Post-Construction Monitoring Studies for the Headwaters Wind Farm Randolph County, Indiana

Final Report

April 1 – October 15, 2020

Prepared for:

EDP Renewables

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WEST

EXECUTIVE SUMMARY

Headwaters Wind Farm LLC (Headwaters), a subsidiary of EDP Renewables, is operating the Headwaters Wind Farm (HWF or Project) in Randolph County, Indiana. HWF became fully operational in 2014 and consists of 100, 2.0-megawatt Vestas V110 wind turbines. This report details the second year of post-construction fatality monitoring studies conducted in accordance with the HWF Habitat Conservation Plan (HCP) and Incidental Take Permit (ITP; TE85617C-0) for Indiana bats and northern long-eared bats.

All turbines are within the migratory range of Indiana bat and northern-long eared bat. During the spring migration period (April 1 – May 15), HWF feathered blades on nights when temperatures were above 10° Celsius (C; 50° Fahrenheit) and wind speeds were below 3.5 meters per second (mps; 11.5 feet per second [ft/s]); during fall migration period (August 1 – October 15), HWF feathered turbine blades at all turbines when wind speeds were below 5.0 mps, (16.4 ft/s) on nights when temperatures were above 10° C to minimize impacts to migrating Indiana and northern long-eared bats. The HCP identified 10 turbines with summer risk for Indiana bat and/or northern long-eared bat. HWF feathered turbine blades at those turbines when wind speeds were below 5.0 mps on nights when temperatures were above 10° C during the summer maternity season (May 16 – July 31) to minimize impacts to summer maternity colonies. The remaining 90 turbines were feathered below the manufacturer's rated cut-in speed of 3.0 m/s (9.8 ft/s) during the summer.

Post-construction monitoring was designed to meet a probability of detection, or *g*, of 0.25. Technicians searched all 100 turbines as road and pad areas to a distance of 100 m (328 ft) from the turbine, every other week during spring (April 1 – May 15). During summer (May 20 – July 29), 10 turbines with summer risk were searched weekly. A dog-handler team searched nine summer risk turbines as cleared plots within a 70-m (230-ft) radius of the turbine base, and a technician searched one turbine as a road and pad to a distance of 100 m. In the fall, a technician searched 48 turbines as road and pad plots to a distance of 100 m from the turbine. Dog-handler teams searched 39 turbines as cleared plots with a 70-m radius and 13 turbines as uncleared plots with a 70 m-radius. All plots were searched once a week during the fall (August 3 – October 15). Searcher efficiency and carcass persistence trials were also conducted during each season to correct for detection and scavenger bias.

One Indiana bat was recorded at HWF on October 9, 2020. No northern long-eared bats were found at HWF. The most commonly found species were eastern red bat (32.7%), followed by silver-haired bat (32.3%), big brown bat (18.4%), and hoary bat (13.5%). Species composition recorded at HWF was similar to previous studies at the Project and other wind facilities in Indiana. Thirteen bats were found in the spring, five bats were found during the summer, and 401 bats were found in the fall. Carcasses of two state-endangered species (little brown bat [n = 1], and evening bat [n = 3]) were also recorded at HWF in the fall. No other state- or federally listed species were recorded. There were 116 bird carcasses recorded; no state- or federally listed birds were found.

Using all of the data collected to date (2019 and 2020), the estimated annual fatality rate at HWF is 5.91 Indiana bats per year, and 1.18 northern long-eared bats per year. The probability that the annual take rate was greater than the expected annual take rate was 0.152 for Indiana bat and 0.143 for northern long-eared bat. The cumulative take estimates for HWF were 10 Indiana bats and zero northern long-eared bats. Together, these estimates indicate that no adaptive management actions are necessary at this time.

STUDY PARTICIPANTS

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REPORT REFERENCE

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INTRODUCTION

Headwaters Wind Farm, LLC (Headwaters), a subsidiary of EDP Renewables North America, is currently operating the Headwaters Wind Farm (HWF or Project) in Randolph County, Indiana. Headwaters obtained an Incidental Take Permit (ITP; TE85617C-0) from the US Fish and Wildlife Service (USFWS) dated June 4, 2019, following their approval of the HWF Habitat Conservation Plan (HCP). The HWF HCP details measures to minimize, mitigate, and monitor impacts to the federally endangered Indiana bat (*Myotis sodalis*) and federally threatened northern long-eared bat (*Myotis septentrionalis*).

All turbines are within the migratory range of Indiana bat and northern-long eared bat. During the spring migration period (April 1 – May 15), HWF feathered blades on nights when temperatures were above 10° Celsius (C; 50° Fahrenheit [F]) and wind speeds were below 3.5 meters per second (mps; 11.5 feet/second [f/s]); during the fall migration (August 1 – October 15), HWF feathered turbine blades when wind speeds were below 5.0 mps on nights when temperatures were above 10° C at all turbines to minimize impacts to migrating Indiana and northern long-eared bats. The HCP identified 10 turbines within 305 meters (m; 1000 feet [ft]) of summer maternity colony habitat for Indiana bat and/or northern long-eared bat. HWF feathered blades at those turbines when wind speeds were below 5.0 mps (16.4 ft per second [ft/s]) on nights when termperatures were above 10°C during the summer maternity season (May 16 – July 31) to minimize impacts to summer maternity colonies. The remaining 90 turbines were feathered below the manufacturer's rated cut-in speed of 3.0 m/s (9.8 ft/s) during the summer. Western EcoSystems Technology, Inc. (WEST) completed a post-construction monitoring study designed to achieve a 25% probability of detecting a single bat carcass (*g* of 0.25, as assessed by the 90% confidence interval [CI] of the estimated distribution of g) using the Evidence of Absence (EoA) fatality estimator.

STUDY AREA

The HWF is in Randolph County, Indiana, less than eight kilometers (km; five miles) southwest of the town of Winchester (Figure 1). HWF lies approximately 341 m (1,119 ft) above mean sea level and has relatively flat topography. Approximately 87% of the nearly 118-square km (29,272-acre) area within HWF is composed of cropland. Corn (*Zea mays*) and soybean (*Glycine max*) are the most common crop types. The next most common landcover is developed areas (e.g., farmsteads) that collectively compose approximately 6% of the site, followed by deciduous forest (5%; Table 1, Figure 1).

The HWF became operational in 2014 and consists of 100, 2.0-megawatt Vestas V110 wind turbines that have a 95 m (312 ft) hub height, a 55 m (180 ft) blade length, and a manufacturer cut-in speed of 3.0 mps.

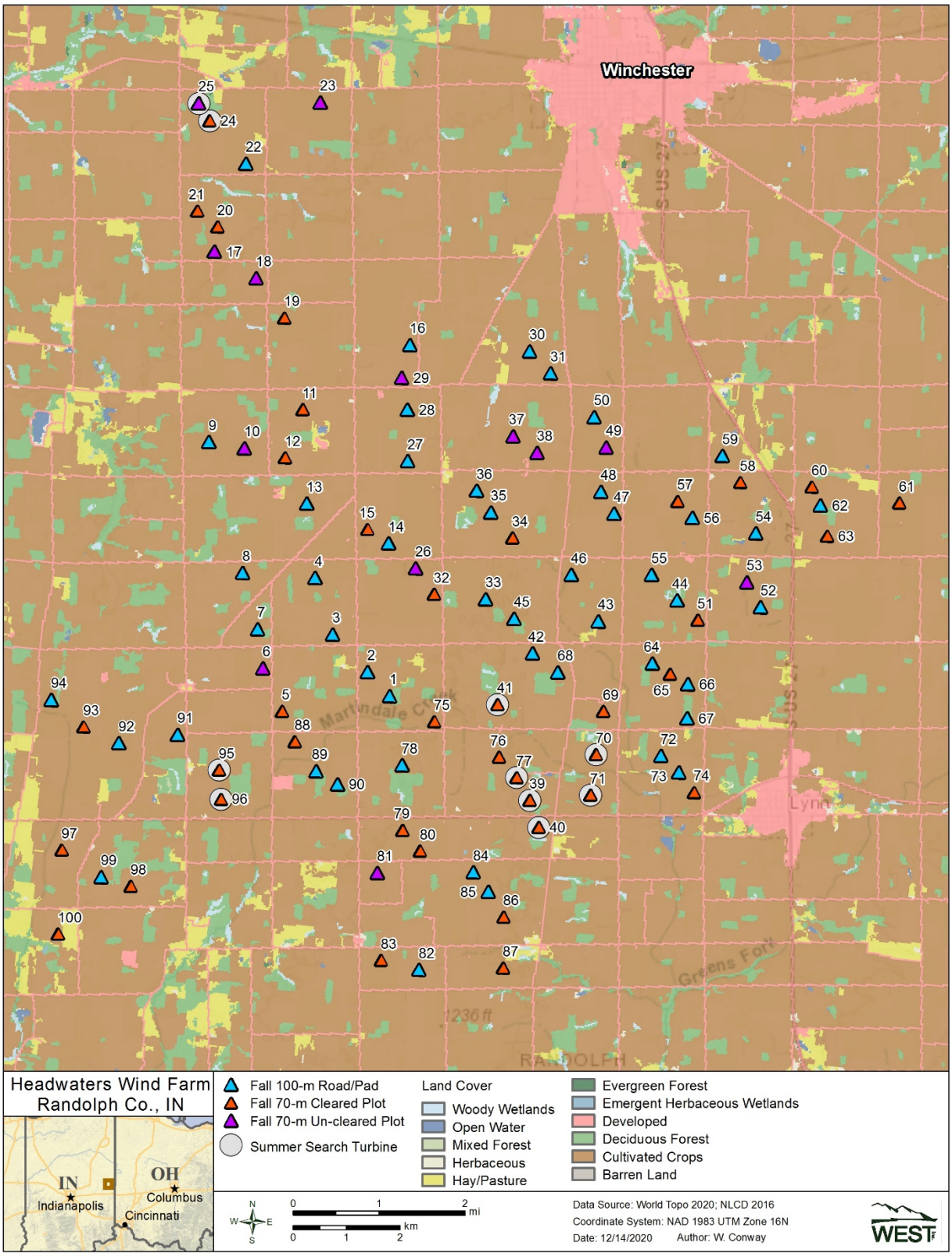


Figure 1. Turbine locations by search type and surrounding land cover at the Headwaters Wind Farm in Randolph County, Indiana.

Table 1. The landcover types, coverage, and composition at the Headwaters Wind Farm, Randolph County, Indiana.

Habitat	Acres	% Composition
Cultivated Crops	25,349	86.5
Developed[1]	1,592	5.4
Deciduous Forest	1,477	5.0
Hay/Pasture	713	2.4
Herbaceous	120	<0.1
Open Water	13	<0.1
Emergent Herbaceous Wetlands	3	<0.1
Evergreen Forest	3	<0.1
Shrub/Scrub	3	<0.1
Total	**29,272**	**100**

[1] Developed areas include high, medium, and low-intensity developed areas, as well as developed open space.

Data from 2011 National Land Cover Database. Sums may not equal total values shown due to rounding.

METHODS

WEST used project-specific data from 2019 to develop a study plan with a target *g* of 0.25 to meet the monitoring commitments in the HCP. WEST submitted a study plan to the USFWS on February 28, 2020, and received approval on April 2, 2020 (M. Reed, USFWS, pers. comm.). The study plan was revised and resubmitted to the USFWS on July 31, 2020, to reflect a decreased availability of uncleared plots for fall monitoring and a subsequent increase in cleared plots, relative to the initial monitoring plan. The main objective of the post-construction monitoring was to document any Indiana bat or northern long-eared bat carcasses that occurred within HWF; however, all bat and bird carcasses observed were recorded, per the HCP.

Standardized Carcass Searches

Technicians and dog-handler teams conducted standardized carcass searches from April 1 – October 15, 2020. All personnel were trained to follow the HWF search protocol, including proper handling and reporting of carcasses. A technician searched the gravel road and pad areas (road and pad plots) under all 100 turbines to a distance of 100 m (328 ft) from the turbine, every other week during the spring (April 1 – May 15; Table 2). A dog-handler team searched nine turbines with summer risk as cleared plots with a 70-m (230-ft) radius, and a technician searched one road and pad plot to a distance of 100 m from the turbine, once a week, from May 20 – July 29 (Figure 1).

All turbines were searched once per week during the fall (Table 2). A technician searched 48 turbines as road and pad plots to a distance of 100 m from the turbine. Dog-handler teams searched 39 turbines where crops were regularly mowed within 70-m radius (cleared plots) and 13 turbines as uncleared plots with a 70-m radius (Figure 1). Uncleared plots were vegetated with soybeans or alfalfa (*Medicago sativa*). Searchers were notified about a blade failure at Turbine 11 on September 7, 2020. Turbine 11 was searched as a cleared plot. This turbine remained non-operational for the remainder of the fall monitoring period and was no longer searched

following the blade break. All other plots were searched once per week between August 3 and October 15, 2020.

Table 2. Search Effort by Season and Plot Type at Headwaters Wind Farm in Randolph County, Indiana.

Season	Plot Type	Search Interval	Number of Turbines
Spring (April 1–May 15)	100-m road and pad	14 days	100
Summer (May 16–July 31)	100-m road and pad	7 days	1
	70-m cleared plot	7 days	9
Fall (August 1–October 15)	100-m road and pad	7 days	48
	70-m cleared plot	7 days	39
	70-m uncleared plot	7 days	

Human Searchers

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

Dog-handler Teams

Prior to conducting searches at HWF, handlers trained their detection dogs on the scent of bat carcasses using methods derived from search and rescue programs and drug detection (Kay 2012, Helfers 2017). Dogs were initially trained on cotton scent swabs from bat carcasses, and progressed to bat carcasses at increasing distances. The detection dog coordinator conducted a 2-day evaluation of each dog-handler team; after teams achieved a searcher efficiency of 75% or greater for 30 bats during evaluation trials, they were approved to conduct standardized carcass searches. Because the objective of the study was to document bat species, 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 HWF included a Belgian Tervuren and a Border Collie mix breed.

Handlers determined the survey start points and the number of transects needed to cover the plot after taking into account wind speed and direction, as well as crop row direction and density (when applicable). Handlers oriented dogs to start searches perpendicular to the wind to maximize scent detection. Both windspeed and crop density can affect scent dispersal across the search area. Transect width varied by plot type to maximize detection and was approximately 10 m (33 ft) apart in un-cleared soybean plots, and 15 m (49 ft) in cleared plots. Dog handlers rewarded detection dogs with either a food reward or a short play session when dogs alerted to a bird or bat carcass.

Data Collection

Carcass searches began after first light, and ended by 1700 hours. For each scheduled search, technicians recorded the date, start and end times, technician name, turbine number, type of search, and if any carcasses or injured bats or birds were found. When a carcass was found, technicians placed a flag near it and continued the search. The technician returned after searching the entire plot to record information for each fatality on a tablet, including the date and time, species, sex and age (when possible), technician name, turbine number, measured distance from turbine, azimuth from turbine, location of carcass as Universal Transverse Mercator coordinates, habitat 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). Digital photographs were taken of each carcass, including any visible injuries, and surrounding habitat. The technician also plotted the location of each carcass on a map of the search area. Carcasses found in non-search areas (e.g., off the graveled area of a road and pad search) were recorded as incidental discoveries and documented following the same protocol for those found during standard searches.

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

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

For bird carcasses, the following category was also used:

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

Bat carcasses were collected under WEST's Native Endangered and Threatened Species Recovery Permit (TE234121-9), and Indiana Special Purpose Salvage Permit (20-106). Technicians placed all bat carcasses in a re-sealable plastic bag labeled with the unique carcass identification number, turbine number, and date, for storage in a freezer on site. Leather and rubber gloves were used to handle all bat carcasses to eliminate possible transmission of rabies or other diseases. Bird carcasses were recorded and left in the field and marked with spray paint to ensure they were not recorded multiple times during surveys. Any bird carcass suspected of being a state- or federally listed species were not spray painted until identification was verified and after consultation with the Indiana Department of Natural Resources (IDNR) and USFWS.

Any injured birds were evaluated for possible rehabilitation and IDNR was notified. Injured bats were recorded from a distance of 1.8 m (6.0 ft) and left in place to avoid contact due to the potential to transmit SARS-Cov-2 to North American bat populations.

