

**Post-construction Monitoring Study  
Sugar Creek Wind Project  
Logan County, Illinois**

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



**Prepared for:**  
**Sugar Creek Wind One LLC**  
465 State Route 10,  
Logan County, Illinois 62671

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## INTRODUCTION AND BACKGROUND

The Sugar Creek Wind Project (Project), located in Logan County, Illinois (Figure 1), is owned by Sugar Creek Wind One LLC (Sugar Creek), a subsidiary of Algonquin Power Company, and is operated by Liberty Power. Sugar Creek obtained a US Fish and Wildlife Service (USFWS) Incidental Take Permit (ITP; ESPE0047644) for the federally listed as endangered Indiana bat (*Myotis sodalis*) and federally listed as threatened northern long-eared bat<sup>1</sup> (*M. septentrionalis*; hereafter, Covered Species) dated July 15, 2022. Sugar Creek also obtained Incidental Take Authorization (ITA) from the Illinois Department of Natural Resources (IDNR) for Covered Species on December 22, 2022. Both the USFWS ITP and IDNR ITA require the Project to minimize impacts to Covered Species and conduct post-construction monitoring (PCM).

Western EcoSystems Technology, Inc. (WEST) completed a second year of post-construction monitoring (PCM) at the Project in 2022 in accordance with the Project's Habitat Conservation Plan (HCP; version dated October 8, 2021; Liberty Power 2021) and Bird and Bat Conservation Strategy (version dated September 30, 2017; Sugar Creek 2017). The 2022 PCM was the first year of the Intensive Monitoring Phase under the Project's ITP. The objectives of this study were to calculate the overall detection probability (*g*) for the Covered Species, and estimate the overall bat fatality rate as specified in the HCP. This report presents the results of the 2022 year of monitoring conducted at the Project from April 1 – October 15, 2022.

## PROJECT LOCATION

The Project is located approximately 13 kilometers (8 miles) west of the city of Lincoln, Illinois (Figure 1). Topography is categorized by gentle, rolling hills largely composed of cultivated croplands and developed areas (Liberty Power 2021). Land cover in the Project is dominated by agriculture (i.e., row crop and pasture) with small creeks and drainages interspersed throughout. Small areas of hay/pasture, woody wetlands, deciduous forest, and open water are also present within the Project (National Land Cover Database 2019; Figure 2).

The Project is a 202-megawatt (MW) wind energy facility that became operational in 2020 and consists of 57 wind turbines: 17 Vestas V110s 2.0-MW turbines that have a 95-meter (m; 312-foot [ft]) hub height and 54-m (177-ft) blade length, and 40 Vestas V150s 4.2-MW turbines that have a 110-m (361-ft) hub height and 75-m (246-ft) blade length. All turbines were within the migratory range of both Covered Species, therefore, to minimize the impacts, all turbines were feathered below wind speeds of 5.0 m/second (m/s; 16.4 ft/s) from sunset to sunrise when temperatures were above 10 degrees (°) Celsius (C; 50° Fahrenheit [F]) during the fall migration period (August 1 – October 15; Table 1). Additionally, all turbines were feathered below the manufactured cut-in speed of 3.0 m/s (9.8 ft/s) from sunset to sunrise when temperatures were

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<sup>1</sup> On November 29, 2022, the USFWS published the final rule to list the northern long-eared bat as endangered under the Endangered Species Act. The status change will take effect on March 31, 2023.

above 4° C (40° F) during the summer maternity season and spring migration period, and winter (March 15 – July 31 and October 16 – March 14, respectively; Table 1).

**Table 1. Seasonal curtailment\* regime at the Sugar Creek Wind Project, Logan County, Illinois.**

Temperature	Spring and Summer: March 15 – July 31	Fall: August 1 – October 15	Winter: October 16 – March 14
Less than 4°C (40°F)	Uncurtail	Uncurtail	Uncurtail
4 to 10°C (50°F)**	3.0m/s	3.0 m/s	3.0 m/s
Greater than 10°C	3.0 m/s	5.0 m/s	3.0 m/s

\* The manufacturer's cut-in wind speed is 3.0 meters per second (m/s; 9.8 feet [ft]/s) across the Project turbines.

\*\* Turbines will be feathered below cut-in when temperatures are above the threshold. Feathering means that turbine blades will be pitched into the wind such that they spin at less than one rotation per minute.

C = Celsius; F = Fahrenheit.

## METHODS

WEST followed PCM methods outlined in the Project's HCP for the Intensive Monitoring Phase, which targeted a probability of detection (*g*) above 0.20 for all Covered Species to meet the monitoring commitments.

### Standardized Carcass Searches

#### *Number of Turbines Sampled, Search Frequency, and Plot Size*

Technicians conducted standardized carcass searches at all 57 turbines from April 1 – October 15, 2022. Search effort varied by season (Table 2), consistent with the Project's HCP.

**Table 2. Search effort by season and plot type at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Season	# Full Plot Turbines	# Road and Pad Turbines	Search Interval
Spring (April 1 – May 29)	0	57	Once per weekly
Summer (June 1 – July 31)	0	57	Once per weekly
Fall (August 1 – October 15)	15	42	Twice per week

# = number.

Searches were conducted within two types of search areas: gravel turbine access roads and pads (road and pad) or full plots (Table 1, Figure 3). Road and pad areas were searched out to 100 m (328 ft) from the turbine base. Full plot searches were conducted within mowed areas centered on the turbines. The full plots were larger than specified in the HCP to reflect the different turbine sizes: 60-m (197-ft) radius circles at nine V110s 2.0 MW turbines and 70-m (230-ft) radius circles at six V150s 4.2 MW turbines. To the extent possible, search times varied between surveys so search areas were surveyed during all daylight periods (i.e., morning, mid-day, and afternoon). During the fall, vegetation at the full plots was mowed and maintained by Project staff to enhance detectability of carcasses.

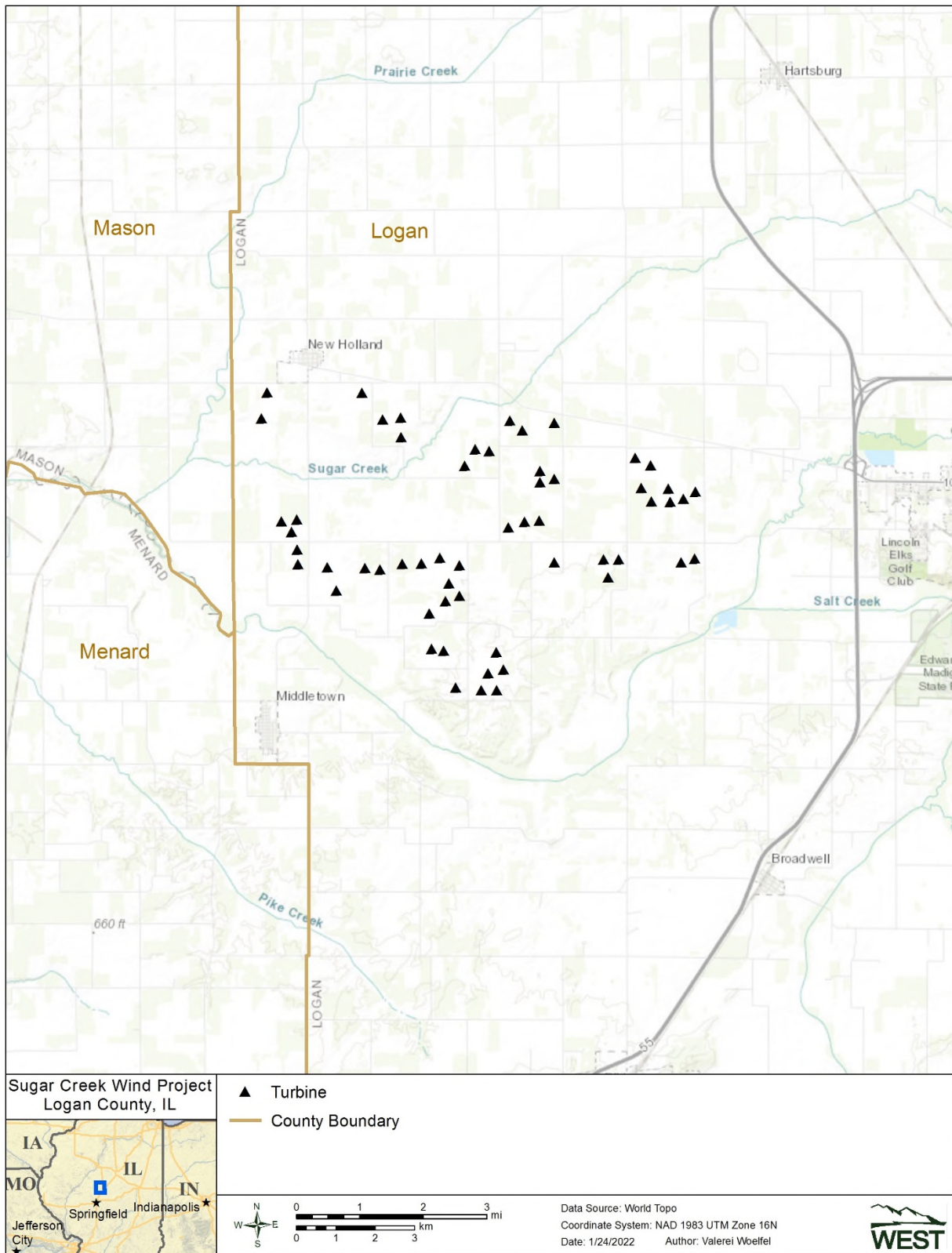


Figure 1. Location of turbines at the Sugar Creek Wind Project, Logan County, Illinois.



