10(a)(1)(A) Permit # ESPER0011726 Annual Report - 2022

Kings Point Wind Project and North Fork Ridge Wind Project

Barton, Dade, Jasper, and Lawrence Counties, Missouri

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10(A)(1)(A) PERMIT # ESPER0011726 ANNUAL REPORT - 2022

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Abbreviations, Parameters, and Definitions

a_i	fraction of ground searched within each distance band
AIC	Akaike information criterion
control	3.0 m/s cut-in speed
CP	carcass persistence
DWP	density-weighted proportion
Empire	Empire District Electric Company
ft	feet
GenEst	Generalized Estimator
g-value	detection probability
I	search interval
k	SE decay
Kings Point	Kings Point Wind Project
m	meters
mph	miles per hour
m/s	meters per second
MW	megawatt
North Fork Ridge	North Fork Ridge Wind Project
p	Searcher efficiency
Permit	10(a)(1)(A) Permit # ESPER0011726
SE	searcher efficiency
TAL	Technical Assistance Letter
treatment	5.0 m/s cut-in speed
USFWS	U. S. Fish and Wildlife Service
v	temporal coverage
WTGs	Wind Turbine Generators
X_i	number of carcasses found within each distance band

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND HISTORY

Empire District Electric Company (Empire) developed and is currently operating two wind power facilities in southwest Missouri. Kings Point Wind Project (Kings Point) is located in Barton, Dade, and Lawrence Counties, Missouri and North Fork Ridge Wind Project (North Fork Ridge) in located in Barton County, Missouri. These two wind projects are collectively referred to as "the Projects" throughout this report. The Projects each consist of 69 Vestas wind turbine generators (WTGs; 12 Vestas V-110 2.0 megawatt [MW], 57 Vestas V-120 2.2-MW) with an approximate capacity of 149.4 MW for each Project. Total, the Projects include 138 WTGs. A map showing the location of the WTGs for the Projects is provided in Appendix A, Figure A-1.

Due to the potential risk of take of the federally endangered gray bat (*Myotis grisescens*) during operations, Empire applied for a Native Endangered Species Recovery Permit under Section 10(a)(1)(A) of the Endangered Species Act (Permit) to evaluate the effectiveness of smart curtailment on reducing gray bat fatalities. The application included a study plan outlining a 4-year research study that was developed through coordination with the U.S Fish and Wildlife Service (USFWS) Columbia, Missouri Ecological Services Field Office and the Missouri Department of Conservation (Stantec 2021). The study plan included both post-construction fatality monitoring for bats, as well as acoustic monitoring for bat activity. The Permit (ESPER0011726) was issued on August 6, 2021. Prior to issuance of the Permit, the Projects operated in accordance with terms outlined in Technical Assistance Letters (TALs) issued by the USFWS on May 10, 2019 for Kings Point and June 6, 2019 for North Fork Ridge. This report summarizes the operations and post-construction fatality monitoring at the Projects for 2022 and is intended to satisfy Condition L (Annual Reporting) of the Permit. This report also includes the results of acoustic monitoring from 2021 and 2022.

1.1.1 Previous Monitoring (2021)

1.1.1.1 Spring and Summer 2021 - TAL

Operations and monitoring during the spring and summer of 2021 were in accordance with the TALs for the Projects. Conditions of the TALs required feathering of all turbine blades below 8.0 meters per second (m/s) when ambient temperature was above 50 degrees Fahrenheit during the gray bat active season (March 1 through November 15) from 30 minutes prior to sunset through 30 minutes after sunrise. Bat fatality monitoring began March 3, 2021 for North Fork Ridge and April 8, 2021 for Kings Point. Bat fatality monitoring included search efforts expected to achieve a detection probability (g-value) of 0.2 based on Evidence of Absence (EofA; Dalthorp et al. 2017). Fatality monitoring included twice weekly searches at all WTGs on graveled roads and pads out to 100 meters (m) from the turbine base and 60-m radius cleared plots around 48 WTGs. Searcher efficiency and carcass persistence trials were completed in accordance with the TALs.

