Operational Monitoring at the Hoopeston Wind Project Vermilion County, Illinois

April – October 2020

Prepared for:

Hoopeston Wind, LLC

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EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. completed operational post-construction fatality monitoring during the spring, summer, and fall of 2020 at the Hoopeston Wind Project (Project) located in Vermilion County, Illinois. This report describes the post-construction fatality monitoring studies conducted in accordance with the Hoopeston Habitat Conservation Plan (HCP) and Incidental Take Permit (ITP) TE54252C-0 for Indiana bats and northern long-eared bats for the third year after the issuance of the ITP. The study objectives were to: 1) determine overall bat fatality rates for the study, 2) estimate Indiana bat and northern long-eared bat take using the Species Composition approach and Evidence of Absence (EoA) framework as outlined in the HCP, and 3) provide the necessary data to determine if adaptive management is triggered.

The Project HCP outlines spring and summer monitoring plans, and, per Section 6.4.2.3, states that the fall season is the only potential season of risk to the federally listed Indiana and northern long-eared bat. The HCP also dictates that the level of monitoring during the fall season for the first three years after receiving an ITP will strive to have a 29% probability of detecting a single bat carcass, such as an Indiana or northern long-eared bat. A modeling approach using data collected in 2019 was used to determine the appropriate monitoring effort for fall 2020 to reach a *g* of 0.29 and the study plan was approved by USFWS in April 2020.

Monitoring occurred during the spring and summer using human technicians, and fall using a combination of human technicians and dog search teams to search for carcasses within search areas. Overall bat fatality estimates for the entire study were calculated using searcher efficiency, carcass persistence and area adjustment estimates. Area adjustment estimates were calculated using a carcass-density distribution modeling approach and Project-specific data from this study to determine the proportion of bats estimated to fall within search areas. Fatality estimates for bats were calculated using the GenEst fatality estimator. Furthermore, seasonal estimates for the fall were used to calculate Indiana and northern long-eared bat take estimates using the Species Composition approach and EoA framework. Bird carcasses were recorded and identified if found during searches or incidentally, but fatality estimates were not calculated.

No Indiana bats or northern long-eared bats, or any other federally or state-listed species, were found during the post-construction fatality monitoring studies. A total of 445 non-listed bats were found during scheduled carcass searches and incidentally. Species found included eastern red bat (46%), followed by silver-haired bat (37%), hoary bat (13%), big brown bat (3%), evening bat (1%) and tri-colored bat (0.2%). The bat species composition recorded at the Project was similar to previous studies at the Project and other wind energy facilities in the Midwest. Bats were mainly found in the fall season and were not concentrated within a specific area of the Project.

Overall bat fatality estimates for the 2020 monitoring period were 13.11 bats per megawatt (90% confidence intervals: 10.40–16.91). The EoA framework estimated that zero Indiana bats and zero northern long-eared bats were killed during 2020, using the 50% credible estimate. Take estimates for 2020 using the Species Composition approach and based on the GenEst estimator

were zero Indiana bat and one northern long-eared bat. The estimated levels of Indiana bat and northern long-eared bat take during 2020 and for the first three years of intensive monitoring were below levels authorized within the ITP, using EoA estimates and/or Species Composition Approach. The projected level of take for the remainder of the Project operation was also estimated to be lower than limits authorized by the HCP and ITP assuming similar levels of mortality in future years. Therefore, adaptive management was not triggered.

STUDY PARTICIPANTS

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REPORT REFERENCE

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INTRODUCTION

Western EcoSystems Technology, Inc. (WEST) completed operational post-construction fatality monitoring during the spring, summer, and fall of 2020 at the Hoopeston Wind Project (Project) in Vermilion County, Illinois. The purpose of the study was to conduct monitoring in accordance with the Hoopeston Habitat Conservation Plan (HCP) and Incidental Take Permit (ITP) TE54252C-0 for Indiana bats (*Myotis sodalis*) and northern long-eared bats (*Myotis septentrionalis*). This was the third year of monitoring under the Project's ITP.

As required in the HCP, the Project feathered turbines below manufacturer cut-in speed (3.0 meters per second [mps]; 6.7 miles per hour) from sunset to sunrise each night from April 1 through October 15. However, the only season considered as risky for the two covered bat species is the fall season. The overall goal of this post-construction fatality monitoring study was to generate reliable fatality estimates for the covered species and to evaluate compliance with the incidental take authorization granted under ITP TE54252C-0. More specifically, the objectives of this study were to: 1) determine overall bat fatality rates for the study, 2) estimate Indiana bat and northern long-eared bat take using the Species Composition approach and Evidence of Absence (EoA) framework for the fall season as outlined in the HCP, and 3) provide the necessary data to determine if adaptive management is triggered.

STUDY AREA

The Project is in the Central Corn Belt Plains Ecoregion, which encompasses a large portion of central Illinois (Woods et al. 2007). This ecoregion is composed of primarily of vast glaciated plains. Tall-grass prairie originally dominated much of the region, and scattered groves of trees and marshes occurred on level uplands. Today, the dominant land use within the Project is tilled agriculture, consisting primarily of corn (*Zea mays*), soybeans (*Glycine max*), and winter wheat (*Triticum sp.).* In addition, there are scattered residences, and small areas of pasture, grasslands, and shelterbelts (Figure 1; National Land Cover Database 2016). Fatality monitoring was completed at 100% of the turbines as shown in Figure 1 and as described in the Methods section below.

The Project is composed of 49 2.0-megawatt (MW) wind turbines capable of generating up to 98 MW. All turbines are V 100 Vestas turbines with a 100-meter (m; 328-feet [ft]) hub height and 49-m (161-ft) blade length.

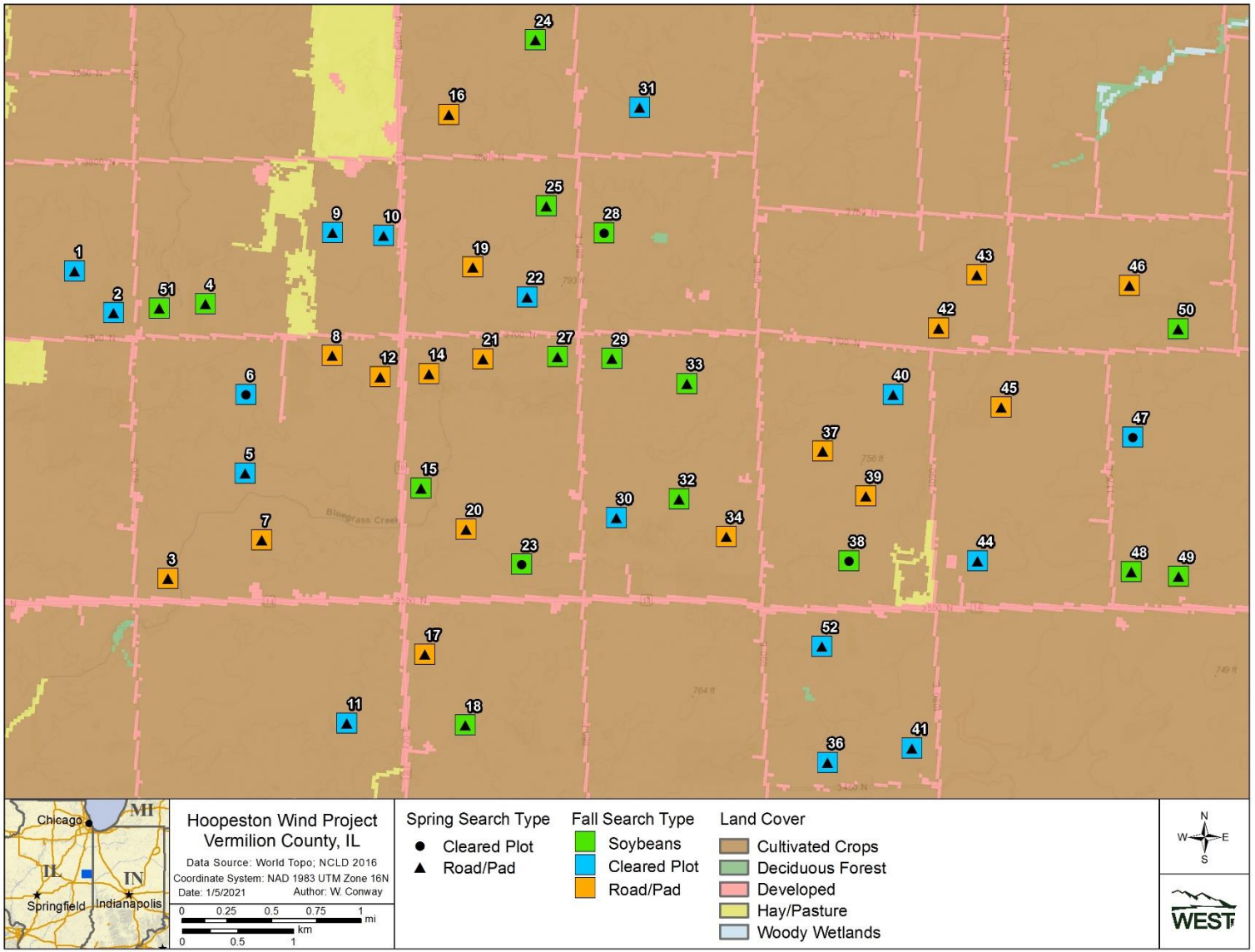

Figure 1. Land cover, turbine layout, and search plot types during the 2020 monitoring period at the Hoopeston Wind Project in Vermilion County, Illinois.

METHODS

The study contained two components: 1) standardized carcass searches, and 2) searcher efficiency and carcass persistence trials using bat carcasses. Carcasses were found under two possible scenarios: 1) during standardized carcass surveys on survey plots or, 2) incidentally (i.e., outside of the search area).

Field Methods

Spring and summer monitoring was completed in accordance with the fixed monitoring described in the HCP. Data collected on searcher efficiency, carcass persistence, and area correction in 2019 was used to model the necessary monitoring effort for fall 2020 to achieve a mean of 0.29 for the probability of detection distribution (*g*). A coordination meeting with USFWS was held on March 31, 2020 to discuss the proposed methods for the 2020 monitoring plan. WEST incorporated USFWS's comments from the meeting and an updated study plan was sent to USFWS via email on April 10, 2020.

Standardized Carcass Searches

All carcass searches were conducted by WEST technicians trained to follow the Project's carcass search protocols, including proper handling and reporting of carcasses. Technicians collected bat carcasses in accordance with WEST's Illinois Department of Natural Resources (IDNR) Scientific Permits (2020), WEST's IDNR Endangered and Threatened Species Permit (7051), WEST's US Fish and Wildlife Service (USFWS) Native Endangered and Threatened Species Recovery Permit (TE234121-9), and the Project's ITP (TE54252C-0). A USFWS-permitted bat biologist (TE19208C-0) verified the identification of all collected bats in person at the end of the study. Due to IDNR concerns regarding to the potential of bats to transmit SARS-Cov-2, bats found prior to July 23, 2020 were recorded, but not collected. In the event that heavily scavenged or decomposed bat carcasses were discovered that could not be positively identified and had potential to be a covered species, a 1-centimeter (cm) by 1-cm tissue sample was collected and sent to the Northern Arizona University School of Forestry and Center for Microbial Genetics and Genomics for further analysis. Bird carcasses were recorded but left in place, and all bird carcasses were verified by WEST biologists experienced with bird identification.

The number and type of plots searched in spring, summer, and fall are presented in Table 1. During the spring and fall study periods, vegetation at 40-m plots was mowed and maintained by Project staff within 10 to 15 cm (four to six inches) in height to enhance detectability of carcasses. Uncleared plots consisted of soybean fields (*Glycine max*; Appendix A).

Table 1. Search Effort by Season and Plot Type at Hoopeston Wind Farm in Vermilion County, Illinois.

