved for the 2023 monitoring period had a mean of 0.22 (95% CI: 0.20–0.23; Table 14). The estimated *g* of 0.22 and 95% CI do not exceed the target

probability of detection value (0.25), indicating the realized g for the 2023 monitoring period is significantly lower (at the 0.05 significance level) than the target g for the year. The overall probability of detection distribution achieved over three years of ITP level monitoring had a mean of 0.27 (95% CI: 0.26–0.28) and is significantly greater than the overall target probability of detection value. 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.

Table 14. Annual and overall probabilities of detection (g), Ba , Bb , and ρ for the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Year	Ba*	Bb*	ρ **	g	95% Confidence Intervals
2021	1,559.98	3,145.32	0.76	0.33	0.32–0.35
2022	1,613.63	4,226.04	1	0.28	0.26–0.29
2023	800.25	2,879.71	1	0.22	0.20–0.23
Overall	3,769.46	10,181.19	2.76	0.27	0.26–0.28

* 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.

** ρ is the weight in the weighted average that is used to combine the probability of detection distributions across years.

The expected average annual take rate reported in the HCP is 1.95 Indiana bats per year and 1.27 northern long-eared bats per year; the total permitted take for each species is 69 Indiana bats and 45 northern long-eared bat over the 35-year permit term. Based on the third year of ITP monitoring, take to-date, M^* at $\alpha = 0.5$ (50th credible bound), is estimated to be 26 Indiana bats and zero northern long-eared bats (Table 15). These values fall below the permitted take level for both species, meaning the Project is in compliance with the ITP. The mean annual take rate (λ) was estimated to be 10.06 (95% CI: 4.20–18.44) Indiana bats per year and 0.67 (95% CI: 0–3.37) northern long-eared bats per year (Table 15). Based on these data, the probability that estimated annual take exceeded expected annual take did not exceed 95% for northern long-eared bat, but Indiana bat annual take did exceed the 95% short-term adaptive management trigger. Therefore, adaptive management responses warrant consideration in accordance with HCP section 5.4.3.

Table 15. Cumulative take estimate to date using Evidence of Absence for studies conducted at Bitter Ridge Wind Farm, Jay County, Indiana in 2021, 2022, and 2023.

Species	Cumulative Take (M^*)	Mean Annual Take Rate (λ)
Indiana bat	26 (50 th credible bound)	10.06 (95% CI: 4.20–18.44)
northern long-eared bat	0 (50 th credible bound)	0.67 (95% CI: 0–3.37)

CI = confidence interval.

DISCUSSION

During the study, a total of 335 bat fatalities were found. The overall bat fatality rate was 20.17 bats per MW (90% CI: 13.98–31.58). The most commonly found bat species were eastern red bat (43.6%), silver-haired bat (27.2%), big brown bat (13.4%), and hoary bat (11.6%). Species composition recorded at the Project was similar to previous studies during 2021 and 2022 at Bitter Ridge, and at Headwaters Wind Farm, a nearby wind farm in Randolph County, Indiana (Rodriguez et al. 2020, 2021).

The overall probability of detection (g) distribution for 2023 PCM surveys had a mean of 0.22 (95% CI: 0.20–0.23). Thus, annual g for 2023 did not meet the target g of 0.25 for the monitoring period, indicating that the detection probability was lower than expected for PCM surveys in 2023, but the overall g for all combined studies from 2021 through 2023 was 0.27 (95%CI: 0.26–0.28) and is higher than the overall target g of 0.25 over the first three years of monitoring as listed in the HCP. Carcass persistence trials indicated persistence times in 2023 were longer than the shortest search interval, confirming that 3.5-day search interval in fall was sufficient to detect the majority of bat carcasses. The area adjustment data from Bitter Ridge indicated that nearly all bat fatalities occurred within 70 m of turbines.

Estimated take for the Covered Species falls below the permitted take level for both species, meaning the Project is in compliance with the ITP. The EoA model estimated the mean annual fatality rate at Bitter Ridge was 10.06 Indiana bats and 0.67 northern long-eared bat. The probability that the annual take rate exceeded the short-term thresholds for northern long-eared bat did not exceed 95%, but the probability did exceed 95% for Indiana bat. HCP section 5.4.3 provides direction on adaptive management responses in the event the short-term threshold is exceeded. Pursuant to HCP section 5.4.3, Bitter Ridge may elect to begin considering adaptive management responses. Consistent with HCP section 5.4.4, Bitter Ridge will be scheduling a meeting with the USFWS to discuss this study and potential adaptive management responses.

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**Appendix A. Carcasses Found during the 2023 Post-construction Monitoring Surveys
at the Bitter Ridge Wind Farm**