1.1.1.2 Fall 2021 – 10(a)(1)(A) Permit

After receiving the Permit, fatality monitoring and operational curtailment were adjusted, and acoustic monitoring was added at the Projects to begin collecting data to address the research objectives outlined in the study plan (Stantec 2021) for the Permit. Fatality monitoring efforts included an expansion of 8 of the search plots from 60-m radius cleared plots to 100-m radius cleared plots on August 23, 2021. On September 7, 2021 (Kings Point) and August 30, 2021 (North Fork Ridge) the Projects began operating half of their turbines at 3.0 m/s (control) and half at 5.0 m/s (treatment) cut-in speeds (i.e., turbines are "feathered" below this wind speed to minimize blade movement, based on the wind speed measured at each turbine's nacelle). Acoustic bat monitors were installed on 30 WTGs in August 2021. Details of the monitoring effort and survey results for the monitoring from 2021 are available in the 2021 annual report (Stantec 2022).

1.1.2 Spring, Summer, Fall 2022 – 10(a)(1)(A), P1Y1

Bat fatality monitoring and acoustic bat activity monitoring was completed at the Projects during the spring, summer, and fall of 2022. Turbine control and treatment operations were the same as they were during the fall 2021 monitoring period, but the bat fatality monitoring effort was increased for 2022 to include searches 3 times per week for all turbines and the addition of 8, 60-m radius cleared plots. The 2022 monitoring period represents the first full year of the study under the Permit and is defined as Phase 1, Year 1 in the Study Plan (Stantec 2021).

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

The goal of this study is to evaluate and understand gray bat fatality rates at the Projects to develop and test an optimal curtailment strategy for reducing impacts. This will aid in the recovery of the gray bat by providing a basis of understanding for gray bat and wind turbine interactions. The study will span 4 years and combines acoustic bat monitoring on WTG nacelles, fatality monitoring beneath WTGs, and operational curtailment treatments applied to WTGs to achieve 4 study objectives:

- Objective 1: Quantify turbine-related fatality rates for gray bats
- Objective 2: Quantify relationship between exposed gray bat activity and fatality
- Objective 3: Quantify effectiveness of blanket curtailment turbine operation (e.g., 5.0 m/s cut-in speed from April 1 – October 31 at temperatures above 50 degrees Celsius, 30 minutes before sunset through 30 minutes after sunrise) for reducing gray bat fatality
- Objective 4: Demonstrate use of nacelle-based acoustic and weather data to optimize turbine operational curtailment and evaluate its effectiveness at reducing gray bat fatality

2.0 METHODS

Survey methods for carcass searches, searcher efficiency (SE) trials, carcass persistence (CP) trials, and acoustic monitoring followed those specified in the Permit conditions and as outlined in the study plan (Stantec 2021), with the following exceptions: search effort was increased from twice per week to three times per week, and additional cleared plots were added in an effort to increase the g-value. Post-construction monitoring included the following components:

- Standardized carcass searches to systematically search plots at all WTGs for bat fatalities attributable to the WTGs;
- SE trials to estimate the percentage of bat carcasses that were found by the searcher(s);
- CP trials to estimate the persistence time of carcasses on-site before scavengers removed them; and
- Acoustic monitoring to assess total bat activity and gray bat activity at nacelle height on WTGs within the rotor-sweep and beneath the rotor-sweep.

2.1 FIELD METHODS

2.1.1 Standardized Carcass Searches

Standardized carcass searches were completed at 100% of the Projects' WTGs between April 4 and October 31, 2022. Standardized carcass searches consisted of searching search plots at each turbine on either (1) the graveled areas of turbine pads and access roads out to 100 m (road and pad searches), (2) within a 60-m radius of turbines (60-m cleared plot) or (3) within a 100-m radius of turbines (100-m cleared plot) during spring, summer, and fall. Figures A-2 and A-3 (see Appendix A) show the search plot types by turbine location for Kings Point and North Fork Ridge, respectively. The distribution of the search plots was as follows:

- Kings Point – 41 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches; and
- North Fork Ridge – 41 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches.

[redacted]

Standardized carcass searches were conducted by qualified searchers trained in fatality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify bat species likely to be found at the Projects. Preliminary bat species identifications were made in the field by qualified staff. When carcass condition allowed, sex and age of the carcass were recorded.

Forearm length was recorded to facilitate species identification. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification. Photos of any bat carcass unable to be identified to the species level were sent to a Stantec permitted bat biologist for positive identification, and carcasses were kept on-site. Any unknown bat or suspected *Myotis* was identified by a Stantec senior bat biologist who holds a USFWS permit for threatened and endangered bats, and/or was sent to the Northern Arizona University's Bat Ecology and Genetics Lab[1] for genetic testing.