Season	Plot Type	Search Interval	Number of Turbines	Search Team
Spring (April 1–May 15)	95-m road and pad	Weekly	44	Human
	40-m cleared plots	Weekly	5	Human
Summer (May 16–July 31)	95-m road and pad	Weekly	49	Human
Fall (August 1–October 15)	95-m road and pad	Weekly	17	Human
	40-m cleared plot	Twice weekly	16	Dog-handler
	70-m uncleared plot	Twice weekly	16	Dog-handler

Technicians delineated the perimeter of each 40-m cleared plot using a Global Positioning System. Road-and-pad areas were digitized from aerial photography with Geographic Information System (GIS) software, and 70-m uncleared plot boundaries were established prior to surveys using GIS software. The plot boundaries were used to verify if carcasses were found inside the search areas, and to estimate the number of carcasses that fell inside or outside of search areas.

In all seasons, technicians searched gravel road and pads by starting 95 m from the turbine, walking towards and around the turbine, and then back towards their vehicle. Human searchers searched 40-m plots in the spring by walking transects spaced five m apart, starting at one side of the plot and systematically searching in a north-south or east-west direction. Technicians alternated the direction of the search pattern on each visit to a plot. Technicians walked at a rate of approximately 45–60 m (148–197 ft) per minute and scanned the ground out to 2.5 m (8.2 ft) on either side of the transect.

Prior to conducting searches at the Project, handlers trained their detection dogs on the scent of bat carcasses using methods derived from search and rescue and drug detection programs (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 two-day evaluation of each dog-handler team; only after teams achieved a searcher efficiency of 75% or greater on cleared plots for at least 30 bats during evaluation trials were they approved to conduct standardized carcass searches. Because the objective of the study was to document bat carcasses, dogs were not explicitly trained on native bird carcasses; however, all detection dogs alerted on birds in the field, and handlers rewarded bird finds in the field to encourage future alerts to bird carcasses.

Dog-handler teams searched all 40-m and 70-m plots in the fall. Both wind speed and vegetation density can affect scent dispersal across the search area and therefore affects optimal transect width and starting locations for the dog-handler teams. Dog-handlers oriented their detection dog to start searches perpendicular to the wind to maximize scent detection and ensure the search area was adequately covered by searching transects spaced as much as 10 m (32 ft) apart in vegetated plots and transects spaced as much as 15 m (49 ft) apart in cleared plots, depending on wind speed and vegetation density. The handler placed a marker by the carcass and rewarded

the dog with either a food reward or a short play session when a detection dog correctly alerted to a bird or bat carcass.

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

- Live/Injured— a live or injured bat or bird
- Intact— a carcass that was completely intact, was not badly decomposed, and showed no sign of being fed upon by a predator or scavenger
- Scavenged— an entire carcass, which showed signs of being fed upon by a predator or scavenger, or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, portion of a carcass), or a carcass that was heavily infested by insects
- Feather Spot (for bird carcasses only)—10 or more feathers (not including down) at one location indicating predation or scavenging

The following information was recorded for each carcass found during standardized surveys:

- Date and time
- Initial species identification
- Sex, and age (if identifiable)
- Geographic coordinate
- Distance and bearing to turbine
- Substrate/ground cover
- Carcass condition (intact, scavenged, injured)
- Estimated time since death (number of days)

Searcher Efficiency Trials

Searcher efficiency trials were conducted at a randomly-chosen subset of 40-m and 70-m plots and road-and-pad turbines. The objective of the searcher efficiency trials was to estimate the probability that a bat carcass was found by human or dog searchers for each plot type. A minimum of 20 bats or bat surrogates were placed and confirmed available per plot type and per season. The number of bats or bat surrogates placed was restricted to two or less per survey area to avoid over-seeding and attracting scavengers.

Personnel conducting carcass surveys did not know when searcher efficiency trials were being conducted or the location of the trial carcasses. In the spring and summer, due to IDNR concerns about SARS-Cov-2, mice carcasses were used as surrogates for these trials. In the fall, permission was granted to resume bias trials using bats, and trial carcasses consisted of big brown bat (*Eptesicus fuscus*) carcasses provided by Illinois Natural History Survey, and of eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*) carcasses found at the Project during the study. Mice and bats used for trials were previously frozen, but with little to no visible decomposition.

All trial carcasses were placed at random locations within the search area prior to the survey that day. Trial carcasses were dropped from waist height and allowed to land in a random posture. Each trial carcass was discreetly marked with a black zip-tie prior to placement so that the carcass

could be identified as a trial carcass after it was found. The number and location of trial carcasses found during each carcass search were recorded. The number of carcasses available for detection during each trial was determined after the carcass search, and any carcasses determined to be unavailable during the survey time were excluded from the searcher efficiency estimates. Personnel conducting carcass surveys had one chance to locate trial carcasses, during the first search after carcass placement. A random path was taken to and from carcass locations to avoid the possibility of detection dogs following a human scent trail to trial carcasses. The trial administrator 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.

Carcass Persistence Trials

Carcass persistence trials were conducted using a subset of the carcasses placed for searcher efficiency trials. The objective of carcass persistence trials was to estimate the average length of time a bat carcass remained in the field. Fifteen trial carcasses were placed in each season to incorporate the effects of varying weather and climatic conditions on carcass persistence. Trials were spread across all plot types.

Personnel monitored the trial carcasses over a 28-day period, checking the carcasses on days 1, 2, 3, 4, 7, 10, 14, 21, and 28 after placement. Carcasses were left at the location until the carcass was completely removed or the trial period ended. On cleared and uncleared plots in the fall, detection dogs were used to confirm when carcasses were removed. Any remaining evidence of the carcass was removed at the end of the 28-day monitoring period.

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 entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the observer 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 server database was developed to store, organize, and retrieve survey data. Data were entered into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All electronic data files were retained for reference.

Fatality Estimates

Fatality estimates were calculated for bats using GenEst (a generalized estimator of fatality; Dalthorp et al. 2018, Simonis et al. 2018). Fatality estimates for bats were based on:

- Observed number of carcasses found within standardized search plots during the

monitoring period.

- Searcher efficiency rates, expressed as the probability that a carcass was found by searchers during searcher efficiency trials.
- Persistence rates, expressed as the estimated average probability a carcass was expected to persist in the search area and be available for detection by the searchers during persistence trials.
- Area adjustment estimates, expressed as the carcass-density weighted adjustment for carcasses that fell outside of the search areas.

Each carcass included in the analysis was adjusted for searcher efficiency, carcass persistence, a detection reduction factor (also referred to as "*k*"; see below), and a search area adjustment to obtain an overall fatality estimate. Overall fatality estimates were calculated using a weighted average across plot types (i.e., cleared plots, uncleared plots, and road and pad plots). The proportion of turbines sampled as each plot type were used as weights.

Confidence intervals surrounding estimates for each season and plot type were calculated, assuming more than five fatalities were detected. Estimates and 90% confidence intervals were calculated using a parametric bootstrap for GenEst (Dalthorp et al. 2018). Bootstrapping is a computer simulation technique that is useful for calculating variances and confidence intervals for complicated test statistics. One thousand bootstrap samples were used. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates were estimates of the lower limit and upper limit of 90% confidence intervals. Estimates and confidence intervals were calculated using a parametric bootstrap (Dalthorp et al. 2018) by season and plot type, as well as overall.

Carcasses Excluded from Fatality Estimation

All carcasses found within the mapped plot boundaries were considered for inclusion in the fatality rate estimation if they had an estimated time of death within the season when the plot was monitored (i.e., carcasses found outside of plots or estimated to have died before the beginning of the season when a plot type was monitored were omitted from the analysis).

Estimation of Searcher Efficiency

Estimates of searcher efficiency were used to adjust carcass counts for detection bias. Searcher efficiency estimated the probability of a carcass being detected by a searcher given the carcass was available to be found. A logistic regression model (Dalthorp et al. 2018) was used to obtain estimates of searcher efficiency while accounting for *k* (see below). Potential covariates, or explanatory variables of interest, for the searcher efficiency models included plot type and season for human teams. Dog-handler teams were only used in one season; therefore, plot type was the only potential variable used for dog-handler teams. Different searcher efficiency models were fit for human searchers and dog-handler teams because dog-handler teams were only used in fall. Models were selected using an information theoretic approach known as AICc, or corrected Akaike Information Criteria (Burnham and Anderson 2002). The selected model was the most parsimonious model within two AICc units of the model with the lowest AICc value.

Detection Reduction Factor

The change in searcher efficiency between successive searches was defined by a parameter called the detection reduction factor (*k*) that ranged from zero to one. When *k* is estimated or assumed to be zero, it implies that 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 GenEst a value of *k*=0.8 was used in accordance with the HCP.

Estimation of Carcass Persistence Rates

Estimates of carcass persistence were used to adjust carcass counts for removal bias. 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 using one of four distributions: exponential, log-logistic, lognormal, or Weibull (Dalthorp et al. 2018, Kalbfleisch and Prentice 2002). 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.

Area Adjustment

The search area adjustment accounted for carcasses falling outside of plot boundaries. The proportion of carcasses that were estimated to have fallen within plots 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 Likelihood (TWL) was used to estimate the carcass-distance density distribution using Project-specific data collected on the distance bat carcasses fell from the turbines during this study. The density distribution of carcasses was estimated by fitting truncated Weibull, truncated Rayleigh, truncated Normal, truncated Gamma, or truncated Gompertz density distributions (parameterized according to R Core Team [2016] and Thomas et al. [2010]) to carcass distances from turbines, and choosing the best-supported distribution through AICc. Parameter estimates for the distribution were obtained using a weighted maximum likelihood approach (Khokan et al. 2013). Weights were assigned to each carcass based on the distance at which it was found (as the proportion of total area searched at that distance) and its probability of being available to be found and detected by searchers. Weights were calculated as the inverse of the product of 1) the proportion of area searched multiplied by 2) the probability of detection. This approach results in weighted maximum likelihood estimates of carcass detection probabilities that vary systematically with distance from turbines. Areas near the turbine tend to have a higher density of bat carcasses than areas farther from the turbine (Huso and Dalthorp 2014) and, therefore, the search area was combined with the carcass-density distribution to estimate the area adjustment. The result was an estimate of the proportion of bat carcasses expected to land within searched areas around the turbines.

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

The fall season was the only season with potential risk to covered species per the HCP; therefore, Indiana and northern long-eared bat fatality estimates were based on fall data using the Species Composition approach and EoA framework, as outlined in the Project's HCP.

Species Composition Approach

Indiana bat and northern long-eared bat fatalities were estimated for the fall using the Species Composition approach. The HCP specified baseline values for fatalities of Indiana bat and northern long-eared bat as 0.29% and 0.24%, respectively (Hoopeston Wind 2017); however, the Project proposed updated species composition rates of 0.03% for Indiana bats and 0.06% for northern long-eared bats based on updated, publicly available post-construction monitoring data (Rodriguez and Studyvin, 2020). USFWS approved the use of these updated rates for 2020 and the years to follow on November 6, 2020 (A. Schorg, pers comm.). Therefore, take estimates for 2020 were estimated using the updated species composition values of 0.03% for Indiana bat and 0.06% for northern long-eared bat. An average take estimate for both Indiana bat and northern long-eared bat was calculated across 2018–2020 using Huso estimates reported in 2018 (Iskali and Pham 2019), the Gen-Est estimate reported in 2019 (Rodriguez et al. 2020) and a Gen-Est estimate calculated in 2020.