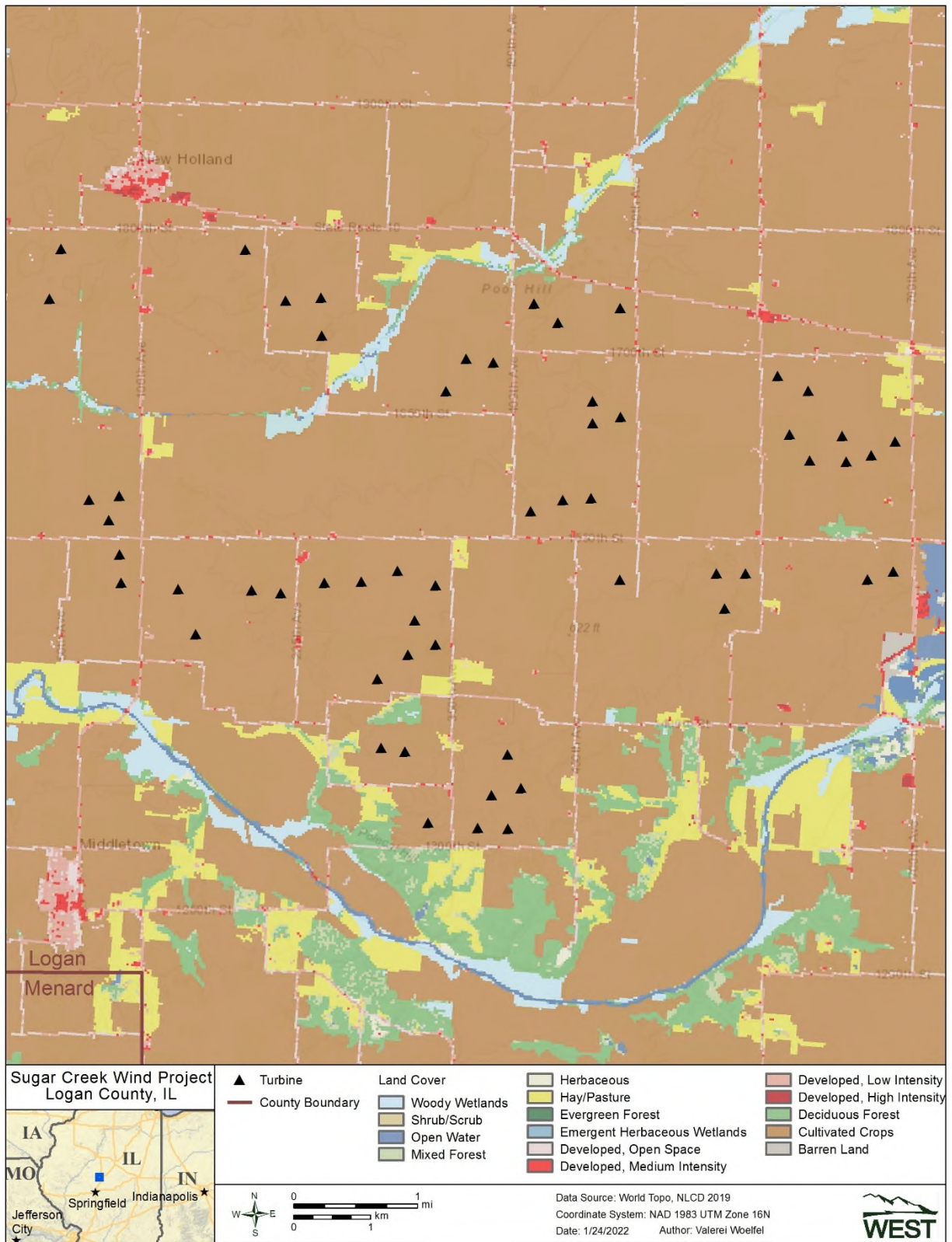


Figure 2. Land cover at the Sugar Creek Wind Project, Logan County, Illinois.

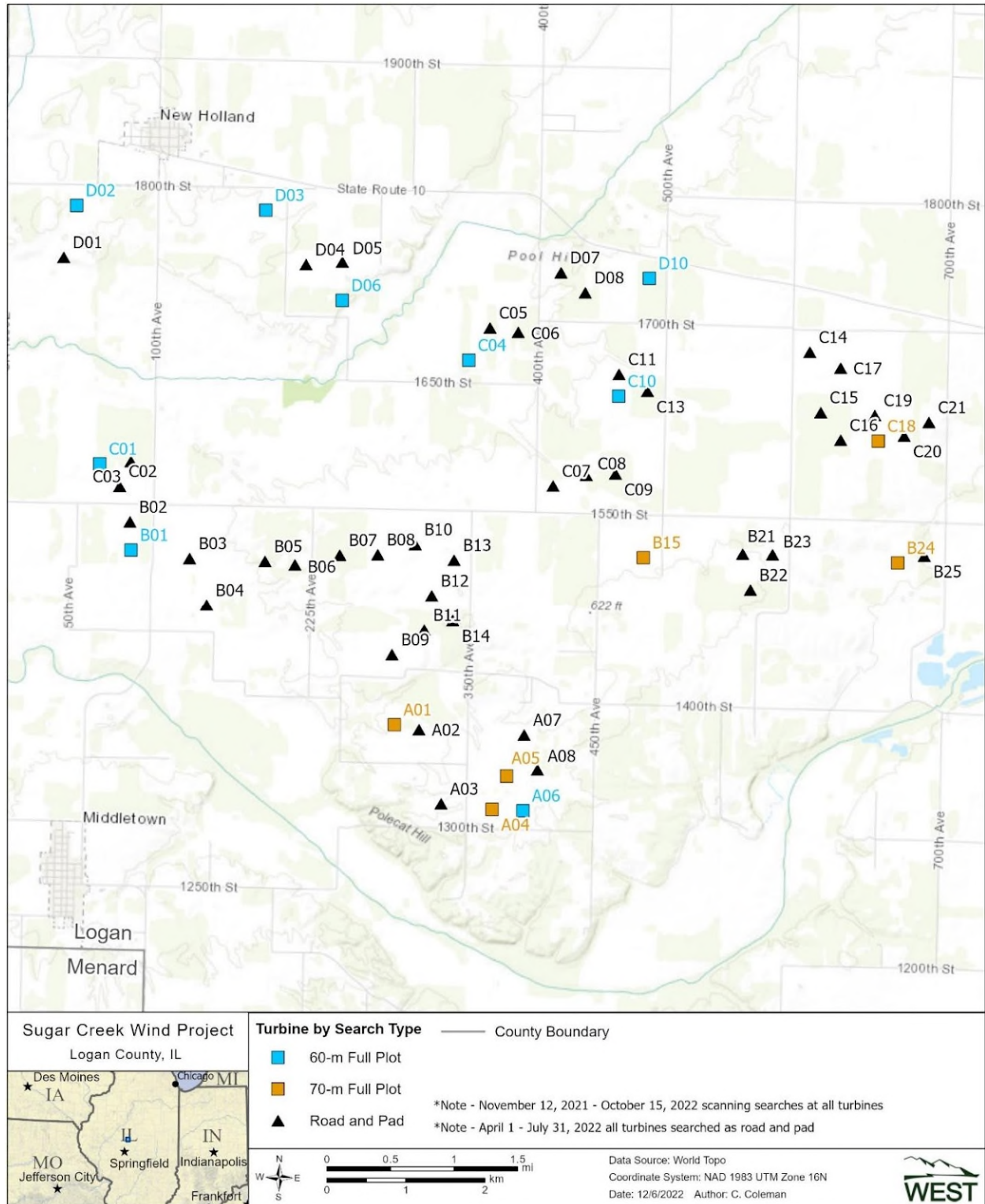


Figure 3. Location of turbines by search type at the Sugar Creek Wind Project, Logan County, Illinois.

### *Search Methods*

Technicians trained in proper search techniques conducted carcass searches and looked for carcasses while walking at a pace of approximately 45–60 m (148–197 ft) per minute (min) within search areas. At road and pad turbines, the technician walked the access road starting at 100 m from the turbine and walked towards the turbine, around the turbine along the gravel pad, and back towards their vehicle, searching out 3.0 m on each side until the entire road and pad was searched. For full plots, technicians walked transects spaced at approximately 5.0 m intervals while scanning the ground for carcasses within 3.0 m of each transect. The technician commenced searching at one side of the full plot and systematically searched the entire plot in a north/south or east/west direction.

### *Data Collection*

Technicians recorded the date, search start and end times, technician name, turbine number, type of search, and if any carcasses were found during each scheduled search. When a carcass was found, technicians placed a flag near it and continued the search. After searching the entire road and pad or full plot, the technician returned to each carcass and recorded the date and time found, technician name, species, sex, and age of the carcass (when possible), turbine number, distance and azimuth from turbine, location of carcass as Universal Transverse Mercator coordinates, habitat surrounding carcass, estimated time since death (e.g., 0–1 days, 2–3 days, 4–7 days, 8–14 days, 15–30 days, or more than 30 days), and condition of carcass (i.e., intact, scavenged, dismembered).

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

- Intact—a carcass that was entirely in one piece, not badly decomposed, and showed no sign of being fed upon by a predator or scavenger
- Scavenged—a carcass that showed signs of being fed upon by a predator or scavenger but was otherwise complete; or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, part of a carcass), or a carcass that has been heavily infested by insects
- Dismembered—all portions of a single carcass found in multiple pieces that are 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 but impaired in some way

For bird carcasses, the following category was also used if needed:

- Feather spot—10 or more feathers (excluding down), or two or more primary feathers at one location indicating predation or scavenging of a bird carcass

Technicians took digital photographs of each fatality, including any visible injuries, and surrounding habitat. Bat carcasses were collected under the Project's USFWS ITP ESPER0047544, WEST's Federal Native Endangered and Threatened Species Recovery Permit

TE234121-9, WEST's State Endangered and Threatened Species Scientific Permit 1531, and individual salvage permits: NH22.6461, NH22.6819, and NH22.6831. Bird carcasses were collected under a Federal Migratory Bird Special Purpose – Utility Permit (MBPER0001905). Technicians placed all 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 carcasses to eliminate possible transmission of rabies or other diseases. Live, injured bats and birds were recorded and considered fatalities for analysis purposes when observed in search areas, and were handled in accordance with permit conditions (left in place).

#### *Carcass Identification and Agency Notification*

Identification of bird carcasses were verified by biologists with extensive field experience in identification of birds and their feathers. A federally permitted bat biologist (Meredith Hoggatt ESPER0039249; Pallavi Sirajuddin TE62046D-0) identified all bat carcasses via photos and/or in hand at the end of the surveys. The USFWS and the IDNR were notified within 24 hours of positive identification any state- or federally listed species.

Tissue samples were collected from heavily scavenged or decomposed bat carcasses that could not be positively identified and had potential to be a Covered Species and submitted to the East Stroudsburg University Wildlife Genetics Institute for identification via deoxyribonucleic acid (DNA) analysis.

#### **Bias Trials**

##### *Searcher Efficiency Trials*

The objective of searcher efficiency (SEEF) trials was to collect data to estimate the probability a technician detected bat carcasses. This effort accounted for any biases associated with changes in conditions such as vegetation, topography, and weather (e.g., rain and/or cloud cover, muddy plots), and technician variability that could have affected SEEF.

SEEF trials commenced with the start of carcass searches and were conducted in the same search areas throughout the study period. SEEF trials were stratified by search area (road and pad and full plot) and season. A bias trial administrator (administrator) placed SEEF trial carcasses (SEEF carcasses) in search areas to keep technicians unaware of when and where the SEEF carcasses were placed. Non-*Myotis* bats found on site or dark-colored domestic mice (*Mus musculus*) were used as surrogates for bats. A random number generator was used to produce the location (distances and bearing) for the trial carcasses.

The administrator placed 62 bat carcasses in random locations. Prior to placement, each SEEF carcass was marked discreetly with electrical tape around one leg so it could be identified as a SEEF carcass. The administrator dropped SEEF carcasses from waist height or higher and allowed them to land in a random posture. To avoid attracting scavengers, no more than two SEEF carcasses were placed at a single turbine at the same time. Technicians conducting carcass searches recorded the location of any SEEF carcasses found. Immediately following the

trial, the bias trial administrator determined the number of SEEF carcasses that were available for detection during the trial.

### *Carcass Persistence Trials*

The objective of carcass persistence trials (CPT) was to collect data to estimate the average probability a bat carcass remained available to be found during the search interval. The data collected were used to adjust for the potential bias of carcasses removed during carcass searches. CPT were conducted throughout the survey period to incorporate the effects of varying weather, climatic conditions, and scavenger densities. Possible means of carcass removal included predators, scavengers, insects, or agricultural practices, such as being plowed into a field. Estimates of bat carcass persistence were used to adjust the total number of carcasses found as compared to those removed from the search area. A random number generator was used to produce the distances and bearing for the trial carcasses.

The administrator dropped 63 bat carcasses for CPT. The same bat species used for SEEF trials also were used for CPT. Carcasses were marked discreetly with electrical tape for recognition by technicians and other personnel, and then dropped from waist height or higher and allowed to land in a random posture within the search area.

CPT carcasses were monitored over a 30-day period according to the following schedule: every day for the first seven days, then on days 10, 14, 21, and 30. The condition of carcasses was recorded each time the CPT carcasses were checked. The schedule varied slightly depending on weather, turbine maintenance, and coordination with other survey work. Following the 30-day period, any remaining evidence of carcasses was removed

### **Search Area Mapping**

Technicians recorded the boundaries of 100 m roads and pads and full plot boundaries using a Trimble submeter Global Positioning Satellite unit. Unsearchable areas within plot boundaries were also mapped. The plot boundaries were used to verify if carcasses were found inside the search areas, and to inform the distribution of carcasses around turbines to estimate the number of carcasses that fell inside or outside of search areas.