During searches, searchers walked at a rate of approximately 2 miles per hour (45 to 60 m per minute) while searching 3 m on either side. For each carcass found, the following data were recorded digitally within Survey123 (ESRI, Redlands, CA):

- Date and time
- Initial species identification (this information was updated as needed based on photos, dentition, or expert opinion)
- Sex, age, and reproductive condition (when applicable; sex was updated based on genetic testing when applicable)
- Global positioning system location
- Distance and bearing to turbine
- Condition (intact, scavenged, decomposed)
- Any notes on presumed cause of death

A digital photograph of each carcass next to a ruler for scale was taken before the carcass was handled and removed. All bat carcasses were labeled, bagged, and stored in onsite freezers at the Projects' Operations and Maintenance Buildings. Bat carcasses were collected and retained under the Permit and Missouri Department of Conservation Wildlife Collector's Permit #s: 19773, 19774, 19775, 19776, 19777, 19778, 19779.

Bat carcasses found in non-search areas were coded as incidental finds and documented in a similar fashion to those found in standardized surveys when possible. These included carcasses found during non-search times or outside the monitoring plot. Incidental bat carcasses were collected and stored in the freezer with the carcasses found during standardized surveys. As per industry standard, incidental finds were not included in the fatality estimates.

2.1.2 Searcher Efficiency Trials

SE trials were used to estimate the probability of bat carcass detection by the searchers. Trials were spread out across Projects, seasons, searchers, and search plot types. The searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Bat carcasses previously collected during the 2021 surveys were used for the trials.

[1] https://in.nau.edu/bat-ecology-genetics/

All SE trial carcasses were randomly placed by a field lead within the search plots. These were placed in the morning prior to the planned carcass searches for that day and checked after the SE trial to ensure they had not been scavenged. The number of trial carcasses found by the searcher in each plot was recorded and compared to the total number placed in the plots prior to the SE trial.

2.1.3 Carcass Persistence Trials

A CP trial was conducted to estimate the average length of time carcasses remained in the search plots before being removed by scavengers. Carcass persistence trials were maintained separate from searcher efficiency trials to facilitate timeliness of persistence checks (e.g., all carcasses had "day 2 check" on the same day) but were also randomly placed in the field within the search plots. Trials took place in all three seasons and across the plot types to determine if CP varied by season or plot type, and trials were conducted separately for each Project. Searchers monitored the CP trial carcasses for up to 28 days. During the CP trials, carcasses were checked every day for the first week, and then regularly checked until missing or 28 days had passed (i.e., approximately days 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, and 28), or until no longer detectable.

The condition of each carcass was recorded during each CP trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing
- Scavenged – carcass with some evidence or signs of scavenging
- Fur spot – no carcass, but fur spot remaining
- Missing – no carcass or fur remaining

2.1.4 Acoustic Monitoring

Wildlife Acoustics (Model SM4BAT FS) acoustic bat detectors with SMM-U1 microphones were mounted on 30 WTG nacelles (height of 120 m; 15 per project) and on the turbine mast (height of 20 m; 5 per project) of 10 WTGs from August 2021 through December 2021, and then redeployed for the 2022 season between February and November. The detectors were set to record echolocation calls of bats that fly in proximity (within approximately 30 m) of the detector microphones from 45 minutes before sunset to 45 minutes after sunset each night of the 2022 monitoring season. Detector locations are shown in Appendix A, Figures A-6 and A-7.

2.2 DATA ANALYSIS – GENEST

Results include summaries of the raw data, including counts of species, the number of searches conducted, and the average search interval (calculated as the sum of the number of visits to a turbine divided by the number of days within a season).

The Generalized Estimator (GenEst; Dalthorp et al. 2018) was used for calculating bias correction factors (SE, and CP) and the overall fatality rate and fatality estimates for all bats at the Projects. Note that throughout the document some estimates may not correspond exactly with subsets of those estimates

(e.g., fatality by species may not add up to total fatality). This is because GenEst generates all estimates as a result of 1,000's of iterations of a model (called "bootstraps"). As each iteration yields slightly different results, different repetitions of the analysis will yield slightly different results.