Evidence of Absence

The EoA framework (Dalthorp et al. 2014; Dalthorp et al. 2017) uses a Bayesian model to estimate the actual number of fatalities, the estimated mortality rate (λ), and the cumulative 30-year projected mortality based on λ. The inputs to the model are the number of found carcasses and the *g* distribution, or the site wide-probability that a carcass was available to be found and detected. The estimate for *g* was based on:

- The monitoring search schedule expressed as number of search and the interval of the searches.
- Searcher efficiency expressed as the proportion of available carcasses found by searchers (see Estimation of Searcher Efficiency Rates on page 11).
- Carcass persistence rates expressed as the estimated average probability a carcass was expected to remain in the study area (see Estimation of Carcass Persistence Rates on page 11).
- Search area adjustment based on the estimated carcass-density distribution weighted by the proportion of area searched(see Area Adjustment section on page 12).
- Detection reduction factor (*k*), expressed as the fraction to which searcher efficiency was reduced with each successive search (see Detection Reduction Factor section on page 9). The factor *k* was assumed to equal 0.8, as outlined in the HCP.

The site-wide probability of detection (*g)* was estimated for each of the three search plot types. The Single Class module from the EoA software (Dalthorp 2019) was used to estimate the *g* distributions for each search plot type. The Multiple Class module from the EoA software was used to combine these *g* distributions to obtain a single *g* distribution for 2020. The Multiple Years module used the *g* distribution from all three years of monitoring as part of the HCP and the carcass counts from all three years to estimate the cumulative mortality (M), the annual take rate (λ), and the projected mortality. The Multiple Years module requires weights (ρ) which were all

assumed to be one, because there was no reason to weight any year more than another. The Multiple Years module uses a simulation approach to project future cumulative mortality and future mortality estimates, which were based on data collected to date. We reported the future cumulative mortality, which doesn't rely on assumptions about future monitoring efforts.

RESULTS

Standardized Carcass Searches

A total of 352 40-m cleared plot searches, 341 70-m uncleared plot searches and 1,037 road and pad searches were completed from April 2 to October 15, 2020. Thirty-one searches (2%) were missed over the course of the survey period due to turbine maintenance and weather constraints.

No Indiana bat or northern long-eared bat carcasses were found during the study. No other federally or state threatened or endangered bat or bird carcasses were found during the study. Details of all carcasses found during the study are presented in Appendix B.

Overall Fatalities

A total of 445 bat carcasses belonging to six species were found during scheduled carcass searches and incidentally. Eastern red bat (n=203, 45.6%) was the most common species fatality, followed by silver-haired bat (n=167, 37.5%), hoary bat (n=56, 12.6%), big brown bat (n=14, 3.2%), evening bat (*Nycticeius humeralis*; n=4, 0.9%) and tri-colored bat (*Perimyotis subflavus*; n=1, 0.2%). Two heavily scavenged bats (e.g., wing membrane only, bones, or partial carcasses) were identified by Northern Arizona University using DNA analysis; both were identified as silver-haired bats.

Forty-four bird carcasses of 20 known species were found during the study (Table 2). Golden-crowned kinglet (*Regulus satrapa*; n=6), killdeer (*Charadrius vociferus*; n=4) and mourning dove (*Zenaida macroura*; n=4) were the most common bird species found, accounting for 32% of the avian carcasses found. All other species were only represented by 1 or 2 carcasses. Six small birds could not be identified to species due to scavenging and decomposition.

Table 2. Total number of carcasses and percent composition of carcasses discovered at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2020 to October 15, 2020.

	Included in GenEst Fatality Estimate		Outside Search Area*		Outside Study Period*		Total	
Species	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
eastern red bat	179	44.3	11	28.95	3	100	203	45.62
silver-haired bat	155	38.3	12	31.5	0	0	167	37.50
hoary bat	51	12.6	5	13.16	0	0	56	12.58
big brown bat	14	3.47	0	0	0	0	14	3.15
evening bat	4	0.99	0	0	0	0	4	0.90
tri-colored bat	1	0.25	0	0	0	0	1	0.22
Overall Bats	**404**	**100**	**38**	**100**	**3**	**100**	**445**	**100**

Table 2. Total number of carcasses and percent composition of carcasses discovered at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2020 to October 15, 2020.

	Included in GenEst Fatality Estimate		Outside Search Area*		Outside Study Period*		Total	
Species	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
golden-crowned kinglet	0	0	2	28.57	0	0	6	13.64
killdeer	0	0	1	14.29	0	0	4	9.09
unidentified passerine	0	0	1	14.29	0	0	4	9.09
mourning dove	0	0	0	0	0	0	4	9.09
red-eyed vireo	0	0	1	14.29	0	0	2	4.55
yellow-throated vireo	0	0	1	14.29	0	0	2	4.55
American redstart	0	0	0	0	0	0	2	4.55
European starling	0	0	0	0	0	0	2	4.55
red-breasted nuthatch	0	0	0	0	0	0	2	4.55
unidentified vireo	0	0	0	0	0	0	2	4.55
yellow-billed cuckoo	0	0	0	0	0	0	2	4.55
tree swallow	0	0	1	14.29	0	0	1	2.27
bay-breasted warbler	0	0	0	0	0	0	1	2.27
blackpoll warbler	0	0	0	0	0	0	1	2.27
brown-headed cowbird	0	0	0	0	0	0	1	2.27
brown creeper	0	0	0	0	0	0	1	2.27
horned lark	0	0	0	0	0	0	1	2.27
northern flicker	0	0	0	0	0	0	1	2.27
pine warbler	0	0	0	0	0	0	1	2.27
ring-necked pheasant	0	0	0	0	0	0	1	2.27
ruby-throated hummingbird	0	0	0	0	0	0	1	2.27
Tennessee warbler	0	0	0	0	0	0	1	2.27
unidentified small bird	0	0	0	0	0	0	1	2.27
Overall Birds	**0**	**0**	**7**	**100**	**0**	**0**	**44**	**100**

*Birds were not included in fatality estimates.

Carcasses for Analysis

Fourteen bat carcasses were estimated to have occurred outside the monitoring period, and forty-one bat carcasses were found outside of search plot boundaries. These carcasses were excluded from the analysis. Bird fatality rates were not estimated and therefore all bird carcasses were excluded from the analysis.

Timing and Distribution of Bat Fatalities

The composition of bat fatalities varied by season; only silver-haired bat were found in the spring, while evening, big brown and tri-colored bats were only found in the fall (Table 3). The vast majority of bat carcasses were found in the fall with a peak in late August to mid-September (Figure 2; Appendix B).

Bat carcasses were found at 47 of the 49 study turbines. Bats were found mainly on uncleared 70-m plots, which were the largest plot areas and searched by dogs (Figure 2; Table 3). No concentrations of bats were found at a certain area or turbine of the Project.

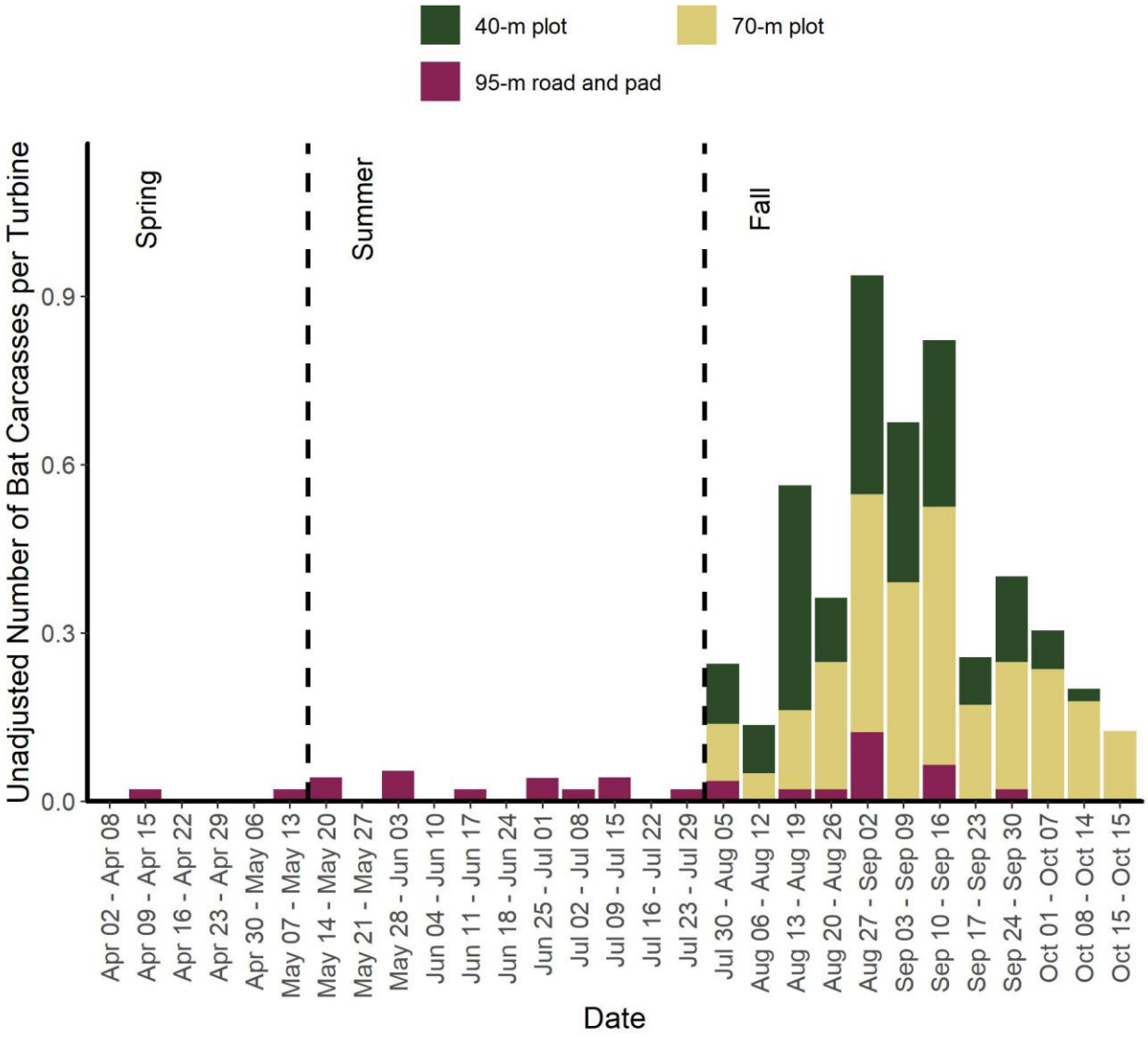

Figure 2. Timing of bat carcasses at the Hoopeston Wind Project from April 2 – October 15, 2020 for carcasses included in the GenEst fatality estimates.

Table 3. Species composition by season and plot type for bat carcasses[1] found at the Hoopeston Wind Project, Vermilion County, Illinois from April 2, 2020 to October 15, 2020.

	Spring				Summer		Fall					
	Road and Pad		40-m Cleared Plot		Road and Pad		40-m Cleared Plot		70-m Uncleared 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	6	3.89	7	3.18	1	7.14
eastern red bat	0	0	0	0	7	58.33	80	51.95	87	39.55	5	35.71
evening bat	0	0	0	0	0	0	0	0	4	1.82	0	0
hoary bat	0	0	0	0	3	25.00	22	14.29	23	10.45	3	21.43
silver-haired bat	4	100	0	0	2	16.67	45	29.22	99	45.00	5	35.71
tri-colored bat	0	0	0	0	0	0	1	0.65	0	0	0	0
Total	**4**	**100**	**0**	**--**	**12**	**100**	**154**	**100**	**220**	**100**	**14**	**100**

[1] This table only includes bat carcasses included in the Gen-Est fatality estimate.

Sums may not equal total values shown due to rounding.

m = meter.

Searcher Efficiency Trials

A total of 130 carcasses were placed across 12 different days between April 16 and October 12, 2020. Raw searcher efficiency ranged from 57.9% to 100% depending on plot type and season (Table 4). The best fit models for dog handler teams and humans suggested that searcher efficiency varied by plot type for human searchers but not for dog handler teams, and searcher efficiency rates did not vary substantially by season (Appendix C). Estimated searcher efficiency rates, which were used in determining fatality and take estimates, are presented in Table 5.

Table 4. Searcher efficiency results at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2 to October 15, 2020 as a function of season and plot search type for bats.