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Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
04/17/2023	eastern red bat	22	5	carcass search	100-m road and pad	scavenged	no
04/24/2023	silver-haired bat	17	25	carcass search	100-m road and pad	scavenged	no
04/24/2023	silver-haired bat	16	25	carcass search	100-m road and pad	scavenged	no
05/01/2023	silver-haired bat	31	15	carcass search	100-m road and pad	intact	no
05/09/2023	silver-haired bat	6	35	carcass search	100-m road and pad	scavenged	no
05/09/2023	silver-haired bat	64	50	carcass search	100-m road and pad	scavenged	no
05/12/2023	eastern red bat	8	11	incidental	70-m cleared plot	intact	yes
05/12/2023	silver-haired bat	50	14	incidental	70-m cleared plot	intact	yes
05/16/2023	eastern red bat	1	18	carcass search	100-m road and pad	scavenged	no
05/16/2023	evening bat	29	11	carcass search	70-m cleared plot	scavenged	yes
05/16/2023	hoary bat	14	29	carcass search	70-m uncleared plot	intact	yes
05/17/2023	eastern red bat	44	43	carcass search	70-m uncleared plot	scavenged	yes
05/18/2023	eastern red bat	46	39	carcass search**	100-m road and pad	scavenged	no
05/19/2023	eastern red bat	11	37	carcass search	70-m cleared plot	scavenged	yes
05/19/2023	silver-haired bat	43	50	carcass search	70-m uncleared plot	scavenged	yes
05/24/2023	eastern red bat	69	22	carcass search	70-m cleared plot	scavenged	yes
05/24/2023	evening bat	8	27	carcass search	100-m road and pad	scavenged	no
05/24/2023	silver-haired bat	16	31	carcass search**	100-m road and pad	scavenged	no
05/25/2023	silver-haired bat	44	38	carcass search	70-m uncleared plot	scavenged	yes
05/25/2023	silver-haired bat	72	38	carcass search**	70-m uncleared plot	scavenged	yes
06/01/2023	evening bat	29	38	carcass search	70-m uncleared plot	scavenged	yes
06/05/2023	eastern red bat	11	32	carcass search	70-m uncleared plot	dismembered	yes
06/05/2023	hoary bat	56	14	carcass search	70-m cleared plot	dismembered	yes
06/13/2023	silver-haired bat	61	43	carcass search	70-m uncleared plot	scavenged	yes
06/16/2023	silver-haired bat	40	33	carcass search	70-m cleared plot	scavenged	yes
06/19/2023	hoary bat	40	14	carcass search	70-m cleared plot	dismembered	yes
06/20/2023	Indiana bat	28	21	carcass search	70-m cleared plot	scavenged	yes
06/20/2023	eastern red bat	15	22	carcass search	70-m cleared plot	scavenged	yes
06/20/2023	eastern red bat	47	43	carcass search	70-m uncleared plot	dismembered	yes
06/20/2023	silver-haired bat	45	43	carcass search	70-m uncleared plot	scavenged	yes
06/22/2023	eastern red bat	59	42	carcass search	70-m uncleared plot	scavenged	yes
06/22/2023	silver-haired bat	35	34	carcass search	100-m road and pad	scavenged	no
06/22/2023	silver-haired bat	40	42	carcass search	70-m uncleared plot	dismembered	yes
06/26/2023	silver-haired bat	26	10	carcass search	100-m road and pad	scavenged	no
06/27/2023	eastern red bat	28	21	incidental	70-m cleared plot	scavenged	yes
06/30/2023	eastern red bat	25	33	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
06/30/2023	eastern red bat	56	37	carcass search	70-m cleared plot	scavenged	yes
06/30/2023	eastern red bat	41	43	incidental	70-m uncleared plot	scavenged	no
06/30/2023	hoary bat	27	37	carcass search	70-m cleared plot	scavenged	yes
07/03/2023	big brown bat	35	14	carcass search	70-m cleared plot	intact	yes
07/05/2023	eastern red bat	20	19	carcass search	70-m cleared plot	dismembered	yes
07/05/2023	eastern red bat	36	19	carcass search	70-m cleared plot	scavenged	yes
07/06/2023	eastern red bat	0	34	carcass search	100-m road and pad	intact	no
07/06/2023	eastern red bat	32	38	carcass search	70-m uncleared plot	scavenged	yes
07/06/2023	eastern red bat	20	42	carcass search	70-m uncleared plot	dismembered	yes
07/07/2023	eastern red bat	0	1	incidental	100-m road and pad	scavenged	no
07/07/2023	eastern red bat	43	11	incidental	70-m cleared plot	intact	yes
07/07/2023	eastern red bat	33	11	incidental	70-m cleared plot	dismembered	yes
07/07/2023	eastern red bat	59	33	carcass search	70-m cleared plot	scavenged	yes
07/07/2023	eastern red bat	0	37	carcass search	70-m cleared plot	scavenged	yes
07/07/2023	eastern red bat	30	37	carcass search	70-m cleared plot	scavenged	yes
07/07/2023	eastern red bat	73	50	carcass search**	70-m uncleared plot	scavenged	yes
07/10/2023	eastern red bat	33	29	carcass search	70-m uncleared plot	intact	yes
07/10/2023	eastern red bat	22	29	carcass search	70-m uncleared plot	dismembered	yes
07/10/2023	eastern red bat	15	32	carcass search	70-m uncleared plot	scavenged	yes
07/11/2023	eastern red bat	55	22	carcass search	70-m cleared plot	scavenged	yes
07/11/2023	eastern red bat	21	50	incidental	70-m uncleared plot	scavenged	yes
07/12/2023	hoary bat	44	36	incidental	100-m road and pad	scavenged	no
07/13/2023	eastern red bat	0	28	carcass search	70-m cleared plot	scavenged	yes
07/13/2023	hoary bat	29	42	carcass search	70-m uncleared plot	dismembered	yes
07/13/2023	hoary bat	60	44	carcass search	70-m uncleared plot	dismembered	yes
07/18/2023	big brown bat	34	29	carcass search	70-m uncleared plot	scavenged	yes
07/18/2023	eastern red bat	4	29	carcass search	70-m uncleared plot	scavenged	yes
07/18/2023	eastern red bat	30	29	carcass search	70-m uncleared plot	scavenged	yes
07/18/2023	eastern red bat	20	29	carcass search	70-m uncleared plot	scavenged	yes
07/19/2023	eastern red bat	3	25	carcass search	100-m road and pad	scavenged	no
07/20/2023	eastern red bat	43	38	carcass search	70-m uncleared plot	scavenged	yes
07/20/2023	eastern red bat	55	38	carcass search	70-m uncleared plot	scavenged	yes
07/21/2023	eastern red bat	33	33	carcass search	70-m cleared plot	scavenged	yes
07/21/2023	eastern red bat	44	37	carcass search	70-m cleared plot	intact	yes
07/21/2023	eastern red bat	2	50	carcass search	70-m uncleared plot	scavenged	yes
07/24/2023	eastern red bat	52	14	carcass search	70-m cleared plot	dismembered	yes
07/24/2023	eastern red bat	56	14	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
07/24/2023	eastern red bat	65	29	carcass search	70-m uncleared plot	scavenged	yes
07/24/2023	eastern red bat	11	29	carcass search	70-m uncleared plot	intact	yes
07/24/2023	hoary bat	14	29	carcass search	70-m uncleared plot	scavenged	yes
07/27/2023	eastern red bat	43	38	carcass search	70-m uncleared plot	scavenged	yes
07/27/2023	eastern red bat	30	44	carcass search	70-m uncleared plot	scavenged	yes
07/28/2023	big brown bat	8	46	carcass search	100-m road and pad	intact	no
07/28/2023	eastern red bat	6	52	carcass search	100-m road and pad	scavenged	no
07/28/2023	hoary bat	46	33	carcass search	70-m cleared plot	scavenged	yes
08/01/2023	big brown bat	8	21	carcass search	70-m cleared plot	scavenged	yes
08/01/2023	big brown bat	24	21	carcass search	70-m cleared plot	dismembered	yes
08/01/2023	big brown bat	21	44	carcass search	70-m uncleared plot	scavenged	yes
08/01/2023	eastern red bat	17	14	carcass search	70-m cleared plot	scavenged	yes
08/01/2023	eastern red bat	38	19	carcass search	70-m cleared plot	scavenged	yes
08/01/2023	eastern red bat	63	21	carcass search**	70-m cleared plot	scavenged	yes
08/01/2023	eastern red bat	18	29	carcass search	70-m uncleared plot	scavenged	yes
08/01/2023	eastern red bat	8	44	carcass search	70-m uncleared plot	scavenged	yes
08/01/2023	hoary bat	49	37	carcass search	70-m cleared plot	scavenged	yes
08/02/2023	eastern red bat	37	11	carcass search	70-m cleared plot	scavenged	yes
08/02/2023	eastern red bat	7	15	carcass search	100-m road and pad	scavenged	no
08/02/2023	eastern red bat	41	15	carcass search	100-m road and pad	scavenged	no
08/02/2023	eastern red bat	36	38	carcass search	70-m uncleared plot	scavenged	yes
08/02/2023	eastern red bat	42	5	carcass search	100-m road and pad	scavenged	no
08/02/2023	eastern red bat	3	6	carcass search	100-m road and pad	scavenged	no
08/02/2023	eastern red bat	5	7	carcass search	100-m road and pad	scavenged	no
08/03/2023	big brown bat	30	19	carcass search	70-m cleared plot	scavenged	yes
08/03/2023	eastern red bat	38	44	carcass search	70-m uncleared plot	scavenged	yes
08/04/2023	eastern red bat	9	30	carcass search	100-m road and pad	scavenged	no
08/07/2023	eastern red bat	27	19	carcass search	70-m cleared plot	scavenged	yes
08/07/2023	eastern red bat	44	43	carcass search	70-m uncleared plot	scavenged	yes
08/07/2023	eastern red bat	50	44	carcass search	70-m uncleared plot	scavenged	yes
08/07/2023	hoary bat	66	43	carcass search	70-m uncleared plot	intact	yes
08/08/2023	eastern red bat	30	50	carcass search	70-m uncleared plot	scavenged	yes
08/08/2023	unidentified non-Myotis	38	10	carcass search	100-m road and pad	dismembered	no
08/09/2023	eastern red bat	9	38	carcass search	70-m uncleared plot	scavenged	yes
08/10/2023	hoary bat	60	11	carcass search	70-m cleared plot	scavenged	yes
08/11/2023	big brown bat	6	22	carcass search	70-m cleared plot	dismembered	yes
08/11/2023	big brown bat	11	37	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
08/11/2023	eastern red bat	54	22	carcass search	70-m cleared plot	intact	yes
08/11/2023	eastern red bat	43	38	carcass search	70-m uncleared plot	scavenged	yes
08/11/2023	hoary bat	23	38	carcass search	70-m uncleared plot	scavenged	yes
08/14/2023	big brown bat	2	20	carcass search	100-m road and pad	scavenged	no
08/14/2023	big brown bat	42	22	carcass search	70-m cleared plot	scavenged	yes
08/14/2023	eastern red bat	30	11	carcass search	70-m cleared plot	scavenged	yes
08/14/2023	eastern red bat	12	13	carcass search	100-m road and pad	scavenged	no
08/14/2023	eastern red bat	0	22	carcass search	70-m cleared plot	scavenged	yes
08/14/2023	eastern red bat	32	22	carcass search	70-m cleared plot	scavenged	yes
08/14/2023	hoary bat	44	22	carcass search	70-m cleared plot	scavenged	yes
08/15/2023	big brown bat	30	44	carcass search	70-m uncleared plot	intact	yes
08/15/2023	eastern red bat	45	1	carcass search	100-m road and pad	scavenged	no
08/15/2023	eastern red bat	49	12	carcass search	100-m road and pad	scavenged	no
08/15/2023	eastern red bat	43	50	carcass search	70-m uncleared plot	scavenged	yes
08/15/2023	eastern red bat	53	6	carcass search	100-m road and pad	scavenged	no
08/15/2023	hoary bat	40	29	carcass search	70-m uncleared plot	scavenged	yes
08/15/2023	hoary bat	69	6	carcass search	100-m road and pad	scavenged	no
08/15/2023	unidentified <i>Lasiurus</i> bat	30	33	carcass search	70-m cleared plot	scavenged	yes
08/16/2023	eastern red bat	41	28	carcass search	70-m cleared plot	scavenged	yes
08/17/2023	big brown bat	11	19	carcass search	70-m cleared plot	scavenged	yes
08/17/2023	eastern red bat	24	44	carcass search	70-m uncleared plot	scavenged	yes
08/18/2023	Seminole bat	41	15	carcass search	100-m road and pad	intact	no
08/18/2023	eastern red bat	32	15	carcass search	100-m road and pad	scavenged	no
08/18/2023	eastern red bat	60	5	carcass search	100-m road and pad	intact	no