2.2.1 Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the searcher. This rate was calculated using the data collected during SE trials (Section 2.1.2) by dividing the number of trial carcasses the observer found by the total number which remained available during the trial (i.e., non-scavenged). Analysis included an evaluation of whether SE differed by searcher, season (spring, summer, fall), or plot type (roads and pads, cleared plots). It was assumed that the size of the cleared plot (i.e., 60-m or 100-m radius) did not influence SE, since both plot types were maintained to the same visibility [redacted]. Trials across both projects were combined for each searcher (i.e., SE was assumed to not vary by Project). SE decay (k) was fixed at 0.67. This value represents the decrease in searcher efficiency (p) on subsequent searches (i.e., if a carcass is missed the first time it is available, it is less likely to be found on subsequent searches than a "fresh" carcass).

GenEst returns numerous models depending on the number of variables included in the analysis, as well as Akaike information criterion (AIC) values for each model. The AIC value is a statistical score for the quality of a model fit, where smaller AIC values are considered better models. However, models within 4 ΔAIC (the difference between each models AIC and the AIC of the "best" model) are generally considered indistinguishable by this measure (Dalthorp et al. 2018). Therefore, the best model was chosen based on a manual review of models with the lowest AIC values, and a top model was chosen from the models within 4 ΔAIC of the top model. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.2 Carcass Persistence

CP represents the average amount of time (in days) that a carcass persists on the landscape after arriving, before being scavenged or decaying. A CP model is generated in GenEst using the data collected as part of the CP trials (Section 2.1.3). CP models in GenEst include censored exponential, Weibull, lognormal, and loglogistic distributions. CP was calculated separately for each Project. Analysis included an evaluation of whether CP varied by season and/or plot type.

GenEst returns numerous models depending on the number of variables included in the analysis, as well as AIC values for each model. The best model was chosen based on a comparison of models with the lowest AIC values, though similar to SE, models were also graphically evaluated to ensure that they are logical, and the top model was chosen from the models within 4 ΔAIC of the top model based on AIC alone. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.3 Density-weighted Proportion (DWP)

The density-weighted proportion (DWP) was calculated based on several parameters described below. Data used included four seasons of data (fall 2021, spring-fall of 2022) across both Projects from road

and pad plot types as well as the 100 m cleared plots (i.e., only plot types that searched out to the full 100-m, thus excluding the 60-m full plots). The following parameters and equations were then used:

$$X_i = number\ of\ carcasses\ found\ within\ distance\ band\ i$$

$$a_i = fraction\ of\ ground\ searched\ within\ distance\ band\ i$$

$$\widehat{M}_i = relative\ mortality\ rate\ in\ each\ ring = \frac{X_i}{a_i}$$

$$\hat{p}(M_i) = fraction\ of\ total\ in\ each\ ring = \widehat{M}_i \Big/ \sum_i \widehat{M}_i$$

The number of carcasses found within each distance band (X_i) is the total of carcasses found within that distance band at road and pad or 100-m full plot turbines. When each carcass was found, searchers recorded the location of the carcass using a sub-meter accuracy global positioning system in a digital datasheet (Collector for ArcGIS). The distance between these locations and the nearest turbine were calculated in GIS, and these values were used to calculate the DWP.

To determine the fraction of ground searched within each distance band (a_i), the turbine roads and pads were digitized, and the proportion of each distance band that included the road and pad was calculated for each of the 82 road and pad plots out to 100 m from the turbine base. These values were then averaged across all road and pad turbines to determine the percentage of each distance band that was searched on roads and pads. For 100-m cleared plot turbines, 100% of the area within 100 meters was searched. It was assumed that all carcasses fell within 100 meters of the turbine base. The weighted average of these values was then calculated for each distance band based on the proportion of road and pad plots to 100-m full plot turbines.

Once the fraction of total mortality in each ring ($\hat{p}(M_i)$) was calculated, turbine-specific DWPs were calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total mortality for that distance band. This utilized the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), and then 100% of the area within 60 m of the turbine base was searched for 60-m full plot turbines, and 0% beyond that.

2.2.4 Adjusted Fatality Estimates (GenEst)

GenEst was used to calculate overall fatality rates for the Projects (per turbine, per MW, for all 69 turbines at Kings Point, and for all 69 turbines at North Fork Ridge). All estimates include 90% confidence intervals. "Per turbine estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the number of turbines (69 turbines), and "per MW estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the total MW (149.4 MW) for each project.

Fatality estimates were split by season.

2.3 DATA ANALYSIS – EVIDENCE OF ABSENCE

EofA (Dalthorp et al. 2017) was used for estimating the overall detection probability (g) and the estimated take of gray bats (M and λ).