Plot Search Type	Season	# Placed	# Available	# Found	% Found
Human searchers: cleared	Spring	19	19	11	57.9
Human searchers: road and pad	Spring	21	20	20	100
Human searchers: road and pad	Summer*	20	20	20	100
Human searchers: road and pad	Fall	20	16	15	93.8
Human searchers: road and pad overall	**All**	**61**	**56**	**55**	**98.2**
Dog-handler team: 40 m cleared plot	Fall	24	23	20	87.0
Dog-handler team: 70 m uncleared plot	Fall	26	22	18	81.8
Dog-handler teams overall	**Fall**	**50**	**45**	**38**	**84.4**

*Only roads and pads were searched during the summer.

Table 5. Overall searcher efficiency probabilities and 90% confidence intervals for bats calculated using a logistic regression model for GenEst estimators at the Hoopeston Wind Project, from April 2 to October 15, 2020.

Search Team and Plot Type	Estimated Searcher Efficiency Rate
Dog-handler	0.84 (0.73–0.91)
Human searchers: Road and pad plot	0.98 (0.91–1.00)
Human searchers: Cleared plot	0.58 (0.39–0.75)

Carcass Persistence Trials

Forty-three carcasses were placed for persistence trials and used to estimate carcass persistence rates. The best-fit model was an exponential distribution with no covariates, suggesting that carcass persistence did not vary across seasons (Appendix C). The estimated median bat carcass persistence time was 7.29 days (Appendix C). The average probability that a bat carcass persisted through a 7-day search interval (spring and summer) was 0.73 (90% confidence interval [CI]: 0.66, 0.78).

Area Adjustment Using Project-Specific Data

None of the plots had any routinely unsearchable areas due to trees, fences, or other obstructions. The best-fit model was a normal distribution (Appendix D) and was used to calculate the area adjustment. The TWL model estimated that approximately 59% of bats fell within the search area of 40-m plot turbines, 97% within the search area of 70-m plot turbines and 7% within the search area of 95-m road and pads (Figure 3).

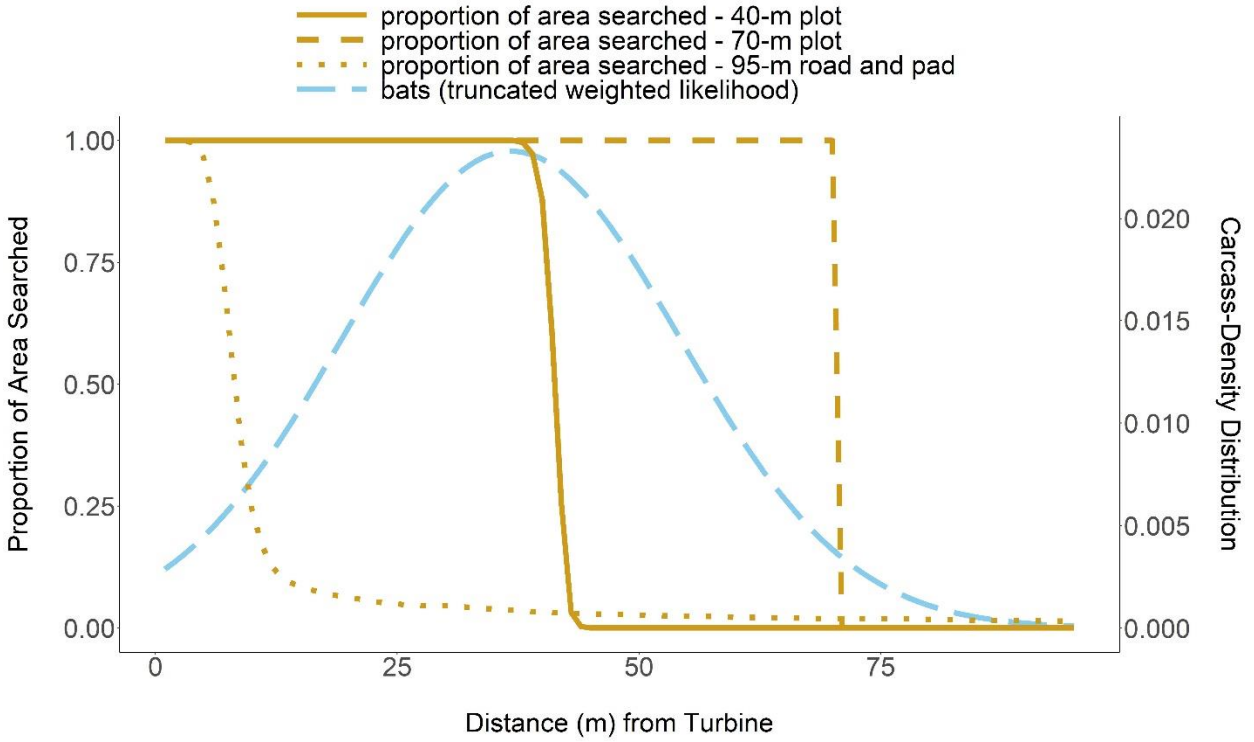

Figure 3. Proportion of area searched by search plot type and estimated carcass density using truncated weighted likelihood methods.

Adjusted Overall Bat Fatality Estimates

Bat fatality estimates were calculated for the year, per the HCP. Fatality estimates were highest in the fall, and the overall estimate for the study was 13.11 bats per megawatt (90% CI: 10.40–16.91; Table 6). Fatality rates by plot type and season are presented in Appendix E.

Table 6. Overall bat fatality rates per turbine and megawatt using GenEst for studies conducted at the Hoopeston Wind Project, Vermilion County, Illinois, from April 2 – October 15, 2019.

Season	Bat Fatality Estimate per Turbine	90% Confidence Limits	Bat Fatality Estimate per Megawatt	90% Confidence Limits
Spring	1.55	0.43–3.28	0.77	0.21–1.64
Summer	4.81	2.53–7.78	2.41	1.26–3.89
Fall	19.71	15.69–24.75	9.85	7.84–12.37
Overall	**26.22**	**20.80—33.83**	**13.11**	**10.40—16.91**

Species Composition Approach

Take estimates for Indiana bat and northern long-eared bat were based on fall fatality estimates (Table 6) and the species composition percentages approved by USFWS. Bat fatality rates included fractions of bats; however, a fraction of a bat cannot be taken in a given year. Therefore, the rates calculated in Tables 7 and 8 were rounded to whole integers to calculate take estimates. Zero Indiana bats and one northern long-eared bats were estimated to be taken in 2020, based on the updated species composition percentages (Table 7). The three-year average of Species Composition take estimates determined that approximately two Indiana bats and two northern long-eared bats were taken per year (Table 8).

Table 7. Indiana and northern long-eared bat fatality estimates using the Species Composition approach for studies conducted at the Hoopeston Wind Project, Vermilion County, Illinois, from April 2 to October 15, 2020.

Bat Species	Bats per Megawatt	Estimated Total Bats	Species Composition	Bats per Year	Take Estimate
Indiana bats	9.85	965.77	0.0003	**0.29**	**0**
Northern long-eared bats	9.85	965.77	0.0006	**0.59**	**1**

Table 8. Three-year average of Indiana and northern long-eared bat fatality estimates using the Species Composition approach for studies conducted at the Hoopeston Wind Project, Vermilion County, Illinois, 2018–2020.

Year	Estimator	Indiana Bats Per Year	Indiana bat Take Estimate	Northern Long-eared Bats Per Year	Northern Long-eared Bat Take Estimate
2018[1]	Huso	2.43	2	2.02	2
2019[1]	Gen-Est	3.87	4	3.20	3
2020[2]	Gen-Est	0.29	0	0.59	1
Overall Average		2.20	2	1.94	2

[1] Species composition estimates from 2018 and 2019 are based off of the HCP baseline rates that stated that Indiana bat fatalities were expected to represent 0.29% of all fatalities and northern long-eared bat were expected to represent 0.24% of all fatalities.
[2] Species composition estimates from 2020 are based off of updated species composition rates of 0.03% for Indiana bat and 0.06% for northern long-eared bat, which were approved by USFWS in October 2020.

Indiana Bat and Northern Long-Eared Bat Take Estimates

Probability of detection

The overall probability of detecting a single bat carcass (*g*), such as an Indiana bat or northern long-eared bat, during the fall 2020 was 0.41 (90% CI: 0.39–0.44; Table 9), exceeding the goal of 0.29. The reason for the increase in detection probably was higher searcher efficiency rates and higher probability of bats falling within search areas, compared to what was predicted before the beginning of the study. The probability of detection increased during each year of the study as Project-specific data was used to refine *g*, with the average *g* of 0.26 for the first three years (Table 9). Variables used to run the single class module and multiple class modules of EoA are presented in Appendix F.

Table 9. Annual and overall probabilities of detection (*g*), Ba, Bb, and p for the Hoopeston Wind Project, Vermilion County, Illinois from 2018–2020.

Year	Ba[a]	Bb[a]	ρ[b]	g	95% Confidence Intervals
2018	181.13	1208.6	1	0.13	0.11–0.15
2019	10.06	29.23	1	0.26	0.13–0.40
2020	645.15	924.52	1	0.41	0.39–0.44
Short-term Trigger (Last 3 Years)	93.79	259.06	NA	0.26	0.22–0.31
Long-term Trigger (Cumulative)	93.79	259.06	NA	0.26	0.22–0.31

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

[b]P is the weight in the weighted average that is used to combine the probability of detection distributions across years**.**

Cumulative Mortality to Date

The EoA cumulative mortality estimates with 50% credibility (which is equivalent to the median value) were zero Indiana bat and zero northern long-eared bat fatalities occurred during the 2018–2020 study period (Table 10). Therefore, the long-term trigger did not fire for either species.

Table 10. Cumulative median take estimates to date using EoA and Project-specific area correction for studies conducted at the Hoopeston Wind Project, Vermilion County, Illinois, from 2018–2020.

Estimate Type	Carcass Count	Bat Fatality Estimate	Permitted Take
EoA - Indiana bat (50% credible bound)	0	0	60
EoA - Northern long-eared bat (50% credible bound)	0	0	60

EoA= Evidence of Absence

Annual Take Rate

Using the Multiple Years Module in the EoA software, the estimated fatality rates (λ) for Indiana bat and northern long-eared bat were calculated based on the *g* values from the fall seasons of 2018–2020 (Table 9). The estimated annual fatality rates for Indiana bat and northern long-eared bat were 0.29 bats per year (Table 11), which is below the expected annual take rate of two (τ) Indiana bats and two (τ) northern long-eared bats per year reported in the HCP. The short-term trigger assesses the probability that the estimated take rate exceeds the expected take rate, Pr(λ > τ). At a 95% confidence level (α = 0.05), Pr(λ > τ) must be greater than or equal to 0.95 for the short-term trigger to fire. The short term-trigger was not fired for either species (Table 11).

Table 11. Estimated median fatality rate (λ) of Indiana and northern long-eared bats using EoA and the Project-specific area correction based on studies conducted at the Hoopeston Wind Project, Vermilion County, Illinois from April 2, 2018 to October 15, 2020.

Estimate Type	Carcass Count	Estimated Median Fatality Rate (λ)	Expected Take Rate (τ)	Pr(λ > τ)
EoA - Indiana bat (50th credible bound)	0	0.29	2	0.076
EoA - Northern long-eared bat (50th credible bound)	0	0.29	2	0.076

EoA= Evidence of Absence

Projected Mortality for Remainder of the Project ITP

The cumulative median 30-year mortality projection at 50% credible interval for both Indiana bat and northern long-eared bat was estimated to be nine fatalities (Table 12), which is below permitted take of 60 individuals of each species described within the Project HCP. Therefore, the projected mortality did not indicate any need for adaptive management.

Table 12. Cumulative median 30-year projected bat fatalities using EoA and the Project-specific area correction for studies conducted at the Hoopeston Wind Project, Vermilion County, Illinois, from April 2, 2018 to October 15, 2020.