08/18/2023	hoary bat	18	21	carcass search	70-m cleared plot	scavenged	yes
08/18/2023	hoary bat	1	31	carcass search	100-m road and pad	intact	no
08/22/2023	big brown bat	20	22	carcass search	70-m cleared plot	scavenged	yes
08/22/2023	big brown bat	6	29	carcass search	70-m uncleared plot	intact	yes
08/22/2023	eastern red bat	45	21	carcass search	70-m cleared plot	dismembered	yes
08/22/2023	eastern red bat	9	25	carcass search	100-m road and pad	scavenged	no
08/22/2023	eastern red bat	53	28	carcass search	70-m cleared plot	scavenged	yes
08/22/2023	eastern red bat	18	29	carcass search	70-m uncleared plot	scavenged	yes
08/22/2023	eastern red bat	5	3	carcass search	100-m road and pad	scavenged	no
08/22/2023	eastern red bat	34	32	carcass search	70-m uncleared plot	scavenged	yes
08/22/2023	eastern red bat	36	42	carcass search	70-m uncleared plot	scavenged	yes
08/22/2023	eastern red bat	43	42	carcass search	70-m uncleared plot	scavenged	yes
08/22/2023	eastern red bat	45	50	carcass search	70-m uncleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
08/22/2023	silver-haired bat	30	21	carcass search	70-m cleared plot	dismembered	yes
08/22/2023	silver-haired bat	11	25	carcass search	100-m road and pad	intact	no
08/23/2023	eastern red bat	20	43	carcass search	70-m uncleared plot	scavenged	yes
08/23/2023	eastern red bat	48	43	carcass search	70-m uncleared plot	scavenged	yes
08/24/2023	eastern red bat	0	17	carcass search	100-m road and pad	scavenged	no
08/24/2023	hoary bat	51	14	carcass search	70-m cleared plot	dismembered	yes
08/25/2023	big brown bat	4	12	carcass search	100-m road and pad	intact	no
08/25/2023	big brown bat	7	34	carcass search	100-m road and pad	scavenged	no
08/25/2023	eastern red bat	24	22	carcass search	70-m cleared plot	intact	yes
08/25/2023	eastern red bat	69	22	carcass search	70-m cleared plot	scavenged	yes
08/25/2023	eastern red bat	17	38	carcass search	70-m uncleared plot	intact	yes
08/25/2023	eastern red bat	41	41	carcass search	100-m road and pad	scavenged	no
08/25/2023	eastern red bat	20	43	carcass search	70-m uncleared plot	scavenged	yes
08/25/2023	eastern red bat	18	43	carcass search	70-m uncleared plot	scavenged	yes
08/25/2023	hoary bat	0	52	carcass search	100-m road and pad	scavenged	no
08/28/2023	big brown bat	30	19	carcass search	70-m cleared plot	scavenged	yes
08/28/2023	eastern red bat	65	18	carcass search	100-m road and pad	scavenged	no
08/28/2023	eastern red bat	59	19	carcass search	70-m cleared plot	intact	yes
08/28/2023	eastern red bat	24	19	carcass search	70-m cleared plot	dismembered	yes
08/28/2023	hoary bat	35	17	carcass search	100-m road and pad	scavenged	no
08/29/2023	big brown bat	15	21	carcass search	70-m cleared plot	scavenged	yes
08/29/2023	big brown bat	22	37	carcass search	70-m cleared plot	intact	yes
08/29/2023	big brown bat	23	38	carcass search	70-m uncleared plot	scavenged	yes
08/29/2023	eastern red bat	65	21	carcass search	70-m cleared plot	scavenged	yes
08/29/2023	eastern red bat	43	28	carcass search	70-m cleared plot	dismembered	yes
08/29/2023	eastern red bat	21	3	carcass search	100-m road and pad	intact	no
08/29/2023	eastern red bat	40	32	carcass search	70-m uncleared plot	scavenged	yes
08/29/2023	hoary bat	35	21	carcass search	70-m cleared plot	scavenged	yes
08/29/2023	silver-haired bat	7	2	carcass search	100-m road and pad	scavenged	no
08/29/2023	silver-haired bat	47	21	carcass search	70-m cleared plot	scavenged	yes
08/29/2023	unidentified non- <i>Myotis</i>	8	38	carcass search	70-m uncleared plot	dismembered	yes
08/30/2023	eastern red bat	3	26	carcass search	100-m road and pad	scavenged	no
08/31/2023	eastern red bat	6	19	carcass search	70-m cleared plot	dismembered	yes
08/31/2023	eastern red bat	20	19	carcass search	70-m cleared plot	scavenged	yes
08/31/2023	silver-haired bat	27	14	carcass search	70-m cleared plot	intact	yes
08/31/2023	silver-haired bat	14	19	carcass search	70-m cleared plot	intact	yes
09/01/2023	big brown bat	44	42	carcass search	70-m uncleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
09/01/2023	big brown bat	1	46	carcass search	100-m road and pad	scavenged	no
09/01/2023	eastern red bat	56	22	carcass search	70-m cleared plot	scavenged	yes
09/01/2023	eastern red bat	57	22	carcass search	70-m cleared plot	scavenged	yes
09/01/2023	eastern red bat	12	23	carcass search	100-m road and pad	intact	no
09/01/2023	eastern red bat	6	3	carcass search	100-m road and pad	intact	no
09/01/2023	eastern red bat	30	38	carcass search	70-m uncleared plot	scavenged	yes
09/01/2023	eastern red bat	33	38	carcass search	70-m uncleared plot	scavenged	yes
09/01/2023	eastern red bat	13	5	carcass search	100-m road and pad	scavenged	no
09/01/2023	silver-haired bat	48	22	incidental	70-m cleared plot	scavenged	no
09/01/2023	silver-haired bat	26	33	carcass search	70-m cleared plot	intact	yes
09/01/2023	silver-haired bat	21	41	carcass search	100-m road and pad	intact	no
09/05/2023	Indiana bat	6	3	carcass search	100-m road and pad	scavenged	no
09/05/2023	big brown bat	30	11	carcass search	70-m cleared plot	dismembered	yes
09/05/2023	big brown bat	33	19	carcass search	70-m cleared plot	scavenged	yes
09/05/2023	big brown bat	47	20	carcass search	100-m road and pad	intact	no
09/05/2023	big brown bat	6	20	carcass search	100-m road and pad	scavenged	no
09/05/2023	big brown bat	28	29	carcass search	70-m uncleared plot	scavenged	yes
09/05/2023	big brown bat	20	33	carcass search	70-m cleared plot	scavenged	yes
09/05/2023	big brown bat	4	50	carcass search	70-m uncleared plot	intact	yes
09/05/2023	big brown bat	5	51	carcass search	100-m road and pad	scavenged	no
09/05/2023	big brown bat	41	6	carcass search	100-m road and pad	intact	no
09/05/2023	eastern red bat	19	29	carcass search	70-m uncleared plot	scavenged	yes
09/05/2023	eastern red bat	20	33	carcass search	70-m cleared plot	scavenged	yes
09/05/2023	eastern red bat	43	50	carcass search	70-m uncleared plot	scavenged	yes
09/05/2023	eastern red bat	9	50	carcass search	70-m uncleared plot	intact	yes
09/05/2023	hoary bat	59	19	carcass search	70-m cleared plot	dismembered	yes
09/05/2023	hoary bat	29	19	carcass search	70-m cleared plot	scavenged	yes
09/05/2023	silver-haired bat	46	14	carcass search	70-m cleared plot	intact	yes
09/05/2023	silver-haired bat	51	17	carcass search	100-m road and pad	scavenged	no
09/05/2023	silver-haired bat	9	18	carcass search	100-m road and pad	intact	no
09/05/2023	silver-haired bat	29	19	carcass search	70-m cleared plot	scavenged	yes
09/05/2023	silver-haired bat	2	20	carcass search	100-m road and pad	scavenged	no
09/05/2023	silver-haired bat	8	28	carcass search	70-m cleared plot	intact	yes
09/05/2023	silver-haired bat	12	29	carcass search	70-m uncleared plot	scavenged	yes
09/05/2023	silver-haired bat	55	3	carcass search	100-m road and pad	scavenged	no
09/05/2023	unidentified <i>Lasiurus</i> bat	4	49	carcass search	100-m road and pad	dismembered	no
09/06/2023	big brown bat	17	21	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
09/06/2023	big brown bat	59	22	carcass search	70-m cleared plot	dismembered	yes
09/06/2023	hoary bat	26	22	carcass search	70-m cleared plot	scavenged	yes
09/06/2023	silver-haired bat	8	21	carcass search	70-m cleared plot	scavenged	yes
09/06/2023	silver-haired bat	26	22	carcass search	70-m cleared plot	scavenged	yes
09/06/2023	silver-haired bat	27	22	carcass search	70-m cleared plot	scavenged	yes
09/06/2023	silver-haired bat	23	22	carcass search	70-m cleared plot	scavenged	yes
09/07/2023	big brown bat	21	19	carcass search	70-m cleared plot	scavenged	yes
09/07/2023	eastern red bat	58	19	carcass search	70-m cleared plot	scavenged	yes
09/07/2023	hoary bat	27	14	carcass search	70-m cleared plot	intact	yes
09/07/2023	hoary bat	39	19	carcass search	70-m cleared plot	scavenged	yes
09/07/2023	silver-haired bat	30	19	carcass search	70-m cleared plot	scavenged	yes
09/07/2023	silver-haired bat	35	19	carcass search	70-m cleared plot	scavenged	yes
09/08/2023	Seminole bat	66	34	carcass search	100-m road and pad	intact	no
09/08/2023	big brown bat	2	2	carcass search	100-m road and pad	scavenged	no
09/08/2023	big brown bat	9	25	carcass search	100-m road and pad	scavenged	no
09/08/2023	big brown bat	27	33	carcass search	70-m cleared plot	dismembered	yes
09/08/2023	big brown bat	24	37	carcass search	70-m cleared plot	dismembered	yes
09/08/2023	eastern red bat	6	12	carcass search	100-m road and pad	scavenged	no
09/08/2023	eastern red bat	29	29	carcass search	70-m uncleared plot	scavenged	yes
09/08/2023	eastern red bat	41	50	carcass search	70-m uncleared plot	scavenged	yes
09/08/2023	hoary bat	47	21	carcass search	70-m cleared plot	scavenged	yes
09/08/2023	hoary bat	5	42	carcass search	70-m uncleared plot	scavenged	yes
09/08/2023	silver-haired bat	39	33	carcass search	70-m cleared plot	dismembered	yes
09/08/2023	silver-haired bat	40	37	carcass search	70-m cleared plot	scavenged	yes
09/08/2023	silver-haired bat	24	38	carcass search	70-m uncleared plot	scavenged	yes
09/08/2023	silver-haired bat	30	38	carcass search	70-m uncleared plot	scavenged	yes
09/08/2023	silver-haired bat	43	42	carcass search	70-m uncleared plot	scavenged	yes
09/11/2023	eastern red bat	40	19	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	big brown bat	50	11	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	eastern red bat	51	11	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	hoary bat	21	22	carcass search	70-m cleared plot	intact	yes
09/12/2023	silver-haired bat	11	11	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	silver-haired bat	30	14	carcass search	70-m cleared plot	intact	yes
09/12/2023	silver-haired bat	38	14	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	silver-haired bat	28	38	carcass search	70-m uncleared plot	scavenged	yes
09/14/2023	eastern red bat	20	19	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	big brown bat	53	22	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
09/15/2023	big brown bat	45	33	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	eastern red bat	7	1	carcass search	100-m road and pad	scavenged	no
09/15/2023	eastern red bat	26	33	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	hoary bat	24	37	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	silver-haired bat	9	29	carcass search	70-m uncleared plot	scavenged	yes
09/15/2023	silver-haired bat	48	38	carcass search	70-m uncleared plot	scavenged	yes
09/19/2023	eastern red bat	41	22	carcass search	70-m cleared plot	intact	yes
09/19/2023	eastern red bat	29	36	carcass search**	100-m road and pad	intact	no
09/19/2023	silver-haired bat	29	22	carcass search	70-m cleared plot	intact	yes
09/19/2023	silver-haired bat	14	22	carcass search	70-m cleared plot	scavenged	yes
09/19/2023	silver-haired bat	3	32	carcass search	70-m uncleared plot	scavenged	yes
09/19/2023	silver-haired bat	53	37	carcass search	70-m cleared plot	scavenged	yes