### **Quality Assurance and Quality Control**

Quality assurance and quality control measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, technicians were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data were identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the technician and/or Project Manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes and measures were implemented. A Microsoft® SQL database was developed to store, organize, and retrieve survey data. All data forms and electronic data files were retained for reference.

## Statistical Analysis

The Evidence of Absence (EoA; Dalthorp et al. 2017) modeling framework was used to estimate the probability of detecting Covered Species. Additionally, per the Project's HCP, the all-bat fatality estimate was calculated using GenEst (a generalized estimator of fatality; Dalthorp et al. 2018, Simonis et al. 2018).

### *Searcher Efficiency Estimation*

SEEF was modeled using logistic regression, while accounting for the *detection reduction factor* ( $k$ ; Dalthorp et al. 2018). Covariates for the models included plot type in the fall and season, and the interactions between these variables. Model selection was done using an information theoretic approach known as AICc, or corrected Akaike Information Criterion (Burnham and Anderson 2002). The best model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value.

The results of SEEF model selection are used differently in GenEst and EoA. The best-supported logistic regression models were used with GenEst to estimate the all-bat fatality rate. EoA uses raw SEEF data (e.g., number of found and available trial carcasses) to inform overall  $g$ . However, the model selection results were used to determine if SEEF data should be pooled, or separated by strata such as season and plot type, prior to inputting SEEF data were input into the EoA software according to the model selection results.

### *Carcass Persistence Estimation*

Data collected during CPT were used to estimate the amount of time, in days, carcasses remained available to be located by the technicians. The average probability a carcass persisted through the search interval (i.e., the time between scheduled searches) was estimated using an interval-censored survival regression with four potential distributions: exponential, log-logistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Dalthorp et al. 2018). As with SEEF, carcass persistence models were fit separately by plot type and season. The best-supported model for EoA and the all-bat fatality estimate was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value. The parameter estimates of the selected model ( $\alpha$  [shape] and  $\beta$  [scale], including the 95% Confidence Interval [CI] of  $\beta$ ) were used as inputs in the EoA Single Class module.

### *Detection Reduction Factor*

The change in SEEF between successive searches was defined by a parameter called the *detection reduction factor* ( $k$ ) that ranged from zero to one. When  $k$  is zero it implied that a carcass is missed on the first search and that carcass would never be found. A  $k$  of one implied SEEF remained constant no matter how many times a carcass is missed. The  $k$  was a required parameter for GenEst; however, data were not collected to estimate  $k$ . A value for  $k$  of 0.67 was assumed in this study for GenEst and a  $k$  of 0.65 for EoA, as specified in the HCP.

### *Search Area Adjustment Estimate*

The search area adjustment accounted for unsearched areas beneath turbines and was calculated as a probability that ranged from zero to one. For example, an area adjustment of 0.75 meant that an estimated 75% of carcasses fell within the search area. Unsearched areas were due to survey obstacles such as ground cover (e.g., tall crops) or terrain, or areas where carcasses fell outside the search area (e.g., a carcass landed 70 m away from the turbine on a plot searched out to 60 m from the turbine base). The area adjustment was estimated as the product of the unsearched area around each turbine and a carcass-density distribution. The carcass-density distribution predicts the likelihood a carcass fell a given distance from the turbine base.

For bats, a truncated weighted maximum likelihood modeling approach (Khokan et al. 2013) was used to estimate the carcass-density distribution. Truncation accounts for carcasses beyond the search radius and weights account for unequal search effort. Distributions considered were normal, gamma, Gompertz, and Weibull (parameterized according to R Development Core Team [2016] and Yee [2010]). Carcass-density distributions were modeled both with all fatalities combined and with models stratified by turbine type or by cut-in speed (3.0 m/s in the spring and 5.0 m/s in the fall). The best model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value. 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. The area adjustment was estimated by combining the carcass-density distribution with the proportion of area searched for each 1.0-m annulus across the search area and summarizing across the distances.

### *Carcasses Excluded from Area Correction Calculations*

Fatalities were excluded from both the area correction used in EoA and the all-bat fatality estimate when the carcass was discovered outside of the spatial and temporal scope of the survey design. For example, carcasses found outside a designated plot were not included in the analysis because the area adjustment accounts for the carcass by adjusting for unsearched areas. Carcasses found prior to the start of surveys (e.g., a carcass found on a plot during plot setup prior to the spring season) were also excluded because the carcass occurred outside of the study period. Note that carcasses found on a plot incidentally were included in the analysis if that plot had a scheduled search during the next round of surveys.

### *Evidence of Absence Detection Probabilities*

The overall  $g$  was estimated using the EoA Software (Dalthorp et al. 2017). The EoA method utilizes data from PCM to estimate site-wide  $g$ . Estimating an annual  $g$  is a three step process: first, the single stratum module is used to estimate  $g$  within each search stratum (e.g., search area type within season), second, search strata are combined within each season to estimate detection probability for each season, and, third, seasonal detection probabilities are combined to estimate an annual detection probability.

Single-stratum detection probability estimates were computed using the EoA Single Class module with inputs that described the estimated carcass removal rate, estimated SEEF rates, and temporal search effort. Data were not available to estimate the detection probability reduction factor ( $k$ ), so an assumed value of 0.65 was used as stated in the Project HCP. Adjustments for number of turbines searched were not included in the single-stratum detection probability estimates. Rather, unsearched turbines were given their own strata with near-zero detection probabilities<sup>2</sup> where relevant (D. Dalthorp, US Geological Survey, pers. comm., 2017), resulting in a searched area adjustment to the seasonal detection probabilities. For the purposes of this analysis, it is assumed that all turbines were operational for the entire study period.

Stratum-specific detection probabilities were combined into seasonal detection probabilities using the EoA multiple class module where the weights for each stratum (density-weighted proportion in the EoA software) were the fraction of Project turbines within the stratum.

Seasonal detection probabilities were combined into a whole-site, whole-year detection probability using the EoA multiple class module where the weights for each stratum were then assumed seasonality of risk for Covered Species which, has previously been estimated as 11% in spring and 89% in fall (USFWS 2016).

#### *Fatality Rate Estimation*

Carcasses included in the all-bat fatality rate estimation were found within the search areas (plots) and had an estimated time of death within the study period. Fatality estimates were calculated for bats, by season and plot type, using GenEst (Dalthorp et al. 2018, Simonis et al. 2018). To obtain an overall estimate of fatality, each carcass included in the analysis was adjusted for SEEF, carcass persistence,  $k$ , and a search area adjustment. Estimates and 90% CI were calculated using a parametric bootstrap (Dalthorp et al. 2018). The relative number of turbines sampled within each plot type was used to weight each plot type estimate within each season, resulting in an overall estimate by season. The overall estimates for each season could then be summed to generate an overall estimate for the entire study period.

#### *Assessment of Adaptive Management Triggers*

As specified in the Project's HCP, evaluation of EoA and the annual PCM to determine the need for adaptive management will take place after Year 3 of post-ITP issuance operations. As the 2022 PCM was the first year of monitoring under the Project's ITP, adaptive management triggers were not evaluated.

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<sup>2</sup> EoA cannot analyze zero-valued detection probabilities. An arbitrarily low detection probability ( $10e-5$ ) was used instead by specifying a beta (0.01, 1,000) distribution for the detection probability.



## RESULTS

### Standardized Carcass Searches

A total of 2,084 searches were completed across all seasons (spring = 447; summer = 485; fall = 1,152). One hundred twenty-two searches (5.6%) were missed due to turbine maintenance, weather constraints, plot conditions, and/or safety hazards.

#### Overall Carcasses

One hundred ninety-six bat carcasses were found during carcass searches (Table 3; Appendix A). Nine bat carcasses were found outside the search areas, outside the study period (died prior to the study period), or found during plot setup, prior to the study starting; therefore, these carcasses were not included in analysis. Thirty-seven bird carcasses were found during surveys (Appendix A); however, no birds were included in the analysis (Table 3).

**Table 3. Number and percent (%) of carcasses by species included and excluded from analysis at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Species	Included in Fatality Estimate		Outside Search Area*		Outside Study Period*		Other*		Total	
	Total	%	Total	%	Total	%	Total	%	Total	%
<b>Bat</b>										
eastern red bat	85	45.45	3	100	3	50.00	0	0	91	46.43
silver-haired bat	37	19.79	0	0	0	0	0	0	37	18.88
hoary bat	32	17.11	0	0	1	16.67	0	0	33	16.84
evening bat	16	8.56	0	0	1	16.67	0	0	17	8.67
big brown bat	12	6.42	0	0	1	16.67	0	0	13	6.63
eastern red bat or Seminole bat	2	1.07	0	0	0	0	0	0	2	1.02
Seminole bat	2	1.07	0	0	0	0	0	0	2	1.02
unidentified lasiurus bat	1	0.53	0	0	0	0	0	0	1	0.51
<b>Overall Bats</b>	<b>187</b>	<b>100</b>	<b>3</b>	<b>100</b>	<b>6</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>196</b>	<b>100</b>
<b>Bird</b>										
cliff swallow	0	0	0	0	0	0	5	14.71	5	13.51
golden-crowned kinglet	0	0	0	0	0	0	5	14.71	5	13.51
killdeer	0	0	0	0	0	0	3	8.82	3	8.11
Tennessee warbler	0	0	0	0	0	0	3	8.82	3	8.11
horned lark	0	0	0	0	0	0	2	5.88	2	5.41
magnolia warbler	0	0	0	0	0	0	2	5.88	2	5.41
red-eyed vireo	0	0	0	0	0	0	2	5.88	2	5.41
white-breasted nuthatch	0	0	0	0	0	0	2	5.88	2	5.41
black-billed cuckoo	0	0	1	33.33	0	0	0	0	1	2.70
red-tailed hawk	0	0	1	33.33	0	0	0	0	1	2.70
sharp-shinned hawk	0	0	1	33.33	0	0	0	0	1	2.70
American redstart	0	0	0	0	0	0	1	2.94	1	2.70
chimney swift	0	0	0	0	0	0	1	2.94	1	2.70
dickcissel	0	0	0	0	0	0	1	2.94	1	2.70
European starling	0	0	0	0	0	0	1	2.94	1	2.70
mourning dove	0	0	0	0	0	0	1	2.94	1	2.70
northern flicker	0	0	0	0	0	0	1	2.94	1	2.70
ruby-crowned kinglet	0	0	0	0	0	0	1	2.94	1	2.70
sedge wren	0	0	0	0	0	0	1	2.94	1	2.70

**Table 3. Number and percent (%) of carcasses by species included and excluded from analysis at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Species	Included in Fatality Estimate		Outside Search Area*		Outside Study Period*		Other*		Total	
	Total	%	Total	%	Total	%	Total	%	Total	%
unidentified warbler	0	0	0	0	0	0	1	2.94	1	2.70
warbling vireo	0	0	0	0	0	0	1	2.94	1	2.70
<b>Overall Birds</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>100</b>	<b>0</b>	<b>0</b>	<b>34</b>	<b>100</b>	<b>37</b>	<b>100</b>

\* Carcasses not included in analysis.

Sums may not equal total values shown due to rounding.