Estimate Type	Carcass Count	Permitted Take	Cumulative Median Projected Mortalities (30 years; *M*)
EoA - Indiana bat (α = 0.5)	0	60	9
EoA - Northern long-eared bat (α = 0.5)	0	60	9

EoA= Evidence of Absence

DISCUSSION

The objectives of this study were to: 1) determine overall bat fatality rates for the entire study, 2) estimate Indiana bat and northern long-eared bat take using the Species Composition approach and Evidence of Absence (EoA) framework as outlined in the HCP, and 3) provide the necessary data to determine if adaptive management is triggered.

Overall Bat Fatality Rates

The species of bats found during the 2020 study were similar to the 2018 and 2019 studies at the Project with eastern red bat being the most common species followed by silver-haired bat and hoary bat. . Fatality estimates at the Project ranged from 10.93 to 17.86 bats per MW from 2018-2020 but had overlapping confidence intervals, indicating no statistical difference among years.

Indiana and northern long-eared bat take estimates

No federally or state-listed bats were found during three years of intensive monitoring at the Project. The estimated level of Indiana bat and northern long-eared bat take was below the levels permitted within the Project ITP and described within the Project HCP. The estimates (using all

ITP monitoring years) of take using the Species Composition approach were higher than EoA-based estimates. However, the lack of any Indiana bat and northern long-eared bat carcasses found during three years of post-construction monitoring suggests that the species composition estimates were biased high. Using the updated Species Composition Approach values approved by USFWS going forward should help these data to be less biased.

Evaluation of Adaptive Management Triggers

The results indicate that none of the adaptive management criteria described in Section 7.4.1 of the HCP were met given the monitoring results to date: the estimated cumulative mortality to date is less than the total permitted take for both species, the estimated annual take rate is not greater than the expected annual take rate for both species, and the projected cumulative mortality is less than the total permitted take for each species. Together, these results indicate that no adaptive management triggers were fired and no actions are required, per the Project's HCP.

REFERENCES

American Wind Wildlife Institute (AWWI). 2020. Technical Report 2nd Edition: Summary of Bat Fatality Monitoring Data Contained in AWWIC. Prepared by American Wind Wildlife Institute (AWWI), Washington, DC. November 24, 2020. Available online: https://awwi.org/resources/awwic-bat-technical-report/

Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72(1): 61-78.

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

Dalthorp, D., M. Huso, D. Dail, and J. Kenyon. 2014. Evidence of Absence Software User Guide. US Geological Survey (USGS) Data Series 881. USGS, Reston, Virginia. September 19, 2014. Available online: http://pubs.usgs.gov/ds/0881/pdf/ds881.pdf

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

Dalthorp, D. H., J. Simonis, L. Madsen, M. M. Huso, P. Rabie, J. M. Mintz, R. Wolpert, J. Studyvin, and F. Korner-Nievergelt. 2018. Generalized Mortality Estimator (GenEst) - R Code & GUI. US Geological Survey (USGS) Software Release. Available online: https://www.usgs.gov/software/genest-a-generalized-estimator-mortality

Dalthorp, D. H. 2019. EoA: Wildlife Mortality Estimator for Scenarios with Low Fatality Rates and Imperfect Detection. R Package Version 2.0.7.

Ellison, L. E. 2012. Bats and Wind Energy: A Literature Synthesis and Annotated Bibliography. Open-File Report No. 2012-1110. US Geological Survey (USGS).

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

Hoopeston Wind, LLC. 2017. Final Habitat Conservation Plan for the Indiana Bat and the Northern Long-Eared Bat: Hoopeston Wind Project, Vermilion County, Illinois. Hoopeston Wind, Charlottesville, Virginia. September 3, 2017. 92 pp.

Huso, M. M. P. and D. Dalthorp. 2014. A Comment on "Bats Killed in Large Numbers at United States Wind Energy Facilities". Bioscience 64(6): 546-547. doi: 10.1093/biosci/biu056.

Iskali, G., and D. Pham. 2019. Operational Monitoring at the Hoopeston Wind Project, Vermilion County, Illinois. Final Report: April – October 2018. Prepared for Hoopeston Wind LLC, Charlottesville, Virgina. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana.

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/

Rodriguez, M., A. Ciecka, L. McManus, and J. Bushey. 2020. Operational Monitoring at the Hoopeston Wind Project, Vermilion County, Illinois. April - October 2019. Prepared for Hoopeston Wind, LLC, Charlottesville, Virginia. Prepared by Western EcoSystems Technology (WEST), Inc., Bloomington, Indiana. January 28, 2020.

Rodriguez, M. and J. Studyvin. 2020. Technical Memorandum: Hoopeston Species Composition Evaluation. Prepared for Hoopeston Wind LLC. Prepared by Western EcoSystems Technology (WEST), Inc. September 15, 2020.

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

Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance Software: Design and Analysis of Distance Sampling Surveys for Estimating Population Size. Journal of Applied Ecology 47(1): 5-14. doi: 10.1111/j.1365-2664.2009.01737.x.

Western EcoSystems Technology, Inc. (WEST). 2019. Regional Summaries of Wildlife Fatalities at Wind Facilities in the United States. 2019 Report from the Renew Database. WEST, Cheyenne, Wyoming. December 31, 2019. Available online: https://west-inc.com/wp-content/uploads/2020/10/WEST_2019_RenewWildlifeFatalitySummaries-1.pdf

Woods, A. J., J. M. Omernik, C. L. Pederson, B. C. Moran, and others. 2007. Ecoregions of Illinois. (Color poster with map, descriptive text, summary tables, and photographs.) US Geological Survey (USGS) map. Last updated October 2, 2007. USGS, Reston, Virginia. US Environmental Protection Agency (USEPA).

Appendix A. Representative Photos of Plot Types at Hoopeston Wind Project.

Appendix A1. Representative photo of vegetation conditions in a 40m clear plot.

Appendix A2. Representative photo of vegetation conditions in a 70 m soy plot.

Appendix B. Complete List of Carcasses Found at the Hoopeston Wind Project during 2020

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
Bats					
04/09/2020	silver-haired bat	68	24	95-m road and pad	intact
05/08/2020	silver-haired bat	52	49	95-m road and pad	scavenged
05/15/2020	silver-haired bat	5	45	95-m road and pad	scavenged
05/15/2020	silver-haired bat	43	46	95-m road and pad	intact
05/20/2020	eastern red bat	2	52	95-m road and pad	scavenged
05/28/2020	eastern red bat	14	27	95-m road and pad	scavenged
05/28/2020	hoary bat	42	38	95-m road and pad	scavenged
05/28/2020	silver-haired bat	32	38	95-m road and pad	scavenged
06/01/2020	eastern red bat	41	18	95-m road and pad	intact
06/16/2020	silver-haired bat	6	45	95-m road and pad	scavenged
06/22/2020	hoary bat	45	6	95-m road and pad	scavenged
06/30/2020	eastern red bat	5	28	95-m road and pad	scavenged
06/30/2020	eastern red bat	35	33	95-m road and pad	intact
07/08/2020	hoary bat	0	38	95-m road and pad	injured
07/14/2020	eastern red bat	21	38	95-m road and pad	intact
07/14/2020	hoary bat	21	30	95-m road and pad	scavenged
07/14/2020	hoary bat	97	37	95-m road and pad	scavenged
07/27/2020	eastern red bat	1	23	95-m road and pad	intact
07/31/2020	eastern red bat	16	6	40-m plot	scavenged
08/01/2020	eastern red bat	32	10	40-m plot	scavenged
08/01/2020	eastern red bat	31	9	40-m plot	scavenged
08/02/2020	eastern red bat	66	28	70-m plot	scavenged
08/02/2020	hoary bat	8	25	70-m plot	scavenged
08/03/2020	eastern red bat	31	1	40-m plot	intact
08/03/2020	eastern red bat	24	2	40-m plot	scavenged
08/03/2020	eastern red bat	61	51	70-m plot	dismembered
08/03/2020	eastern red bat	68	51	70-m plot	intact
08/03/2020	hoary bat	12	19	95-m road and pad	scavenged
08/03/2020	hoary bat	55	28	70-m plot	dismembered
08/04/2020	big brown bat	24	30	40-m plot	scavenged
08/04/2020	eastern red bat	20	11	40-m plot	scavenged
08/04/2020	eastern red bat	17	32	70-m plot	scavenged
08/04/2020	eastern red bat	11	41	40-m plot	scavenged
08/04/2020	hoary bat	1	45	95-m road and pad	intact
08/06/2020	eastern red bat	42	4	70-m plot	scavenged
08/06/2020	eastern red bat	55	5	40-m plot	dismembered
08/06/2020	eastern red bat	20	5	40-m plot	intact
08/06/2020	eastern red bat	11	6	40-m plot	scavenged
08/06/2020	hoary bat	30	4	70-m plot	scavenged
08/07/2020	eastern red bat	21	47	40-m plot	scavenged
08/07/2020	eastern red bat	82	48	70-m plot	scavenged
08/07/2020	hoary bat	67	49	70-m plot	dismembered
08/10/2020	hoary bat	30	22	40-m plot	intact
08/11/2020	eastern red bat	29	2	40-m plot	scavenged
08/13/2020	eastern red bat	31	1	40-m plot	scavenged
08/13/2020	eastern red bat	51	29	70-m plot	scavenged
08/13/2020	eastern red bat	32	33	70-m plot	intact
08/13/2020	eastern red bat	35	6	40-m plot	intact
08/13/2020	evening bat	41	29	70-m plot	scavenged
08/14/2020	big brown bat	38	30	40-m plot	intact

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
08/14/2020	eastern red bat	34	30	40-m plot	intact
08/14/2020	eastern red bat	35	36	40-m plot	intact
08/14/2020	eastern red bat	37	36	40-m plot	intact
08/14/2020	eastern red bat	21	36	40-m plot	intact
08/14/2020	eastern red bat	1	52	40-m plot	intact
08/14/2020	eastern red bat	31	52	40-m plot	intact
08/14/2020	eastern red bat	41	52	40-m plot	intact
08/14/2020	hoary bat	38	11	40-m plot	intact
08/14/2020	hoary bat	40	30	40-m plot	intact
08/15/2020	eastern red bat	14	46	95-m road and pad	intact
08/15/2020	eastern red bat	34	47	40-m plot	scavenged
08/15/2020	eastern red bat	2	47	40-m plot	scavenged
08/15/2020	hoary bat	35	40	40-m plot	scavenged
08/15/2020	hoary bat	25	44	40-m plot	scavenged
08/17/2020	eastern red bat	32	10	40-m plot	scavenged
08/17/2020	eastern red bat	30	22	40-m plot	intact
08/17/2020	eastern red bat	26	51	70-m plot	intact
08/17/2020	eastern red bat	9	9	40-m plot	scavenged
08/17/2020	eastern red bat	21	9	40-m plot	scavenged
08/17/2020	hoary bat	40	10	40-m plot	scavenged
08/17/2020	hoary bat	18	5	40-m plot	intact
08/18/2020	big brown bat	23	41	40-m plot	scavenged
08/18/2020	big brown bat	34	47	40-m plot	intact
08/18/2020	eastern red bat	41	23	70-m plot	scavenged
08/18/2020	eastern red bat	12	30	40-m plot	scavenged
08/18/2020	eastern red bat	47	32	70-m plot	scavenged
08/18/2020	eastern red bat	37	32	70-m plot	scavenged
08/18/2020	eastern red bat	36	36	40-m plot	scavenged
08/18/2020	eastern red bat	26	44	40-m plot	intact
08/18/2020	eastern red bat	21	50	70-m plot	intact
08/18/2020	eastern red bat	39	52	40-m plot	scavenged
08/18/2020	evening bat	43	50	70-m plot	intact
08/18/2020	silver-haired bat	31	38	70-m plot	intact
08/19/2020	eastern red bat	46	4	70-m plot	dismembered
08/19/2020	eastern red bat	2	40	40-m plot	scavenged
08/19/2020	hoary bat	47	4	70-m plot	scavenged
08/19/2020	hoary bat	36	40	40-m plot	scavenged
08/19/2020	hoary bat	37	40	40-m plot	scavenged
08/19/2020	silver-haired bat	20	40	40-m plot	intact
08/20/2020	eastern red bat	44	10	40-m plot	scavenged
08/20/2020	eastern red bat	76	28	70-m plot	intact
08/20/2020	hoary bat	35	38	70-m plot	intact
08/21/2020	eastern red bat	17	2	40-m plot	scavenged
08/21/2020	eastern red bat	46	29	70-m plot	scavenged
08/21/2020	eastern red bat	38	51	70-m plot	scavenged
08/21/2020	eastern red bat	35	51	70-m plot	scavenged
08/21/2020	eastern red bat	70	51	70-m plot	scavenged
08/21/2020	eastern red bat	12	6	40-m plot	scavenged
08/21/2020	evening bat	43	51	70-m plot	scavenged
08/21/2020	hoary bat	22	27	70-m plot	scavenged
08/22/2020	eastern red bat	32	36	40-m plot	scavenged