Carcass Identification and Agency Notification

Identification of bird carcasses were verified by biologists with significant field experience in identification of birds and their feathers. All bat carcasses were identified via photographs within 48 hours by federally permitted bat biologists (TE19208C-0 and TE234121-9). Any carcasses or injured animals of state- or federally endangered species were reported to the appropriate agency within 48 hours. The identifications of all bat carcasses were also verified in hand by a permitted bat biologist (TE13580D-0) at the end of the surveys and delivered to the USFWS Field Office in Bloomington, Indiana, on December 31, 2020.

Tissue samples were collected from heavily scavenged or decomposed carcasses that could not be positively identified and sent to the Northern Arizona University School of Forestry and Center for Microbial Genetics and Genomics for identification via genetics.

Bias Trials

Searcher Efficiency Trials

The objective of the searcher efficiency trials was to estimate the probability searchers found a carcass. Approximately 20 bat carcasses per plot type (i.e., road and pad, uncleared plot, and cleared plot) and season were placed during searcher efficiency trials for 256 available trial carcasses. Multiple trials were conducted in each season of the study period to measure potential changes in plot conditions on searcher efficiency over time. Estimates of searcher efficiency were used to adjust the total number of carcasses found for those missed by technicians, accounting for detection bias in EoA.

Searcher efficiency trials were conducted in the same areas where carcass searches occurred. Searcher efficiency trials were conducted blindly; technicians conducting carcass searches did not know when trials were conducted or the location of the carcasses. Carcasses were placed over three to seven dates each season of the study period to incorporate potential differences in searcher efficiency due to plot conditions over time. No more than two carcasses were placed on a plot to avoid over-seeding. Trial carcasses consisted of big brown bat (*Eptesicus fuscus*) carcasses provided by Indiana State University and eastern red bats (*Lasiurus borealis*), big brown bats, hoary bats (*Lasiurus cinereus*), and silver-haired bats (*Lasionycteris noctivagans*) found on site.

Each trial bat carcass was discreetly marked with a black zip-tie around the upper forelimb for identification as a study carcass after it is found. Carcasses were dropped from waist-height or higher and allowed to land in a random posture. 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 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. Carcasses were checked to confirm availability the day of searches.

Carcass Persistence Trials

The objective of carcass persistence trials was to estimate the average 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. Estimates of carcass persistence were used to adjust the number of carcasses found for those removed from the study area, thereby accounting for persistence bias in the EoA estimates. Fifteen bat carcasses were monitored per season, for a total of 45 bat carcasses in persistence trials. Trials were conducted each season, and across all plot types to incorporate the effects of varying weather and scavenger densities. No more than two trial carcasses were placed on a plot to avoid potential over-seeding.

Technicians conducting carcass searches 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 4 days, then on days 7, 10, 14, 20, and 30. Trial carcasses were monitored until they were removed by scavenging or other means, completely decomposed, or at the end of the carcass persistence trial, whichever occurred first. On cleared and uncleared plots, detection dogs were used to confirm when carcasses were removed. At the end of the 30-day period, any evidence of the carcasses that remained was removed from the search plot.

Search Area Mapping

Technicians recorded the boundaries of the cleared plots and road and pad plots using an Arrow 100 submeter global positioning satellite unit. The boundaries of plots were used to quantify the amount of area searched and compared to carcass distribution estimates to estimate the number of carcasses that fell outside plot boundaries.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data analysis, and report writing. Following field surveys, technicians were responsible for inspecting data for completeness and accuracy. 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 were made in all affected steps.

Data Compilation and Storage

A Microsoft® SQL database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference.

Searcher Efficiency Estimation

The total number of trial carcasses found and the number of trial carcasses available were used as inputs for each search strata (Single Class Module) in the EoA software. To determine if raw searcher efficiency data should be pooled or subset by strata (i.e., season or plot type), searcher efficiency data were first modeled using logistic regression (Dalthorp et al. 2018). Potential covariates for the logistic regression models included plot type and season. Cleared and uncleared 70-m plots (both searched with dog-handler teams) were not searched in every season, in contrast to road and pad plots (searched by humans). Therefore, searcher efficiency was modeled separately for dog-handler teams searching full plots and humans searching road and pad plots. Season was the only potential covariate considered for searcher efficiency on roads and pad plots (i.e., human searchers). Searcher efficiency for 70-m plots considered plot type (cleared and uncleared) and season (summer and fall) as potential covariates. For both sets of models, an information theoretic approach known as AICc, or corrected Akaike Information Criterion, was used to for model selection (Burnham et al. 2002). The best fit model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value. Searcher efficiency values were input into the EoA software according to the model selection results.

The change in searcher efficiency between successive searches was defined by a parameter called the detection reduction factor (k) that can range from zero to one. When k is zero, it implies a carcass that was missed on the first search would never be found on subsequent searches. A k of one implies searcher efficiency remained constant no matter how many times a carcass was missed. The detection reduction factor was a required parameter for EoA; however, data were not collected to estimate k. 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.

Carcass Persistence Rate Estimation

The average probability a carcass persisted through the search interval (i.e., the time between scheduled searches) was estimated using an interval-censored survival regression with four potential distributions: exponential, log-logistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Dalthorp et al. 2018). Season was the only potential covariate considered in carcass persistence models. The most parsimonious model within two AICc units of the model with the lowest AICc value was selected as the best model. 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.

Area Adjustment

The search area adjustment accounted for unsearched areas beneath turbines, and was calculated as a probability that ranged from zero to one. The area adjustment was estimated as the product of the unsearched area around each turbine and a carcass-density distribution. A truncated weighted maximum likelihood (TWL) modeling approach (Khokan et al. 2013) was used to estimate the carcass-density distribution using site-specific fatality locations. The TWL approach uses weight based probability of detection and the proportion of area searched in each

1.0-m annulus around the turbine, out to the maximum plot extent (e.g., 70 m). Distributions considered were normal, gamma, Gompertz, Rayleigh and Weibull (parameterized according to Yee [2020] and R Development Core Team [2016]). The proportion of area searched was calculated in a Geographic Information System as the amount of area searched divided by the total area searched at each 1.0-m annulus around the turbine.

Carcasses Excluded from Analysis

Fatalities were excluded from the area adjustment modeling when the carcass was discovered outside of the plot boundary or monitoring period. 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 on a plot incidentally were included in the analysis if that plot had a scheduled search in the future.

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

Evidence of Absence

EoA was used to estimate cumulative take to-date (*M**, the median of the posterior distribution of *M*), mean annual take rate (λ), and the probability that the estimated take rate (λ) exceeded the expected take rate (τ) for both of the covered species for this Project, Indiana bat and northern long-eared bat. Estimates were calculated using the EoA R package (**eoa** version 2.0.7), using the Single Class, Multiple Class, and Multiple Years modules of EoA.

In addition, the bias corrections for searcher efficiency, carcass persistence, and area searched, the seasonality of risk to the covered species was also included as a bias correction in the estimate of detection probability because *Myotis* risk is unevenly distributed across seasons. The Midwest Wind Multi-Species Habitat Conservation Plan (MSHCP) arrival proportions served as the basis for the analysis, with 7% in spring, 36% in summer, and 57% in fall. These percentages cannot be applied directly at HWF for two reasons: first, only 10 out of 100 turbines have summer risk, and, secondly, the blade failure at Turbine 11 resulted in 99 (instead of 100) turbines posing risk to bats for the second half of the fall monitoring period.

Due to the blade break at Turbine 11, the fall monitoring season was split into two fall seasons, with the first season, fall 1, occurring prior to the blade break (August 1 – September 7) and the second, fall 2, occurring after the blade break (September 8 – October 15). The MSHCP fall arrival proportion was rescaled according to the proportion of total days in the fall monitoring period that fell within each sub-season, assuming uniform carcass arrival within the fall season (Table 3).

To account for partial risk during the summer monitoring season and for the loss of Turbine 11 during the fall 2 season, a new sampling fraction was calculated for each set of turbines (turbines with no summer risk, turbines with summer risk, and Turbine 11, which has no summer risk, but was not searched in fall 2). The raw risk for each of these three groups was calculated by adding together the split MSHCP arrival proportions for the seasons during which each group of turbines was monitored. “Split” MSHCP arrival proportions refer to arrival proportions that include two fall

seasons, where the 0.57 fall MSHCP proportion is split into two fall seasons according to their durations (Table 3). Then the sampling fraction weighted risk was calculated by multiplying the overall sampling fraction of each group by the raw risk (Table 4). Finally, re-weighted arrival proportions were calculated for each season by dividing the split MSHCP arrival proportions by the total sampling fraction weighted risk (Table 5). Note that the re-scaled arrival proportions do not sum to one, but the weights across all search strata do sum to one once sampling fraction is reapplied, based on the total number of turbines at the facility (100 turbines).

Table 3. Original and rescaled arrival proportions for each season at Headwaters Wind Farm in Randolph County, Indiana.

Season	Proportion of monitoring season	MSHCP Arrival	MSHCP Split Arrival
Spring	1.00	0.07	0.07
Summer	1.00	0.36	0.36
Fall 1	0.54	0.57	0.31
Fall 2	0.46	0.57	0.26

MSHCP = Midwest Multi-Species Habitat Conservation Plan

Table 4. Distribution of risk across all possible season combinations at the Headwaters Wind Farm in Randolph County, Indiana.

Seasons Searched	Number of Turbines with Risk	Raw Risk (sum of seasonal risk for the stratum)	Sampling Fraction	Sampling Fraction Weighted Risk
Spring, Summer, Fall 1, Fall 2	10	1.00	0.10	0.100
Spring, Fall 1, Fall 2	89	0.64	0.89	0.570
Spring, Fall 1	1	0.38	0.01	0.004
Total Weighted Risk				**0.674**

Table 5. Reweighted arrival proportions for each season at Headwaters Wind Farm in Randolph County, Indiana

Season	Re-weighted Arrival Proportion
Spring (April 1 – May 15)	0.104
Summer (May 16 – July 31)	0.535
Fall 1 (August 1 – September 7)	0.459
Fall 2 (September 8 – October 15)	0.388

The EoA Single Class module was used to estimate the distribution of detection probability in each search strata. This resulted in Ba and Bb parameters that define the Beta distribution of detection probability in each strata. The EoA Multiple Class module was then used to combine detection probability distributions across strata, with weights for each class defined by the sampling fraction, the area adjustment, and arrival proportions. For unsearched area, Beta distribution parameters Ba = 0.001 and Bb = 1000 were used to define a detection probability of approximately zero. Finally, the Multiple Years module was used to combine detection probability distributions across 2019 and 2020. The results from the Multiple Years module (Ba and Bb

parameters for the detection probability to date) were used to estimate *M** (the median of the posterior distribution of *M*), mean take rate $\hat{\lambda}$ and its 90% CI, and the probability that $\hat{\lambda} > \tau$. Appendix A shows how the compliance metrics were calculated using the EoA Graphical User Interface[1].

The EoA Multiple Years module requires the input ρ, which weights the years appropriately. ρ was set to 1 for 2020 because 2020 was the first full year of ITP operations. In 2019, risk to bats was only present after the receipt of the ITP in the summer through the end of the fall monitoring period (June 25 – October 15, 2020). The same approach used to rescale arrival proportions for summer risk was applied to the 2019 data assuming zero turbines had risk in the spring in addition to 10 turbines with summer risk. The rescaled spring risk for 2019 was then subtracted from one (the relative risk value assigned to 2020), yielding the relative risk in 2019 compared to 2020. Using this approach, ρ = 0.88 for 2019.

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 was on pace to exceed 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 Indiana bat and northern long-eared bat.

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 trigger an adaptive management response in time 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) exceeds the expected take rate (τ = T ÷ years in permit) at α = 0.05, per the HCP. The short-term trigger is designed to evaluate a rolling window of six years of post-construction monitoring data. If, within any 6-year rolling window, the estimated take rate exceeds the expected take rate with 95% confidence, the short-term trigger would be met, indicating that the minimization plan in the HCP may need to be adjusted to ensure that the cumulative take estimate (*M**) remains within the permitted limit over the ITP term. To date, two years of data have been collected, so the short-term trigger was evaluated over a term of two years.

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) under the HCP (i.e., test whether cumulative take has met permitted take). Per the HCP, cumulative take to date (*M**) was estimated at α = 0.5 (using the median, or 50th credible bound, of the posterior destruction of estimated mortality). If the cumulative take to date at α = 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 α = 0.5 is greater than or equal to the total permitted take (*M** ≥ T), then the take limit has been met and the Project must take avoidance measures.

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

RESULTS

Avian and Bat Carcass Surveys

Ten turbines were searched weekly in the summer, and all 100 turbines were searched every two weeks in the spring and weekly in the fall, for a total of 1,570 turbine searches across seasons (Table 6). Sixteen searches were missed due to turbine maintenance, weather constraints, and safety hazards. Four hundred and fifty-two bat carcasses and 116 bird carcasses were found during surveys and incidentally (Tables 7 and 8, Appendix A). The number, species, location, modeled searcher efficiency and carcass persistence, area adjustment biases, and EoA estimates are discussed below, and further details on EoA estimates are provided in Appendices B and C.

Table 6. Number of searches per plot type, by season at Headwaters Wind Farm, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Season	Plot Type	Number of Searches
Spring (April 1 – May 15)	100-m road and pad	400
Summer (May 16 – August 1)	70-m cleared plot	93
	100-m road and pad	11
Fall (August 1 – October 15)	70-m cleared plot	401
	70-m uncleared plot	139
	100-m road and pad	526
Overall		**1,570**

m = meters.

Species Composition

One Indiana bat was recorded at Turbine 75 at HWF on October 9, 2020 and had an estimated time of death of two to three days prior. Turbine 75 is not within 305 m of summer maternity colony habitat, and timing of the fatality suggests the bat was a migrant (Figure 2). The Indiana bat was initially recorded as an unknown *Myotis* and was reviewed in-hand by a federally permitted bat biologist (TE19208C-0) on October 12. The Indiana bat was reported to USFWS on October 12 after its identification was confirmed. The carcass was dismembered, preventing assignment of sex to the carcass. The USFWS had reduced office hours due to SARS-Cov-2, so the carcass was delivered to the USFWS office on October 21, 2020. No northern long-eared bat carcasses were found during the study.

Thirteen bats were found in the spring, nine bats were found in the summer, and 430 bats were found in the fall (Appendix A). The most commonly found bat species were eastern red bat (148 carcasses; 32.7%) silver-haired bat (146 carcasses; 32.3%), and big brown bat (83 carcasses; 18.4%). Sixty-one hoary bat (13.5%) were also found (Table 7, Appendix B).

One little brown bat (*Myotis lucifugus*) was recorded at HWF on August 28, 2020, at Turbine 100. The little brown bat is a state-endangered species, and the carcass was reported to IDNR on August 28, 2020. Per the HCP, the USFWS was also notified, and the carcass was taken to the USFWS office in Bloomington, Indiana, on September 16. Three evening bats (*Nycticeius*

humeralis) were recorded at HWF. The evening bat is a state-endangered species, and the first two carcasses were recorded on August 6 and 18 and reported to the IDNR on August 6 and August 19, respectively. The third carcass was found on October 2, 2020 and was identified as an evening bat via Deoxyribonucleic Acid (DNA) analysis on December 12, 2020. This carcass was reported to IDNR on December 14, 2020.

Table 7. Number and percent (%) of bat carcasses by species included and excluded from the area correction found at the Headwaters Wind Farm, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

	Included in Area Correction		Outside Search Area		Outside Study Period		Total	
Species	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
eastern red bat	143	33.10	1	50.00	4	22.22	148	32.70
silver-haired bat	144	33.33	1	50.00	1	5.56	146	32.30
big brown bat	78	18.06	0	0	5	27.78	83	18.36
hoary bat	54	12.50	0	0	7	38.89	61	13.50
seminole bat	3	0.69	0	0	0	0	3	0.69
evening bat	2	0.46	0	0	1	5.56	3	0.66
unidentified lasiurus bat	2	0.46	0	0	0	0	2	0.44
unidentified non-myotis	2	0.46	0	0	0	0	2	0.44
unidentified tree bat	2	0.46	0	0	0	0	2	0.44
Indiana bat	1	0.23	0	0	0	0	1	0.22
little brown bat	1	0.23	0	0	0	0	1	0.22
Overall Bats	**432**	**100**	**2**	**100**	**18**	**100**	**452**	**100**

Sums may not equal total values shown due to rounding.