09/20/2023	unidentified <i>Lasiurus</i> bat	5	37	incidental	70-m cleared plot	scavenged	yes
09/21/2023	eastern red bat	64	14	carcass search	70-m cleared plot	scavenged	yes
09/21/2023	silver-haired bat	6	20	carcass search	100-m road and pad	scavenged	no
09/22/2023	big brown bat	36	50	carcass search	70-m uncleared plot	scavenged	yes
09/22/2023	eastern red bat	30	50	carcass search	70-m uncleared plot	scavenged	yes
09/22/2023	hoary bat	40	37	carcass search	70-m cleared plot	scavenged	yes
09/22/2023	hoary bat	11	38	carcass search	70-m uncleared plot	scavenged	yes
09/22/2023	hoary bat	7	9	carcass search	100-m road and pad	scavenged	no
09/22/2023	silver-haired bat	53	33	carcass search	70-m cleared plot	scavenged	yes
09/22/2023	silver-haired bat	44	37	carcass search	70-m cleared plot	scavenged	yes
09/22/2023	silver-haired bat	1	41	carcass search	100-m road and pad	scavenged	no
09/22/2023	silver-haired bat	34	6	carcass search	100-m road and pad	intact	no
09/26/2023	big brown bat	57	11	carcass search	70-m cleared plot	scavenged	yes
09/26/2023	eastern red bat	50	14	carcass search	70-m cleared plot	scavenged	yes
09/26/2023	eastern red bat	37	19	carcass search	70-m cleared plot	scavenged	yes
09/26/2023	eastern red bat	33	20	carcass search	100-m road and pad	scavenged	no
09/26/2023	eastern red bat	11	43	carcass search	70-m uncleared plot	scavenged	yes
09/26/2023	hoary bat	30	14	carcass search	70-m cleared plot	intact	yes
09/26/2023	hoary bat	50	33	carcass search	70-m cleared plot	scavenged	yes
09/26/2023	silver-haired bat	11	11	carcass search	70-m cleared plot	scavenged	yes
09/26/2023	silver-haired bat	8	13	carcass search	100-m road and pad	scavenged	no
09/26/2023	silver-haired bat	43	19	carcass search	70-m cleared plot	scavenged	yes
09/26/2023	silver-haired bat	36	33	carcass search	70-m cleared plot	intact	yes
09/26/2023	silver-haired bat	20	43	carcass search	70-m uncleared plot	scavenged	yes
09/29/2023	big brown bat	20	22	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
09/29/2023	eastern red bat	44	14	carcass search	70-m cleared plot	scavenged	yes
09/29/2023	hoary bat	43	19	carcass search	70-m cleared plot	scavenged	yes
09/29/2023	hoary bat	11	44	carcass search	70-m uncleared plot	scavenged	yes
09/29/2023	silver-haired bat	39	22	carcass search	70-m cleared plot	scavenged	yes
09/29/2023	silver-haired bat	26	38	carcass search	70-m uncleared plot	scavenged	yes
09/29/2023	silver-haired bat	30	42	carcass search	70-m uncleared plot	scavenged	yes
10/03/2023	silver-haired bat	20	11	carcass search	70-m cleared plot	scavenged	yes
10/03/2023	silver-haired bat	6	40	carcass search	100-m road and pad	scavenged	no
10/03/2023	silver-haired bat	37	50	carcass search	70-m uncleared plot	scavenged	yes
10/03/2023	silver-haired bat	5	7	carcass search	100-m road and pad	scavenged	no
10/04/2023	silver-haired bat	28	38	carcass search	70-m uncleared plot	scavenged	yes
10/05/2023	eastern red bat	30	19	carcass search	70-m cleared plot	scavenged	yes
10/05/2023	silver-haired bat	0	17	carcass search	100-m road and pad	intact	no
10/06/2023	silver-haired bat	32	21	carcass search	70-m cleared plot	scavenged	yes
10/06/2023	silver-haired bat	65	21	carcass search	70-m cleared plot	scavenged	yes
10/06/2023	silver-haired bat	16	22	carcass search	70-m cleared plot	scavenged	yes
10/06/2023	silver-haired bat	18	28	carcass search	70-m cleared plot	scavenged	yes
10/06/2023	silver-haired bat	38	38	carcass search	70-m uncleared plot	scavenged	yes
10/06/2023	silver-haired bat	6	45	carcass search	100-m road and pad	scavenged	no
10/06/2023	silver-haired bat	7	7	carcass search	100-m road and pad	scavenged	no
10/09/2023	hoary bat	65	14	carcass search	70-m cleared plot	intact	yes
10/09/2023	silver-haired bat	63	14	carcass search	70-m cleared plot	intact	yes
10/09/2023	silver-haired bat	33	14	carcass search	70-m cleared plot	intact	yes
10/10/2023	eastern red bat	4	10	carcass search	100-m road and pad	scavenged	no
10/10/2023	eastern red bat	5	18	carcass search	100-m road and pad	intact	no
10/10/2023	evening bat	29	32	carcass search	70-m uncleared plot	scavenged	yes
10/10/2023	silver-haired bat	3	13	carcass search	100-m road and pad	intact	no
10/10/2023	silver-haired bat	32	2	carcass search	100-m road and pad	scavenged	no
10/10/2023	silver-haired bat	56	29	carcass search	70-m uncleared plot	intact	yes
10/10/2023	silver-haired bat	12	29	carcass search	70-m uncleared plot	intact	yes
10/10/2023	silver-haired bat	21	32	carcass search	70-m uncleared plot	scavenged	yes
10/11/2023	silver-haired bat	42	43	incidental	70-m uncleared plot	scavenged	no
10/12/2023	eastern red bat	40	11	carcass search	70-m cleared plot	scavenged	yes
10/13/2023	eastern red bat	6	26	carcass search	100-m road and pad	intact	no
10/13/2023	eastern red bat	18	38	carcass search	70-m uncleared plot	scavenged	yes
10/13/2023	eastern red bat	22	5	carcass search	100-m road and pad	scavenged	no
10/13/2023	evening bat	47	33	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
10/13/2023	silver-haired bat	30	21	carcass search	70-m cleared plot	scavenged	yes
10/13/2023	silver-haired bat	53	22	carcass search	70-m cleared plot	scavenged	yes
10/13/2023	silver-haired bat	51	38	carcass search	70-m uncleared plot	scavenged	yes
04/03/2023	golden-crowned kinglet	80	2	carcass search	100-m road and pad	intact	no
05/08/2023	Baltimore oriole	11	5	carcass search	100-m road and pad	intact	no
05/12/2023	European starling	41	11	incidental	70-m cleared plot	intact	yes
05/12/2023	European starling	33	14	incidental	70-m cleared plot	intact	yes
05/12/2023	red-tailed hawk	65	14	incidental**	70-m cleared plot	intact	yes
05/16/2023	red-tailed hawk	23	29	carcass search	70-m uncleared plot	feather spot	yes
05/16/2023	turkey vulture	40	29	carcass search	70-m uncleared plot	dismembered	yes
05/19/2023	horned lark	30	37	carcass search	70-m cleared plot	scavenged	yes
05/19/2023	unidentified passerine	5	52	carcass search	100-m road and pad	feather spot	no
05/23/2023	red-eyed vireo	62	14	carcass search	70-m cleared plot	scavenged	yes
05/23/2023	unidentified buteo	44	29	carcass search	70-m uncleared plot	dismembered	yes
05/25/2023	black-billed cuckoo	41	38	carcass search	70-m uncleared plot	dismembered	yes
05/25/2023	chimney swift	56	38	carcass search	70-m uncleared plot	scavenged	yes
05/25/2023	eastern screech-owl	98	42	carcass search**	70-m uncleared plot	dismembered	yes
05/31/2023	horned lark	17	22	carcass search	70-m cleared plot	intact	yes
05/31/2023	mourning dove	23	21	carcass search	70-m cleared plot	scavenged	yes
06/02/2023	house sparrow	38	50	carcass search	70-m uncleared plot	dismembered	yes
06/06/2023	unidentified sparrow	67	21	carcass search	70-m cleared plot	scavenged	yes
06/09/2023	house sparrow	35	50	carcass search	70-m uncleared plot	dismembered	yes
06/13/2023	chimney swift	12	19	carcass search	70-m cleared plot	intact	yes
06/19/2023	red-tailed hawk	74	32	carcass search**	70-m uncleared plot	scavenged	yes
06/22/2023	red-tailed hawk	54	44	carcass search	70-m uncleared plot	scavenged	yes
07/07/2023	horned lark	39	33	carcass search	70-m cleared plot	intact	yes
07/10/2023	red-tailed hawk	45	29	carcass search	70-m uncleared plot	dismembered	yes
07/11/2023	brown-headed cowbird	38	38	incidental	70-m uncleared plot	scavenged	yes
07/11/2023	horned lark	42	22	carcass search	70-m cleared plot	scavenged	yes
07/14/2023	horned lark	47	33	carcass search	70-m cleared plot	scavenged	yes
07/19/2023	red-tailed hawk	51	28	incidental	70-m cleared plot	scavenged	no
07/20/2023	horned lark	21	28	carcass search	70-m cleared plot	scavenged	yes
07/24/2023	European starling	24	32	carcass search	70-m uncleared plot	scavenged	yes
07/24/2023	horned lark	44	14	carcass search	70-m cleared plot	scavenged	yes
07/25/2023	mourning dove	5	31	carcass search	100-m road and pad	dismembered	no
07/25/2023	turkey vulture	35	22	carcass search	70-m cleared plot	scavenged	yes
07/27/2023	horned lark	59	28	carcass search	70-m cleared plot	dismembered	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
07/28/2023	mourning dove	0	33	carcass search	70-m cleared plot	scavenged	yes
08/02/2023	killdeer	40	22	carcass search	70-m cleared plot	scavenged	yes
08/02/2023	killdeer	46	41	carcass search	100-m road and pad	scavenged	no
08/07/2023	horned lark	36	11	carcass search	70-m cleared plot	scavenged	yes
08/16/2023	horned lark	48	28	carcass search	70-m cleared plot	scavenged	yes
08/17/2023	killdeer	8	14	carcass search	70-m cleared plot	dismembered	yes
08/25/2023	turkey vulture	16	46	carcass search	100-m road and pad	intact	no
08/29/2023	horned lark	50	22	carcass search	70-m cleared plot	scavenged	yes
08/29/2023	red-eyed vireo	28	50	carcass search	70-m uncleared plot	scavenged	yes
08/31/2023	horned lark	35	19	carcass search	70-m cleared plot	scavenged	yes
08/31/2023	horned lark	50	19	carcass search	70-m cleared plot	scavenged	yes
08/31/2023	horned lark	68	19	carcass search	70-m cleared plot	feather spot	yes
09/01/2023	horned lark	33	22	incidental	70-m cleared plot	scavenged	yes
09/01/2023	killdeer	59	21	carcass search	70-m cleared plot	intact	yes
09/01/2023	pine warbler	63	36	carcass search	100-m road and pad	scavenged	no
09/05/2023	turkey vulture	18	29	carcass search	70-m uncleared plot	scavenged	yes
09/08/2023	Tennessee warbler	68	46	carcass search	100-m road and pad	scavenged	no
09/08/2023	horned lark	32	33	carcass search	70-m cleared plot	scavenged	yes
09/11/2023	horned lark	44	19	carcass search	70-m cleared plot	scavenged	yes
09/11/2023	red-tailed hawk	39	33	incidental	70-m cleared plot	dismembered	no
09/12/2023	horned lark	17	14	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	horned lark	14	14	carcass search	70-m cleared plot	scavenged	yes
09/12/2023	red-eyed vireo	40	38	carcass search	70-m uncleared plot	scavenged	yes
09/14/2023	horned lark	15	19	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	horned lark	53	21	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	horned lark	19	22	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	horned lark	57	22	carcass search	70-m cleared plot	scavenged	yes
09/15/2023	pine warbler	18	28	carcass search	70-m cleared plot	scavenged	yes
09/19/2023	Tennessee warbler	2	25	carcass search	100-m road and pad	scavenged	no
09/19/2023	Tennessee warbler	25	33	carcass search	70-m cleared plot	scavenged	yes
09/19/2023	red-eyed vireo	7	40	carcass search	100-m road and pad	intact	no
09/19/2023	red-tailed hawk	3	30	carcass search	100-m road and pad	scavenged	no
09/21/2023	horned lark	15	14	carcass search	70-m cleared plot	scavenged	yes
09/21/2023	horned lark	54	14	carcass search	70-m cleared plot	scavenged	yes
09/22/2023	horned lark	59	28	carcass search	70-m cleared plot	scavenged	yes
09/27/2023	European starling	13	21	carcass search	70-m cleared plot	scavenged	yes
09/29/2023	brown-headed cowbird	1	11	carcass search	70-m cleared plot	scavenged	yes