2.3.1 Estimation of Detection Probability (g)

For analysis of the 2022 data, Stantec used the "Multiple Class Module" to combine data from the two search classes (roads and pads and cleared plots) and across the three seasons (spring, summer, and fall). Site-specific monitoring data were used to calculate the g-value for each search class, including the following inputs:

- Search interval (I), calculated as the average time between searches per plot type
- Number of searches, calculated as the average number of times each turbine per plot type was visited
- Spatial coverage (a), set to the average DWP for that search class (i.e., roads and pads or the weighted average of the cleared plots combining both 100-m and 60-m plot sizes)
- Temporal coverage (v), set to 1 for the summer and 0.925 for spring and fall since monitoring occurred during the entire period of risk during the summer, and on-site pre-construction acoustic data suggests 95% of gray bat activity occurs after March in the spring and before November in the fall
- SE, calculated using the "carcasses removed after one search" option and inputting the total number of carcasses available and found per plot type and season across all searchers
- Factor by which SE changes with each search (k) was fixed at 0.67
- CP distribution calculated using field trials to estimate the parameters, and the top model was selected based on results from within EofA.

This input was done for both road and pad searches and for cleared plots to calculate the detection probability (g) within those searched areas. Within the Multiple Class Module, the fraction of total carcasses arriving within each class needs to be assigned to the DWP column. This differs from the DWP calculated in Section 2.2.3, which is the proportion of bats expected to fall within the searched area at a particular turbine, whereas this DWP is the proportion of bats expected to fall within that class. The DWP was calculated for each of the plot types, as well as for an "unsearched" class to account for carcasses that fall outside of the searched areas. The DWPs of these three classes (roads and pads, cleared plots and unsearched) must sum to one. The DWPs for roads and pads and cleared plots were calculated based on the DWPs calculated for the turbines within those plots (Section 2.2.3), using the average DWP for the plot type and multiplying it by the proportion of turbines within that plot type. The unsearched class was then calculated as one minus the sum of the DWPs for the searched areas.

Once these inputs were complete, the "Estimate overall detection probability (g)" option was chosen, and the overall detection probability for the survey period was calculated.

2.3.2 Estimation of Gray Bat Fatalities

For analysis of the 2022 data, the “Multiple Years Module” was used with the results of the detection probability (g) obtained as described in Section 2.3.1, along with the number of observed gray bat fatalities. This analysis was run separately for each Project to determine the total estimated mortality (M), and the annual fatality rate (λ) for gray bats. Credible intervals were evaluated assuming α=0.5.

2.4 DATA ANALYSIS – ACOUSTIC MONITORING AND TURBINE OPERATION

Stantec processed acoustic bat data collected at the Projects using Kaleidoscope Pro (KPro; Wildlife Acoustics, Inc.; version 5.4.0 or later) to eliminate noise (e.g., insects, rain, wind) and assign automated identifications of species to files using the Bats of North America classifier (version 5.4.0; 0 Balanced [Neutral] setting). Trained bat biologists visually reviewed all files in AnalookW (version 4.4n or newer) to confirm they contained a bat pass (i.e., at least 2 bat echolocation call pulses). Files that did not contain a bat pass were manually removed and not analyzed further. We also reviewed files categorized as noise and files not identified as a species to search for any misclassification of bat passes. We also visually vetted all files classified by KPro as species of interest, including federally endangered gray bats and the candidate species tricolored bats (*Perimyotis subflavus*), along with files labeled as other species that could potentially be confused with these species.

We extracted file-level information from all bat passes using the CountLabels tool in AnalookW software and attributed all bat passes with timestamp (rounded to the nearest 10-minute interval), species, and metadata including Project, turbine number, detector position (nacelle or mid-tower), operational treatment. We evaluated all turbine data files to determine whether detectors were functioning properly on a nightly basis.

Stantec obtained turbine rotor speed, ambient air temperature, and wind speed averaged across 10-minute intervals for the duration of the monitoring period at the nacelle of each Project turbine at which acoustic detectors were deployed. We categorized every 10-minute interval as meeting or not meeting curtailment conditions based on the parameters assigned to that turbine during the particular time period and categorized turbines as curtailed if rotor speed was less than 1 rpm during a 10-minute interval in which curtailment conditions were met. For each 10-minute interval in which acoustic detectors were operating, we calculated the number of bat passes per species detected. Bat passes recorded during 10-minute intervals in which turbine rotor speed exceeded 1 rpm were categorized as “exposed” to turbine operation. We compared acoustic exposure as a proportion of total bat activity and a rate of exposed passes per detector-night per turbine to bat fatality data per turbine to assess spatial patterns, per week to assess temporal patterns, and also overall per operational treatment, combining data from Kings Point and North Fork Ridge.