### Species Composition

No Covered Species were identified during the study. Eastern red bat (*Lasiurus borealis*; 91 carcasses; 46.4%) was the most commonly found species during surveys and incidentally, followed by silver-haired bat (*Lasionycteris noctivagans*; 37; 18.9%), hoary bat (*Lasiurus cinereus*; 33; 16.8%), evening bat (*Nycticeius humeralis*; 17; 8.7%), big brown bat (*Eptesicus fuscus*; 13; 6.6%), and Seminole bat (*L. seminolus*), and eastern red or Seminole bat (two; 1.0%, each; Table 3). One heavily scavenged bat (i.e., wing membrane only) was found during surveys and identified as unidentified *Lasiurus* bat. One black-billed cuckoo (*Coccyzus erythrophthalmus*, a state-listed as threatened species) was also found at Turbine B04 on May 11, 2022 (Table 3; Appendix A).

### Bias Trails

#### Searcher Efficiency Trials

Sixty-two bats were placed for SEEF trials on six separate dates and 51 were available for searchers to find (Table 4). The best-fit model indicated that SEEF varied by search area type in the fall (Table 5). Overall, the observed SEEF ratios were 100% on road and pads and 46.2% on full plots (Table 4).

**Table 4. Searcher efficiency results for road and pad search areas at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022, as a function of season and carcass size.**

Search Area Type	Season	# Placed	# Available	# Found	% Found
Road and Pad	Spring	15	15	15	100
	Summer	19	16	16	100
	Fall	12	7	7	100
	<b>Overall</b>	<b>46</b>	<b>38</b>	<b>38</b>	<b>100</b>
Full Plot	Fall	16	13	6	46.2
	<b>Overall</b>	<b>16</b>	<b>13</b>	<b>6</b>	<b>46.2</b>

# = number; % = percent.

**Table 5. Searcher efficiency models for bats from the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022 (n = 51).**

Covariates	k Value	AICc	Delta AICc
Plot Search Type (fall)	k fixed at 0.67	23.20	0*
Season	k fixed at 0.67	34.44	11.24
No Covariates	k fixed at 0.67	42.88	19.68

\* Selected model.

AICc = corrected Akaike Information Criterion.

Delta AICc = change in AICc.

### *Carcass Persistence Trials*

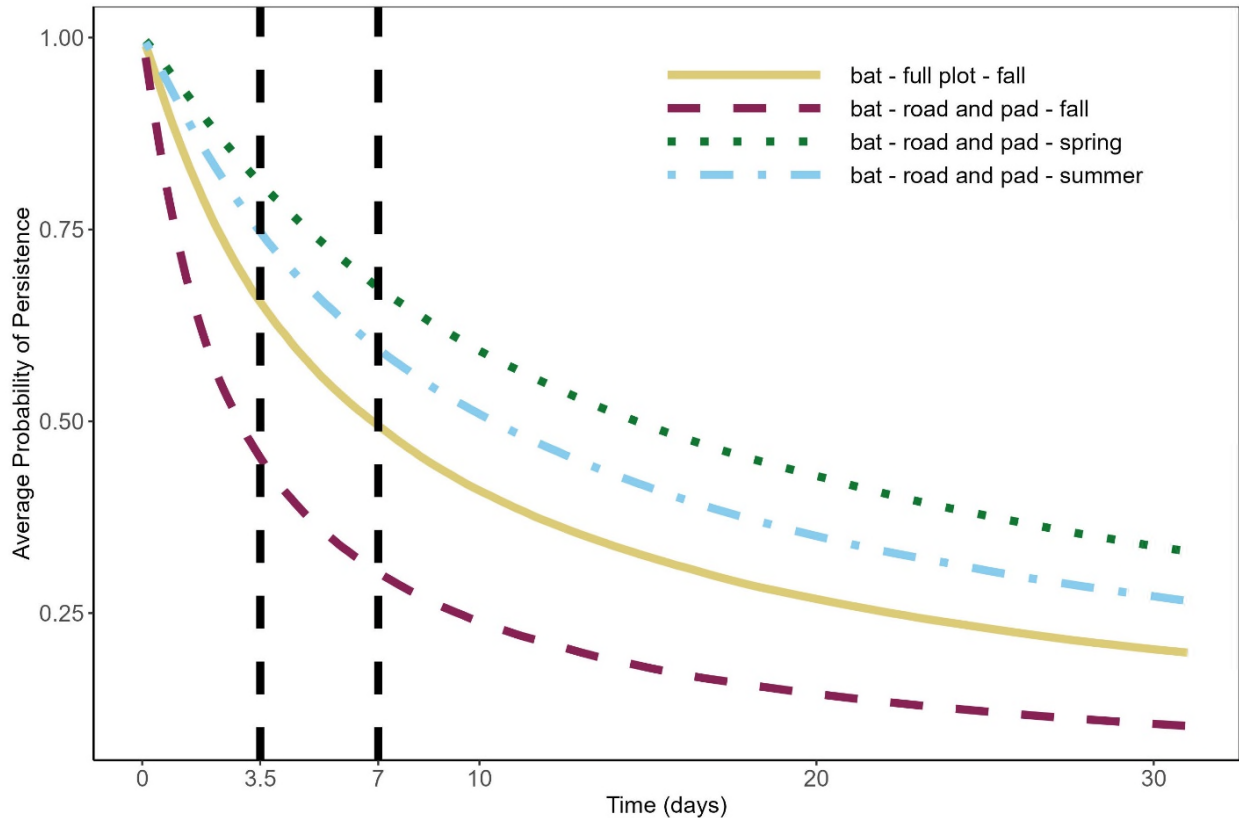
Sixty-three carcasses were placed for CPT in search areas throughout the duration of the study (Appendix B). The best-fit model for carcass persistence rates had a loglogistic distribution and indicated that carcass persistence varied by season and plot search type during fall (Table 6; Appendix B). The median carcass persistence time on full plots was 2.76 days during the fall (Table 6). The median carcass persistence time on road and pads was 5.94 days in the spring, 4.23 days in the summer, and 1.19 days in the fall.

The average probability a carcass persisted through the weekly search interval on roads and pads was 0.67 (90% CI: 0.53–0.80) in the spring and 0.59 (90% CI: 0.44–0.72) in the summer. The average probability a carcass persisted through the twice weekly search interval in the fall was 0.45 (90% CI: 0.30–0.61) on road and pads and 0.66 (90% CI: 0.50–0.80) on full plots (Figure 4).

**Table 6. Carcass persistence top models with covariates, distributions, and model parameters for the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Season	Search Area Type	Distribution	Predicted Median		
			Removal Times (days)	Parameter 1	Parameter 2
Spring	Road and pad	loglogistic*	5.94	shape = 0.862	scale = 1.782
Summer	Road and pad	loglogistic*	4.23	shape = 0.862	scale = 1.443
Fall	Road and pad	loglogistic*	1.19	shape = 0.862	scale = 0.172
	Full plot	loglogistic*	2.76	shape = 0.862	scale = 1.015

\* Parameterization follows the FAdist parameterization for this distribution.



**Figure 4. The average probability of carcass persistence on road and pads and full plots over time (in days) at 2.0-megawatt (MW) and 4.2-MW turbines at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Note: The vertical dashed lines indicate the weekly and twice weekly search intervals for the road and pad and full plot search areas.

### Search Area Adjustment

The best-fit model for carcass density distribution using 2022 PCM data presented diagnostic features that suggested a poor overall fit to the data and implausible results. Therefore, carcass data from the 2022 PCM was pooled with the carcass data collected at the Project during the 2021 PCM. The pooled data were then examined using two covariates: blade length (54-m or 75-m) and turbine operation. The best-fit model for the distribution of bats with respect to distance from turbine base included blade length as a covariate, suggesting the distribution of bats varied across turbine types (Appendix C). Therefore, two different density models were used for the separate turbine types. The truncated weighted maximum likelihood (TWL) area adjustment for bats at roads and pads was estimated to be 0.06 and 0.13 at turbines with 54-m and 75-m blades, respectively (Table 7). The TWL area adjustment for bats at full plots was estimated to be 0.61 and 0.84 at turbines with 54-m and 75-m blades, respectively (Table 7).

**Table 7. Truncated weighted maximum likelihood search area adjustment estimates for the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022, for bats by blade length (54-meter [m], n = 81; 75-m, n = 326).**

Size Class	Search Area Type	Distributions	Parameter 1	Parameter 2	Area Adjustment
BAT (54-m blades)	Road and pad	Gamma	2.3760	0.0322	0.06
	Full plot	Gamma	2.3760	0.0322	0.61
BAT (75-m blades)	Road and pad	Normal	44.7805	27.3998	0.13
	Full plot	Normal	44.7805	27.3998	0.84

**Adjusted Overall Bat Fatality Estimates**

The overall bat fatality estimate was 14.53 bats per MW (90% CI: 9.81–42.88; Table 8a). Bat fatality estimates were highest during the fall, followed by summer and spring (Table 8b). Inputs used to calculate fatality estimates are presented in Appendix D.

**Table 8a. Overall fatality rates per megawatt (MW) and per turbine for overall search area studies conducted at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Search Area Type	Per MW Estimates		Per Turbine Estimates	
	Estimate	90% CI	Estimate	90% CI
Road and Pad	16.00	10.57–45.12	53.79	36.33–115.01
Full Plot	4.99	2.86–21.01	14.87	8.77–47.00
<b>Overall</b>	<b>14.53</b>	<b>9.81–42.88</b>	<b>47.87</b>	<b>33.28–106.44</b>

CI = confidence interval.

**Table 8b. Estimated fatality rates, with 90% confidence intervals (CI) at overall search areas for studies conducted at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Search Area Type	Spring		Summer		Fall	
	57 Turbines Searched Estimate	90% CI	57 Turbines Searched Estimate	90% CI	57 Turbines Searched Estimate	90% CI
<b>Estimated Fatality Rates (Fatalities/Turbine/Season[s])</b>						
Road and Pad	4.20	2.43–7.85	11.43	6.97–28.16	37.96	23.35–80.13
Full Plot	n/a*	n/a*	n/a*	n/a*	14.87	8.77–47.00
<b>Overall</b>	<b>3.97</b>	<b>2.07–6.83</b>	<b>22.56</b>	<b>13.51–36.49</b>	<b>66.67</b>	<b>46.18–96.96</b>
<b>Estimated Fatality Rates (Fatalities/megawatt/Season[s])</b>						
Road and Pad	1.18	0.65–2.73	3.60	2.06–11.92	11.12	6.62–31.17
Full Plot	n/a*	n/a*	n/a*	n/a*	4.99	2.86–21.01
<b>Overall</b>	<b>1.18</b>	<b>0.65–2.73</b>	<b>3.60</b>	<b>2.06–11.92</b>	<b>9.65</b>	<b>6.01–28.18</b>

\*Full plot searches were not conducted in the spring and summer

**Estimate of Probability of Detection (g)**

The overall *g* achieved for the 2022 monitoring period was 0.104 (95% CI: 0.078–0.133; Table 9). Inputs required to run the EoA Single Class module and stratum-specific *g* distribution values are described in Appendix E. Seasonal inputs required for the Multiple Class module are described in Table 9.

**Table 9. Probability of carcass detection for full plot and road and pad searches, based on season, at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

Season	Ba*	Bb*	Seasonal Arrival Proportion	Overall Probability of Detection (g)	g 95% CI
Spring	80.731	1,049.84437	0.11	0.071	0.057–0.087
Fall	41.911	347.262882	0.89	0.108	0.079–0.140
<b>Annual**</b>	<b>49.125</b>	<b>424.596</b>	-	<b>0.104</b>	<b>0.078–0.133</b>

\* Ba and Bb are the two parameters that characterize a beta distribution, which describes the detection probability.

\*\* Overall g was calculated as a mixture beta distribution using the Evidence of Absence software.

CI = confidence interval.