Appendix A. Carcasses found at the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Search Area Type	Physical Condition	Detection-Dog Search
09/29/2023	horned lark	27	19	carcass search	70-m cleared plot	scavenged	yes
09/29/2023	horned lark	44	19	carcass search	70-m cleared plot	scavenged	yes
09/29/2023	horned lark	53	33	carcass search	70-m cleared plot	scavenged	yes
10/03/2023	horned lark	50	15	carcass search	100-m road and pad	scavenged	no
10/03/2023	horned lark	16	33	carcass search	70-m cleared plot	scavenged	yes
10/03/2023	red-eyed vireo	36	14	carcass search	70-m cleared plot	scavenged	yes
10/06/2023	red-tailed hawk	36	42	carcass search	70-m uncleared plot	intact	yes

** Carcass was found outside the search area.

m = meters.

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**Appendix B. Truncated Weighted Likelihood Area Adjustment Estimate Model
Fitting Results**

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Appendix B1. Search area adjustment models for bats from the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Distribution	AICc	Delta AICc
Gompertz	27,762.04	0*
normal	26,930.33	168.29
Weibull	21,111.95	349.91
gamma	27,635.85	873.81

* Selected model.

AICc = Corrected Akaike Information Criterion.

Delta AICc = Change in AICc.

Appendix B2. Truncated weighted maximum likelihood search area estimates for the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Size Class	Search Area Type	Distribution	Parameter 1	Parameter 2	Area Adjustment
Bat	70-m dog aided plot	Gompertz	0.0604	0.0030	0.92
	100-m road and pad plot	Gompertz	0.0604	0.0030	0.05

m = meters.

n = 325 bats.

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

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Appendix C1. Inputs needed to run Evidence of Absence (EoA): Single Class Module for the Bitter Ridge Wind Farm, Jay County, Indiana, from April 1 – October 15, 2023.

Season	Plot Type	Search Interval (I)	Number of Searches**	Spatial Coverage (a)	Searcher Efficiency		Carcass Persistence*	
					Carcasses Available	Carcasses Found	Shape (α)	Scale (β)
spring	100-m road and pad plot	7	6	0.05	60	50	1.95	2.84
summer	100-m road and pad plot	7	11	0.05	60	50	1.95	2.32
summer	70-m cleared plot	7	11	0.92	39	35	0.7	17.0
summer	70-m uncleared plot	7	11	0.92	39	35	0.7	17.0
fall	100-m road and pad plot	3.5	21	0.05	60	50	1.95	1.32
fall	70-m cleared plot	3.5	21	0.92	37	24	0.7	16.9
fall	70-m uncleared plot	3.5	21	0.92	37	24	0.7	16.9

* A loglogistic distribution was used for carcass persistence distribution.

** This shows the actual number of searches. If using the EoA Graphical User Interface, it is necessary to add a search to each of the values because the EoA Graphical User Interface automatically subtracts one search as a clearing search.

m = meters.

Appendix C2. Inputs needed to run Evidence of Absence to combine across plot types within seasons: Multiple Class Module for the Bitter Ridge Wind Farm, Jay County, Indiana, from 2023.

Season	Plot Type	Ba	Bb	Within-season Sampling Fraction (DWP)
spring	100-m road and pad plot	157.9	3801.41	1.00
summer	100-m road and pad plot	68.61	1854.17	0.59
summer	70-m cleared plot	119.16	69.42	0.22
summer	70-m uncleared plot	119.16	69.42	0.19
fall	100-m road and pad plot	62.08	1822.22	0.71
fall	70-m cleared plot	66.59	41.33	0.15
fall	70-m uncleared plot	66.59	41.33	0.13

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.

DWP = density-weighted proportion.

Appendix C3. Inputs needed to run the Evidence of Absence to combine across seasons: Multiple Class Module for the Bitter Ridge Wind Farm, Jay County, Indiana, from 2023.

Season	Ba	Bb	Arrival Proportions (DWP)
Spring (April 1 – May 15)	157.898	1,485.57	0.07
Summer (May 16 – July 30)	516.447	1,345.408	0.36
Fall (August 1 – October 15)	326.326	1,293.769	0.57

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

DWP = density-weighted proportion.

Appendix C4. Inputs needed to run the Evidence of Absence: Multiple Years Module for the Bitter Ridge Wind Farm, Jay County, Indiana, from 2023.

Year	Ba	Bb	Weights (ρ)
2021	1559.98	3145.32	0.76
2022	1613.628	4226.04	1
2023	800.248	2879.711	1

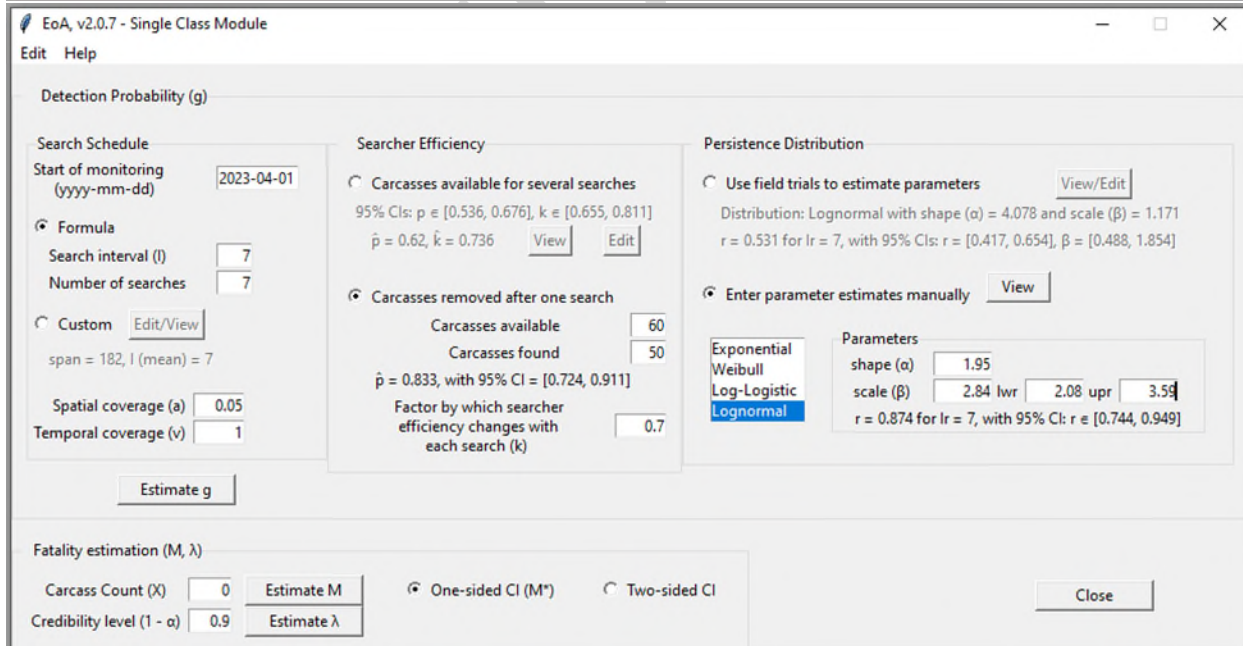
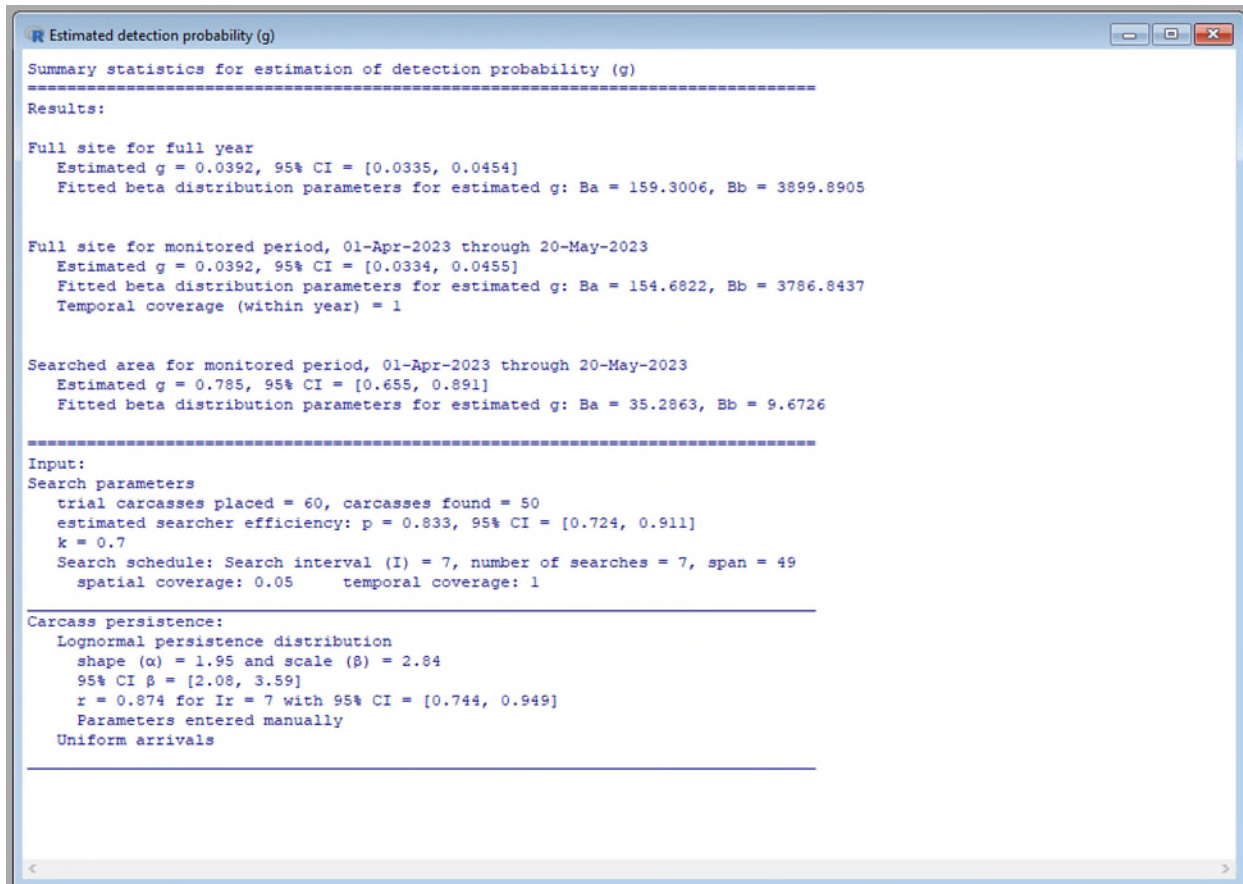
Ba and Bb are the parameters for the beta distribution used to characterize the probability of detection. The g value is the mean of that distribution.