Two bat carcasses, which consisted mainly of bone and fur, were identified as an unknown migratory tree bats due to the presence of frosted tips on its fur (hoary bat, eastern red bat, or silver-haired bat (Whitaker and Mumford 2009). Two bat carcasses, which also consisted mainly of bone and fur, were identified as unidentified *Lasiurus* spp. based on the presence of frosted tips and furred uropatagiums. No *Myoti*s spp. occurring in Indiana have frosted tips; thus, they were eliminated from the list of potential species. Two additional bat carcasses that consisted of wings were identified as unidentified non-myotis based on their forearm measurements of 50 millimeters (mm; 2.0 inches [in]; Schwartz et al. 2016).

Over the course of the monitoring period, 40 heavily scavenged bats (e.g., wing membrane only, bones, or partial carcasses) were sent off for identification via DNA analysis; none were identified as federally listed species, and one carcass was identified as an evening bat, which is state-endangered. The remaining bats were identified as common species, including eastern red bat, big brown bat, hoary bat, and silver-haired bat.

One hundred sixteen birds were recorded, belonging to 28 species (Table 8, Appendix B). Seventeen birds could not be identified to species; two were juvenile birds with pin feathers that were flightless, and, thus, could not have collided with wind turbines. The remaining fifteen birds were found as partial carcasses or feather spots and could not be identified. Two unknown birds were identified as unknown raptors. One of these consisted of a foot and leg bones, and did not have potential to be either a bald (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*),

based on the small size of the hallux, which measured approximately 20.0 mm (0.8 in; EDM International, Inc. 2020). The second was identified as a likely Canada goose (*Branta canadensis*) or turkey vulture (*Cathartes aura*) based on the broad, u-shaped groove of the feather shaft, and did not have potential to be either a bald or golden eagle due to their relatively short feather lengths (USFWS 2020). No state- or federally listed bird species were recorded.

Table 8. Number and percent (%) of bird carcasses by species found at the Headwaters Wind Farm, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Species	Total	%
horned lark	27	23.28
killdeer	27	23.28
mourning dove	7	6.03
turkey vulture	5	4.31
unidentified passerine	4	3.45
unidentified warbler	4	3.45
red-eyed vireo	3	2.59
red-tailed hawk	3	2.59
European starling	2	1.72
field sparrow	2	1.72
Mallard	2	1.72
pine warbler	2	1.72
rock pigeon	2	1.72
unidentified raptor	2	1.72
unidentified small bird	2	1.72
American redstart	1	0.86
barn swallow	1	0.86
brown-headed cowbird	1	0.86
Canada warbler	1	0.86
cliff swallow	1	0.86
Cooper's hawk	1	0.86
golden-crowned kinglet	1	0.86
northern rough-winged swallow	1	0.86
palm warbler	1	0.86
Philadelphia vireo	1	0.86
red-breasted nuthatch	1	0.86
ruby-crowned kinglet	1	0.86
silver-haired bat	1	0.86
tree swallow	1	0.86
unidentified buteo	1	0.86
unidentified kinglet	1	0.86
unidentified sparrow	1	0.86
unidentified swallow	1	0.86
wood thrush	1	0.86
yellow-billed cuckoo	1	0.86
yellow-breasted chat	1	0.86
yellow-throated warbler	1	0.86
Overall Birds	**116**	**100**

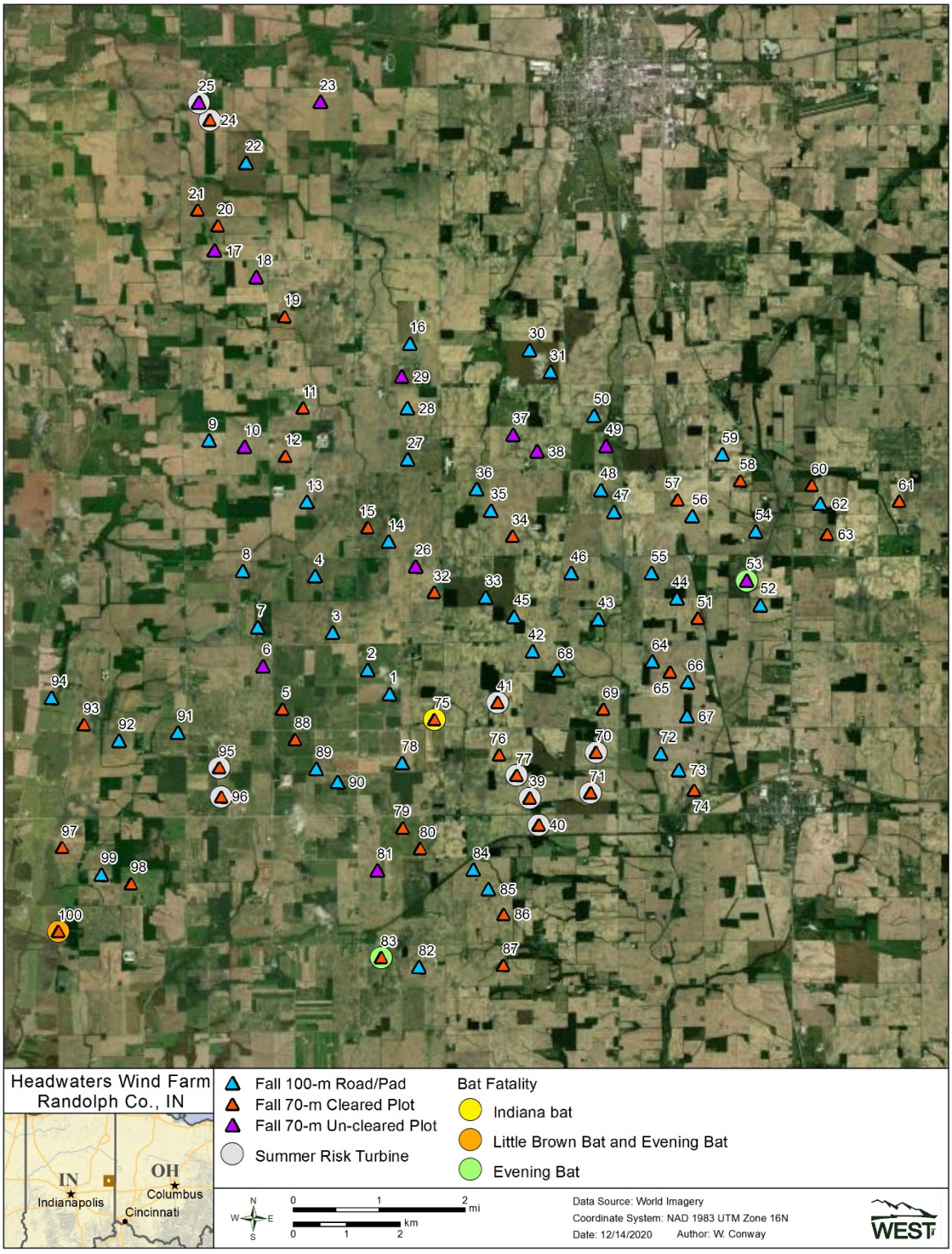


Figure 2. Location of Indiana bat and evening bat carcasses in relation to summer risk turbines at the Headwaters Wind Farm from April 1 – October 15, 2020.

Weather Patterns Preceding Myotis Fatalities

Two *Myotis* carcasses were found during the survey period, including one Indiana bat (found October 9, 2020) and one little brown bat (found August 28, 2020). Both bats had estimated time of deaths two to three days prior. Wind speed and temperature data from on-site weather stations were plotted for all possible nights of death based on the estimated times of death for each carcass (Figure 3). Wind speeds were generally higher than 5.0 mps on the nights preceding the discovery of the Indiana bat, but varied between approximately 2.5–11.0 mps (8.2–36.0 ft/s). Temperature varied between approximately 20–30°C (68–86°F) on the nights preceding the discovery of the little brown bat (Figure 3). Wind speed was more variable across the nights preceding the discovery of the little brown bat, but temperatures generally ranged between 25–30°C (77–86°F; Figure 3).

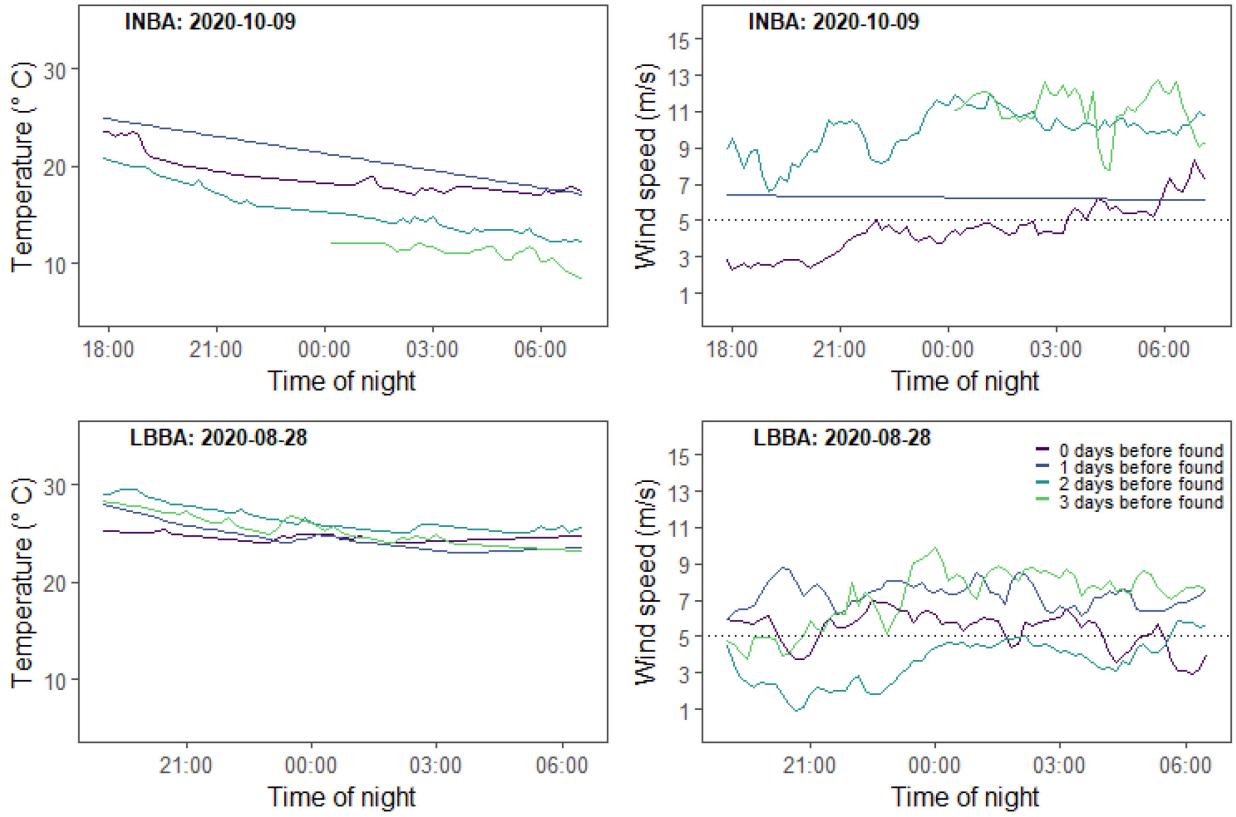


Figure 3. Temperature and wind speeds proceeding *Myotis* carcass discoveries at the Headwaters Wind Farm, Randolph County, Indiana, August 28, 2020, and October 9, 2020.

Note: LBBA denotes little brown bat, and INBA denotes Indiana bat. Plots show time series of wind speed and temperature at 10-minute intervals, starting 30 minutes before sunset and ending 30 minutes after sunrise. The horizontal dashed line in the wind speed panels displays the curtailment threshold of 5.0 meters per second.

Carcasses for Analysis

Twenty-six of the 452 bats found during the spring, summer, and fall monitoring seasons were excluded from modeling the area correction for EoA; two bat carcasses were excluded from analysis because they were found off plot, for example, outside the graveled search area of a turbine that was searched only as a road and pad plot. Another 22 bats were excluded because their estimated time of death was prior to the start of surveys for each season (Table 7). No estimates of bird fatalities were calculated, therefore, no bird carcasses were included in analysis (Table 8).

The composition of bat species varied by season; only eastern red bat, hoary bat, and silver-haired bat were found in the spring and summer, while big brown bat, evening bat, seminole bat (*Lasiurus seminolus*), Indiana bat, and little brown bat were only found in the fall (Table 9). The majority of bat carcasses were recorded on 70-m cleared plots, and no bat carcasses were recorded on the single road and pad plot searched during the summer. A similar number of bat carcasses were found on the road and pad plots and the uncleared plots during the fall (Table 9).

Searcher Efficiency Trials

One hundred fifty-two bats were placed for searcher efficiency trials, and 128 were available for search teams to find across all seasons and plot types. Searcher efficiency rates ranged from 60.7% in uncleared plots in the fall to 82.6% on cleared plots in the fall by dog teams, and ranged between 95–100% by humans on roads and pads (Table 10). 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 or between seasons (Table 11). The best-fit model for searcher efficiency on roads and pads did not support the inclusion of season as a covariate (Table 12). Thus, for EoA, the total number of available and found searcher efficiency trials were summed across season and plot type, but the stratification of 70-m plots and road and pad plots remained. The EoA inputs for the 70-m plots were 80 available carcasses and 54 found carcasses for all seasons. The EoA inputs for road and pad plots were 48 available carcasses and 47 found carcasses for all seasons (Table 10).

Table 9. Species composition by season and plot type for bat carcasses[1] found at the Headwaters Wind Farm, Randolph County, Indiana from April 1, 2020 to October 15, 2020.

	Spring		Summer				Fall					
	Road and Pad		70-m Cleared Plot		Road and Pad		70-m Uncleared Plot		70-m Cleared Plot		Road and Pad	
Species	# of Carcasses	%	# of Carcasses	%	# of Carcasses	%	# of Carcasses	%	# of Carcasses	%	# of Carcasses	%
big brown bat	0	0	0	0	0	0	16	24.62	48	16.96	13	19.70
eastern red bat	3	23.07	2	40.00	0	0	18	27.69	94	33.22	25	37.87
evening bat	0	0	0	0	0	0	1	1.54	0	0	0	0
hoary bat	2	15.38	1	20.00	0	0	8	12.31	33	11.66	7	10.61
Indiana bat	0	0	0	0	0	0	0	0	1	0.35	0	0
little brown bat	0	0	0	0	0	0	0	0	1	0.35	0	0
seminole bat	0	0	0	0	0	0	20	30.77	81	28.62	1	1.50
silver-haired bat	8	61.50	2	40.00	0	0	0	0	2	0.71	20	30.30
unidentified non-myotis	0	0	0	0	0	0	1	1.54	19	6.71	0	0
unknown lasiurus	0	0	0	0	0	0	1	1.54	2	0.71	0	0
unknown tree bat	0	0	0	0	0	0	0	0	2	0.71	0	0
Total	**13**	**100**	**5**	**100**	**0**	**--**	**65**	**100**	**283**	**100**	**66**	**100**

[1] This table only includes bat carcasses included in the area adjustment calculation.

Sums may not equal total values shown due to rounding.

m = meter.

Table 10. Searcher efficiency results by plot type at the Headwaters Wind Farm, Randolph County, Indiana from April 1, 2020 to October 15, 2020.

Season	Plot Type	Number Placed	Number Available	Number Found	% Found
Spring	Roads and Pads	20	20	19	95.0
Summer	Cleared	34	29	18	62.0
	Roads and Pads	10	9	9	100
Fall	Uncleared	32	28	17	60.7
	Cleared	30	23	19	82.6
	Roads and Pads	26	19	19	100
Overall 70-meter Plots (Cleared and Uncleared)		**96**	**80**	**54**	**67.5**
Overall Roads and Pads		**56**	**48**	**47**	**97.9**
Overall		**152**	**128**	**101**	**78.9**

Table 11. Searcher efficiency models for 70-meter plots at the Headwaters Wind Farm, Randolph County, Indiana from May 16, 2020 to October 15, 2020.

Covariates	k Value	AICc	Delta AICc
No covariates	0.67	102.94	0*
Plot Search Type + Season	0.67	103.59	0.65
Plot Type	0.67	104.16	1.22
Season	0.67	104.44	1.50

* Selected model.