## CONCLUSION

During the 2022 monitoring period, Intensive Monitoring was conducted in accordance with the HCP and no covered species were found. The 2022 probability of detection was influenced by several factors that differed from the expectations in the HCP, including shorter carcass persistence in the fall and lower search area adjustments for both roads and pads and full plots at turbines with 54-m blade lengths. As per the HCP, Covered Species fatality estimates will be calculated and adaptive management triggers will be evaluated in Year 3 of monitoring.

## 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., 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. doi: 10.3133/ds1055. Available online: <https://pubs.usgs.gov/ds/1055/ds1055.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>
- Esri. 2023. World Imagery and Aerial Photos (World Topo). ArcGIS Resource Center. Environmental Systems Research Institute (Esri), producers of ArcGIS software, Redlands, California. Accessed January 2023. Available online: [https://www.arcgis.com/home/webmap/viewer.html?useExistin\\_g=1&layers=10df2279f9684e4a9f6a7f08febac2a9](https://www.arcgis.com/home/webmap/viewer.html?useExistin_g=1&layers=10df2279f9684e4a9f6a7f08febac2a9)
- Kalbfleisch, J. D. and R. L. Prentice. 2002. The Statistical Analysis of Failure Time Data. John Wiley & Sons, Hoboken, New Jersey.
- 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.
- Liberty Power. 2021. Habitat Conservation Plan for Indiana and Northern Long-Eared Bat, Sugar Creek Wind Project, Logan County, Illinois. Sugar Creek Wind One LLC, Oakville, Ontario, Canada. October 8, 2021.

National Land Cover Database (NLCD). 2019. National Land Cover Database 2019 - Landcover & Imperviousness (NLCD2019). Available online: <https://www.mrlc.gov/data>. As cited includes:

Homer, C., J. Dewitz, S. Jin, G. Xian, C. Costello, P. Danielson, L. Gass, M. Funk, J. Wickham, S. Stehman, R. Auch, and K. Riitters. 2020. Conterminous United States Land Cover Change Patterns 2001–2016 from the 2016 National Land Cover Database. *ISPRS Journal of Photogrammetry and Remote Sensing* 162(5): 184-199. doi: 10.1016/j.isprs.2020.02.019.

Jin, S., C. Homer, L. Yang, P. Danielson, J. Dewitz, C. Li, Z. Zhu, G. Xian, and D. Howard. 2019. Overall Methodology Design for the United States National Land Cover Database 2016 Products. *Remote Sensing*. 2971. doi: 10.3390/rs11242971.

Wickham, J., S. V. Stehman, D. G. Sorenson, L. Gass, and J. A. Dewitz. 2021, Thematic Accuracy Assessment of the NLCD 2016 Land Cover for the Conterminous United States: *Remote Sensing of Environment* 257: 112357. doi: 10.1016/j.rse.2021.112357.

*and*

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.isprs.2018.09.006.

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

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. doi: 10.3133/tm7C19. Available online: <https://pubs.usgs.gov/tm/7c19/tm7c19.pdf>

Sugar Creek Wind, LLC. 2017. Bird and Bat Conservation Strategy for the Sugar Creek Wind Project with Technical Assistance Measures Incorporated to Address Listed Bat Risk. September 30, 2017. 330 pp.

US Fish and Wildlife Service (USFWS). 2016. Midwest Wind Energy Multi-Species Habitat Conservation Plan.

Yee, T. W. 2010. The Vgam Package for Categorical Data Analysis. *Journal of Statistical Software* 32(10): 1-34.

**Appendix A. Carcasses Found during the 2022 Post-construction Monitoring Surveys at the Sugar Creek Wind Project in Logan County, Illinois, from April 1 – October 15, 2022**



**Appendix A1. Species found during carcasses searches and incidentally at Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Species</b>	<b>Scientific name</b>
<b>Bat</b>	
eastern red bat	<i>Lasiurus borealis</i>
silver-haired bat	<i>Lasionycteris noctivagans</i>
hoary bat	<i>Lasiurus cinereus</i>
evening bat	<i>Nycticeius humeralis</i>
big brown bat	<i>Eptesicus fuscus</i>
eastern red bat or Seminole bat	–
Seminole bat	<i>Lasiurus seminolus</i>
unidentified <i>Lasiurus</i> bat	–
<b>Bird</b>	
cliff swallow	<i>Petrochelidon pyrrhonota</i>
golden-crowned kinglet	<i>Regulus satrapa</i>
killdeer	<i>Charadrius vociferus</i>
Tennessee warbler	<i>Leiothlypis peregrina</i>
horned lark	<i>Eremophila alpestris</i>
magnolia warbler	<i>Setophaga magnolia</i>
red-eyed vireo	<i>Vireo olivaceus</i>
white-breasted nuthatch	<i>Sitta carolinensis</i>
black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>
red-tailed hawk	<i>Buteo jamaicensis</i>
sharp-shinned hawk	<i>Accipiter striatus</i>
American redstart	<i>Setophaga ruticilla</i>
chimney swift	<i>Chaetura pelagica</i>
dickcissel	<i>Spiza americana</i>
European starling	<i>Sturnus vulgaris</i>
mourning dove	<i>Zenaida macroura</i>
northern flicker	<i>Colaptes auratus</i>
ruby-crowned kinglet	<i>Corthylio calendula</i>
sedge wren	<i>Cistothorus platensis</i>
unidentified warbler	–

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
04/15/2022	eastern red bat	21	B09	carcass search	road and pad	intact
04/27/2022	eastern red bat	45	B06	carcass search	road and pad	scavenged
04/28/2022	silver-haired bat	25	C20	carcass search	road and pad	intact
05/05/2022	silver-haired bat	22	C11	carcass search	road and pad	intact
05/05/2022	silver-haired bat	28	C15	carcass search	road and pad	intact
05/05/2022	silver-haired bat	20	C21	carcass search	road and pad	intact
05/11/2022	eastern red bat	20	A05	carcass search	road and pad	intact
05/11/2022	evening bat	82	A02	carcass search	road and pad	intact
05/11/2022	silver-haired bat	7	A05	carcass search	road and pad	scavenged
05/12/2022	eastern red bat	108	B25	carcass search*	road and pad	scavenged
05/12/2022	eastern red bat	33	C09	carcass search	road and pad	scavenged
05/12/2022	evening bat	12	B09	carcass search	road and pad	intact
05/12/2022	evening bat	50	C13	carcass search	road and pad	scavenged
05/12/2022	silver-haired bat	62	C13	carcass search	road and pad	dismembered
05/17/2022	evening bat	15	A01	carcass search	road and pad	scavenged
05/17/2022	evening bat	80	B10	carcass search	road and pad	scavenged
05/19/2022	evening bat	10	C05	carcass search	road and pad	intact
05/19/2022	hoary bat	18	D04	carcass search	road and pad	intact
05/25/2022	evening bat	82	B03	carcass search	road and pad	intact
05/27/2022	hoary bat	42	B23	carcass search	road and pad	scavenged
06/08/2022	silver-haired bat	28	B09	carcass search	road and pad	scavenged
06/09/2022	eastern red bat	58	C13	carcass search	road and pad	intact
06/09/2022	hoary bat	2	C17	carcass search	road and pad	scavenged
06/10/2022	eastern red bat	5	C04	carcass search	road and pad	intact
06/10/2022	evening bat	98	D10	carcass search	road and pad	scavenged
06/15/2022	hoary bat	75	A04	carcass search	road and pad	scavenged
06/16/2022	silver-haired bat	59	C13	carcass search	road and pad	scavenged
06/22/2022	eastern red bat	5	B05	carcass search	road and pad	intact
06/22/2022	eastern red bat	37	B06	carcass search	road and pad	intact
06/23/2022	eastern red bat	5	C11	carcass search	road and pad	intact
06/27/2022	eastern red bat	33	A07	carcass search	road and pad	intact
06/29/2022	eastern red bat	8	B22	carcass search	road and pad	scavenged
06/29/2022	eastern red bat	55	D04	carcass search	road and pad	scavenged
07/06/2022	eastern red bat	30	A04	carcass search	road and pad	scavenged
07/06/2022	eastern red bat	96	C16	carcass search	road and pad	intact
07/06/2022	hoary bat	14	C13	carcass search	road and pad	intact
07/13/2022	evening bat	14	A02	carcass search	road and pad	intact

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
07/14/2022	eastern red bat	7	B23	carcass search	road and pad	intact
07/14/2022	evening bat	7	C14	carcass search	road and pad	intact
07/15/2022	eastern red bat	19	C02	carcass search	road and pad	intact
07/19/2022	big brown bat	8	A04	carcass search	road and pad	scavenged
07/19/2022	big brown bat	17	A05	carcass search	road and pad	intact
07/19/2022	eastern red bat	17	A03	carcass search	road and pad	intact
07/19/2022	eastern red bat	33	A03	carcass search	road and pad	scavenged
07/19/2022	eastern red bat	21	A04	carcass search	road and pad	scavenged
07/19/2022	eastern red bat	5	B02	carcass search	road and pad	scavenged
07/19/2022	evening bat	13	A03	carcass search	road and pad	intact
07/20/2022	big brown bat	5	C14	carcass search	road and pad	scavenged
07/20/2022	hoary bat	13	B21	carcass search	road and pad	scavenged
07/20/2022	unidentified lasiurus bat	31	C09	carcass search	road and pad	dismembered
07/21/2022	eastern red bat	13	D10	carcass search	road and pad	scavenged
07/21/2022	eastern red bat	14	D10	carcass search	road and pad	intact
07/26/2022	big brown bat	21	A04	carcass search	road and pad	intact
07/26/2022	eastern red bat	44	A04	carcass search	road and pad	intact
07/26/2022	eastern red bat	2	A05	carcass search	road and pad	scavenged
07/26/2022	eastern red bat	43	B06	carcass search	road and pad	scavenged
07/26/2022	eastern red bat	13	B14	carcass search	road and pad	intact
07/27/2022	eastern red bat	5	B15	carcass search	road and pad	intact
08/01/2022	big brown bat	20	A01	carcass search	full plot	intact
08/01/2022	eastern red bat	43	A04	carcass search	full plot	intact
08/01/2022	evening bat	16	A04	carcass search	full plot	intact
08/01/2022	hoary bat	7	A07	carcass search	road and pad	intact
08/03/2022	big brown bat	5	D07	carcass search	road and pad	intact
08/03/2022	eastern red bat	5	B15	carcass search	full plot	intact
08/03/2022	eastern red bat	53	B24	carcass search	full plot	scavenged
08/03/2022	evening bat	30	C15	carcass search	road and pad	scavenged
08/03/2022	hoary bat	31	D10	carcass search	full plot	intact
08/04/2022	big brown bat	6	B12	carcass search	road and pad	scavenged
08/04/2022	eastern red bat	0	A03	carcass search	road and pad	dismembered
08/04/2022	eastern red bat	1	D02	carcass search	full plot	intact
08/05/2022	big brown bat	18	C13	carcass search	road and pad	scavenged
08/05/2022	big brown bat	47	C13	carcass search	road and pad	intact
08/08/2022	big brown bat	7	D06	carcass search	full plot	scavenged
08/08/2022	eastern red bat	31	B04	carcass search	road and pad	intact