3.0 RESULTS

Fatality monitoring was completed for both Kings Point and North Fork Ridge. From April 1 – October 31, 2022, the WTGs at the Projects were operating as specified in the Permit at either control cut-in speed (3.0 m/s) or treatment cut-in speed (5.0 m/s). Figures A-4 and A-5 (see Appendix A) show the control and treatment assignments for Kings Point and North Fork Ridge, respectively. Results for both Projects are presented below.

3.1 SHARED RESULTS

Calculations for SE and DWP were shared between projects. Searchers were regularly shared between projects but not always to a degree that warranted testing on a project-specific basis. Additionally, combining both projects and all available seasons allowed for a more robust estimation of DWP.

3.1.1 Searcher Efficiency

SE trials were conducted during the post-construction monitoring during all three seasons (spring, summer, and fall) in 2022 using a total of 481 trial carcasses. Data were analyzed in GenEst, with searcher, season, and plot type as the three predictor variables. The selected model included season, searcher, plot type, and an interaction between season and plot type as the predictors (Appendix B, Table B-1). This resulted in a total of 84 searcher efficiency estimates that were used in fatality estimation. A summary of these estimates is provided below.

Based on the results of the top model, searcher efficiency ranged from 9.4% to 86.2% on cleared plots and ranged from 30.5% to 97.3% on roads and pads for all seasons. The average searcher efficiency ranged from 27.0% (spring) to 48.4% (fall) on cleared plots and from 56.5% (spring) to 82.2% (summer) on roads and pads (Table 3-1). There was variability among all combinations of covariates, but searcher efficiency was generally higher on road and pad plots than on cleared plots and higher on average during fall than the spring and summer seasons.

Table 3-1. Searcher efficiency during 2022 post-construction monitoring at the Kings Point and North Fork Ridge Wind Projects.

Season	Cleared Plots Trial Carcases	Cleared Plots Searcher Efficiency (90% CI)	Road and Pad Plots Trial Carcasses	Road and Pad Plots Searcher Efficiency (90 % CI)
Spring	64	0.270 (0.035 – 0.886)	65	0.565 (0.143 – 0.970)
Summer	88	0.328 (0.044 – 0.897)	88	0.822 (0.358 - 992)
Fall	86	0.484 (0.091 – 0.956)	90	0.758 (0.273 - 988)

3.1.2 Density-weighted Proportion (DWP)

Stantec used the 235 bats found during standardized searches on road and pad and 100 m cleared plots at both Projects to calculate DWP (Table 3-2).

Table 3-2. Calculation of the Density-weighted Proportion (DWP) at the Kings Point and North Fork Ridge Wind Projects based on bat carcasses found between September 1, 2021 and October 31, 2022 (excluding winter).

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total	Cumulative Percent of Carcasses
0-10	10	49.9%	20.0	1.1%	1.1%
10-20	14	16.1%	87.2	4.6%	5.7%
20-30	19	15.1%	125.9	6.7%	12.3%
30-40	35	13.6%	256.6	13.6%	25.9%
40-50	49	12.1%	404.7	21.4%	47.3%
50-60	35	11.4%	305.7	16.2%	63.5%
60-70	27	10.8%	249.4	13.2%	76.6%
70-80	27	10.5%	256.0	13.5%	90.2%
80-90	11	10.3%	106.5	5.6%	95.8%
90-100	8	10.1%	79.4	4.2%	100.0%

Therefore, based on data from carcasses found, it is assumed that 63.5% of all bat carcasses fall within 60 m of the turbine base and within the 60 m cleared plot searches, and 36.5% fall beyond the 60 m cleared plots.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. Therefore, all cleared plot turbines have a DWP of 63.5% (60 m cleared) or 100% (100 m cleared), and the DWP for road and pad turbines ranges from 2.9% to 7.1%.