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
08/22/2020	eastern red bat	34	41	40-m plot	scavenged
08/22/2020	eastern red bat	21	50	70-m plot	scavenged
08/22/2020	hoary bat	26	36	40-m plot	scavenged
08/24/2020	big brown bat	32	3	95-m road and pad	scavenged
08/24/2020	eastern red bat	47	1	40-m plot	scavenged
08/24/2020	eastern red bat	26	22	40-m plot	scavenged
08/24/2020	eastern red bat	73	25	70-m plot	scavenged
08/24/2020	eastern red bat	25	28	70-m plot	scavenged
08/24/2020	eastern red bat	7	9	40-m plot	scavenged
08/24/2020	hoary bat	40	33	70-m plot	scavenged
08/25/2020	big brown bat	59	18	70-m plot	scavenged
08/25/2020	big brown bat	40	5	40-m plot	scavenged
08/25/2020	big brown bat	45	51	70-m plot	intact
08/25/2020	eastern red bat	28	11	40-m plot	unknown
08/25/2020	eastern red bat	19	32	70-m plot	unknown
08/25/2020	eastern red bat	41	40	40-m plot	scavenged
08/25/2020	eastern red bat	59	51	70-m plot	scavenged
08/25/2020	hoary bat	34	15	70-m plot	scavenged
08/25/2020	hoary bat	50	4	70-m plot	intact
08/25/2020	silver-haired bat	45	23	70-m plot	unknown
08/25/2020	silver-haired bat	61	4	70-m plot	intact
08/26/2020	eastern red bat	64	38	70-m plot	scavenged
08/26/2020	eastern red bat	69	49	70-m plot	intact
08/27/2020	eastern red bat	37	10	40-m plot	scavenged
08/27/2020	eastern red bat	47	24	70-m plot	feather spot
08/27/2020	eastern red bat	31	25	70-m plot	intact
08/27/2020	eastern red bat	51	27	70-m plot	scavenged
08/27/2020	eastern red bat	76	33	70-m plot	scavenged
08/27/2020	eastern red bat	35	5	40-m plot	dismembered
08/27/2020	eastern red bat	40	6	40-m plot	dismembered
08/27/2020	silver-haired bat	6	2	40-m plot	scavenged
08/28/2020	big brown bat	12	48	70-m plot	scavenged
08/28/2020	big brown bat	29	50	70-m plot	scavenged
08/28/2020	eastern red bat	31	23	70-m plot	scavenged
08/28/2020	eastern red bat	30	41	40-m plot	unknown
08/28/2020	eastern red bat	31	48	70-m plot	scavenged
08/28/2020	tri-colored bat	30	36	40-m plot	intact
08/29/2020	eastern red bat	25	11	40-m plot	scavenged
08/29/2020	eastern red bat	24	11	40-m plot	scavenged
08/29/2020	eastern red bat	28	30	40-m plot	scavenged
08/29/2020	eastern red bat	30	30	40-m plot	scavenged
08/29/2020	eastern red bat	43	49	70-m plot	scavenged
08/29/2020	silver-haired bat	38	11	40-m plot	intact
08/29/2020	silver-haired bat	36	40	40-m plot	intact
08/29/2020	silver-haired bat	35	44	40-m plot	intact
08/31/2020	big brown bat	32	33	70-m plot	scavenged
08/31/2020	eastern red bat	33	1	40-m plot	scavenged
08/31/2020	eastern red bat	13	1	40-m plot	scavenged
08/31/2020	eastern red bat	53	1	40-m plot	scavenged
08/31/2020	eastern red bat	32	10	40-m plot	dismembered
08/31/2020	eastern red bat	32	2	40-m plot	scavenged

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
08/31/2020	eastern red bat	78	29	70-m plot	scavenged
08/31/2020	eastern red bat	21	3	95-m road and pad	unknown
08/31/2020	eastern red bat	22	33	70-m plot	scavenged
08/31/2020	eastern red bat	43	4	70-m plot	scavenged
08/31/2020	eastern red bat	32	5	40-m plot	dismembered
08/31/2020	eastern red bat	20	5	40-m plot	scavenged
08/31/2020	eastern red bat	32	9	40-m plot	dismembered
08/31/2020	hoary bat	11	24	70-m plot	scavenged
08/31/2020	hoary bat	10	24	70-m plot	scavenged
08/31/2020	hoary bat	53	25	70-m plot	unknown
08/31/2020	hoary bat	70	9	40-m plot	unknown
08/31/2020	silver-haired bat	77	1	40-m plot	scavenged
08/31/2020	silver-haired bat	68	29	70-m plot	scavenged
08/31/2020	silver-haired bat	70	29	70-m plot	scavenged
08/31/2020	silver-haired bat	20	3	95-m road and pad	scavenged
08/31/2020	silver-haired bat	44	33	70-m plot	dismembered
08/31/2020	silver-haired bat	31	4	70-m plot	scavenged
08/31/2020	silver-haired bat	23	4	70-m plot	intact
08/31/2020	silver-haired bat	49	4	70-m plot	intact
08/31/2020	silver-haired bat	21	51	70-m plot	scavenged
08/31/2020	silver-haired bat	46	51	70-m plot	scavenged
09/01/2020	eastern red bat	35	11	40-m plot	scavenged
09/01/2020	eastern red bat	51	15	70-m plot	scavenged
09/01/2020	eastern red bat	42	18	70-m plot	dismembered
09/01/2020	eastern red bat	73	18	70-m plot	scavenged
09/01/2020	eastern red bat	39	30	40-m plot	scavenged
09/01/2020	eastern red bat	28	32	70-m plot	scavenged
09/01/2020	eastern red bat	56	32	70-m plot	scavenged
09/01/2020	eastern red bat	59	34	95-m road and pad	scavenged
09/01/2020	eastern red bat	20	36	40-m plot	scavenged
09/01/2020	eastern red bat	20	38	70-m plot	scavenged
09/01/2020	eastern red bat	32	44	40-m plot	scavenged
09/01/2020	eastern red bat	43	48	70-m plot	injured
09/01/2020	eastern red bat	45	48	70-m plot	scavenged
09/01/2020	hoary bat	31	11	40-m plot	scavenged
09/01/2020	hoary bat	16	17	95-m road and pad	scavenged
09/01/2020	silver-haired bat	1	14	95-m road and pad	scavenged
09/01/2020	silver-haired bat	46	18	70-m plot	scavenged
09/01/2020	silver-haired bat	9	22	40-m plot	scavenged
09/01/2020	silver-haired bat	24	30	40-m plot	scavenged
09/01/2020	silver-haired bat	30	30	40-m plot	scavenged
09/01/2020	silver-haired bat	0	38	70-m plot	intact
09/01/2020	silver-haired bat	37	48	70-m plot	dismembered
09/01/2020	silver-haired bat	61	48	70-m plot	scavenged
09/01/2020	silver-haired bat	57	49	70-m plot	scavenged
09/02/2020	eastern red bat	10	40	40-m plot	scavenged
09/02/2020	eastern red bat	0	46	95-m road and pad	scavenged
09/02/2020	eastern red bat	7	52	40-m plot	scavenged
09/02/2020	hoary bat	30	47	40-m plot	intact
09/02/2020	silver-haired bat	69	50	70-m plot	scavenged
09/02/2020	silver-haired bat	61	50	70-m plot	scavenged

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
09/02/2020	silver-haired bat	52	50	70-m plot	scavenged
09/02/2020	silver-haired bat	36	52	40-m plot	scavenged
09/03/2020	eastern red bat	24	2	40-m plot	scavenged
09/03/2020	eastern red bat	25	22	40-m plot	scavenged
09/03/2020	eastern red bat	43	27	70-m plot	scavenged
09/03/2020	eastern red bat	47	28	70-m plot	scavenged
09/03/2020	eastern red bat	40	33	70-m plot	scavenged
09/03/2020	eastern red bat	53	4	70-m plot	dismembered
09/03/2020	eastern red bat	30	9	40-m plot	scavenged
09/03/2020	hoary bat	8	1	40-m plot	intact
09/03/2020	hoary bat	17	22	40-m plot	intact
09/03/2020	hoary bat	19	25	70-m plot	scavenged
09/03/2020	silver-haired bat	37	10	40-m plot	scavenged
09/03/2020	silver-haired bat	25	2	40-m plot	scavenged
09/03/2020	silver-haired bat	35	28	70-m plot	scavenged
09/03/2020	silver-haired bat	56	29	70-m plot	scavenged
09/03/2020	silver-haired bat	67	51	70-m plot	scavenged
09/03/2020	silver-haired bat	38	51	70-m plot	scavenged
09/04/2020	eastern red bat	16	18	70-m plot	scavenged
09/04/2020	eastern red bat	12	30	40-m plot	intact
09/04/2020	eastern red bat	27	38	70-m plot	scavenged
09/04/2020	eastern red bat	38	44	40-m plot	scavenged
09/04/2020	eastern red bat	53	48	70-m plot	scavenged
09/04/2020	eastern red bat	24	49	70-m plot	dismembered
09/04/2020	eastern red bat	18	49	70-m plot	scavenged
09/04/2020	eastern red bat	59	50	70-m plot	scavenged
09/04/2020	evening bat	27	50	70-m plot	scavenged
09/04/2020	hoary bat	30	23	70-m plot	scavenged
09/04/2020	hoary bat	29	30	40-m plot	scavenged
09/04/2020	silver-haired bat	43	23	70-m plot	scavenged
09/04/2020	silver-haired bat	40	23	70-m plot	scavenged
09/04/2020	silver-haired bat	22	36	40-m plot	scavenged
09/04/2020	silver-haired bat	12	44	40-m plot	scavenged
09/07/2020	eastern red bat	22	24	70-m plot	scavenged
09/07/2020	eastern red bat	68	24	70-m plot	scavenged
09/07/2020	eastern red bat	31	28	70-m plot	scavenged
09/07/2020	eastern red bat	38	28	70-m plot	scavenged
09/07/2020	eastern red bat	49	28	70-m plot	scavenged
09/08/2020	eastern red bat	56	10	40-m plot	dismembered
09/08/2020	eastern red bat	49	32	70-m plot	scavenged
09/08/2020	eastern red bat	44	32	70-m plot	scavenged
09/08/2020	eastern red bat	9	33	70-m plot	dismembered
09/08/2020	eastern red bat	25	33	70-m plot	scavenged
09/08/2020	eastern red bat	31	33	70-m plot	scavenged
09/08/2020	eastern red bat	46	5	40-m plot	scavenged
09/08/2020	hoary bat	71	32	70-m plot	scavenged
09/09/2020	big brown bat	29	2	40-m plot	scavenged
09/09/2020	eastern red bat	35	2	40-m plot	scavenged
09/09/2020	eastern red bat	23	40	40-m plot	dismembered
09/09/2020	eastern red bat	26	41	40-m plot	intact
09/09/2020	eastern red bat	20	44	40-m plot	scavenged