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
08/08/2022	eastern red bat	17	B23	carcass search	road and pad	scavenged
08/08/2022	eastern red bat	8	B23	carcass search	road and pad	intact
08/08/2022	hoary bat	27	C06	carcass search	road and pad	intact
08/09/2022	big brown bat	32	C11	carcass search	road and pad	intact
08/09/2022	eastern red bat	15	B24	carcass search	full plot	intact
08/09/2022	eastern red bat	38	C13	carcass search	road and pad	scavenged
08/09/2022	eastern red bat	87	C15	carcass search	road and pad	intact
08/09/2022	eastern red bat	7	D08	carcass search	road and pad	intact
08/09/2022	eastern red bat	65	D10	carcass search	full plot	intact
08/09/2022	hoary bat	26	C10	carcass search	full plot	dismembered
08/10/2022	eastern red bat	34	A07	carcass search	road and pad	intact
08/10/2022	eastern red bat	5	A07	carcass search	road and pad	intact
08/10/2022	eastern red bat	46	B07	carcass search	road and pad	feather spot
08/10/2022	hoary bat	32	A05	carcass search	full plot	intact
08/10/2022	hoary bat	5	B08	carcass search	road and pad	dismembered
08/10/2022	hoary bat	12	B08	carcass search	road and pad	intact
08/11/2022	eastern red bat	61	B24	carcass search	full plot	intact
08/11/2022	eastern red bat	30	B24	carcass search	full plot	scavenged
08/11/2022	eastern red bat	36	C03	carcass search	road and pad	scavenged
08/12/2022	eastern red bat	110	A02	carcass search*	road and pad	intact
08/12/2022	eastern red bat	0	A05	carcass search	full plot	scavenged
08/12/2022	eastern red bat	0	C06	carcass search	road and pad	scavenged
08/15/2022	eastern red bat	65	B24	carcass search	full plot	dismembered
08/15/2022	eastern red bat	37	D10	carcass search	full plot	injured
08/16/2022	eastern red bat	13	A01	carcass search	full plot	intact
08/16/2022	eastern red bat	11	A04	carcass search	full plot	scavenged
08/16/2022	eastern red bat	30	A06	carcass search	full plot	intact
08/16/2022	eastern red bat	2	A08	carcass search	road and pad	intact
08/16/2022	hoary bat	24	A01	carcass search	full plot	dismembered
08/17/2022	eastern red bat	77	C03	carcass search	road and pad	scavenged
08/17/2022	hoary bat	27	D02	carcass search	full plot	intact
08/18/2022	eastern red bat	23	A05	carcass search	full plot	intact
08/18/2022	eastern red bat	1	A07	carcass search	road and pad	scavenged
08/18/2022	eastern red bat	10	C13	carcass search	road and pad	intact
08/18/2022	hoary bat	56	A06	carcass search	full plot	intact
08/18/2022	hoary bat	35	B15	carcass search	full plot	intact
08/18/2022	hoary bat	25	C08	carcass search	road and pad	scavenged

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
08/19/2022	eastern red bat	41	B23	carcass search	road and pad	intact
08/19/2022	eastern red bat	24	C05	carcass search	road and pad	scavenged
08/22/2022	eastern red bat	50	A01	carcass search	full plot	intact
08/22/2022	eastern red bat	2	A05	carcass search	full plot	scavenged
08/22/2022	hoary bat	7	A02	carcass search	road and pad	scavenged
08/22/2022	silver-haired bat	24	B01	carcass search	full plot	intact
08/23/2022	eastern red bat	47	C03	carcass search	road and pad	intact
08/25/2022	hoary bat	9	B09	carcass search	road and pad	scavenged
08/26/2022	eastern red bat	37	B22	carcass search	road and pad	intact
08/26/2022	eastern red bat	30	D07	carcass search	road and pad	intact
08/29/2022	eastern red bat	7	D04	carcass search	road and pad	intact
08/29/2022	eastern red bat or Seminole bat	52	C06	carcass search	road and pad	scavenged
08/29/2022	hoary bat	40	C03	carcass search	road and pad	dismembered
08/30/2022	hoary bat	38	B15	carcass search	full plot	scavenged
08/30/2022	Seminole bat	33	B24	carcass search	full plot	intact
08/31/2022	eastern red bat	35	B12	carcass search	road and pad	scavenged
08/31/2022	hoary bat	25	A01	carcass search	full plot	scavenged
08/31/2022	hoary bat	61	A01	carcass search	full plot	dismembered
08/31/2022	hoary bat	32	B07	carcass search	road and pad	scavenged
08/31/2022	silver-haired bat	8	B06	carcass search	road and pad	intact
08/31/2022	silver-haired bat	28	B14	carcass search	road and pad	intact
09/01/2022	eastern red bat	13	C03	carcass search	road and pad	intact
09/01/2022	silver-haired bat	39	C09	carcass search	road and pad	intact
09/02/2022	big brown bat	6	A04	carcass search	full plot	intact
09/02/2022	eastern red bat	68	A01	carcass search	full plot	scavenged
09/02/2022	eastern red bat	52	A01	carcass search	full plot	scavenged
09/02/2022	eastern red bat	12	A04	carcass search	full plot	intact
09/02/2022	eastern red bat	30	A04	carcass search	full plot	intact
09/02/2022	evening bat	19	A05	carcass search	full plot	intact
09/02/2022	evening bat	36	A08	carcass search	road and pad	intact
09/02/2022	hoary bat	28	A04	carcass search	full plot	dismembered
09/02/2022	hoary bat	49	B06	carcass search	road and pad	intact
09/05/2022	eastern red bat	47	C10	carcass search	full plot	intact
09/05/2022	eastern red bat	11	C13	carcass search	road and pad	intact
09/05/2022	eastern red bat	0	D07	carcass search	road and pad	intact
09/05/2022	silver-haired bat	8	B15	carcass search	full plot	intact
09/05/2022	silver-haired bat	30	C17	carcass search	road and pad	intact

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
09/06/2022	hoary bat	8	C01	carcass search	full plot	intact
09/06/2022	silver-haired bat	20	B21	carcass search	road and pad	scavenged
09/08/2022	big brown bat	15	D04	carcass search	road and pad	intact
09/08/2022	eastern red bat	4	D04	carcass search	road and pad	intact
09/08/2022	Seminole bat	30	D04	carcass search	road and pad	intact
09/09/2022	eastern red bat	13	B05	carcass search	road and pad	intact
09/09/2022	hoary bat	47	A01	carcass search	full plot	scavenged
09/12/2022	eastern red bat	60	C06	carcass search	road and pad	intact
09/12/2022	hoary bat	45	D03	carcass search	full plot	intact
09/12/2022	silver-haired bat	49	C01	carcass search	full plot	intact
09/12/2022	silver-haired bat	53	C03	carcass search	road and pad	intact
09/12/2022	silver-haired bat	7	C06	carcass search	road and pad	intact
09/13/2022	silver-haired bat	58	B15	carcass search	full plot	scavenged
09/13/2022	silver-haired bat	43	B24	carcass search	full plot	scavenged
09/14/2022	eastern red bat or Seminole bat	47	A01	carcass search	full plot	intact
09/15/2022	eastern red bat	11	B22	carcass search	road and pad	intact
09/15/2022	hoary bat	47	D02	carcass search	full plot	scavenged
09/16/2022	eastern red bat	62	B24	carcass search	full plot	intact
09/16/2022	eastern red bat	62	C13	carcass search	road and pad	intact
09/16/2022	silver-haired bat	46	A05	carcass search	full plot	scavenged
09/16/2022	silver-haired bat	95	A08	carcass search	road and pad	dismembered
09/16/2022	silver-haired bat	15	B24	carcass search	full plot	intact
09/16/2022	silver-haired bat	48	C10	carcass search	full plot	scavenged
09/16/2022	silver-haired bat	29	C15	carcass search	road and pad	scavenged
09/19/2022	eastern red bat	44	D02	carcass search	full plot	intact
09/20/2022	eastern red bat	28	A01	carcass search	full plot	scavenged
09/20/2022	eastern red bat	114	A05	incidental*	full plot	scavenged
09/22/2022	eastern red bat	49	B15	carcass search	full plot	intact
09/22/2022	eastern red bat	7	B21	carcass search	road and pad	scavenged
09/22/2022	eastern red bat	53	D06	carcass search	full plot	scavenged
09/22/2022	evening bat	20	B15	carcass search	full plot	intact
09/22/2022	evening bat	15	C09	carcass search	road and pad	intact
09/22/2022	silver-haired bat	12	C06	carcass search	road and pad	intact
09/22/2022	silver-haired bat	25	C09	carcass search	road and pad	intact
09/22/2022	silver-haired bat	14	D07	carcass search	road and pad	intact
09/23/2022	silver-haired bat	68	A01	carcass search	full plot	scavenged
09/23/2022	silver-haired bat	32	A07	carcass search	road and pad	intact

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
09/23/2022	silver-haired bat	36	B05	carcass search	road and pad	scavenged
09/26/2022	hoary bat	10	C15	carcass search	road and pad	intact
09/26/2022	silver-haired bat	5	C13	carcass search	road and pad	scavenged
09/27/2022	silver-haired bat	48	A01	carcass search	full plot	scavenged
09/27/2022	silver-haired bat	72	B08	carcass search	road and pad	intact
10/03/2022	eastern red bat	58	C18	carcass search	full plot	scavenged
10/07/2022	silver-haired bat	35	A07	carcass search	road and pad	intact
10/07/2022	silver-haired bat	69	C19	carcass search	road and pad	intact
10/10/2022	silver-haired bat	24	D04	carcass search	road and pad	intact
10/11/2022	eastern red bat	21	A04	carcass search	full plot	intact
10/13/2022	hoary bat	54	C11	carcass search	road and pad	dismembered
04/14/2022	golden-crowned kinglet	95	B23	carcass search	road and pad	scavenged
04/20/2022	sharp-shinned hawk	54	B08	carcass search*	road and pad	scavenged
04/27/2022	sedge wren	49	B06	carcass search	road and pad	intact
04/28/2022	red-tailed hawk	64	B25	carcass search*	road and pad	intact
05/06/2022	red-eyed vireo	32	D04	carcass search	road and pad	intact
05/11/2022	black-billed cuckoo	142	B04	carcass search*	road and pad	scavenged
05/12/2022	killdeer	46	B15	carcass search	road and pad	intact
06/01/2022	unidentified warbler	1	B11	carcass search	road and pad	feather spot
06/10/2022	mourning dove	2	D10	carcass search	road and pad	intact
06/29/2022	white-breasted nuthatch	1	B22	carcass search	road and pad	intact
07/27/2022	northern flicker	87	B24	carcass search	road and pad	feather spot
08/08/2022	European starling	64	D06	carcass search	full plot	intact
08/12/2022	horned lark	44	A05	carcass search	full plot	intact
08/12/2022	killdeer	36	A01	carcass search	full plot	feather spot
08/15/2022	killdeer	44	B24	carcass search	full plot	scavenged
08/23/2022	white-breasted nuthatch	0	C06	carcass search	road and pad	scavenged
08/26/2022	dickcissel	2	B22	carcass search	road and pad	intact
09/02/2022	cliff swallow	7	A04	carcass search	full plot	intact
09/02/2022	cliff swallow	52	B24	carcass search	full plot	intact
09/02/2022	Tennessee warbler	18	A02	carcass search	road and pad	intact
09/05/2022	Tennessee warbler	55	C09	carcass search	road and pad	intact
09/06/2022	Tennessee warbler	34	B14	carcass search	road and pad	intact
09/08/2022	chimney swift	24	C19	carcass search	road and pad	intact
09/08/2022	cliff swallow	49	B24	carcass search	full plot	intact
09/08/2022	cliff swallow	21	C16	carcass search	road and pad	intact
09/09/2022	cliff swallow	47	A05	carcass search	full plot	scavenged

**Appendix A2. Complete listing of carcasses found at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Found Date</b>	<b>Species</b>	<b>Distance from Turbine</b>	<b>Turbine</b>	<b>Search Type</b>	<b>Search Area Type</b>	<b>Physical Condition</b>
09/14/2022	horned lark	-2	B07	carcass search	road and pad	intact
09/23/2022	magnolia warbler	12	A07	carcass search	road and pad	scavenged
09/29/2022	warbling vireo	9	C17	carcass search	road and pad	scavenged
10/03/2022	American redstart	63	C15	carcass search	road and pad	scavenged
10/03/2022	golden-crowned kinglet	55	B24	carcass search	full plot	scavenged
10/03/2022	golden-crowned kinglet	71	C21	carcass search	road and pad	scavenged
10/03/2022	red-eyed vireo	78	C11	carcass search	road and pad	scavenged
10/03/2022	ruby-crowned kinglet	15	D04	carcass search	road and pad	intact
10/06/2022	golden-crowned kinglet	6	D01	carcass search	road and pad	scavenged
10/06/2022	magnolia warbler	49	D02	carcass search	full plot	scavenged
10/07/2022	golden-crowned kinglet	65	C20	carcass search	road and pad	intact

\* Carcass was found outside the search area.