$\rho = \text{rho}$.

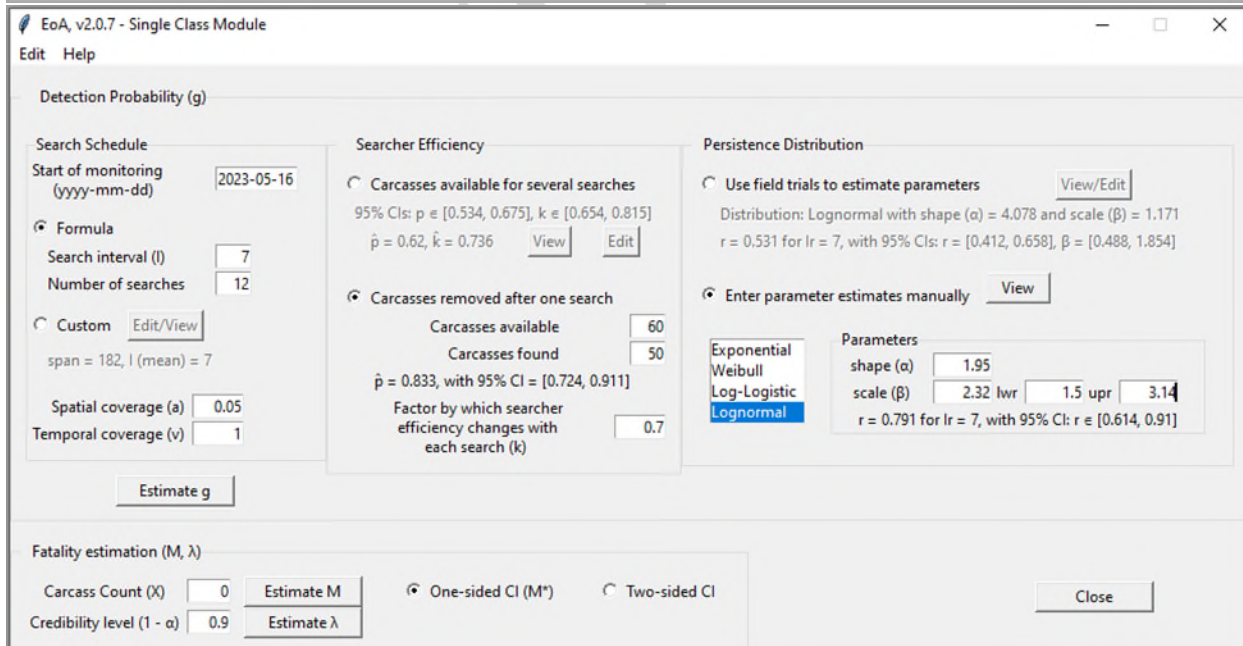
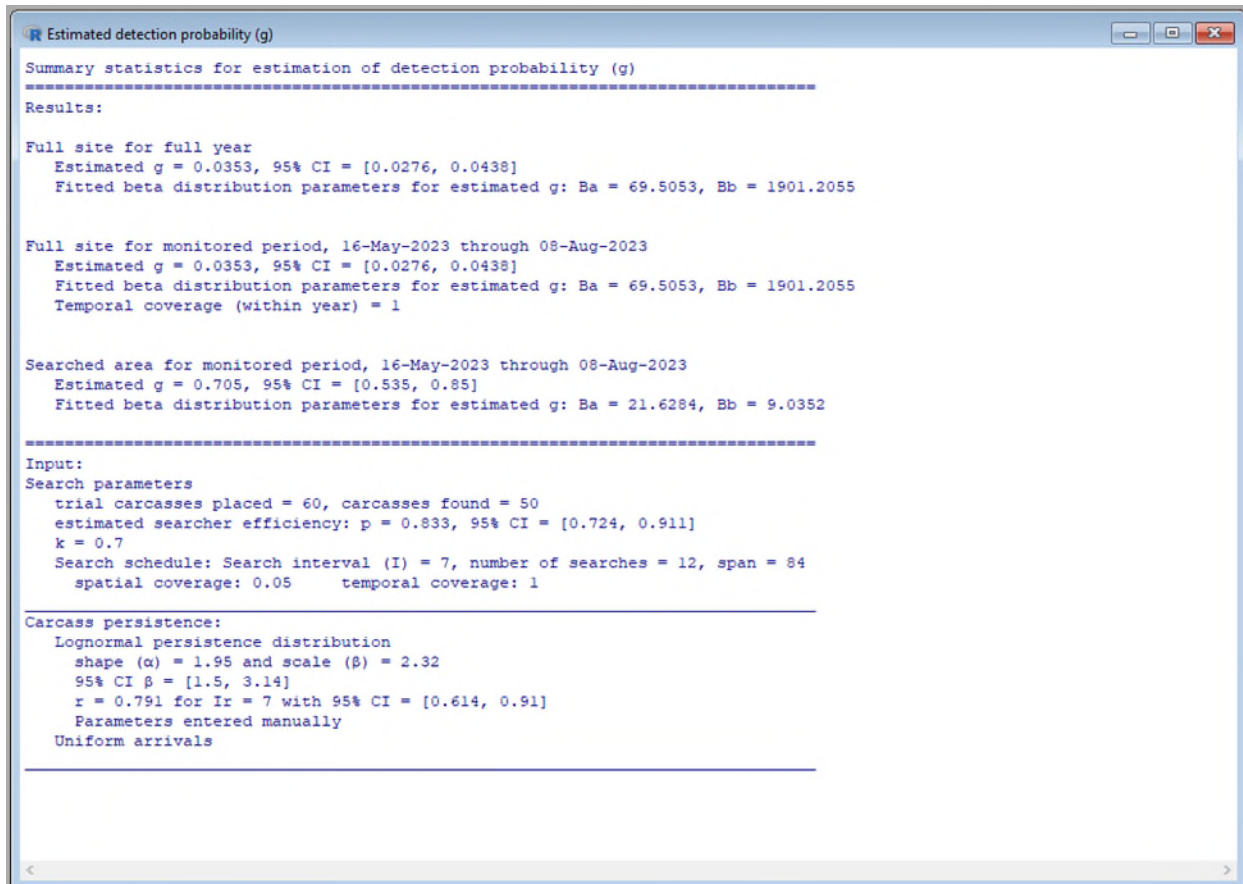
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Appendix D. Screenshots of Inputs for Single Class and Multiple Class Modules in Evidence of Absence

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Appendix D1. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Spring 2023, for 100-meter road and pad plots at a 7-day search interval.



Appendix D2. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Summer 2023, for 100-meter road and pad plots at a 7-day search interval.

EoA, v2.0.7 - Single Class Module

Edit Help

Detection Probability (g)

Search Schedule
 Start of monitoring (yyyy-mm-dd)
 Formula
 Search interval (I)
 Number of searches
 Custom
 span = 182, l (mean) = 7
 Spatial coverage (a)
 Temporal coverage (v)

Searcher Efficiency
 Carcasses available for several searches
 95% CIs: $p \in [0.536, 0.676]$, $k \in [0.655, 0.811]$
 $\hat{p} = 0.62$, $\hat{k} = 0.736$
 Carcasses removed after one search
 Carcasses available
 Carcasses found
 $\hat{p} = 0.897$, with 95% CI = [0.774, 0.964]
 Factor by which searcher efficiency changes with each search (k)

Persistence Distribution
 Use field trials to estimate parameters
 Distribution: Lognormal with shape (α) = 4.078 and scale (β) = 1.171
 $r = 0.531$ for $l_r = 7$, with 95% CIs: $r = [0.403, 0.653]$, $\beta = [0.488, 1.854]$
 Enter parameter estimates manually
 Parameters
 shape (α)
 scale (β) lwr upr
 $r = 0.736$ for $l_r = 7$, with 95% CI: $r \in [0.666, 0.794]$

Fatality estimation (M, λ)
 Carcass Count (X) One-sided CI (M*) Two-sided CI
 Credibility level (1 - α)

Estimated detection probability (g)

Summary statistics for estimation of detection probability (g)

Results:

Full site for full year
 Estimated $g = 0.636$, 95% CI = [0.567, 0.702]
 Fitted beta distribution parameters for estimated g : $B_a = 124.3618$, $B_b = 71.2288$

Full site for monitored period, 16-May-2023 through 08-Aug-2023
 Estimated $g = 0.636$, 95% CI = [0.567, 0.702]
 Fitted beta distribution parameters for estimated g : $B_a = 124.3618$, $B_b = 71.2288$
 Temporal coverage (within year) = 1

Searched area for monitored period, 16-May-2023 through 08-Aug-2023
 Estimated $g = 0.691$, 95% CI = [0.616, 0.762]
 Fitted beta distribution parameters for estimated g : $B_a = 105.2644$, $B_b = 47.0457$

Input:

Search parameters
 trial carcasses placed = 39, carcasses found = 35
 estimated searcher efficiency: $p = 0.897$, 95% CI = [0.774, 0.964]
 $k = 0.7$
 Search schedule: Search interval (I) = 7, number of searches = 12, span = 84
 spatial coverage: 0.92 temporal coverage: 1

Carcass persistence:
 Weibull persistence distribution
 shape (α) = 0.7 and scale (β) = 16.91
 95% CI $\beta = [11.14, 25.66]$
 $r = 0.736$ for $l_r = 7$ with 95% CI = [0.666, 0.794]
 Parameters entered manually
 Uniform arrivals

Appendix D3. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Summer 2023, for 70-meter cleared dog-aided plots 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)

Formula

Search interval (I)

Number of searches

Custom

span = 182, l (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

Searcher Efficiency

Carcasses available for several searches

95% CIs: $p \in [0.536, 0.676]$, $k \in [0.655, 0.811]$

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

Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.897$, with 95% CI = [0.774, 0.964]

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

Persistence Distribution

Use field trials to estimate parameters

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

$r = 0.531$ for $l_r = 7$, with 95% CIs: $r \in [0.403, 0.653]$, $\beta \in [0.488, 1.854]$