AICc = corrected Akaike Information Criterion.

Table 12. Searcher efficiency models for roads and pads at the Headwaters Wind Farm, Randolph County, Indiana from April 1, 2020 to October 15, 2020.

Covariates	k Value	AICc	Delta AICc
No covariates	0.67	11.81	0*
Season	0.67	16.53	4.72

* Selected model.

AICc = corrected Akaike Information Criterion.

Carcass Persistence Trials

The best fit model for carcass persistence rates was an intercept-only model with a Weibull distribution, which suggests bat carcass persistence rates did not vary by season (Table 13). The estimated median carcass persistence time was 10.4 days. The average probability that a carcass persisted through a 7-day search interval was 0.75 (90% CI: 0.66, 0.83). The average probability that a carcass persisted through a 14-day search interval was 0.63 (90% CI: 0.54, 0.72). Because the best model did not include covariates, this carcass persistence distribution was applied to all search strata in EoA.

Table 13. Carcass persistence models with covariates and distributions for bats at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020 (n = 45).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	No Covariates	Weibull	194.24	0*
Season	No Covariates	Weibull	195.81	1.57
No Covariates	–	exponential[1]	196.45	2.21
No Covariates	No Covariates	lognormal	196.75	2.51
No Covariates	No Covariates	loglogistic	196.97	2.73
Season	–	exponential[1]	197.16	2.92
Season	No Covariates	lognormal	197.65	3.41
No Covariates	Season	Weibull	197.86	3.62
Season	No Covariates	loglogistic	198.34	4.10
Season	Season	Weibull	199.63	5.39
No Covariates	Season	lognormal	200.79	6.55
No Covariates	Season	loglogistic	201.14	6.90
Season	Season	lognormal	202.19	7.95
Season	Season	loglogistic	202.91	8.67

* Selected model.

[1] The exponential model does not have a scale parameter.

AICc = corrected Akaike Information Criterion.

Area Correction

None of the plots had any routinely unsearchable areas due to trees, fences, or other obstructions. The TWL area correction for bats in the fall was calculated using a Gompertz distribution, as 0.74 at full plots and 0.08 at roads and pads (Tables 14 and 15, Figure 4).

Table 14. Search area adjustment models for bats from the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Distribution	AICc	Delta AICc
Gompertz	21,387.02	0*
normal	21,485.16	98.14
Rayleigh	21,521.13	134.12
Weibull	21,521.92	134.91
gamma	21,566.03	179.01

* Selected model.

AICc = corrected Akaike Information Criterion.

Table 15. Truncated weighted maximum likelihood search area adjustment estimates for the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020*.

Plot Type	Distribution	Parameter 1	Parameter 2	Area Correction
70-meter plot	Gompertz	0.0397	0.0037	0.74
road and pad	Gompertz	0.0397	0.0037	0.08

* n = 426 bats.

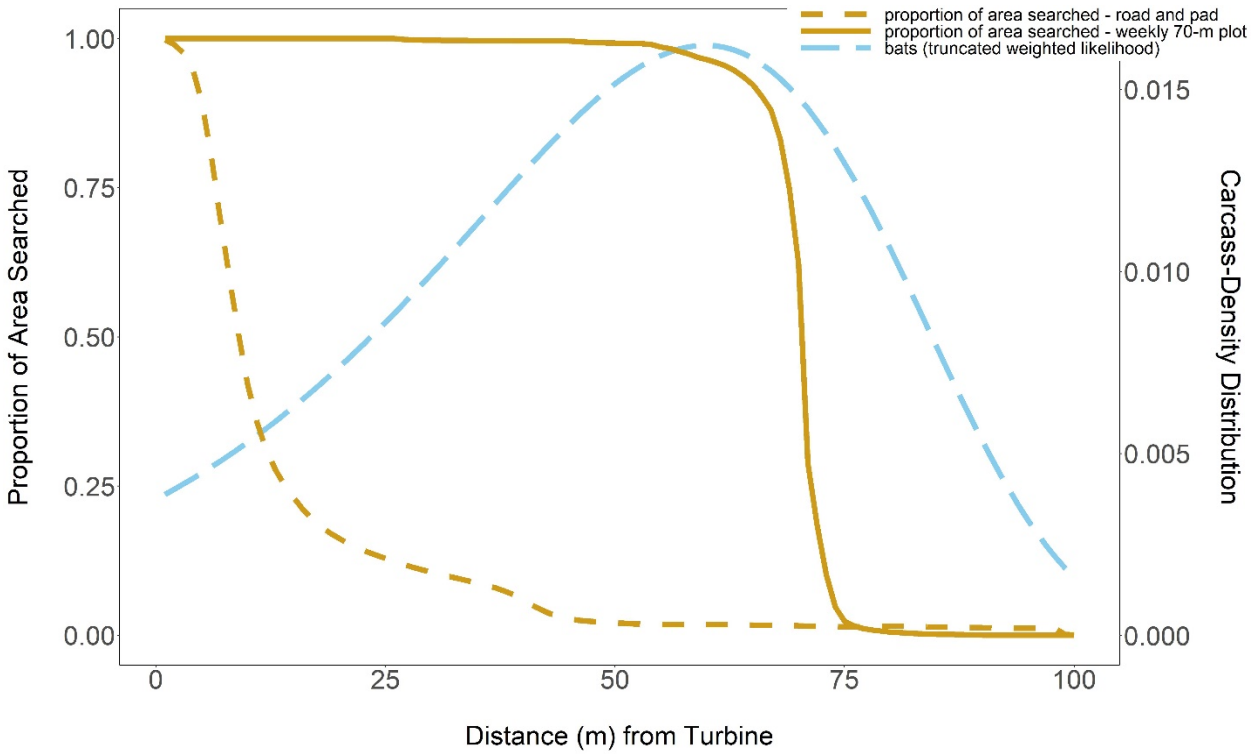


Figure 4. Density of bat carcasses per area searched at all roads and pads and 70-meter plots at the Headwaters Wind Farm, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Indiana Bat and Northern Long-eared Bat Take Estimates

Evidence of Absence Framework

One Indiana bat and zero northern long-eared bat carcasses were found during the study. The overall g achieved for the 2020 monitoring period was 0.23 (90% CI: 0.22, 0.25). The expected value of g = 0.25 falls within the 90% CI overall monitoring period, indicating there is no statistical difference between the target *g* and realized *g* for the 2020 monitoring effort. Inputs required to run the EoA Single Class module are shown in Table 16. Stratum specific *g* values and inputs required for the multiple class module are in Tables 17, 18, and Appendix C.

Table 16. Inputs needed to run Evidence of Absence: Single Class Module for the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

		Search	Number of	Spatial	Temporal	Searcher Efficiency		Results	
Season	Plot Type	interval (l)	searches	coverage (a)	coverage (v)	Carcasses available	Carcasses found	Ba	Bb
spring	road/pad	14	4	1	1	48	47	62.52	40.47
summer	cleared	7	10	1	1	80	54	59.52	41.81
summer	road/pad	7	11	1	1	48	47	101.46	36.17
fall.1	cleared	7	6	1	1	80	54	59.64	44.40
fall.1	uncleared	7	6	1	1	80	54	59.64	44.40
fall.1	road/pad	7	6	1	1	48	47	101.52	36.46
fall.2	cleared	7	4	1	1	80	54	58.21	47.77
fall.2	uncleared	7	5	1	1	80	54	59.35	45.70
fall.2	road/pad	7	5	1	1	48	47	101.14	36.48

k was assumed to be 0.67 for all strata. A weibull distribution with a shape (α) of 17.150 and scale (β) of 10.957 was assumed for carcass persistence. Ninety-five percent upper and lower confidence intervals on (β) were set at 10.957 and 26.816. The Ba and Bb columns report the estimated parameters for the Beta distribution describing the probability of detection (*g*) in each search strata. For the Single Class Module, we use spatial coverage and temporal coverage values set to 1. The detection probability distributions are weighted according to sampling fraction, area adjustment, and temporal coverage (i.e., arrival proportions) when combining across strata in the Multiple Class Module of EoA.

Table 17. Weights applied to search strata in the Evidence of Absence Multiple Class Module, for the Headwaters Wind Energy Project, Randolph County, Indiana.

Season	Plot Type	Area Correction	Arrival Weight	Sampling Fraction	dwp
spring	road/pad	0.08	0.10	1.00	0.01
summer	cleared	0.74	0.53	0.09	0.04
summer	road/pad	0.08	0.53	0.01	0.00
fall.1	cleared	0.74	0.41	0.39	0.12
fall.1	uncleared	0.74	0.41	0.13	0.04
fall.1	road/pad	0.08	0.41	0.48	0.02
fall.2	cleared	0.74	0.44	0.38	0.12
fall.2	uncleared	0.74	0.44	0.13	0.04
fall.2	road/pad	0.08	0.44	0.48	0.02

The weight for each strata (dwp) is the product of the area correction, arrival weight, and sampling fraction associated with each strata. Unsearched areas are inputted in the EoA Multiple Class Module with equivalent weights and all dwp must sum to one. See Appendix B1 for full inputs.

Table 18. Inputs for the Evidence of Absence Multiple Years module and the associated detection probabilities for each year for the Headwaters Wind Energy Project, Randolph County, Indiana.

Year	ρ	Ba	Bb	$\hat{g}$ (90% CI)
2019	0.88	34.92	147.62	0.19 (0.15, 0.24)
2020	1.00	522.96	1728.37	0.23 (0.22, 0.25)
Overall	–	171.54	633.61	0.21 (0.19, 0.24)

Note: The "Overall" detection probability distribution parameters and estimate are a weighted average of the 2019 and 2020 detection probability distributions.

CI = confidence intervals.

Adaptive Management—Evidence of Absence Short-term Trigger

Mean annual take rate was estimated to be 5.91 (90% CI = 1.340, 13.140) Indiana bats per year and 1.18 (90% CI = less than 0.005, 4.540) northern long-eared bats per year (Table 18). The expected annual take rate reported in the HCP is 9.55 Indiana bats per year and 2.53 northern long-eared bats per year. The short-term trigger assesses the probability that the estimated take rate exceeds the expected take rate, $\Pr(\lambda > \tau)$. At a 95% confidence level ($\alpha = 0.05$), $\Pr(\lambda > \tau)$ must be greater than or equal to 0.95 for the short-term trigger to fire. For Indiana bat, $\Pr(\lambda > \tau) = 0.152$ (Table 20). For northern long-eared bat, $\Pr(\lambda > \tau) = 0.143$ (Table 20). Neither probability meets or exceeds 0.95, indicating the short-term trigger was not met and no adaptive management actions are necessary (Figure 5).

Adaptive Management—Evidence of Absence Long-term Trigger

Cumulative take to-date, M^* at $\alpha = 0.5$ (50^{th} credible bound), is estimated to be 10 for Indiana bat and zero for northern long-eared bat (Table 21). These values fall below the total permitted take for each species (258 Indiana bats and 68 northern long-eared bat over the 27-year permit term). The long-term trigger was not met and the Project is in compliance for both species because $M^* < T$ for both species. Therefore, an avoidance response is not necessary.

Table 19. Estimated fatality rate (λ) using Evidence of Absence for studies conducted at the Headwaters Wind Farm from April 1, 2020 to October 15, 2020.

Species	Mean λ	95% CI
Indiana bat	5.91	1.340, 13.140
Northern long-eared bat	1.18	<0.005, 4.540

CI = Confidence Interval.

Table 20. Probability the estimated take rates exceeded the expected take rates of 9.55 Indiana bats per year and 2.53 northern long-eared bats per year. Probabilities were calculated using Evidence of Absence for studies conducted at Headwaters Wind Farm, April 1, 2020 to October 15, 2020.

Species	Expected Take Rate (τ)	Pr(λ > τ)*	Short-term trigger fires at α = 0.05?
Indiana bat	9.55	0.152	No
Northern long-eared bat	2.53	0.143	No

* Pr(λ > τ) reads, "the probability that λ (the annual take rate) is greater than τ (the expected annual take rate based on the total permitted take, used as a threshold for adaptive management)." If this probability is less than 0.95 (e.g., α = 0.05 for a one-sided test), then no adaptive management is triggered because there is not sufficient evidence that the estimated annual take rate is greater than the expected annual take rate.

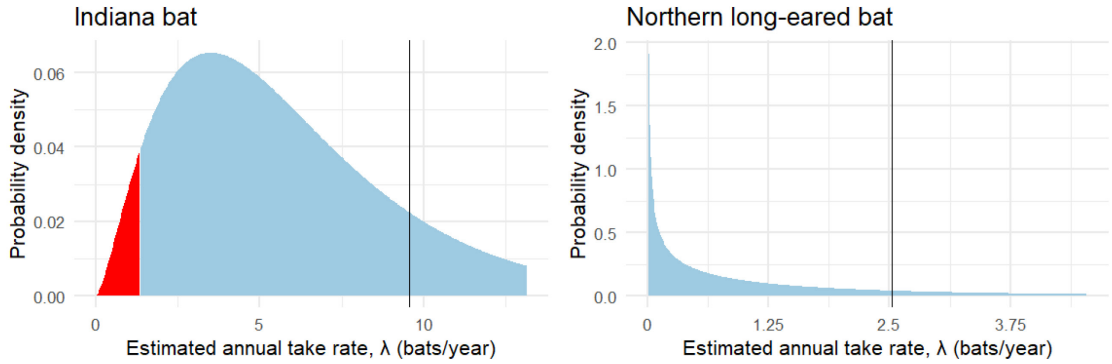


Figure 5. Posterior distributions of the estimated annual take rate at Headwaters Wind Farm, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Note: The red region of the posterior distributions shows the region of the lower 5% quantile of the distributions (red region may not be visible when the posterior distribution is skewed heavily toward zero). The vertical line marks the expected take rate. The short-term trigger evaluates whether the vertical line falls within or to the left of the red region of the posterior distributions. For both species, the short-term trigger is not met because the vertical line (expected take rate) is not within or to the left of the red regions. In other words, the probability that estimated take rate is greater than the expected take rate does not exceed 95%.

Table 21. Cumulative take estimate to date using Evidence of Absence for studies conducted at Headwaters Wind Farm, July 2, 2019 to October 15, 2020.

Species	Cumulative take (M*)	Permitted Take (T)	Long-term trigger fires at α = 0.5?
Indiana bat (50th credible bound)	10	258	No
northern long-eared bat (50th credible bound)	0	68	No

DISCUSSION

The monitoring completed during 2020 provided evidence that minimization measures implemented at the HWF reduced the take of Indiana bat and northern long-eared bats to a rate that is compatible with ITP compliance over the duration of the permit term. The overall *g* achieved for the 2020 monitoring period fell within the 90% CI of the target *g* for the monitoring period, indicating there is no statistical difference between the target *g* and realized *g* for the 2020 monitoring effort. The distribution was skewed below g = 0.25 due to a change in the carcass fall distribution compared to 2019. No adaptive management triggers were met for HWF in 2020.

REFERENCES

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

Dalthorp, D. and M. Huso. 2015. A Framework for Decision Points to Trigger Adaptive Management Actions in Long-Term Incidental Take Permits. US Geological Survey Open-File Report 2015-1227. 88 pp. doi: 10.3133/ofr20151227. Available online: https://pubs.usgs.gov/of/2015/1227/ofr20151227.pdf

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

EDM International, Inc. (EDM). 2020. Guide to Raptor Remains. EDM, Fort Collins, Colorado. Accessed November 2020. Information online: https://edmlink.com/component/zoo/item/guide-to-raptor-remains

Esri. 2020. World Imagery and Aerial Photos. (World Topo). ArcGIS Resource Center. Environmental Systems Research Institute (Esri), producers of ArcGIS software, Redlands, California. Last updated October 14, 2020. Information online: https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=10df2279f9684e4a9f6a7f08febac2a9

Helfers, F. 2017. The Nose Work Handler - Foundation to Finesse. Dogwise Publishing, Wenatchee, WA. 144 pp.

Huso, M., D. Dalthorp, and F. Korner-Nievergelt. 2017. Statistical Principles of Post-Construction Fatality Monitoring Design. Pp. *In*: M. Perrow, ed. Wildlife and Wind Farms, Conflicts and Solutions. Pelagic Publishing, Exeter, United Kingdom. Vol. 2, Onshore: Monitoring and Mitigation.