**Appendix B. Carcass Persistence Trial Information and Model Tables for the Sugar Creek  
Wind Project in Logan County, Illinois, from April 1 – October 15, 2022**

**Appendix B1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Date Placed</b>	<b>Season</b>	<b>Species</b>	<b>Turbine</b>	<b>*Before Removal</b>	<b>**After Removal</b>
04/06/2022	Spring	big brown bat	B05	05/06/2022	05/06/2022
04/06/2022	Spring	big brown bat	B10	04/06/2022	04/06/2022
04/06/2022	Spring	eastern red bat	A08	04/08/2022	04/09/2022
04/06/2022	Spring	eastern red bat	B03	04/19/2022	04/27/2022
04/06/2022	Spring	eastern red bat	B07	04/13/2022	04/16/2022
04/06/2022	Spring	eastern red bat	B13	04/06/2022	04/06/2022
04/06/2022	Spring	silver-haired bat	B02	04/16/2022	04/19/2022
04/06/2022	Spring	silver-haired bat	B06	04/07/2022	04/09/2022
04/14/2022	Spring	big brown bat	C16	04/21/2022	04/24/2022
04/14/2022	Spring	eastern red bat	B21	04/24/2022	04/28/2022
04/14/2022	Spring	eastern red bat	C09	04/20/2022	04/21/2022
04/14/2022	Spring	eastern red bat	C18	04/19/2022	04/20/2022
04/14/2022	Spring	eastern red bat	C20	04/19/2022	04/20/2022
04/14/2022	Spring	silver-haired bat	B15	04/21/2022	04/24/2022
04/14/2022	Spring	silver-haired bat	C13	04/19/2022	04/20/2022
06/08/2022	Summer	big brown bat	A04	06/09/2022	06/10/2022
06/08/2022	Summer	eastern red bat	A05	06/13/2022	06/15/2022
06/08/2022	Summer	eastern red bat	B01	06/09/2022	06/09/2022
06/08/2022	Summer	eastern red bat	B04	06/08/2022	06/08/2022
06/08/2022	Summer	eastern red bat	B08	06/22/2022	06/29/2022
06/08/2022	Summer	evening bat	A01	06/12/2022	06/13/2022
06/08/2022	Summer	evening bat	B06	06/08/2022	06/08/2022
06/08/2022	Summer	evening bat	B13	06/11/2022	06/12/2022
06/08/2022	Summer	hoary bat	B02	06/11/2022	06/12/2022
06/22/2022	Summer	big brown bat	C19	07/20/2022	07/20/2022
06/22/2022	Summer	eastern red bat	B15	07/20/2022	07/20/2022
06/22/2022	Summer	eastern red bat	B22	06/25/2022	06/26/2022
06/22/2022	Summer	eastern red bat	C15	06/25/2022	06/26/2022
06/22/2022	Summer	silver-haired bat	B21	06/23/2022	06/24/2022
06/22/2022	Summer	silver-haired bat	B23	06/24/2022	06/25/2022
06/22/2022	Summer	silver-haired bat	C08	06/25/2022	06/26/2022
06/22/2022	Summer	silver-haired bat	C10	07/20/2022	07/20/2022
06/22/2022	Summer	silver-haired bat	C17	07/20/2022	07/20/2022
06/22/2022	Summer	silver-haired bat	C21	06/22/2022	06/22/2022
08/15/2022	Fall	eastern red bat	B15	08/20/2022	08/21/2022
08/15/2022	Fall	eastern red bat	C09	08/15/2022	08/16/2022
08/15/2022	Fall	eastern red bat	C17	08/28/2022	09/05/2022
08/15/2022	Fall	eastern red bat	D07	08/15/2022	08/16/2022
08/15/2022	Fall	eastern red bat	D10	08/15/2022	08/17/2022
08/15/2022	Fall	silver-haired bat	B15	08/20/2022	08/21/2022
08/15/2022	Fall	silver-haired bat	B24	08/21/2022	08/24/2022
08/15/2022	Fall	silver-haired bat	C15	08/15/2022	08/15/2022
08/15/2022	Fall	silver-haired bat	C16	09/14/2022	09/14/2022
09/05/2022	Fall	eastern red bat	A01	09/11/2022	09/14/2022
09/05/2022	Fall	eastern red bat	A04	09/06/2022	09/07/2022
09/05/2022	Fall	eastern red bat	A05	09/10/2022	09/11/2022
09/05/2022	Fall	eastern red bat	A06	09/06/2022	09/06/2022
09/05/2022	Fall	eastern red bat	A07	09/05/2022	09/05/2022
09/05/2022	Fall	eastern red bat	B04	09/14/2022	09/18/2022
09/05/2022	Fall	eastern red bat	B06	09/06/2022	09/06/2022
09/05/2022	Fall	eastern red bat	B14	09/06/2022	09/06/2022

**Appendix B1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Date Placed</b>	<b>Season</b>	<b>Species</b>	<b>Turbine</b>	<b>*Before Removal</b>	<b>**After Removal</b>
09/05/2022	Fall	eastern red bat	C03	09/05/2022	09/06/2022
09/05/2022	Fall	eastern red bat	D01	09/06/2022	09/07/2022
09/05/2022	Fall	eastern red bat	D04	09/05/2022	09/07/2022
09/05/2022	Fall	hoary bat	A04	09/06/2022	09/06/2022
09/05/2022	Fall	hoary bat	A05	09/06/2022	09/07/2022
09/05/2022	Fall	hoary bat	A06	09/05/2022	09/05/2022
09/05/2022	Fall	hoary bat	B01	09/09/2022	09/10/2022
09/05/2022	Fall	silver-haired bat	A01	09/06/2022	09/07/2022
09/05/2022	Fall	silver-haired bat	B01	09/14/2022	09/18/2022
09/05/2022	Fall	silver-haired bat	B02	09/06/2022	09/07/2022
09/05/2022	Fall	silver-haired bat	B10	09/06/2022	09/06/2022
09/05/2022	Fall	silver-haired bat	B11	09/06/2022	09/06/2022

\* Last date checked before removal.

\*\* Date checked after removal.

**Appendix B2. Carcass persistence top models with covariates, distributions, and model parameters for the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

<b>Size Class</b>	<b>Season</b>	<b>Plot Search Type</b>	<b>Distribution</b>	<b>Predicted Median Removal Times (days)</b>	<b>Parameter 1</b>	<b>Parameter 2</b>
Bat	Spring	Road and Pad	loglogistic**	5.94	shape = 0.862	scale = 1.782
Bat	Summer	Road and Pad	loglogistic**	4.23	shape = 0.862	scale = 1.443
Bat	Fall	Road and Pad	loglogistic**	1.19	shape = 0.862	scale = 0.172
Bat	Fall	Full Plot	loglogistic**	2.76	shape = 0.862	scale = 1.015

\*\* Parameterization follows the FAdist parameterization for this distribution.

**Appendix C. Truncated Weighted Likelihood Area Adjustment Estimate Model Fitting  
Results for the Sugar Creek Wind Project in Logan County, Illinois, from April 1 –  
October 15, 2022.**

**Appendix C1. Truncated weighted maximum likelihood (TWL) search area adjustment models for the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022. Fatalities from 2021 post-construction monitoring were included in modeling. Separate TWL models were fit across blade length stratum, (54 m, n = 81; 75 m, n = 326) and pooled across all stratum (n=407). The distributions and AICc scores are presented for the top 10 models.**

Blade Length			AICc	Delta AICc
54 meters	75 meters	Pooled		
gamma	norm	NA	63,335.54	0*
weibull	norm	NA	63,353.16	17.6
gamma	weibull	NA	63,389.26	53.7
weibull	weibull	NA	63,406.88	71.3
norm	norm	NA	63,436.34	100.8
norm	weibull	NA	63,490.06	154.5
NA	NA	weibull	63,501.90	166.4
gamma	gamma	NA	63,518.42	182.9
gompertz	norm	NA	63,518.48	182.9
gamma	gompertz	NA	63,526.83	191.3

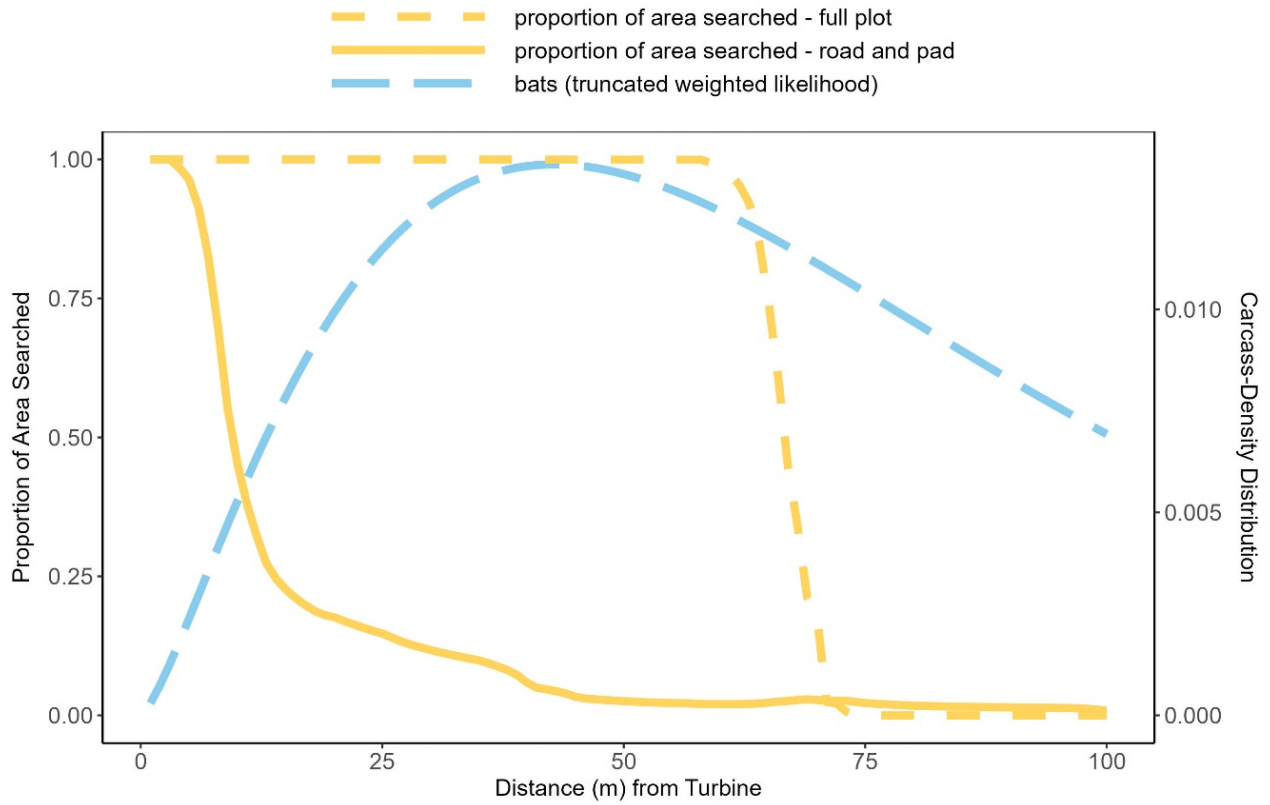
\* Selected model.