Enter parameter estimates manually

Parameters

shape (α)

scale (β) lwr upr

$r = 0.736$ for $l_r = 7$, with 95% CI: $r \in [0.666, 0.794]$

Fatality estimation (M, λ)

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

Credibility level (1 - α)

Estimated detection probability (g)

Summary statistics for estimation of detection probability (g)

Results:

Full site for full year

Estimated $g = 0.636$, 95% CI = [0.568, 0.702]

Fitted beta distribution parameters for estimated g : $B_a = 124.4391$, $B_b = 71.1729$

Full site for monitored period, 16-May-2023 through 08-Aug-2023

Estimated $g = 0.636$, 95% CI = [0.568, 0.702]

Fitted beta distribution parameters for estimated g : $B_a = 124.4391$, $B_b = 71.1729$

Temporal coverage (within year) = 1

Searched area for monitored period, 16-May-2023 through 08-Aug-2023

Estimated $g = 0.691$, 95% CI = [0.616, 0.762]

Fitted beta distribution parameters for estimated g : $B_a = 105.3194$, $B_b = 46.9923$

Input:

Search parameters

trial carcasses placed = 39, carcasses found = 35

estimated searcher efficiency: $p = 0.897$, 95% CI = [0.774, 0.964]

$k = 0.7$

Search schedule: Search interval (I) = 7, number of searches = 12, span = 84

spatial coverage: 0.92 temporal coverage: 1

Carcass persistence:

Weibull persistence distribution

shape (α) = 0.7 and scale (β) = 16.91

95% CI β = [11.14, 25.66]

$r = 0.736$ for $l_r = 7$ with 95% CI = [0.666, 0.794]

Parameters entered manually

Uniform arrivals

Appendix D4. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Summer 2023, for 70-meter uncleared dog-aided plots at a 7-day search interval.

EoA, v2.0.7 - Single Class Module

Edit Help

Detection Probability (g)

Search Schedule

Start of monitoring (yyyy-mm-dd)

Formula

Search interval (I)

Number of searches

Custom

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

Searcher Efficiency

Carcasses available for several searches

95% CIs: $p \in [0.534, 0.675]$, $k \in [0.654, 0.815]$

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

Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.833$, with 95% CI = [0.724, 0.911]

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

Persistence Distribution

Use field trials to estimate parameters

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

$r = 0.653$ for $lr = 3.5$, with 95% CIs: $r = [0.533, 0.779]$, $\beta = [0.488, 1.854]$

Enter parameter estimates manually

Parameters

shape (α)

scale (β) lwr upr

$r = 0.73$ for $lr = 3.5$, with 95% CI: $r \in [0.559, 0.861]$

Fatality estimation (M, λ)

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

Credibility level (1 - α)

Estimated detection probability (g)

Summary statistics for estimation of detection probability (g)

Results:

Full site for full year

Estimated $g = 0.0324$, 95% CI = [0.0248, 0.0409]

Fitted beta distribution parameters for estimated g : $Ba = 60.0154$, $Bb = 1792.4401$

Full site for monitored period, 01-Aug-2023 through 17-Oct-2023

Estimated $g = 0.0324$, 95% CI = [0.0248, 0.0409]

Fitted beta distribution parameters for estimated g : $Ba = 60.0154$, $Bb = 1792.4401$

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Aug-2023 through 17-Oct-2023

Estimated $g = 0.648$, 95% CI = [0.483, 0.796]

Fitted beta distribution parameters for estimated g : $Ba = 22.1349$, $Bb = 12.0274$

Input:

Search parameters

trial carcasses placed = 60, carcasses found = 50

estimated searcher efficiency: $p = 0.833$, 95% CI = [0.724, 0.911]

$k = 0.7$

Search schedule: Search interval (I) = 3.5, number of searches = 22, span = 77

spatial coverage: 0.05 temporal coverage: 1

Carcass persistence:

Lognormal persistence distribution

shape (α) = 1.95 and scale (β) = 1.32

95% CI $\beta = [0.58, 2.05]$

$r = 0.73$ for $lr = 3.5$ with 95% CI = [0.559, 0.861]

Parameters entered manually

Uniform arrivals

Appendix D5. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Fall 2023, for 100-meter road and pad searches at a 3.5-day search interval.

EoA, v2.0.7 - Single Class Module

Edit Help

Detection Probability (g)

Search Schedule

Start of monitoring (yyyy-mm-dd)

Formula

Search interval (I)

Number of searches

Custom

span = 182, I (mean) = 7

Spatial coverage (a)

Temporal coverage (v)

Searcher Efficiency

Carcasses available for several searches

95% CI: $p \in [0.536, 0.676]$, $k \in [0.655, 0.811]$

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

Carcasses removed after one search

Carcasses available

Carcasses found

$\hat{p} = 0.649$, with 95% CI = [0.488, 0.787]

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

Persistence Distribution

Use field trials to estimate parameters

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

$r = 0.653$ for $lr = 3.5$, with 95% CI: $r = [0.527, 0.769]$, $\beta = [0.488, 1.854]$

Enter parameter estimates manually

Parameters

shape (α)

scale (β) lwr upr

$r = 0.826$ for $lr = 3.5$, with 95% CI: $r \in [0.775, 0.866]$

Fatality estimation (M, λ)

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

Credibility level (1 - α)

Estimated detection probability (g)

Summary statistics for estimation of detection probability (g)

Results:

Full site for full year

Estimated $g = 0.622$, 95% CI = [0.528, 0.712]

Fitted beta distribution parameters for estimated g : $Ba = 65.0744$, $Bb = 39.4899$

Full site for monitored period, 01-Aug-2023 through 17-Oct-2023

Estimated $g = 0.622$, 95% CI = [0.528, 0.712]

Fitted beta distribution parameters for estimated g : $Ba = 65.0744$, $Bb = 39.4899$

Temporal coverage (within year) = 1

Searched area for monitored period, 01-Aug-2023 through 17-Oct-2023

Estimated $g = 0.676$, 95% CI = [0.572, 0.773]

Fitted beta distribution parameters for estimated g : $Ba = 55.6463$, $Bb = 26.6147$

Input:

Search parameters

trial carcasses placed = 37, carcasses found = 24

estimated searcher efficiency: $p = 0.649$, 95% CI = [0.488, 0.787]

$k = 0.7$

Search schedule: Search interval (I) = 3.5, number of searches = 22, span = 77

spatial coverage: 0.92 temporal coverage: 1

Carcass persistence:

Weibull persistence distribution

shape (α) = 0.7 and scale (β) = 16.91

95% CI $\beta = [11.14, 25.66]$

$r = 0.826$ for $lr = 3.5$ with 95% CI = [0.775, 0.866]

Parameters entered manually

Uniform arrivals

Appendix D6. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Fall 2023, for 70-meter cleared dog-aided plots at a 3.5-day search interval.

EoA, v2.0.7 - Single Class Module

Edit Help

Detection Probability (g)

Search Schedule
 Start of monitoring (yyyy-mm-dd)
 Formula
 Search interval (I)
 Number of searches
 Custom
 span = 182, l (mean) = 7
 Spatial coverage (a)
 Temporal coverage (v)

Searcher Efficiency
 Carcasses available for several searches
 95% CIs: $p \in [0.536, 0.676]$, $k \in [0.655, 0.811]$
 $\hat{p} = 0.62$, $\hat{k} = 0.736$
 Carcasses removed after one search
 Carcasses available
 Carcasses found
 $\hat{p} = 0.649$, with 95% CI = [0.488, 0.787]
 Factor by which searcher efficiency changes with each search (k)

Persistence Distribution
 Use field trials to estimate parameters
 Distribution: Lognormal with shape (α) = 4.078 and scale (β) = 1.171
 $r = 0.653$ for $l_r = 3.5$, with 95% CIs: $r = [0.542, 0.774]$, $\beta = [0.488, 1.854]$
 Enter parameter estimates manually
 Parameters:
 shape (α)
 scale (β) lwr upr
 $r = 0.826$ for $l_r = 3.5$, with 95% CI: $r \in [0.775, 0.866]$

Fatality estimation (M, λ)
 Carcass Count (X) One-sided CI (M*) Two-sided CI
 Credibility level (1 - α)

Estimated detection probability (g)

Summary statistics for estimation of detection probability (g)

Results:

Full site for full year
 Estimated g = 0.624, 95% CI = [0.527, 0.715]
 Fitted beta distribution parameters for estimated g: Ba = 62.6001, Bb = 37.7755

Full site for monitored period, 01-Aug-2023 through 17-Oct-2023
 Estimated g = 0.624, 95% CI = [0.527, 0.715]
 Fitted beta distribution parameters for estimated g: Ba = 62.6001, Bb = 37.7755
 Temporal coverage (within year) = 1

Searched area for monitored period, 01-Aug-2023 through 17-Oct-2023
 Estimated g = 0.678, 95% CI = [0.572, 0.776]
 Fitted beta distribution parameters for estimated g: Ba = 53.5449, Bb = 25.4424

Input:

Search parameters
 trial carcasses placed = 37, carcasses found = 24
 estimated searcher efficiency: $p = 0.649$, 95% CI = [0.488, 0.787]
 $k = 0.7$
 Search schedule: Search interval (I) = 3.5, number of searches = 22, span = 77
 spatial coverage: 0.92 temporal coverage: 1

Carcass persistence:
 Weibull persistence distribution
 shape (α) = 0.7 and scale (β) = 16.91
 95% CI $\beta = [11.14, 25.66]$
 $r = 0.826$ for $l_r = 3.5$ with 95% CI = [0.775, 0.866]
 Parameters entered manually
 Uniform arrivals

Appendix D7. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Single Class Module inputs for Fall 2023, for 70-meter uncleared dog-aided plots at a 3.5-day search interval.

EoA, v2.0.7 - Multiple Class Module

Edit Help

Options

Overall

Estimate total mortality (M)

Credibility level (1 - α)

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	0.07	0	157.898	3801.405	0.03988	[0.034, 0.0462]
summer	0.36	0	516.447	1345.408	0.2774	[0.257, 0.298]
fall	0.57	0	326.326	1293.764	0.2014	[0.182, 0.221]

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	0.07	0	157.9	3801	0.040	[0.034, 0.046]
summer	0.36	0	516.4	1345	0.277	[0.257, 0.298]
fall	0.57	0	326.3	1294	0.201	[0.182, 0.221]

Results for full site

Detection probability

Estimated g = 0.217, 95% CI = [0.204, 0.231]

Fitted beta distribution parameters for estimated g: Ba = 800.2486, Bb = 2879.7119

Mortality

Test of assumed relative weights (rho)

Class	Assumed	Fitted (95% CI)
unsearched	0.000	NA
spring	0.070	[0.012, 0.993]
summer	0.360	[0.001, 0.785]
fall	0.570	[0.000, 0.895]

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

Appendix D8. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Class Module inputs and output for Spring, Summer, and Fall 2023 (n=52 in spring and fall, and 22 in summer), searched at a 7-day interval in the spring and summer, and a 3.5-day interval in the fall.