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

Kay, D. 2012. Super Sniffer Drill Book - a Workbook for Training Detector Dogs. Coveran Publishing House, 86 pp.

Khokan, M. R., W. Bari, and J. A. Khan. 2013. Weighted Maximum Likelihood Approach for Robust Estimation: Weibull Model. Dhaka University Journal of Science 61(2): 153-156.

National Land Cover Database (NLCD). 2016. *As cited* includes:

Yang, L., S. Jin, P. Danielson, C. Homer, L. Gass, S. M. Bender, A. Case, C. Costello, J. Dewitz, J. Fry, M. Funk, B. Granneman, G. C. Liknes, M. Rigge, and G. Xian. 2018. A New Generation of the United States National Land Cover Database: Requirements, Research Priorities, Design, and Implementation Strategies. ISPRS Journal of Photogrammetry and Remote Sensing 146: 108-123. doi: 10.1016/j.isprsjprs.2018.09.006.

and

Multi-Resolution Land Characteristics (MRLC). 2019. National Land Cover Database (NLCD) 2016. Multi-Resolution Land Characteristics (MRLC) Consortium. US Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center, MRLC Project, Sioux Falls, South Dakota. May 10, 2019. Information online: https://www.mrlc.gov/data

North American Datum (NAD). 1983. NAD83 Geodetic Datum.

R Development Core Team. 2016. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. Information online: http://www.R-project.org/

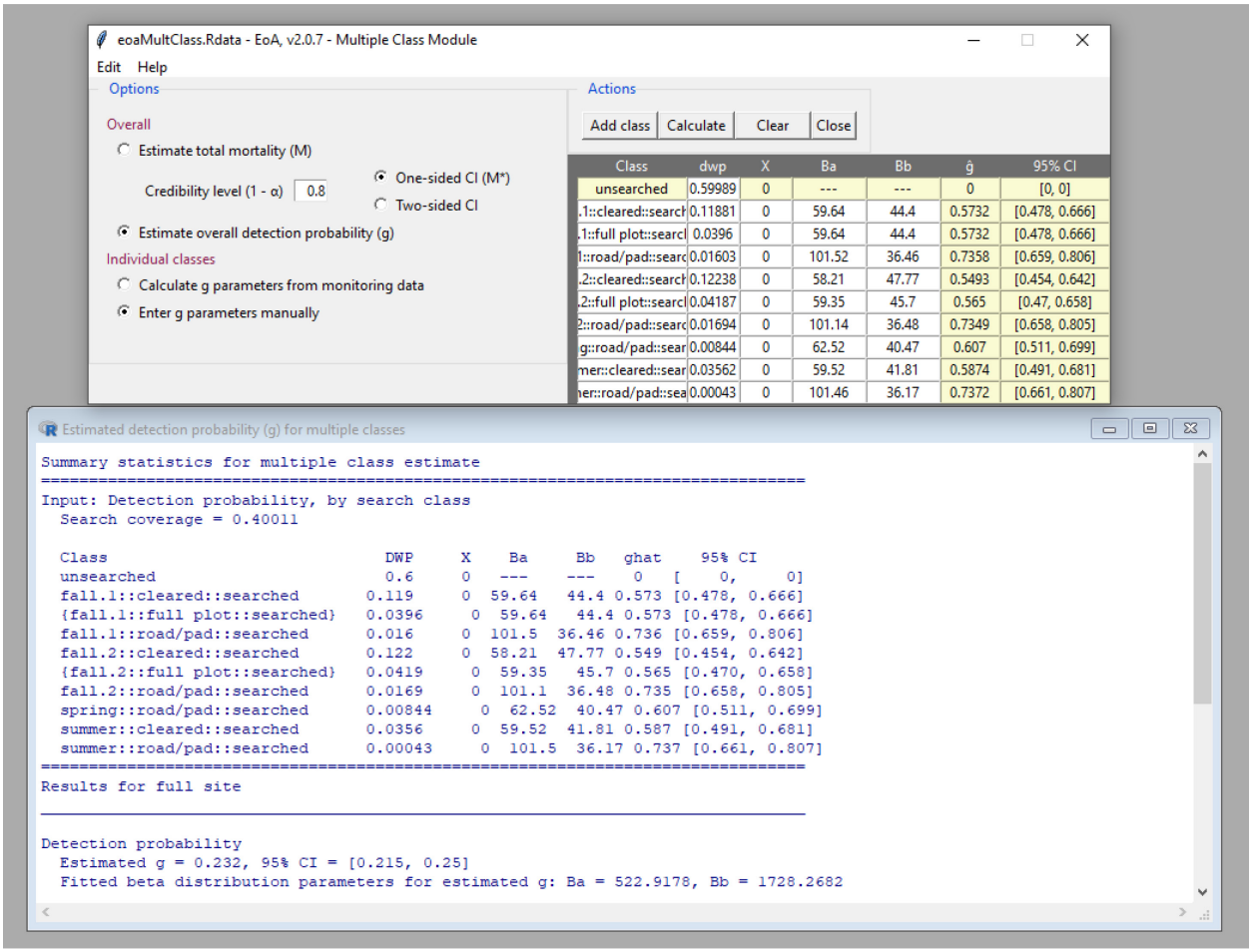
Schwartz, C. W., E. R. Schwartz, D. Fantz, V. L. Jackson, and Missouri Department of Conservation (MDC). 2016. The Wild Mammals of Missouri. Third Revised Edition. Univeresity of Missouri Press and MDC, Columbia, Missouri. 426 pp.

US Fish and Wildlife Service (USFWS). 2020. The Feather Atlas. Flight Feathers of North American Birds, USFWS Forensics Laboratory. Last Update February 28, 2020. Accessed November 2020. Information online: https://www.fws.gov/lab/featheratlas/

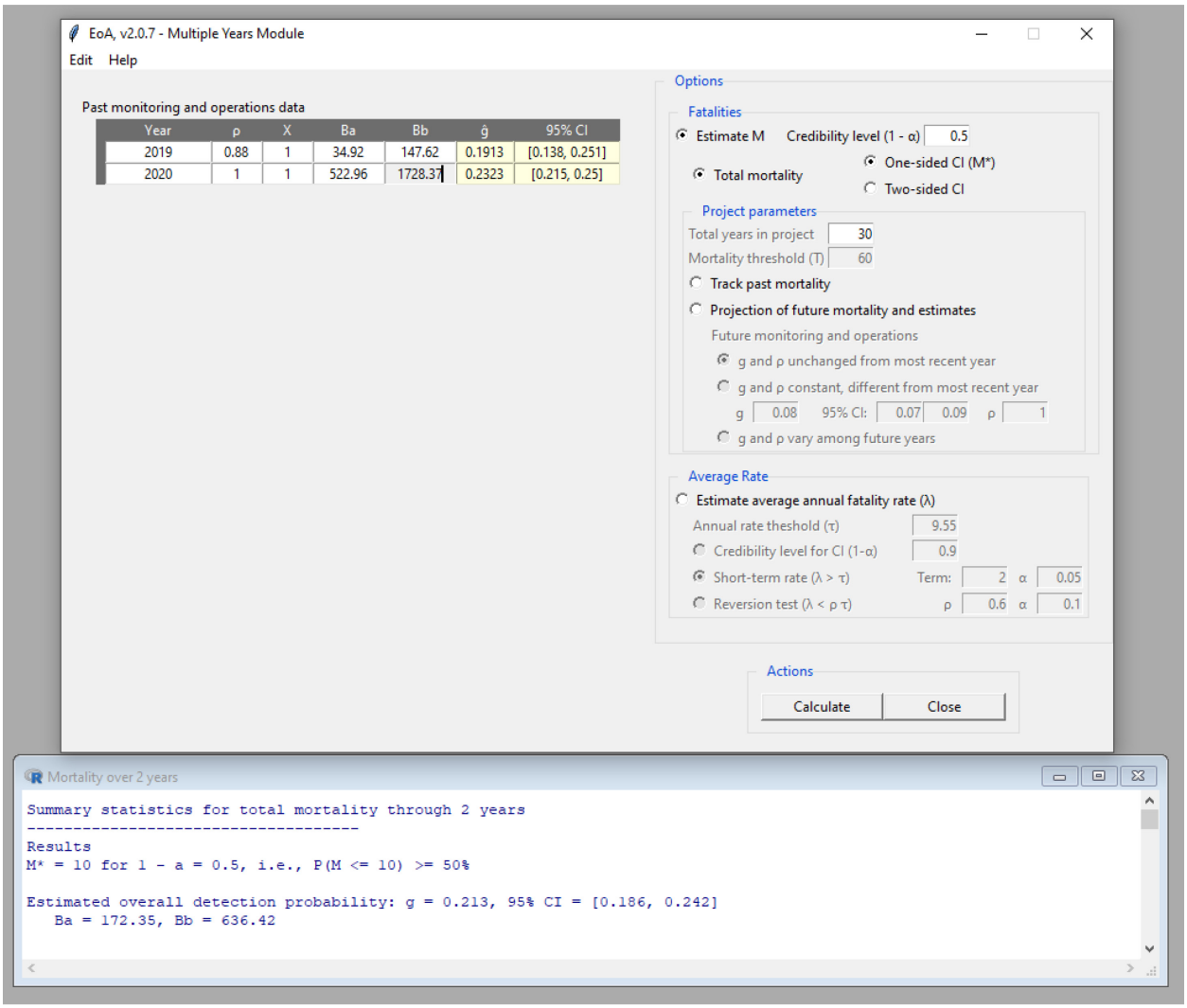
Whitaker, J. O. and R. E. Mumford, eds. 2009. Mammals of Indiana. Indiana University Press, Bloomington, Indiana. 660 pp.,

Yee, T. and C. Moler. 2020. Vgam: Vector Generalized Linear and Additive Models. R package version 1.13. April 28, 2020. Information online: https://cran.r-project.org/web/packages/VGAM/index.html

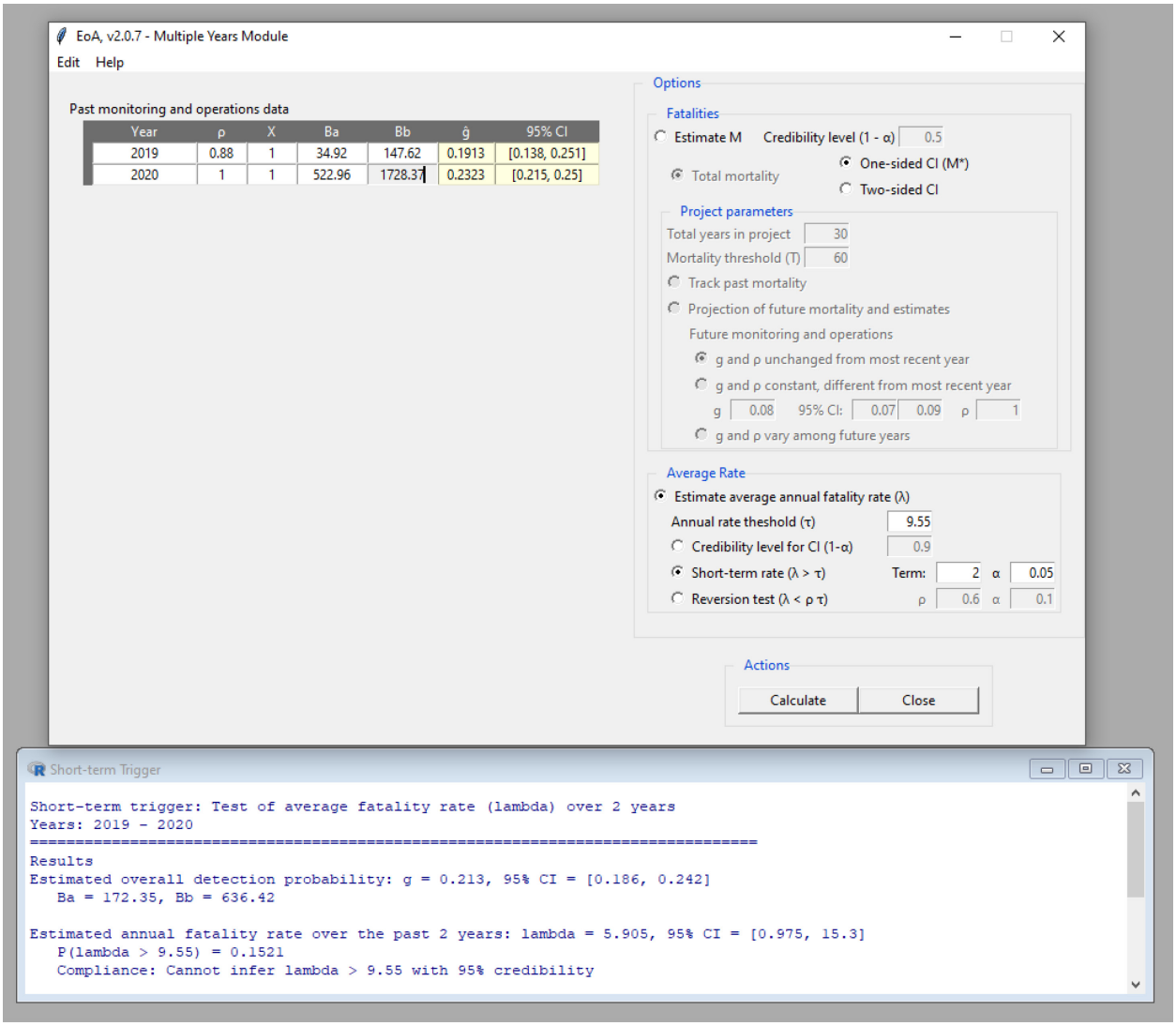
Appendix A. Additional Information for the Evidence of Absence Analysis



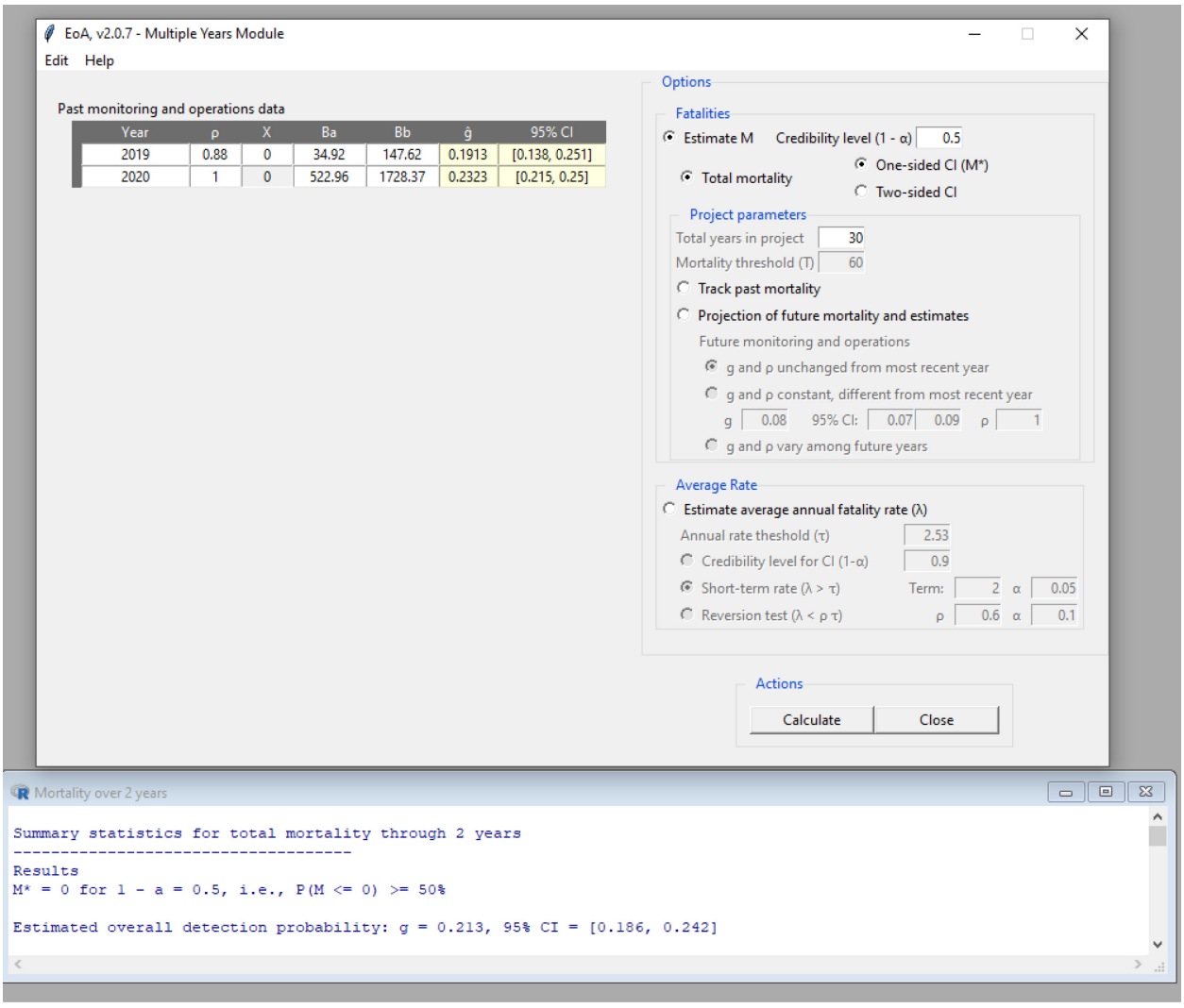
Appendix A1. Inputs and outputs from the Evidence of Absence Graphical User Interface Multiple Class Module for Indiana bat and northern long-eared bat. Inputs are based on values reported in the main text.