AICc = corrected Akaike Information Criterion; Delta AICc = change in AICc

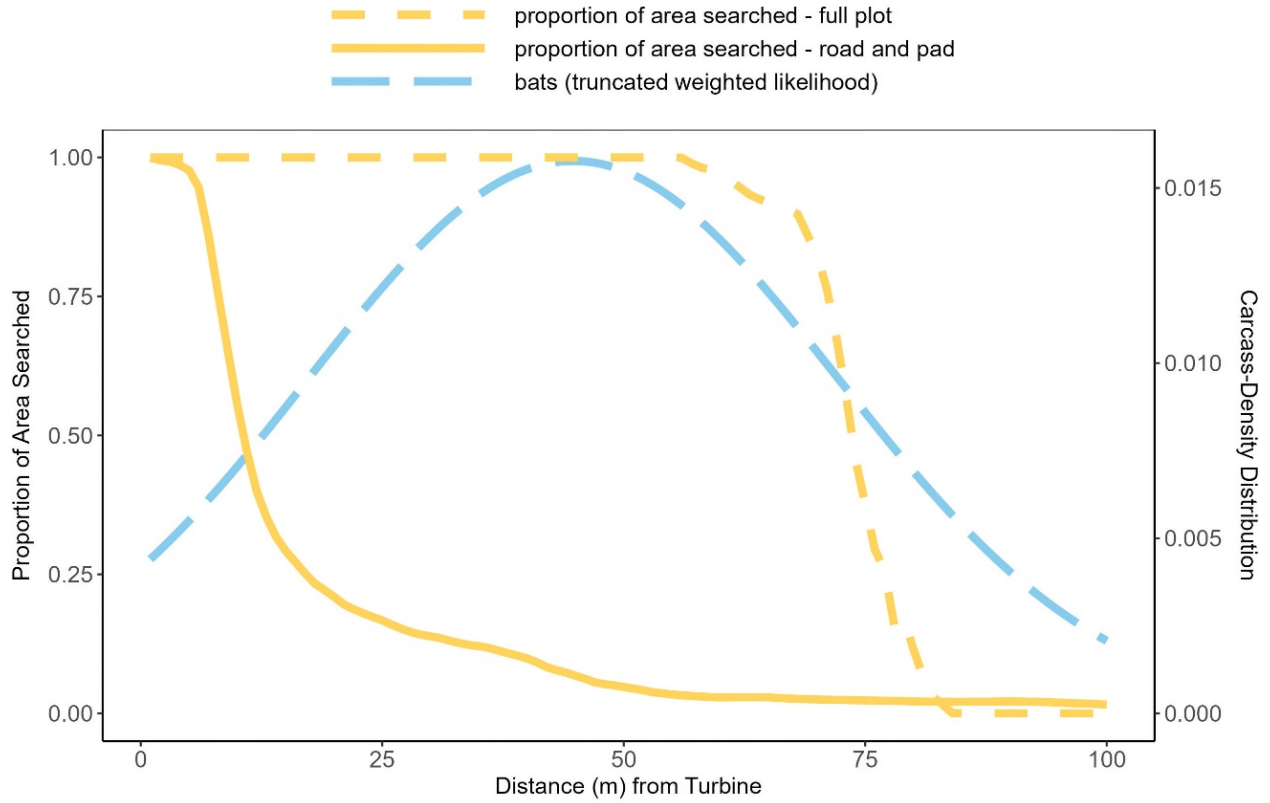
**Appendix C2. Area correction model selection by turbine model and pooled with distribution.**

2 MW Turbines	4.2 MW Turbines	Pooled	AIC	AICc	Delta AICc
gamma	norm	NA	63,335.40	63,335.54	0*
weibull	norm	NA	63,353.01	63,353.16	17.6
gamma	weibull	NA	63,389.11	63,389.26	53.7
weibull	weibull	NA	63,406.73	63,406.88	71.3
norm	norm	NA	63,436.19	63,436.34	100.8
norm	weibull	NA	63,489.91	63,490.06	154.5
NA	NA	weibull	63,501.87	63,501.90	166.4
gamma	gamma	NA	63,518.28	63,518.42	182.9
gompertz	norm	NA	63,518.33	63,518.48	182.9
gamma	gompertz	NA	63,526.68	63,526.83	191.3
weibull	gamma	NA	63,535.89	63,536.04	200.5
weibull	gompertz	NA	63,544.30	63,544.45	208.9
NA	NA	norm	63,551.56	63,551.59	216.0
gompertz	weibull	NA	63,572.05	63,572.20	236.7
NA	NA	gamma	63,596.20	63,596.23	260.7
norm	gamma	NA	63,619.07	63,619.22	283.7
norm	gompertz	NA	63,627.48	63,627.63	292.1
gompertz	gamma	NA	63,701.22	63,701.36	365.8
gompertz	gompertz	NA	63,709.62	63,709.77	374.2
NA	NA	gompertz	63,862.36	63,862.39	526.9

MW = megawatt; AICc = corrected Akaike Information Criterion; Delta AICc = change in AICc.



**Appendix C3. Estimated carcass-density distribution for 54-meter blade length turbines, and proportion of area searched by distance from turbine at Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**



**Appendix C3. Estimated carcass-density distribution for 75-meter blade length turbines, and proportion of area searched by distance from turbine at Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

**Appendix D. Bat Fatality Rates and Adjustment Factors Table for the Sugar Creek Wind Project in Logan County, Illinois, from April 1 – October 15, 2022.**



**Appendix D1. Estimated fatality rates and adjustment factors, with 90% confidence intervals (CI) at full plot search areas for studies conducted at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

	Fall	
	6 turbines searched Estimate	90% CI
<b>Search Area Adjustment</b>		
54-meter blade turbine	0.61	0.09–0.90
75-meter blade turbine	0.84	0.68–0.93
<b>Searcher Efficiency</b>		
	0.46	0.26–0.68
<b>Average Probability of a Carcass Persisting Through the Search Interval*</b>		
	0.66	0.50–0.80
<b>Probability of Available and Detected</b>		
	0.32	0.18–0.50
<b>Estimated Fatality Rates (Fatalities/Turbine/Season[s])</b>		
	14.87	8.77–47.00
<b>Estimated Fatality Rates (Fatalities/Megawatt/Season[s])</b>		
	4.99	2.86–21.01

\* The search interval was twice per week.

**Appendix D2. Estimated fatality rates and adjustment factors, with 90% confidence intervals (CI) at road and pad weekly search areas for studies conducted at the Sugar Creek Wind Project, Logan County, Illinois, from April 1 – October 15, 2022.**

	Spring		Summer		Fall	
	57 Turbines Searched Estimate	90% CI	57 Turbines Searched Estimate	90% CI	57 Turbines Searched Estimate	90% CI
<b>Search Area Adjustment</b>						
54-m blade turbine	0.06	0.01–0.10	0.06	0.01–0.10	0.06	0.01–0.10
75-m blade turbine	0.13	0.10–0.15	0.13	0.10–0.15	0.13	0.10–0.15
<b>Searcher Efficiency</b>						
	0.99	0.93–1.00	0.99	0.93–1.00	0.99	0.93–1.00
<b>Average Probability of a Carcass Persisting Through the Search Interval*</b>						
	0.67	0.53–0.80	0.59	0.44–0.72	0.45	0.30–0.61
<b>Probability of Available and Detected</b>						
	0.73	0.60–0.86	0.67	0.53–0.79	0.37	0.24–0.52
<b>Estimated Fatality Rates (Fatalities/Turbine/Season[s])</b>						
	4.20	2.43–7.85	11.43	6.97–28.16	37.96	23.35–80.13
<b>Estimated Fatality Rates (Fatalities/Megawatt/Season[s])</b>						
	1.18	0.65–2.73	3.60	2.06–11.92	11.12	6.62–31.17

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

m = meter

**Appendix E. Inputs Required to Run the EoA Single Class Module and Stratum-Specific  $g$  Distribution Values at the Sugar Creek Wind Project in Logan County, Illinois, from April 1 – October 15, 2022**

**Appendix E. Single Class Module Inputs for stratum *g* estimation.**

Season	Search Area Type	# of Turbines Searched	Total # of Turbines	Arrival Proportion	Sampling Fraction	Plot Shape	Plot Size	Start Date	End Date	Search Interval	Turbine MW
spring	road and pad	17	57	0.11	0.30	circle	100	1-Apr	29-May	7.5	2.0
spring	road and pad	40	57	0.11	0.70	circle	100	1-Apr	29-May	7.5	4.2
fall	full plot	9	57	0.89	0.16	circle	60	2-Aug	15-Oct	3.5	2.0
fall	full plot	6	57	0.89	0.11	circle	70	2-Aug	15-Oct	3.5	4.2
fall	road and pad	8	57	0.89	0.14	circle	100	2-Aug	15-Oct	3.5	2.0
fall	road and pad	34	57	0.89	0.60	circle	100	2-Aug	15-Oct	3.5	4.2

MW = megawatt; # = number.

**Appendix E. (continued) Single Class Module Inputs for stratum *g* estimation.**

Season	Search Area Type	# of SEEF	# of SEEF Found	# of SEEF Placed	<i>k</i>	# of Searches	CPT Shape Parameter	CPT Scale Parameter	CPT Scale Parameter-Lower	CPT Scale Parameter-Upper
spring	road and pad	0.99	37	38	0.65	9	1.16	5.94	2.93	12.07
spring	road and pad	0.99	37	38	0.65	9	1.16	5.94	2.93	12.07
fall	full plot	0.46	6	13	0.65	21	1.16	2.76	1.29	5.89
fall	full plot	0.46	6	13	0.65	21	1.16	2.76	1.29	5.89
fall	road and pad	0.99	37	38	0.65	21	1.16	1.19	0.53	2.65
fall	road and pad	0.99	37	38	0.65	21	1.16	1.19	0.53	2.65

SEEF = searcher efficiency; # = number; *k* = detection reduction factor; CPT = carcass persistence trials.

**Appendix E. (continued) Single Class Module Inputs for stratum *g* estimation.**

Season	Search Area Type	CPT Distribution	CPT Scale Parameter Confidence Level	Area Correction	<i>g</i> - Beta Distribution, Alpha Parameter	<i>g</i> - Beta Distribution, Beta Parameter	<i>g</i> - lower	<i>g</i> - upper	
spring	road and pad	Log-Logistic	0.95	0.06	62.95	1,443.83	0.04	0.03	0.05
spring	road and pad	Log-Logistic	0.95	0.13	56.51	616.27	0.08	0.07	0.10
fall	full plot	Log-Logistic	0.95	0.61	9.42	31.37	0.23	0.13	0.35
fall	full plot	Log-Logistic	0.95	0.84	8.19	17.98	0.31	0.18	0.47
fall	road and pad	Log-Logistic	0.95	0.06	22.24	761.05	0.03	0.02	0.04
fall	road and pad	Log-Logistic	0.95	0.13	21.28	348.92	0.06	0.04	0.08

CPT = carcass persistence trials; *g* = detection probability.