EoA, v2.0.7 - Multiple Years Module

Edit Help

Past monitoring and operations data

Year	ρ	X	Ba	Bb	\hat{g}	95% CI
2021	0.76	2	1559.98	3145.32	0.3315	[0.318, 0.345]
2022	1	3	1613.63	4226.04	0.2763	[0.265, 0.288]
2023	1	2	800.248	2879.711	0.2175	[0.204, 0.231]

Options

Fatalities

Estimate M Credibility level (1 - α) 0.5

Total mortality One-sided CI (M*)

Two-sided CI

Project parameters

Total years in project 30

Mortality threshold (T) 359

Track past mortality

Projection of future mortality and estimates

Future monitoring and operations

g and ρ unchanged from most recent year

g and ρ constant, different from most recent year

g 0.08 95% CI: 0.07 0.09 ρ 1

g and ρ vary among future years

Average Rate

Estimate average annual fatality rate (λ)

Annual rate threshold (τ) 1.95

Credibility level for CI (1- α) 1e-5

Short-term rate ($\lambda > \tau$) Term: 3 α 0.05

Reversion test ($\lambda < \rho \tau$) ρ 0.6 α 0.1

Actions

Calculate Close

Short-term Trigger

Short-term trigger: Test of average fatality rate (λ) over 3 years

Years: 2021 - 2023

Results

Estimated overall detection probability: $g = 0.27$, 95% CI = [0.263, 0.278]

Ba = 3769.5, Bb = 10181

Estimated annual fatality rate over the past 3 years: $\lambda = 9.254$, 95% CI = [3.86, 17]

$P(\lambda > 1.95) = 0.9994$

Exceedance: $\lambda > 1.95$ with 95% credibility

Input

Threshold for short-term rate (τ) = 1.95 per year

Period	rel_wt	X	Ba	Bb	ghat	95% CI
2021	0.760	2	1560	3145	0.332	[0.318, 0.345]
2022	1.000	3	1614	4226	0.276	[0.265, 0.288]
2023	1.000	2	800.2	2880	0.217	[0.204, 0.231]

Appendix D9. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Year Module for Indiana bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text.

EoA, v2.0.7 - Multiple Years Module

Edit Help

Past monitoring and operations data

Year	ρ	X	Ba	Bb	\hat{g}	95% CI
2021	0.76	2	1559.98	3145.32	0.3315	[0.318, 0.345]
2022	1	3	1613.63	4226.04	0.2763	[0.265, 0.288]
2023	1	2	800.248	2879.711	0.2175	[0.204, 0.231]

Options

Fatalities

Estimate M Credibility level (1 - α) 0.5

Total mortality One-sided CI (M*)

Two-sided CI

Project parameters

Total years in project 30

Mortality threshold (τ) 6

Track past mortality

Projection of future mortality and estimates

Future monitoring and operations

g and ρ unchanged from most recent year

g and ρ constant, different from most recent year

g 0.08 95% CI: 0.07 0.09 ρ 1

g and ρ vary among future years

Average Rate

Estimate average annual fatality rate (λ)

Annual rate threshold (τ) 1.95

Credibility level for CI (1 - α) 1e-5

Short-term rate ($\lambda > \tau$) Term: 3 α 0.05

Reversion test ($\lambda < \rho \tau$) ρ 0.6 α 0.1

Actions

Calculate Close

Mortality over 3 years

Summary statistics for mortality estimates through 3 years

Results

$M^* = 26$ for $1 - \alpha = 0.5$, i.e., $P(M \leq 26) \geq 50\%$
 Estimated overall detection probability: $g = 0.27$, 95% CI = [0.263, 0.278]
 $Ba = 3769.5$, $Bb = 10181$
 Estimated baseline fatality rate (for $\rho = 1$): $\lambda = 10.06$, 95% CI = [4.2, 18.4]

Cumulative Mortality Estimates

Year	X	g	M^*	median	95% CI	mean	95% CI
2021	2	0.332	6	6	[2, 15]	7.545	[1.254, 19.37]
2022	5	0.300	17	17	[8, 32]	18.33	[6.355, 36.54]
2023	7	0.270	26	26	[14, 47]	27.76	[11.59, 50.9]

Annual Mortality Estimates

Year	X	g	M^*	median	95% CI	mean	95% CI
2021	2	0.332	6	6	[2, 15]	7.5450	[1.2540, 19.3700]
2022	3	0.276	11	11	[4, 24]	12.6700	[3.0570, 29.0100]
2023	2	0.217	10	10	[3, 26]	11.5100	[1.9110, 29.5800]

Test of assumed relative weights (ρ) and potential bias

Fitted ρ

Assumed ρ	95% CI
0.76	[0.123, 1.557]
1	[0.351, 2.054]
1	[0.205, 1.926]

$p = 0.9414$ for likelihood ratio test of H_0 : assumed $\rho =$ true ρ
 Quick test of relative bias: 0.993

Input

Year (or period)	ρ	X	Ba	Bb	\hat{g}	95% CI
2021	0.760	2	1560	3145	0.332	[0.318, 0.345]
2022	1.000	3	1614	4226	0.276	[0.265, 0.288]

Appendix D10. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Year Module for Indiana bat Incidental Take Permit term-to-date detection probability and cumulative take estimate (M^*). Inputs are based on values reported in the main text.

EoA, v2.0.7 - Multiple Years Module

Edit Help

Past monitoring and operations data

Year	ρ	X	Ba	Bb	\hat{g}	95% CI
2021	0.76	0	1559.98	3145.32	0.3315	[0.318, 0.345]
2022	1	0	1613.63	4226.04	0.2763	[0.265, 0.288]
2023	1	0	800.248	2879.711	0.2175	[0.204, 0.231]

Options

Fatalities

Estimate M Credibility level (1 - α)

Total mortality One-sided CI (M*)

Two-sided CI

Project parameters

Total years in project

Mortality threshold (T)

Track past mortality

Projection of future mortality and estimates

Future monitoring and operations

g and ρ unchanged from most recent year

g and ρ constant, different from most recent year

g 95% CI: ρ

g and ρ vary among future years

Average Rate

Estimate average annual fatality rate (λ)

Annual rate threshold (τ)

Credibility level for CI (1 - α)

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

Reversion test ($\lambda < \rho \tau$) ρ α

Actions

Short-term Trigger

Short-term trigger: Test of average fatality rate (λ) over 3 years

Years: 2021 - 2023

=====

Results

Estimated overall detection probability: $g = 0.27$, 95% CI = [0.263, 0.278]

Ba = 3769.5, Bb = 10181

Estimated annual fatality rate over the past 3 years: $\lambda = 0.6169$, 95% CI = [0.000612, 3.1]

$P(\lambda > 1.27) = 0.1514$

Compliance: Cannot infer $\lambda > 1.27$ with 95% credibility

Input

Threshold for short-term rate (τ) = 1.27 per year

Period	rel_wt	X	Ba	Bb	ghat	95% CI
2021	0.760	0	1560	3145	0.332	[0.318, 0.345]
2022	1.000	0	1614	4226	0.276	[0.265, 0.288]
2023	1.000	0	800.2	2880	0.217	[0.204, 0.231]

Appendix D11. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Year Module for northern long-eared bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text.

EoA, v2.0.7 - Multiple Years Module

Edit Help

Past monitoring and operations data

Year	ρ	X	Ba	Bb	\hat{g}	95% CI
2021	0.76	0	1559.98	3145.32	0.3315	[0.318, 0.345]
2022	1	0	1613.63	4226.04	0.2763	[0.265, 0.288]
2023	1	0	800.248	2879.711	0.2175	[0.204, 0.231]

Options

Fatalities

Estimate M Credibility level (1 - α) 0.5

Total mortality One-sided CI (M*)

Two-sided CI

Project parameters

Total years in project 30

Mortality threshold (T) 4

Track past mortality

Projection of future mortality and estimates

Future monitoring and operations

g and ρ unchanged from most recent year

g and ρ constant, different from most recent year

g 0.08 95% CI: 0.07 0.09 ρ 1

g and ρ vary among future years

Average Rate

Estimate average annual fatality rate (λ)

Annual rate threshold (τ) 1.95

Credibility level for CI (1 - α) 1e-5

Short-term rate ($\lambda > \tau$) Term: 3 α 0.05

Reversion test ($\lambda < \rho \tau$) ρ 0.6 α 0.1

Actions

Calculate Close

Mortality over 3 years

Results

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

Estimated overall detection probability: $g = 0.27$, 95% CI = [0.263, 0.278]

Ba = 3769.5, Bb = 10181

Estimated baseline fatality rate (for $\rho = 1$): $\lambda = 0.6705$, 95% CI = [0.000666, 3.37]

Cumulative Mortality Estimates

Year	X	g	M*	median	95% CI	mean	95% CI
2021	0	0.332	0	0	[0, 4]	1.509	[0.001486, 7.582]
2022	0	0.300	0	0	[0, 5]	1.666	[0.00164, 8.371]
2023	0	0.270	0	0	[0, 6]	1.851	[0.001837, 9.299]

Annual Mortality Estimates

Year	X	g	M*	median	95% CI	mean	95% CI
2021	0	0.332	0	0	[0, 4]	1.5090	[0.0015, 7.5820]
2022	0	0.276	0	0	[0, 6]	1.8100	[0.0018, 9.0970]
2023	0	0.217	0	0	[0, 7]	2.3020	[0.0023, 11.5700]

Test of assumed relative weights (ρ) and potential bias

Assumed ρ	Fitted ρ	95% CI
0.76	[0.005, 2.462]	
1	[0.007, 2.626]	
1	[0.007, 2.664]	

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

Quick test of relative bias: 0.988

Input

Year (or period)	ρ	X	Ba	Bb	\hat{g}	95% CI
2021	0.760	0	1560	3145	0.332	[0.318, 0.345]
2022	1.000	0	1614	4226	0.276	[0.265, 0.288]
2023	1.000	0	800.2	2880	0.217	[0.204, 0.231]

Appendix D12. Screen shot of Evidence of Absence (v2.0.7) graphical user interface, Multiple Year Module for northern long-eared bat Incidental Take Permit term-to-date detection probability and cumulative take estimate (M^*). Inputs are based on values reported in the main text.