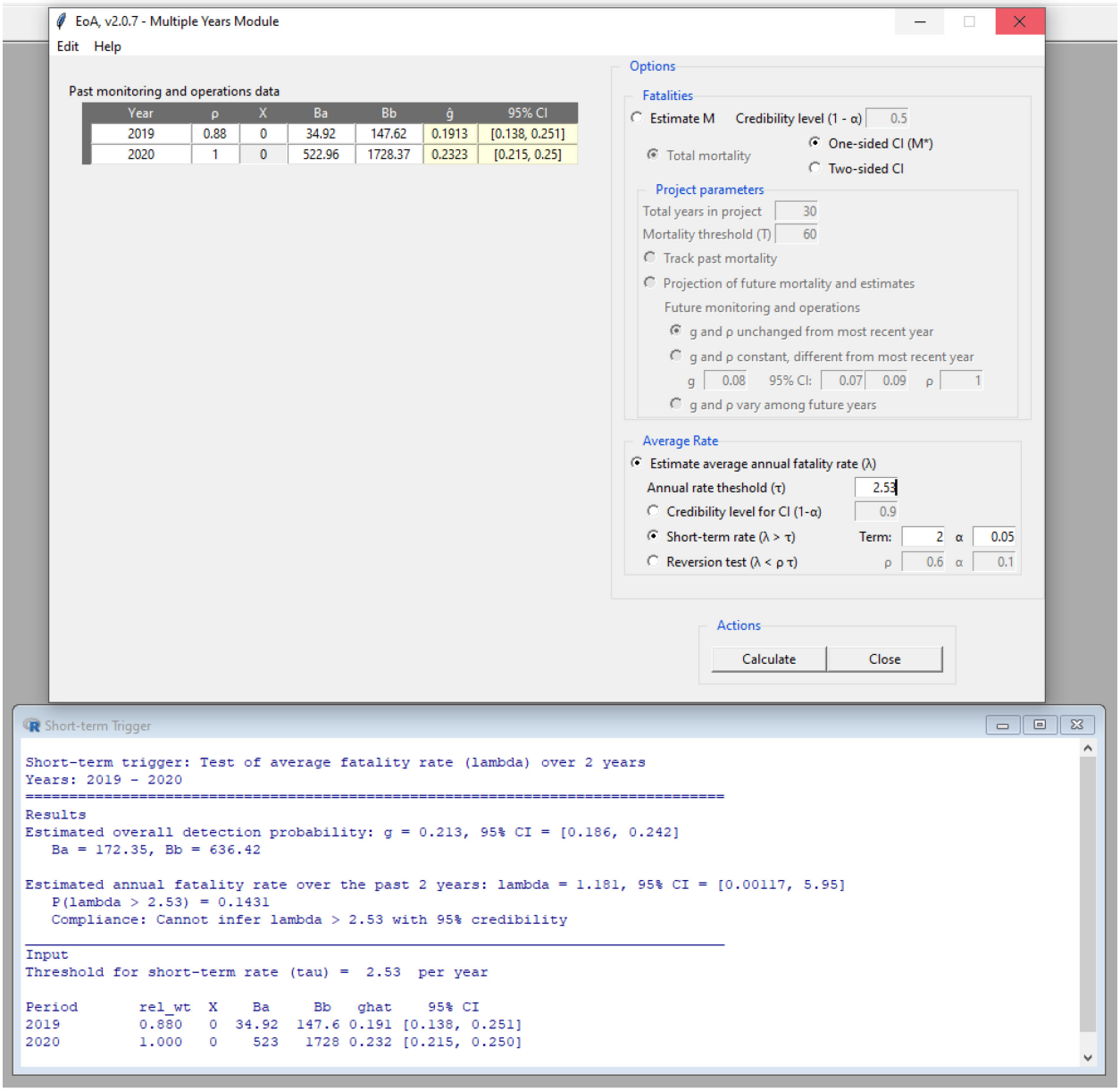
Appendix A2. Inputs and outputs from the Evidence of Absence Graphical User Interface Multiple Years module for the M* calculation for Indiana bat.



Appendix A3. Inputs and outputs from the Evidence of Absence Graphical User Interface Multiple Years module for the short-term trigger test for Indiana bat.



Appendix A4. Inputs and outputs from the Evidence of Absence Graphical User Interface Multiple Years module for the M* calculation for northern long-eared bat.



Appendix A5. Inputs and outputs from the Evidence of Absence Graphical User Interface Multiple Years module for the short-term trigger test for northern long-eared bat.

Appendix B. Fatality Listing for 2020 Post-construction Surveys at the Headwaters Wind Farm

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
Bat Carcasses					
4/1/2020	eastern red bat	100	9	100-m road/pad	intact
4/4/2020	hoary bat	23	30	100-m road/pad	intact
4/13/2020	eastern red bat	80	4	100-m road/pad	scavenged
4/14/2020	eastern red bat	31	54	100-m road/pad	scavenged
4/14/2020	silver-haired bat	10	51	100-m road/pad	intact
4/28/2020	silver-haired bat	82	34	100-m road/pad	intact
4/28/2020	silver-haired bat	0	49	100-m road/pad	scavenged
4/29/2020	silver-haired bat	51	88	100-m road/pad	scavenged
4/30/2020	silver-haired bat	34	40	100-m road/pad	injured
4/30/2020	silver-haired bat	41	71	100-m road/pad	scavenged
4/30/2020	silver-haired bat	1	74	100-m road/pad	scavenged
5/13/2020	silver-haired bat	37	79	100-m road/pad	intact
5/14/2020	hoary bat	28	67	100-m road/pad	intact
5/20/2020	big brown bat	24	70	70-m plot	intact
5/20/2020	silver-haired bat	30	39	70-m plot	dismembered
5/20/2020	silver-haired bat	38	71	70-m plot	scavenged
5/26/2020	eastern red bat	25	1	off plot incidental	scavenged
5/26/2020	silver-haired bat	41	59	100-m road/pad	scavenged
5/27/2020	hoary bat	31	39	70-m plot	scavenged
6/2/2020	silver-haired bat	39	40	70-m plot	scavenged
6/16/2020	eastern red bat	63	40	70-m plot	intact
7/28/2020	eastern red bat	40	95	70-m plot	scavenged
8/3/2020	big brown bat	5	29	70-m plot	scavenged
8/3/2020	hoary bat	36	18	70-m plot	scavenged
8/4/2020	big brown bat	44	61	70-m plot	scavenged
8/4/2020	big brown bat	29	90	100-m road/pad	scavenged
8/4/2020	big brown bat	11	94	100-m road/pad	scavenged
8/4/2020	eastern red bat	28	11	70-m plot	dismembered
8/4/2020	eastern red bat	38	2	100-m road/pad	scavenged
8/4/2020	eastern red bat	13	37	70-m plot	scavenged
8/4/2020	eastern red bat	31	57	70-m plot	scavenged
8/4/2020	eastern red bat	5	78	100-m road/pad	intact
8/4/2020	eastern red bat	6	99	100-m road/pad	scavenged
8/4/2020	hoary bat	64	60	70-m plot	scavenged
8/4/2020	hoary bat	69	61	70-m plot	scavenged
8/6/2020	big brown bat	3	50	100-m road/pad	scavenged
8/6/2020	big brown bat	24	69	70-m plot	scavenged
8/6/2020	big brown bat	25	71	70-m plot	scavenged
8/6/2020	eastern red bat	5	47	100-m road/pad	scavenged
8/6/2020	eastern red bat	10	6	70-m plot	scavenged
8/6/2020	eastern red bat	18	67	100-m road/pad	scavenged
8/6/2020	eastern red bat	30	72	100-m road/pad	scavenged
8/6/2020	evening bat	36	83	70-m plot	scavenged
8/6/2020	hoary bat	33	75	70-m plot	scavenged
8/6/2020	hoary bat	38	75	70-m plot	scavenged
8/6/2020	hoary bat	19	87	70-m plot	dismembered
8/7/2020	big brown bat	63	39	70-m plot	scavenged
8/7/2020	big brown bat	6	93	70-m plot	scavenged
8/7/2020	big brown bat	31	97	70-m plot	scavenged
8/7/2020	eastern red bat	23	100	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
8/7/2020	hoary bat	32	74	70-m plot	scavenged
8/10/2020	big brown bat	51	24	70-m plot	scavenged
8/11/2020	big brown bat	63	34	70-m plot	scavenged
8/11/2020	big brown bat	28	7	100-m road/pad	intact
8/11/2020	eastern red bat	23	37	70-m plot	scavenged
8/11/2020	eastern red bat	15	5	70-m plot	scavenged
8/11/2020	eastern red bat	17	61	70-m plot	intact
8/11/2020	hoary bat	47	6	70-m plot	scavenged
8/11/2020	hoary bat	11	94	100-m road/pad	scavenged
8/13/2020	big brown bat	27	60	70-m plot	scavenged
8/13/2020	big brown bat	42	86	70-m plot	scavenged
8/13/2020	eastern red bat	56	41	70-m plot	dismembered
8/13/2020	eastern red bat	5	44	100-m road/pad	scavenged
8/13/2020	eastern red bat	59	47	100-m road/pad	intact
8/13/2020	eastern red bat	15	59	100-m road/pad	intact
8/13/2020	eastern red bat	24	63	70-m plot	scavenged
8/13/2020	eastern red bat	66	79	70-m plot	scavenged
8/13/2020	eastern red bat	73	79	70-m plot	scavenged
8/13/2020	eastern red bat	32	80	70-m plot	scavenged
8/13/2020	eastern red bat	26	86	70-m plot	scavenged
8/13/2020	eastern red bat	34	88	70-m plot	dismembered
8/14/2020	big brown bat	12	65	70-m plot	dismembered
8/14/2020	big brown bat	42	70	70-m plot	scavenged
8/14/2020	big brown bat	32	71	70-m plot	scavenged
8/14/2020	big brown bat	21	74	70-m plot	scavenged
8/14/2020	eastern red bat	35	39	70-m plot	scavenged
8/14/2020	eastern red bat	37	39	70-m plot	scavenged
8/14/2020	eastern red bat	39	39	70-m plot	scavenged
8/14/2020	hoary bat	25	65	70-m plot	dismembered
8/14/2020	hoary bat	24	71	70-m plot	scavenged
8/14/2020	hoary bat	22	76	70-m plot	scavenged
8/14/2020	hoary bat	64	76	70-m plot	scavenged
8/14/2020	unidentified lasiurus bat	51	74	70-m plot	dismembered
8/17/2020	big brown bat	26	11	70-m plot	dismembered
8/17/2020	big brown bat	16	12	70-m plot	intact
8/17/2020	big brown bat	2	20	70-m plot	intact
8/17/2020	big brown bat	5	23	70-m plot	scavenged
8/17/2020	eastern red bat	30	29	70-m plot	scavenged
8/18/2020	big brown bat	31	15	70-m plot	scavenged
8/18/2020	big brown bat	15	28	100-m road/pad	scavenged
8/18/2020	big brown bat	39	34	70-m plot	scavenged
8/18/2020	big brown bat	16	53	70-m plot	dismembered
8/18/2020	big brown bat	19	53	70-m plot	scavenged
8/18/2020	big brown bat	7	92	100-m road/pad	scavenged
8/18/2020	eastern red bat	17	2	100-m road/pad	scavenged
8/18/2020	eastern red bat	51	58	70-m plot	scavenged
8/18/2020	eastern red bat	46	58	70-m plot	scavenged
8/18/2020	eastern red bat	40	58	70-m plot	scavenged
8/18/2020	eastern red bat	50	58	70-m plot	scavenged
8/18/2020	eastern red bat	46	58	70-m plot	scavenged
8/18/2020	eastern red bat	54	75	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
8/18/2020	eastern red bat	10	99	100-m road/pad	scavenged
8/18/2020	evening bat	11	53	70-m plot	dismembered
8/18/2020	hoary bat	54	58	70-m plot	dismembered
8/18/2020	hoary bat	31	58	70-m plot	scavenged
8/18/2020	hoary bat	4	8	100-m road/pad	scavenged
8/19/2020	big brown bat	31	26	70-m plot	scavenged
8/19/2020	eastern red bat	21	26	70-m plot	scavenged
8/19/2020	eastern red bat	57	57	70-m plot	scavenged
8/19/2020	eastern red bat	35	57	70-m plot	dismembered
8/19/2020	hoary bat	55	57	70-m plot	scavenged
8/20/2020	big brown bat	8	60	70-m plot	scavenged
8/20/2020	big brown bat	30	79	70-m plot	scavenged
8/20/2020	eastern red bat	17	10	70-m plot	scavenged
8/20/2020	eastern red bat	30	64	100-m road/pad	intact
8/20/2020	eastern red bat	33	79	70-m plot	scavenged
8/20/2020	eastern red bat	8	84	100-m road/pad	scavenged
8/20/2020	hoary bat	50	60	70-m plot	scavenged
8/20/2020	hoary bat	51	60	70-m plot	scavenged
8/20/2020	hoary bat	23	80	70-m plot	scavenged
8/25/2020	big brown bat	25	13	100-m road/pad	scavenged
8/25/2020	big brown bat	43	26	70-m plot	scavenged
8/25/2020	big brown bat	16	45	100-m road/pad	intact
8/25/2020	big brown bat	42	53	70-m plot	scavenged
8/25/2020	big brown bat	20	53	70-m plot	intact
8/25/2020	big brown bat	18	63	70-m plot	intact
8/25/2020	eastern red bat	6	17	70-m plot	scavenged
8/25/2020	eastern red bat	32	26	70-m plot	scavenged
8/25/2020	eastern red bat	16	3	100-m road/pad	intact
8/25/2020	eastern red bat	30	3	100-m road/pad	scavenged
8/25/2020	eastern red bat	23	37	70-m plot	scavenged
8/25/2020	eastern red bat	33	60	70-m plot	scavenged
8/25/2020	hoary bat	23	60	70-m plot	dismembered
8/26/2020	eastern red bat	54	15	70-m plot	scavenged
8/27/2020	big brown bat	20	10	70-m plot	scavenged
8/27/2020	big brown bat	9	27	100-m road/pad	dismembered
8/27/2020	big brown bat	24	34	70-m plot	scavenged
8/27/2020	big brown bat	18	42	100-m road/pad	scavenged
8/27/2020	big brown bat	15	69	70-m plot	scavenged
8/27/2020	big brown bat	33	69	70-m plot	intact
8/27/2020	big brown bat	38	79	70-m plot	scavenged
8/27/2020	big brown bat	30	83	70-m plot	scavenged
8/27/2020	big brown bat	56	86	70-m plot	intact
8/27/2020	eastern red bat	51	10	70-m plot	scavenged
8/27/2020	eastern red bat	44	34	70-m plot	scavenged
8/27/2020	eastern red bat	26	44	100-m road/pad	intact
8/27/2020	eastern red bat	25	79	70-m plot	intact
8/27/2020	eastern red bat	34	87	70-m plot	scavenged
8/27/2020	eastern red bat	50	87	70-m plot	scavenged
8/27/2020	hoary bat	33	6	70-m plot	scavenged
8/27/2020	hoary bat	24	69	70-m plot	scavenged
8/27/2020	hoary bat	12	87	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
8/27/2020	silver-haired bat	72	85	100-m road/pad	scavenged
8/28/2020	eastern red bat	41	71	70-m plot	dismembered
8/28/2020	little brown bat	54	100	70-m plot	scavenged
8/29/2020	big brown bat	21	40	70-m plot	intact
8/29/2020	big brown bat	19	65	70-m plot	dismembered
8/29/2020	big brown bat	28	77	70-m plot	scavenged
8/29/2020	big brown bat	15	77	70-m plot	scavenged
8/29/2020	eastern red bat	42	39	70-m plot	scavenged
8/29/2020	eastern red bat	22	39	70-m plot	scavenged
8/29/2020	eastern red bat	31	40	70-m plot	scavenged
8/29/2020	eastern red bat	25	77	70-m plot	scavenged
8/29/2020	hoary bat	27	39	70-m plot	scavenged
8/29/2020	silver-haired bat	24	77	70-m plot	scavenged
8/29/2020	unidentified lasiurus bat	36	65	70-m plot	dismembered
8/31/2020	big brown bat	10	18	70-m plot	dismembered
8/31/2020	big brown bat	1	25	70-m plot	scavenged
8/31/2020	big brown bat	31	25	70-m plot	scavenged
8/31/2020	big brown bat	21	29	70-m plot	scavenged
8/31/2020	eastern red bat	38	11	70-m plot	dismembered
8/31/2020	eastern red bat	55	11	70-m plot	intact
8/31/2020	eastern red bat	63	12	70-m plot	scavenged
8/31/2020	eastern red bat	31	15	70-m plot	intact
8/31/2020	eastern red bat	50	19	70-m plot	scavenged
8/31/2020	hoary bat	38	19	70-m plot	dismembered
8/31/2020	hoary bat	30	2	100-m road/pad	scavenged
8/31/2020	hoary bat	50	29	70-m plot	scavenged
8/31/2020	hoary bat	47	32	70-m plot	dismembered
8/31/2020	unidentified non-myotis	22	19	70-m plot	dismembered
9/1/2020	big brown bat	26	15	70-m plot	scavenged
9/1/2020	big brown bat	27	53	70-m plot	dismembered
9/1/2020	big brown bat	51	60	70-m plot	scavenged
9/1/2020	eastern red bat	55	15	70-m plot	scavenged
9/1/2020	eastern red bat	16	15	70-m plot	scavenged
9/1/2020	eastern red bat	39	49	70-m plot	scavenged
9/1/2020	eastern red bat	35	53	70-m plot	dismembered
9/1/2020	eastern red bat	31	57	70-m plot	dismembered
9/1/2020	eastern red bat	50	58	70-m plot	scavenged
9/1/2020	eastern red bat	39	61	70-m plot	intact
9/1/2020	eastern red bat	54	61	70-m plot	scavenged
9/1/2020	eastern red bat	50	61	70-m plot	scavenged
9/1/2020	eastern red bat	2	94	100-m road/pad	scavenged
9/1/2020	eastern red bat	27	99	100-m road/pad	scavenged
9/1/2020	hoary bat	28	15	70-m plot	intact
9/1/2020	hoary bat	23	15	70-m plot	scavenged
9/1/2020	hoary bat	43	34	70-m plot	scavenged
9/1/2020	hoary bat	34	61	70-m plot	intact
9/1/2020	silver-haired bat	29	15	70-m plot	scavenged
9/1/2020	silver-haired bat	37	15	70-m plot	scavenged
9/1/2020	silver-haired bat	63	15	70-m plot	scavenged
9/1/2020	silver-haired bat	31	37	70-m plot	scavenged
9/1/2020	silver-haired bat	41	53	70-m plot	dismembered