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
09/09/2020	eastern red bat	12	51	70-m plot	intact
09/09/2020	eastern red bat	49	52	40-m plot	scavenged
09/09/2020	eastern red bat	45	52	40-m plot	intact
09/09/2020	hoary bat	25	36	40-m plot	scavenged
09/09/2020	hoary bat	28	40	40-m plot	scavenged
09/09/2020	hoary bat	29	47	40-m plot	scavenged
09/09/2020	hoary bat	68	49	70-m plot	scavenged
09/09/2020	silver-haired bat	30	47	40-m plot	scavenged
09/09/2020	silver-haired bat	31	47	40-m plot	scavenged
09/09/2020	silver-haired bat	70	49	70-m plot	dismembered
09/10/2020	eastern red bat	10	2	40-m plot	intact
09/10/2020	eastern red bat	40	24	70-m plot	scavenged
09/10/2020	eastern red bat	6	27	70-m plot	scavenged
09/10/2020	eastern red bat	15	28	70-m plot	scavenged
09/10/2020	eastern red bat	67	33	70-m plot	scavenged
09/10/2020	eastern red bat	63	4	70-m plot	intact
09/10/2020	eastern red bat	21	9	40-m plot	scavenged
09/10/2020	hoary bat	37	33	70-m plot	scavenged
09/10/2020	hoary bat	13	5	40-m plot	scavenged
09/10/2020	silver-haired bat	38	10	40-m plot	scavenged
09/10/2020	silver-haired bat	5	22	40-m plot	intact
09/10/2020	silver-haired bat	52	24	70-m plot	scavenged
09/10/2020	silver-haired bat	31	33	70-m plot	scavenged
09/10/2020	silver-haired bat	31	4	70-m plot	intact
09/11/2020	big brown bat	8	18	70-m plot	scavenged
09/11/2020	big brown bat	14	50	70-m plot	scavenged
09/11/2020	eastern red bat	31	36	40-m plot	intact
09/11/2020	eastern red bat	28	41	40-m plot	scavenged
09/11/2020	eastern red bat	14	47	40-m plot	intact
09/11/2020	eastern red bat	35	48	70-m plot	scavenged
09/11/2020	eastern red bat	25	50	70-m plot	scavenged
09/11/2020	hoary bat	30	32	70-m plot	scavenged
09/11/2020	hoary bat	31	36	40-m plot	intact
09/11/2020	hoary bat	43	49	70-m plot	scavenged
09/11/2020	hoary bat	40	50	70-m plot	scavenged
09/11/2020	silver-haired bat	13	40	40-m plot	scavenged
09/11/2020	silver-haired bat	21	48	70-m plot	intact
09/11/2020	silver-haired bat	34	49	70-m plot	scavenged
09/11/2020	silver-haired bat	52	49	70-m plot	intact
09/14/2020	eastern red bat	37	16	95-m road and pad	intact
09/14/2020	eastern red bat	57	24	70-m plot	scavenged
09/14/2020	eastern red bat	64	33	70-m plot	scavenged
09/14/2020	eastern red bat	31	33	70-m plot	scavenged
09/14/2020	eastern red bat	21	9	40-m plot	scavenged
09/14/2020	hoary bat	2	1	40-m plot	scavenged
09/14/2020	hoary bat	43	4	70-m plot	scavenged
09/14/2020	silver-haired bat	16	10	40-m plot	scavenged
09/14/2020	silver-haired bat	35	10	40-m plot	scavenged
09/14/2020	silver-haired bat	0	16	95-m road and pad	injured
09/14/2020	silver-haired bat	43	24	70-m plot	scavenged
09/14/2020	silver-haired bat	19	24	70-m plot	scavenged

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
09/14/2020	silver-haired bat	24	28	70-m plot	scavenged
09/14/2020	silver-haired bat	41	33	70-m plot	scavenged
09/14/2020	silver-haired bat	47	4	70-m plot	scavenged
09/14/2020	silver-haired bat	35	4	70-m plot	scavenged
09/14/2020	silver-haired bat	46	4	70-m plot	scavenged
09/14/2020	silver-haired bat	6	9	40-m plot	scavenged
09/14/2020	silver-haired bat	38	9	40-m plot	scavenged
09/15/2020	eastern red bat	13	30	40-m plot	scavenged
09/15/2020	eastern red bat	23	36	40-m plot	scavenged
09/15/2020	eastern red bat	37	47	40-m plot	intact
09/15/2020	eastern red bat	29	51	70-m plot	scavenged
09/15/2020	silver-haired bat	26	11	40-m plot	scavenged
09/15/2020	silver-haired bat	52	11	40-m plot	scavenged
09/15/2020	silver-haired bat	26	18	70-m plot	scavenged
09/15/2020	silver-haired bat	28	30	40-m plot	scavenged
09/15/2020	silver-haired bat	24	32	70-m plot	scavenged
09/15/2020	silver-haired bat	56	32	70-m plot	scavenged
09/15/2020	silver-haired bat	23	32	70-m plot	scavenged
09/15/2020	silver-haired bat	32	43	95-m road and pad	scavenged
09/15/2020	silver-haired bat	67	48	70-m plot	scavenged
09/15/2020	silver-haired bat	68	51	70-m plot	scavenged
09/15/2020	silver-haired bat	55	51	70-m plot	scavenged
09/16/2020	eastern red bat	44	28	70-m plot	scavenged
09/16/2020	eastern red bat	37	38	70-m plot	scavenged
09/16/2020	eastern red bat	30	44	40-m plot	scavenged
09/16/2020	silver-haired bat	50	25	70-m plot	scavenged
09/16/2020	silver-haired bat	40	28	70-m plot	scavenged
09/16/2020	silver-haired bat	40	52	40-m plot	intact
09/16/2020	silver-haired bat	31	52	40-m plot	intact
09/17/2020	hoary bat	37	18	70-m plot	scavenged
09/17/2020	silver-haired bat	41	11	40-m plot	intact
09/17/2020	silver-haired bat	42	24	70-m plot	scavenged
09/17/2020	silver-haired bat	30	24	70-m plot	scavenged
09/17/2020	silver-haired bat	52	32	70-m plot	scavenged
09/17/2020	silver-haired bat	47	51	70-m plot	scavenged
09/17/2020	silver-haired bat	24	51	70-m plot	dismembered
09/18/2020	eastern red bat	55	38	70-m plot	scavenged
09/18/2020	silver-haired bat	37	48	70-m plot	scavenged
09/21/2020	eastern red bat	59	28	70-m plot	scavenged
09/21/2020	eastern red bat	28	9	40-m plot	scavenged
09/21/2020	hoary bat	21	33	70-m plot	scavenged
09/21/2020	silver-haired bat	35	25	70-m plot	dismembered
09/21/2020	silver-haired bat	46	4	70-m plot	intact
09/22/2020	eastern red bat	12	11	40-m plot	intact
09/22/2020	silver-haired bat	94	32	70-m plot	scavenged
09/22/2020	silver-haired bat	58	32	70-m plot	scavenged
09/22/2020	silver-haired bat	37	36	40-m plot	scavenged
09/22/2020	silver-haired bat	7	40	40-m plot	intact
09/22/2020	silver-haired bat	37	44	40-m plot	intact
09/24/2020	eastern red bat	45	51	70-m plot	scavenged
09/24/2020	eastern red bat	68	51	70-m plot	scavenged

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
09/24/2020	hoary bat	50	2	40-m plot	dismembered
09/24/2020	silver-haired bat	23	10	40-m plot	scavenged
09/24/2020	silver-haired bat	40	5	40-m plot	intact
09/24/2020	silver-haired bat	40	5	40-m plot	scavenged
09/24/2020	silver-haired bat	59	51	70-m plot	scavenged
09/25/2020	eastern red bat	38	41	40-m plot	intact
09/25/2020	eastern red bat	31	52	40-m plot	scavenged
09/25/2020	silver-haired bat	43	11	40-m plot	intact
09/25/2020	silver-haired bat	65	32	70-m plot	scavenged
09/25/2020	silver-haired bat	43	32	70-m plot	intact
09/25/2020	silver-haired bat	26	36	40-m plot	intact
09/25/2020	silver-haired bat	35	36	40-m plot	intact
09/25/2020	silver-haired bat	88	38	70-m plot	scavenged
09/25/2020	silver-haired bat	53	48	70-m plot	scavenged
09/25/2020	silver-haired bat	45	49	70-m plot	scavenged
09/25/2020	silver-haired bat	65	50	70-m plot	scavenged
09/28/2020	eastern red bat	49	27	70-m plot	scavenged
09/28/2020	silver-haired bat	43	10	40-m plot	scavenged
09/28/2020	silver-haired bat	43	2	40-m plot	dismembered
09/28/2020	silver-haired bat	22	2	40-m plot	intact
09/28/2020	silver-haired bat	70	24	70-m plot	scavenged
09/28/2020	silver-haired bat	19	24	70-m plot	scavenged
09/28/2020	silver-haired bat	75	28	70-m plot	scavenged
09/28/2020	silver-haired bat	25	6	40-m plot	dismembered
09/28/2020	silver-haired bat	32	6	40-m plot	scavenged
09/29/2020	eastern red bat	64	15	70-m plot	scavenged
09/29/2020	eastern red bat	55	50	70-m plot	scavenged
09/29/2020	silver-haired bat	39	15	70-m plot	scavenged
09/29/2020	silver-haired bat	1	20	95-m road and pad	dismembered
09/29/2020	silver-haired bat	37	23	70-m plot	scavenged
09/29/2020	silver-haired bat	59	23	70-m plot	scavenged
09/29/2020	silver-haired bat	64	32	70-m plot	scavenged
09/29/2020	silver-haired bat	31	36	40-m plot	intact
09/29/2020	silver-haired bat	25	44	40-m plot	scavenged
09/29/2020	silver-haired bat	64	49	70-m plot	scavenged
09/29/2020	silver-haired bat	58	49	70-m plot	scavenged
10/01/2020	silver-haired bat	38	24	70-m plot	scavenged
10/01/2020	silver-haired bat	56	27	70-m plot	scavenged
10/01/2020	silver-haired bat	59	28	70-m plot	scavenged
10/01/2020	silver-haired bat	48	33	70-m plot	scavenged
10/01/2020	silver-haired bat	0	51	70-m plot	injured
10/01/2020	silver-haired bat	63	51	70-m plot	scavenged
10/01/2020	silver-haired bat	32	6	40-m plot	scavenged
10/02/2020	silver-haired bat	28	15	70-m plot	scavenged
10/02/2020	silver-haired bat	55	32	70-m plot	intact
10/02/2020	silver-haired bat	54	38	70-m plot	scavenged
10/02/2020	silver-haired bat	29	49	70-m plot	dismembered
10/02/2020	silver-haired bat	47	49	70-m plot	scavenged
10/02/2020	silver-haired bat	65	50	70-m plot	scavenged
10/02/2020	silver-haired bat	67	50	70-m plot	scavenged
10/02/2020	silver-haired bat	40	9	40-m plot	intact