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
9/1/2020	silver-haired bat	37	61	70-m plot	scavenged
9/1/2020	silver-haired bat	6	78	100-m road/pad	intact
9/1/2020	silver-haired bat	8	90	100-m road/pad	intact
9/1/2020	silver-haired bat	30	91	100-m road/pad	intact
9/2/2020	big brown bat	29	51	70-m plot	scavenged
9/2/2020	eastern red bat	37	51	70-m plot	scavenged
9/2/2020	eastern red bat	34	51	70-m plot	scavenged
9/2/2020	hoary bat	66	26	70-m plot	dismembered
9/2/2020	hoary bat	7	26	70-m plot	scavenged
9/2/2020	silver-haired bat	20	26	70-m plot	scavenged
9/3/2020	big brown bat	17	5	70-m plot	scavenged
9/3/2020	big brown bat	4	59	100-m road/pad	scavenged
9/3/2020	big brown bat	23	79	70-m plot	scavenged
9/3/2020	eastern red bat	36	79	70-m plot	scavenged
9/3/2020	eastern red bat	27	81	70-m plot	scavenged
9/3/2020	eastern red bat	59	83	70-m plot	dismembered
9/3/2020	hoary bat	5	35	100-m road/pad	scavenged
9/3/2020	silver-haired bat	19	10	70-m plot	scavenged
9/3/2020	silver-haired bat	28	69	70-m plot	scavenged
9/3/2020	silver-haired bat	34	75	70-m plot	scavenged
9/3/2020	silver-haired bat	35	86	70-m plot	scavenged
9/3/2020	silver-haired bat	34	86	70-m plot	scavenged
9/3/2020	silver-haired bat	64	86	70-m plot	dismembered
9/4/2020	eastern red bat	25	71	70-m plot	scavenged
9/4/2020	eastern red bat	27	93	70-m plot	scavenged
9/4/2020	eastern red bat	44	93	70-m plot	scavenged
9/4/2020	eastern red bat	15	93	70-m plot	scavenged
9/4/2020	eastern red bat	36	96	70-m plot	dismembered
9/4/2020	silver-haired bat	18	93	70-m plot	scavenged
9/5/2020	big brown bat	42	17	70-m plot	scavenged
9/5/2020	silver-haired bat	25	17	70-m plot	scavenged
9/5/2020	silver-haired bat	38	19	70-m plot	scavenged
9/7/2020	big brown bat	38	12	70-m plot	scavenged
9/7/2020	big brown bat	68	24	70-m plot	dismembered
9/7/2020	big brown bat	27	24	70-m plot	dismembered
9/7/2020	eastern red bat	12	12	70-m plot	scavenged
9/7/2020	eastern red bat	51	12	70-m plot	scavenged
9/7/2020	hoary bat	39	12	70-m plot	scavenged
9/7/2020	silver-haired bat	12	24	70-m plot	scavenged
9/8/2020	eastern red bat	1	33	100-m road/pad	intact
9/8/2020	eastern red bat	13	37	70-m plot	scavenged
9/8/2020	eastern red bat	30	61	70-m plot	scavenged
9/8/2020	eastern red bat	5	61	70-m plot	dismembered
9/8/2020	hoary bat	27	38	70-m plot	scavenged
9/8/2020	hoary bat	11	45	100-m road/pad	intact
9/8/2020	hoary bat	18	78	100-m road/pad	intact
9/8/2020	silver-haired bat	35	45	100-m road/pad	intact
9/9/2020	eastern red bat	44	15	70-m plot	scavenged
9/9/2020	eastern red bat	50	34	70-m plot	scavenged
9/9/2020	eastern red bat	26	34	70-m plot	scavenged
9/9/2020	eastern red bat	73	51	70-m plot	intact

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
9/9/2020	eastern red bat	55	58	70-m plot	scavenged
9/9/2020	eastern red bat	31	58	70-m plot	scavenged
9/9/2020	hoary bat	54	15	70-m plot	scavenged
9/9/2020	hoary bat	37	35	100-m road/pad	scavenged
9/9/2020	hoary bat	44	51	70-m plot	intact
9/9/2020	silver-haired bat	54	15	70-m plot	scavenged
9/9/2020	silver-haired bat	8	26	70-m plot	scavenged
9/9/2020	silver-haired bat	54	34	70-m plot	intact
9/9/2020	silver-haired bat	36	34	70-m plot	scavenged
9/9/2020	silver-haired bat	64	49	70-m plot	intact
9/9/2020	silver-haired bat	27	6	70-m plot	dismembered
9/9/2020	silver-haired bat	39	6	70-m plot	dismembered
9/9/2020	unidentified non-myotis	15	5	70-m plot	dismembered
9/10/2020	big brown bat	27	67	100-m road/pad	scavenged
9/10/2020	big brown bat	30	83	70-m plot	scavenged
9/10/2020	big brown bat	30	83	70-m plot	scavenged
9/10/2020	eastern red bat	12	43	100-m road/pad	scavenged
9/10/2020	eastern red bat	10	63	70-m plot	dismembered
9/10/2020	eastern red bat	6	67	100-m road/pad	dismembered
9/10/2020	eastern red bat	40	75	70-m plot	dismembered
9/10/2020	eastern red bat	60	75	70-m plot	scavenged
9/10/2020	eastern red bat	52	83	70-m plot	scavenged
9/10/2020	silver-haired bat	37	35	100-m road/pad	scavenged
9/10/2020	silver-haired bat	27	37	70-m plot	scavenged
9/10/2020	silver-haired bat	4	44	100-m road/pad	intact
9/10/2020	silver-haired bat	24	46	100-m road/pad	scavenged
9/10/2020	silver-haired bat	2	54	100-m road/pad	intact
9/10/2020	silver-haired bat	41	60	70-m plot	scavenged
9/10/2020	silver-haired bat	41	60	70-m plot	scavenged
9/10/2020	silver-haired bat	30	60	70-m plot	scavenged
9/10/2020	silver-haired bat	41	67	100-m road/pad	scavenged
9/10/2020	silver-haired bat	50	75	70-m plot	scavenged
9/10/2020	silver-haired bat	12	75	70-m plot	scavenged
9/10/2020	silver-haired bat	62	79	70-m plot	scavenged
9/10/2020	silver-haired bat	34	83	70-m plot	scavenged
9/10/2020	silver-haired bat	57	83	70-m plot	scavenged
9/10/2020	silver-haired bat	33	83	70-m plot	scavenged
9/10/2020	silver-haired bat	18	84	100-m road/pad	intact
9/10/2020	silver-haired bat	15	85	100-m road/pad	scavenged
9/10/2020	silver-haired bat	33	86	70-m plot	scavenged
9/10/2020	silver-haired bat	64	87	70-m plot	scavenged
9/10/2020	silver-haired bat	65	87	70-m plot	scavenged
9/11/2020	big brown bat	71	93	70-m plot	scavenged
9/11/2020	seminole bat	21	64	100-m road/pad	intact
9/11/2020	eastern red bat	53	77	70-m plot	scavenged
9/11/2020	eastern red bat	27	93	70-m plot	scavenged
9/11/2020	eastern red bat	62	93	70-m plot	scavenged
9/11/2020	hoary bat	26	100	70-m plot	intact
9/11/2020	hoary bat	23	76	70-m plot	dismembered
9/11/2020	hoary bat	37	93	70-m plot	scavenged
9/11/2020	silver-haired bat	35	40	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
9/11/2020	silver-haired bat	35	40	70-m plot	scavenged
9/11/2020	silver-haired bat	36	40	70-m plot	scavenged
9/11/2020	silver-haired bat	8	71	70-m plot	scavenged
9/11/2020	silver-haired bat	25	76	70-m plot	intact
9/11/2020	silver-haired bat	25	93	70-m plot	scavenged
9/11/2020	silver-haired bat	19	93	70-m plot	scavenged
9/11/2020	silver-haired bat	15	93	70-m plot	scavenged
9/11/2020	silver-haired bat	63	95	70-m plot	scavenged
9/11/2020	silver-haired bat	65	96	70-m plot	scavenged
9/11/2020	silver-haired bat	53	96	70-m plot	scavenged
9/14/2020	big brown bat	28	53	70-m plot	scavenged
9/14/2020	eastern red bat	40	12	70-m plot	scavenged
9/14/2020	eastern red bat	38	15	70-m plot	scavenged
9/14/2020	eastern red bat	63	15	70-m plot	dismembered
9/14/2020	hoary bat	29	15	70-m plot	scavenged
9/14/2020	silver-haired bat	44	12	70-m plot	scavenged
9/14/2020	silver-haired bat	40	15	70-m plot	scavenged
9/14/2020	silver-haired bat	35	15	70-m plot	scavenged
9/14/2020	silver-haired bat	28	15	70-m plot	scavenged
9/14/2020	silver-haired bat	25	15	70-m plot	scavenged
9/14/2020	silver-haired bat	35	17	70-m plot	scavenged
9/15/2020	eastern red bat	34	57	70-m plot	dismembered
9/15/2020	eastern red bat	38	58	70-m plot	scavenged
9/15/2020	silver-haired bat	15	19	70-m plot	dismembered
9/15/2020	silver-haired bat	20	29	70-m plot	scavenged
9/15/2020	silver-haired bat	13	49	70-m plot	scavenged
9/15/2020	silver-haired bat	63	57	70-m plot	scavenged
9/15/2020	silver-haired bat	41	58	70-m plot	scavenged
9/15/2020	silver-haired bat	31	58	70-m plot	scavenged
9/15/2020	silver-haired bat	38	58	70-m plot	scavenged
9/15/2020	silver-haired bat	38	60	70-m plot	scavenged
9/15/2020	silver-haired bat	52	61	70-m plot	scavenged
9/15/2020	unidentified tree bat	15	58	70-m plot	dismembered
9/17/2020	eastern red bat	8	10	70-m plot	scavenged
9/17/2020	seminole bat	37	75	70-m plot	scavenged
9/17/2020	eastern red bat	53	81	70-m plot	scavenged
9/17/2020	hoary bat	15	81	70-m plot	scavenged
9/17/2020	hoary bat	27	86	70-m plot	dismembered
9/17/2020	silver-haired bat	55	35	100-m road/pad	dismembered
9/17/2020	silver-haired bat	24	48	100-m road/pad	scavenged
9/17/2020	silver-haired bat	29	69	70-m plot	dismembered
9/17/2020	silver-haired bat	38	69	70-m plot	dismembered
9/17/2020	silver-haired bat	39	79	70-m plot	dismembered
9/17/2020	silver-haired bat	28	81	70-m plot	scavenged
9/17/2020	silver-haired bat	44	81	70-m plot	scavenged
9/17/2020	silver-haired bat	55	81	70-m plot	scavenged
9/17/2020	silver-haired bat	33	83	70-m plot	dismembered
9/17/2020	silver-haired bat	37	86	70-m plot	scavenged
9/18/2020	big brown bat	23	74	70-m plot	dismembered
9/18/2020	eastern red bat	46	100	70-m plot	scavenged
9/18/2020	eastern red bat	56	100	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
9/18/2020	eastern red bat	0	93	70-m plot	intact
9/18/2020	eastern red bat	40	96	70-m plot	dismembered
9/18/2020	eastern red bat	33	96	70-m plot	scavenged
9/18/2020	eastern red bat	45	96	70-m plot	scavenged
9/18/2020	eastern red bat	40	96	70-m plot	scavenged
9/18/2020	hoary bat	28	71	70-m plot	scavenged
9/18/2020	hoary bat	45	96	70-m plot	scavenged
9/18/2020	silver-haired bat	55	93	70-m plot	scavenged
9/18/2020	silver-haired bat	21	93	70-m plot	scavenged
9/18/2020	silver-haired bat	16	93	70-m plot	scavenged
9/18/2020	silver-haired bat	37	98	70-m plot	intact
9/18/2020	silver-haired bat	19	98	70-m plot	dismembered
9/18/2020	silver-haired bat	30	98	70-m plot	dismembered
9/18/2020	silver-haired bat	55	98	70-m plot	dismembered
9/21/2020	big brown bat	20	19	70-m plot	scavenged
9/21/2020	big brown bat	33	19	70-m plot	scavenged
9/21/2020	big brown bat	58	24	70-m plot	scavenged
9/21/2020	seminole bat	26	12	70-m plot	scavenged
9/21/2020	silver-haired bat	26	12	70-m plot	dismembered
9/21/2020	silver-haired bat	41	12	70-m plot	scavenged
9/21/2020	silver-haired bat	36	23	70-m plot	scavenged
9/22/2020	eastern red bat	15	27	100-m road/pad	intact
9/22/2020	eastern red bat	8	28	100-m road/pad	intact
9/22/2020	eastern red bat	16	37	70-m plot	dismembered
9/22/2020	eastern red bat	60	58	70-m plot	scavenged
9/22/2020	eastern red bat	35	61	70-m plot	dismembered
9/22/2020	silver-haired bat	49	37	70-m plot	dismembered
9/23/2020	big brown bat	49	60	70-m plot	scavenged
9/23/2020	big brown bat	46	63	70-m plot	scavenged
9/23/2020	silver-haired bat	45	60	70-m plot	scavenged
9/24/2020	big brown bat	32	69	70-m plot	scavenged
9/24/2020	eastern red bat	38	87	70-m plot	scavenged
9/24/2020	silver-haired bat	35	10	70-m plot	scavenged
9/24/2020	silver-haired bat	6	75	70-m plot	dismembered
9/25/2020	big brown bat	21	77	70-m plot	scavenged
9/25/2020	eastern red bat	14	96	70-m plot	scavenged
9/25/2020	hoary bat	37	100	70-m plot	scavenged
9/25/2020	silver-haired bat	20	40	70-m plot	scavenged
9/25/2020	silver-haired bat	39	71	70-m plot	dismembered
9/25/2020	silver-haired bat	36	71	70-m plot	scavenged
9/25/2020	silver-haired bat	41	76	70-m plot	scavenged
9/25/2020	silver-haired bat	47	77	70-m plot	scavenged
9/28/2020	eastern red bat	6	23	70-m plot	scavenged
9/28/2020	hoary bat	39	15	70-m plot	intact
9/28/2020	silver-haired bat	38	15	70-m plot	scavenged
9/28/2020	silver-haired bat	42	15	70-m plot	dismembered
9/28/2020	silver-haired bat	9	15	70-m plot	dismembered
9/28/2020	silver-haired bat	49	29	70-m plot	scavenged
9/29/2020	hoary bat	54	37	70-m plot	scavenged
9/29/2020	hoary bat	44	61	70-m plot	scavenged
9/29/2020	hoary bat	53	61	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
9/29/2020	silver-haired bat	1	34	70-m plot	intact
9/29/2020	silver-haired bat	46	34	70-m plot	dismembered
9/29/2020	silver-haired bat	11	4	100-m road/pad	intact
9/29/2020	silver-haired bat	32	51	70-m plot	scavenged
9/29/2020	silver-haired bat	26	58	70-m plot	scavenged
9/29/2020	silver-haired bat	16	58	70-m plot	dismembered
9/29/2020	silver-haired bat	47	61	70-m plot	scavenged
10/1/2020	eastern red bat	17	44	100-m road/pad	intact
10/1/2020	eastern red bat	43	81	70-m plot	scavenged
10/1/2020	eastern red bat	64	87	70-m plot	dismembered
10/1/2020	hoary bat	27	86	70-m plot	dismembered
10/1/2020	silver-haired bat	55	44	100-m road/pad	intact
10/1/2020	unidentified tree bat	37	80	70-m plot	dismembered
10/2/2020	evening bat	29	100	70-m plot	dismembered
10/2/2020	silver-haired bat	63	77	70-m plot	scavenged
10/3/2020	silver-haired bat	29	96	70-m plot	scavenged
10/5/2020	silver-haired bat	34	17	70-m plot	scavenged
10/5/2020	silver-haired bat	32	32	70-m plot	scavenged
10/6/2020	big brown bat	5	4	100-m road/pad	scavenged
10/6/2020	big brown bat	28	69	70-m plot	scavenged
10/6/2020	eastern red bat	26	34	70-m plot	scavenged
10/6/2020	silver-haired bat	53	69	70-m plot	scavenged
10/8/2020	silver-haired bat	24	72	100-m road/pad	intact
10/8/2020	silver-haired bat	19	83	70-m plot	scavenged
10/9/2020	Indiana bat	18	75	70-m plot	intact
10/10/2020	hoary bat	26	70	70-m plot	dismembered
10/12/2020	eastern red bat	NA	25	70-m plot	NA
10/12/2020	eastern red bat	46	29	70-m plot	intact
10/12/2020	eastern red bat	54	29	70-m plot	dismembered
10/12/2020	silver-haired bat	57	12	70-m plot	scavenged
10/12/2020	silver-haired bat	50	12	70-m plot	intact
10/12/2020	silver-haired bat	26	58	70-m plot	intact
10/13/2020	eastern red bat	9	60	70-m plot	intact
10/13/2020	silver-haired bat	47	63	70-m plot	intact
10/13/2020	silver-haired bat	87	89	100-m road/pad	intact
10/14/2020	big brown bat	59	88	70-m plot	dismembered
10/14/2020	eastern red bat	28	67	100-m road/pad	intact
10/14/2020	eastern red bat	69	79	70-m plot	scavenged
10/14/2020	eastern red bat	29	79	70-m plot	scavenged
10/14/2020	eastern red bat	40	87	70-m plot	scavenged
10/14/2020	silver-haired bat	13	5	70-m plot	dismembered
10/14/2020	silver-haired bat	24	5	70-m plot	intact
10/14/2020	silver-haired bat	9	55	100-m road/pad	intact
10/14/2020	silver-haired bat	14	67	100-m road/pad	intact
10/14/2020	silver-haired bat	27	83	70-m plot	dismembered
Bird Carcasses					
4/1/2020	horned lark	0	27	100-m road/pad	scavenged
4/3/2020	European starling	13	94	100-m road/pad	scavenged
4/15/2020	unidentified swallow	10	96	100-m road/pad	feather spot
4/28/2020	ruby-crowned kinglet	74	38	100-m road/pad	scavenged
5/11/2020	field sparrow	1	8	100-m road/pad	intact

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
5/20/2020	Cooper's hawk	65	70	70-m plot	dismembered
5/20/2020	turkey vulture	67	40	70-m plot	dismembered
5/20/2020	unidentified passerine	55	77	70-m plot	intact
5/27/2020	horned lark	18	96	70-m plot	scavenged
5/27/2020	turkey vulture	55	39	70-m plot	scavenged
6/9/2020	yellow-breasted chat	77	39	70-m plot	scavenged
6/23/2020	unidentified small bird	57	95	70-m plot	dismembered
7/14/2020	unidentified raptor	60	95	70-m plot	dismembered
7/21/2020	barn swallow	10	95	70-m plot	dismembered
7/22/2020	turkey vulture	17	41	70-m plot	dismembered
7/22/2020	unidentified small bird	30	70	70-m plot	dismembered
8/4/2020	horned lark	23	57	70-m plot	feather spot
8/4/2020	killdeer	59	11	70-m plot	feather spot
8/4/2020	killdeer	26	57	70-m plot	feather spot
8/4/2020	killdeer	30	57	70-m plot	feather spot
8/4/2020	mourning dove	83	63	70-m plot	feather spot
8/4/2020	red-tailed hawk	19	34	70-m plot	scavenged
8/4/2020	red-tailed hawk	33	34	70-m plot	dismembered
8/6/2020	brown-headed cowbird	2	84	100-m road/pad	scavenged
8/6/2020	cliff swallow	30	46	100-m road/pad	intact
8/6/2020	field sparrow	83	35	100-m road/pad	intact
8/6/2020	killdeer	55	79	70-m plot	feather spot
8/7/2020	horned lark	56	39	70-m plot	intact
8/7/2020	horned lark	69	70	70-m plot	dismembered
8/7/2020	killdeer	46	96	70-m plot	feather spot
8/7/2020	northern rough-winged swallow	36	96	70-m plot	dismembered
8/7/2020	unidentified sparrow	39	96	70-m plot	feather spot
8/11/2020	horned lark	50	5	70-m plot	feather spot
8/11/2020	horned lark	38	61	70-m plot	scavenged
8/11/2020	red-tailed hawk	31	53	70-m plot	scavenged
8/13/2020	mourning dove	10	63	70-m plot	feather spot
8/14/2020	horned lark	54	77	70-m plot	feather spot
8/14/2020	killdeer	43	71	70-m plot	scavenged
8/14/2020	tree swallow	33	96	70-m plot	scavenged
8/18/2020	Canada warbler	24	15	70-m plot	scavenged
8/18/2020	horned lark	42	15	70-m plot	feather spot
8/19/2020	horned lark	80	57	70-m plot	dismembered
8/20/2020	horned lark	57	63	70-m plot	feather spot
8/20/2020	killdeer	66	5	70-m plot	feather spot
8/20/2020	killdeer	60	80	70-m plot	feather spot
8/20/2020	killdeer	53	80	70-m plot	feather spot
8/20/2020	killdeer	64	80	70-m plot	feather spot
8/20/2020	killdeer	39	86	70-m plot	dismembered
8/21/2020	horned lark	51	100	70-m plot	dismembered
8/22/2020	killdeer	63	98	70-m plot	feather spot
8/24/2020	killdeer	31	21	70-m plot	feather spot
8/24/2020	killdeer	38	21	70-m plot	feather spot
8/24/2020	killdeer	54	21	70-m plot	feather spot
8/24/2020	mourning dove	40	21	70-m plot	feather spot
8/25/2020	mourning dove	51	63	70-m plot	feather spot
8/25/2020	unidentified raptor	23	63	70-m plot	dismembered

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
8/27/2020	horned lark	71	83	70-m plot	feather spot
8/27/2020	killdeer	55	88	70-m plot	feather spot
8/27/2020	killdeer	41	88	70-m plot	feather spot
8/27/2020	killdeer	69	88	70-m plot	feather spot
8/27/2020	mourning dove	73	79	70-m plot	feather spot
8/27/2020	unidentified buteo	0	5	70-m plot	dismembered
8/28/2020	horned lark	64	71	70-m plot	scavenged
8/28/2020	killdeer	54	70	70-m plot	feather spot
8/28/2020	killdeer	53	70	70-m plot	feather spot
8/31/2020	mourning dove	43	21	70-m plot	feather spot
9/1/2020	red-eyed vireo	24	15	70-m plot	intact
9/1/2020	rock pigeon	14	38	70-m plot	intact
9/3/2020	killdeer	170	80	70-m plot	feather spot
9/3/2020	killdeer	50	80	70-m plot	feather spot
9/4/2020	killdeer	27	70	70-m plot	feather spot
9/4/2020	mallard	55	74	70-m plot	dismembered
9/10/2020	horned lark	61	79	70-m plot	feather spot
9/10/2020	horned lark	43	80	70-m plot	feather spot
9/10/2020	rock pigeon	81	36	100-m road/pad	feather spot
9/11/2020	horned lark	59	65	70-m plot	feather spot
9/14/2020	killdeer	59	21	70-m plot	feather spot
9/15/2020	horned lark	60	63	70-m plot	feather spot
9/15/2020	pine warbler	29	58	70-m plot	scavenged
9/15/2020	red-eyed vireo	43	58	70-m plot	scavenged
9/15/2020	unidentified passerine	29	58	70-m plot	dismembered
9/15/2020	unidentified warbler	51	27	100-m road/pad	dismembered
9/17/2020	red-eyed vireo	41	86	70-m plot	scavenged
9/17/2020	yellow-billed cuckoo	40	81	70-m plot	scavenged
9/18/2020	horned lark	NA	70	70-m plot	NA
9/18/2020	pine warbler	49	100	70-m plot	scavenged
9/21/2020	horned lark	66	15	70-m plot	scavenged
9/21/2020	Philadelphia vireo	30	24	70-m plot	scavenged
9/21/2020	unidentified passerine	55	26	70-m plot	dismembered
9/22/2020	killdeer	24	92	100-m road/pad	feather spot
9/22/2020	unidentified warbler	67	51	70-m plot	dismembered
9/23/2020	horned lark	7	60	70-m plot	dismembered
9/23/2020	mallard	36	63	70-m plot	dismembered
9/24/2020	killdeer	37	75	70-m plot	dismembered
9/24/2020	palm warbler	29	6	70-m plot	dismembered
9/24/2020	yellow-throated warbler	31	50	100-m road/pad	scavenged
9/25/2020	horned lark	54	70	70-m plot	feather spot
9/28/2020	American redstart	78	17	70-m plot	scavenged
9/28/2020	killdeer	44	21	70-m plot	feather spot
9/28/2020	turkey vulture	7	17	70-m plot	intact
9/28/2020	turkey vulture	33	23	70-m plot	scavenged
9/28/2020	unidentified passerine	50	29	70-m plot	dismembered
9/29/2020	horned lark	18	34	70-m plot	intact
10/1/2020	unidentified warbler	29	75	70-m plot	intact
10/2/2020	horned lark	62	70	70-m plot	feather spot
10/5/2020	horned lark	46	12	70-m plot	scavenged
10/5/2020	red-breasted nuthatch	35	25	70-m plot	scavenged

Appendix B. Complete listing of carcasses found at the Headwaters Wind Energy Project, Randolph County, Indiana, from April 1, 2020 to October 15, 2020.

Found Date	Common Name	Distance from Turbine	Search Location	Search Type	Physical Condition
10/8/2020	golden-crowned kinglet	67	64	100-m road/pad	intact
10/8/2020	horned lark	26	80	70-m plot	intact
10/9/2020	European starling	17	100	70-m plot	scavenged
10/10/2020	horned lark	38	77	70-m plot	dismembered
10/12/2020	wood thrush	26	23	70-m plot	intact
10/13/2020	mourning dove	0	84	100-m road/pad	intact
10/13/2020	unidentified kinglet	29	69	70-m plot	scavenged
10/14/2020	unidentified warbler	60	83	70-m plot	scavenged

m = meter.

Appendix C. Evidence of Absence Multiple Class Module Inputs

Appendix C1. Evidence of Absence Inputs for the Multiple Class Module for Data Collected at Headwaters Wind Farm, April 1, 2020 to October 15, 2020.

Class	X*	dwp	Ba	Bb
fall.1::cleared::searched	0	0.1188066	59.64157	44.39620
fall.1::cleared::unsearched	0	0.0417448	0.01000	1,000.00000
fall.1:: uncleared::searched	0	0.0396022	59.64157	44.39620
fall.1:: uncleared::unsearched	0	0.0139149	0.01000	1,000.00000
fall.1::road/pad::searched	0	0.0160270	101.51504	36.46339
fall.1::road/pad::unsearched	0	0.1815748	0.01000	1,000.00000
fall.2::cleared::searched	0	0.1223752	58.21054	47.77404
fall.2::cleared::unsearched	0	0.0429987	0.01000	1,000.00000
fall.2:: uncleared::searched	0	0.0418652	59.35076	45.70167
fall.2:: uncleared::unsearched	0	0.0147101	0.01000	1,000.00000
fall.2::road/pad::searched	0	0.0169429	101.14040	36.47576
fall.2::road/pad::unsearched	0	0.1919505	0.01000	1,000.00000
spring::road/pad::searched	0	0.0084353	62.51704	40.47185
spring::road/pad::unsearched	0	0.0955657	0.01000	1,000.00000
summer::cleared::searched	0	0.0356214	59.52286	41.80728
summer::cleared::unsearched	0	0.0125162	0.01000	1,000.00000
summer::road/pad::searched	0	0.0004338	101.45886	36.16938
summer::road/pad::unsearched	0	0.0049148	0.01000	1,000.00000

*Carcass counts are not included in the Multiple Class Module because it is used to combine detection probability distributions. Carcass counts are used in the Multiple Years Module to calculate ITP compliance metrics.

X = number of carcasses; dwp = stratum weight; Ba = first parameter for Beta distribution; Bb = second parameter for Beta distribution.

Appendix C2. Evidence of Absence Inputs for the Multiple Class Module for Data Collected at Headwaters Wind Farm, April 1, 2020 to October 15, 2020.

Class	Median Detection Probability for Searched Time and Area	Median Weighted Detection Probability (Contribution to Overall g)
fall.1::cleared::searched	0.574	0.068
fall.1:: uncleared::searched	0.574	0.023
fall.1::road/pad::searched	0.737	0.012
fall.2::cleared::searched	0.550	0.067
fall.2:: uncleared::searched	0.565	0.024
fall.2::road/pad::searched	0.736	0.012
spring::road/pad::searched	0.608	0.005
summer::cleared::searched	0.588	0.021
summer::road/pad::searched	0.738	<0.005