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
10/05/2020	hoary bat	5	6	40-m plot	intact
10/05/2020	silver-haired bat	62	24	70-m plot	scavenged
10/05/2020	silver-haired bat	53	25	70-m plot	scavenged
10/05/2020	silver-haired bat	53	25	70-m plot	scavenged
10/05/2020	silver-haired bat	61	33	70-m plot	scavenged
10/05/2020	silver-haired bat	38	6	40-m plot	scavenged
10/05/2020	unidentified bat	25	22	40-m plot	dismembered
10/06/2020	silver-haired bat	38	18	70-m plot	scavenged
10/07/2020	silver-haired bat	4	48	70-m plot	scavenged
10/08/2020	eastern red bat	39	25	70-m plot	intact
10/08/2020	silver-haired bat	55	51	70-m plot	dismembered
10/09/2020	eastern red bat	43	18	70-m plot	intact
10/09/2020	eastern red bat	45	5	40-m plot	scavenged
10/09/2020	eastern red bat	68	52	40-m plot	intact
10/09/2020	silver-haired bat	35	15	70-m plot	scavenged
10/09/2020	silver-haired bat	0	15	70-m plot	scavenged
10/09/2020	silver-haired bat	34	32	70-m plot	intact
10/09/2020	silver-haired bat	29	49	70-m plot	scavenged
10/12/2020	eastern red bat	61	28	70-m plot	scavenged
10/12/2020	silver-haired bat	58	24	70-m plot	scavenged
10/12/2020	silver-haired bat	40	9	40-m plot	scavenged
10/13/2020	eastern red bat	39	11	40-m plot	scavenged
10/13/2020	eastern red bat	31	18	70-m plot	intact
10/13/2020	eastern red bat	58	23	70-m plot	scavenged
10/13/2020	eastern red bat	46	32	70-m plot	scavenged
10/13/2020	eastern red bat	34	38	70-m plot	intact
10/13/2020	eastern red bat	67	49	70-m plot	scavenged
10/13/2020	silver-haired bat	62	18	70-m plot	scavenged
10/13/2020	silver-haired bat	70	18	70-m plot	dismembered
10/14/2020	eastern red bat	25	51	70-m plot	scavenged
10/14/2020	silver-haired bat	43	1	40-m plot	scavenged
10/14/2020	unidentified bat	48	9	40-m plot	scavenged
10/15/2020	eastern red bat	74	38	70-m plot	scavenged
10/15/2020	eastern red bat	42	44	40-m plot	scavenged
10/15/2020	eastern red bat	55	50	70-m plot	scavenged
10/15/2020	silver-haired bat	49	36	40-m plot	scavenged
10/15/2020	silver-haired bat	74	38	70-m plot	scavenged
10/15/2020	silver-haired bat	20	48	70-m plot	scavenged
Birds					
04/02/2020	killdeer	10	8	95-m road and pad	scavenged
04/30/2020	mourning dove	7	10	95-m road and pad	intact
05/15/2020	ruby-throated hummingbird	2	48	95-m road and pad	scavenged
05/19/2020	blackpoll warbler	2	20	95-m road and pad	intact
05/19/2020	brown-headed cowbird	6	20	95-m road and pad	intact
07/14/2020	ring-necked pheasant	1	40	95-m road and pad	scavenged
07/27/2020	killdeer	21	9	95-m road and pad	feather spot
08/03/2020	killdeer	27	6	40-m plot	feather spot

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
08/07/2020	unidentified small bird	22	41	40-m plot	feather spot
08/22/2020	horned lark	6	50	70-m plot	injured
08/24/2020	tree swallow	47	1	40-m plot	scavenged
08/27/2020	killdeer	29	6	40-m plot	feather spot
09/01/2020	unidentified passerine	77	15	70-m plot	scavenged
09/08/2020	mourning dove	40	9	40-m plot	feather spot
09/10/2020	mourning dove	40	5	40-m plot	feather spot
09/14/2020	mourning dove	2	22	40-m plot	intact
09/14/2020	red-breasted nuthatch	32	24	70-m plot	scavenged
09/14/2020	yellow-billed cuckoo	35	10	40-m plot	scavenged
09/21/2020	American redstart	57	4	70-m plot	dismembered
09/21/2020	yellow-throated vireo	52	33	70-m plot	dismembered
09/22/2020	bay-breasted warbler	40	40	40-m plot	intact
09/22/2020	European starling	10	15	70-m plot	dismembered
09/24/2020	yellow-throated vireo	84	4	70-m plot	scavenged
09/25/2020	European starling	11	15	70-m plot	dismembered
09/25/2020	red-eyed vireo	82	38	70-m plot	scavenged
09/29/2020	pine warbler	6	45	95-m road and pad	scavenged
09/29/2020	unidentified passerine	53	32	70-m plot	dismembered
10/01/2020	unidentified passerine	44	51	70-m plot	dismembered
10/05/2020	northern flicker	18	33	70-m plot	scavenged
10/08/2020	American redstart	53	51	70-m plot	dismembered
10/08/2020	unidentified vireo	59	4	70-m plot	scavenged
10/08/2020	yellow-billed cuckoo	70	25	70-m plot	dismembered
10/09/2020	unidentified vireo	35	50	70-m plot	scavenged
10/13/2020	red-eyed vireo	50	23	70-m plot	scavenged
10/14/2020	brown creeper	64	51	70-m plot	dismembered
10/14/2020	golden-crowned kinglet	32	25	70-m plot	scavenged
10/14/2020	golden-crowned kinglet	49	25	70-m plot	dismembered
10/14/2020	golden-crowned kinglet	64	51	70-m plot	dismembered
10/14/2020	golden-crowned kinglet	52	6	40-m plot	scavenged
10/14/2020	golden-crowned kinglet	95	9	40-m plot	scavenged
10/14/2020	Tennessee warbler	56	29	70-m plot	scavenged
10/14/2020	unidentified passerine	62	27	70-m plot	dismembered

Appendix B1. Carcasses found at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2020.

Date Found	Species	Distance from Turbine (m)	Turbine ID	Search Area Type	Physical Condition
10/15/2020	golden-crowned kinglet	21	38	70-m plot	dismembered
10/15/2020	red-breasted nuthatch	44	50	70-m plot	scavenged

*Cleared plots are denoted as 40 –m plots in this table, and un-cleared plots are denoted as 70-m plots.

Appendix C. Searcher Efficiency and Carcass Persistence Modeling Estimates and Results

Appendix C1. Searcher efficiency logistic regression models for bats (dog-handler teams) from the Hoopeston Wind Project, Vermilion County, Illinois search efficiency trials from August 1, 2019 to October 15, 2020.

Covariate	AICc	Delta AICc
No Covariates (Intercept)	40.99	0*
Plot Type	42.96	1.97

AICc = Akaike Information Criteria

*Selected model

Appendix C2. Searcher efficiency logistic regression models for bats (human searchers) from the Hoopeston Wind Project, Vermilion County, Illinois search efficiency trials from April 2, to October 15, 2020.

Covariate	AICc	Delta AICc
Plot Type	40.10	0*
Season	54.86	14.76
No Covariates (Intercept)	57.35	17.25

AICc = Akaike Information Criteria

*Selected model

Appendix C3. Carcass persistence models and covariates for bats at the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2019 to October 15, 2019 (n = 43).

Shape Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	-	exponential[1]	186.89	0
Season	No Covariates	Weibull	187.13	0.24
No Covariates	-	exponential[1]	188.13	1.24*
No Covariates	No Covariates	Weibull	189.57	2.68
No Covariates	No Covariates	loglogistic	191.02	4.13
Season	No Covariates	loglogistic	191.73	4.84
Season	No Covariates	lognormal	191.85	4.96
No Covariates	Season	Weibull	191.99	5.10
Season	Season	Weibull	192.13	5.24
No Covariates	No Covariates	lognormal	192.17	5.28
No Covariates	Season	loglogistic	195.23	8.34
No Covariates	Season	lognormal	196.03	9.14
Season	Season	lognormal	196.85	9.96
Season	Season	loglogistic	196.86	9.97

* Selected model

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

Appendix C4. Carcass persistence top model with covariates, distributions, and model parameters for the Hoopeston Wind Project, Vermilion County, Illinois, from April 2, 2019 to October 15, 2020.

Distribution	Estimated Removal Time (days)	Parameter 1	Parameter 2
exponential	7.29	rate=0.095	–

Appendix D. Truncated Weighted Likelihood (TWL) Area Adjustment Estimate Model Fitting Results

Appendix D1. Truncated weighted maximum likelihood search area adjustment estimates for the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2020 to October 15, 2020 (Bat n = 404).

Search Area Type	Distribution	Parameter 1	Parameter 2	Area Adjustment
40-m plot	normal	36.78	17.49	0.59
70-m plot	normal	36.78	17.49	0.97
95-m road and pad	normal	36.78	17.49	0.07

Appendix D2. Search area adjustment models for bats from the Hoopeston Wind Project, Vermillion County, Illinois, from April 2, 2020 to October 15, 2020.

Distribution	AICc	Delta AICc
normal	9,684.10	0*
Gompertz	9,701.80	17.71
Weibull	9,749.16	65.07
Rayleigh	9,780.40	96.30
gamma	9,885.59	201.49

* Selected model

Appendix E. Bat Fatality Rates at the Hoopeston Wind Project Using the GenEst Fatality Estimator

Appendix E1. Estimated fatality rates and adjustment factors, with 90% confidence intervals at for all plots search areas for studies conducted at the Hoopeston Wind Project, Vermillion County, IL, from April 2 to October 15, 2020.

	Fall		Spring		Summer	
	Estimate	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Search Area Adjustment						
40-m plot	0.59	0.48–0.70	0.59	0.48–0.70		
70-m plot	0.97	0.92–1.00				
95-m road and pad	0.07	0.05–0.09	0.07	0.05–0.09	0.07	0.05–0.09
Searcher Efficiency						
40-m plot	0.84	0.73–0.91	0.58	0.39–0.75		
70-m plot	0.84	0.73–0.91				
95-m road and pad	0.98	0.91–1.00	0.98	0.91–1.00	0.98	0.91–1.00
Average Probability of a Carcass Persisting Through the Search Interval**						
40-m plot	0.85	0.81–0.88	0.73	0.67–0.78		
70-m plot	0.85	0.81–0.88				
95-m road and pad	0.73	0.67–0.78	0.73	0.67–0.78	0.73	0.67–0.78
Probability of Available and Detected						
40-m plot	0.77	0.70–0.82	0.53	0.39–0.65		
70-m plot	0.77	0.70–0.82				
95-m road and pad	0.82	0.78–0.86	0.75	0.69–0.80	0.72	0.66–0.77
Estimated Fatality Rates (Fatalities/Turbine/Seasons(s))						
40-m plot	23.93	19.16–30.59	0	n/a*		
70-m plot	18.29	16.59–21.09				
95-m road and pad	16.86	9.05–28.23	1.72	n/a*	4.81	2.53–7.78
Estimated Fatality Rates (Fatalities/MW/Seasons(s))						
40-m plot	11.97	9.58–15.29	0	n/a*		
70-m plot	9.14	8.29–10.55				
95-m road and pad	8.43	4.53–14.11	0.86	n/a*	2.41	1.26–3.89

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

** The search interval was twice per week in Fall and weekly in Fall and Spring and Summer.

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

Appendix F1. Inputs needed to run Evidence of Absence: Single Class Module for the Hoopeston Wind Project, Vermilion County, Illinois, from April 2, 2020 to October 15, 2020.

			Number	Spatial	Searcher Efficiency		Results	
Season	Plot Type	Search interval (I)	of searches	Coverage (a)	Carcasses available	Carcasses found	Ba	Bb
spring	road/pad	7	7	0.068	57	56	382.27	7,523.75
spring	cleared	7	7	0.588	19	11	26.44	64.45
summer	road/pad	7	11	0.068	57	56	332.16	6,533.63
fall	road/pad	7	11	0.068	57	56	386.18	7,576.16
fall	cleared	3.5	22	0.588	45	38	257.61	296.32
fall	uncleared	3.5	22	0.975	45	38	130.25	39.31

Appendix F2. Inputs needed to run Evidence of Absence: Multiple Class Module for the Hoopeston Wind Project, Vermilion County, Illinois, from 2018–2020.

Season	Plot Type	Ba	Bb	Sampling Fraction	Temporal coverage (v)	Weights (ρ)
fall	road/pad	386.18	7576.16	0.367	1	0.367
fall	cleared	257.61	296.32	0.306	1	0.306
fall	uncleared	130.25	39.31	0.327	1	0.327