3.2 KINGS POINT

3.2.1 Carcass Searches

A total of 5,906 searches were conducted between April 4 and October 31, 2022. A summary of search effort by season with total numbers of bats found is presented in Table 3-3. A total of 273 bat carcasses were found during standardized carcass searches, and 4 bat carcasses were found incidentally.

Table 3-3. Summary of bat fatality monitoring conducted between April 4 and October 31, 2022, at the Kings Point Wind Project.

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Spring	April 4 – May 31	1,690	2.49	19	1
Summer	June 1 – August 31	2,533	2.51	183	2
Fall	September 1 – October 31	1,683	2.50	71	1
Total	April 4 – October 31	5,906	2.50	273	4

3.2.2 Species Composition

All 273 bat carcasses found during standardized carcass searches were identified to the species level. A summary of species composition by season for bats found during the standardized carcass searches is shown in Table 3-4. Of the 273 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 193 individuals). The hoary bat (*Lasiurus cinereus*; 41) was the second most common species followed by evening bat (*Nycticieus humeralis*; 20). Tricolored bats (*Perimyotis subflavus*) made up 2.2% (6) of overall carcasses. Gray bats and silver-haired bats (*Lasionycteris noctivagans*) comprised 1.8% of total finds with 5 carcasses each. Incidental finds included 1 hoary bat in the spring, 2 eastern red bats in the summer, and 1 eastern red bat in the fall.

Table 3-4. Summary of bat carcasses found during standardized carcass searches between April 4 and October 31, 2022, during post-construction monitoring at the Kings Point Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat *Eptesicus fuscus*	0 0.0%	1 0.5%	2 2.8%	3 1.1%
Eastern Red Bat *Lasiurus borealis*	8 42.1%	145 79.2%	40 56.3%	193 70.7%
Evening Bat *Nycticeius humeralis*	5 26.3%	0 0.0%	15 21.1%	20 7.3%
Gray Bat[1, 2] *Myotis grisescens*	0 0.0%	3 1.6%	2 2.8%	5 1.8%
Hoary Bat[1] *Lasuirus cinereus*	3 15.8%	28 15.3%	10 14.1%	41 15.0%
Silver-haired Bat[1] *Lasionycteris noctivagans*	3 15.8%	1 0.5%	1 1.4%	5 1.8%
Tricolored Bat[1] *Perimyotis subflavus*	0 0.0%	5 2.7%	1 1.4%	6 2.2%
Total	19 7.0%	183 67.0%	71 26.0%	273

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

3.2.3 Carcass Persistence

CP was tested using 60 carcasses across the 3 seasons, with 10 trials for each combination of plot type and season. The top models for CP in GenEst included Weibull and exponential distributions, with effects of season and/or plot type (Appendix B, Table B-2). We selected the model with the lowest AIC which was both the best model and also the most parsimonious. The selected model had a Weibull distribution and included season as a variable (no effect of plot type). Carcass persistence was shortest in the summer, which averaged 1.83 days, compared to spring which averaged 7.02 days, and fall which averaged 2.69 days (Table 3-5).

Table 3-5. Carcass persistence during 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	20	7.02 (5.35 – 9.09)
Summer	20	1.83 (1.04 – 3.09)
Fall	20	2.69 (1.60 – 4.49)

3.2.4 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat fatality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.2.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 273 carcasses were found during standardized searches at the Kings Point Wind Project. The total estimated fatality for all bats was highest during the summer season (3,104 bats), followed by fall (1,222 bats), and lowest in the spring (208 bats) as summarized in Table 3-6 and Figure 3-1. Annual fatality estimates, combining all seasons, results in an overall bat fatality estimate of 4,640 bats (90% CI: 3,495 – 6,273) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 67 bats/turbine (90% CI: 51 – 91) or 31 bats/MW (90% CI: 23 – 42).

Table 3-6. Bat fatality rates by season from 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	208.28 (102.75 – 364.50)	3.02 (1.49 – 5.28)	1.39 (0.69 – 2.44)
Summer	June 1 – August 31	3,104.46 (2,222.17 – 4,609.28)	44.99 (32.21 – 66.80)	20.78 (14.87 – 30.85)
Fall	September 1 – November 15	1,221.58 (780.00 – 1865.32)	17.70 (11.30 – 27.03)	8.18 (5.22 – 12.49)
Annual	March 1 – November 15	4,639.86 (3,495.27 – 6,273.46)	67.24 (50.66 – 90.92)	31.06 (23.40 – 41.99)

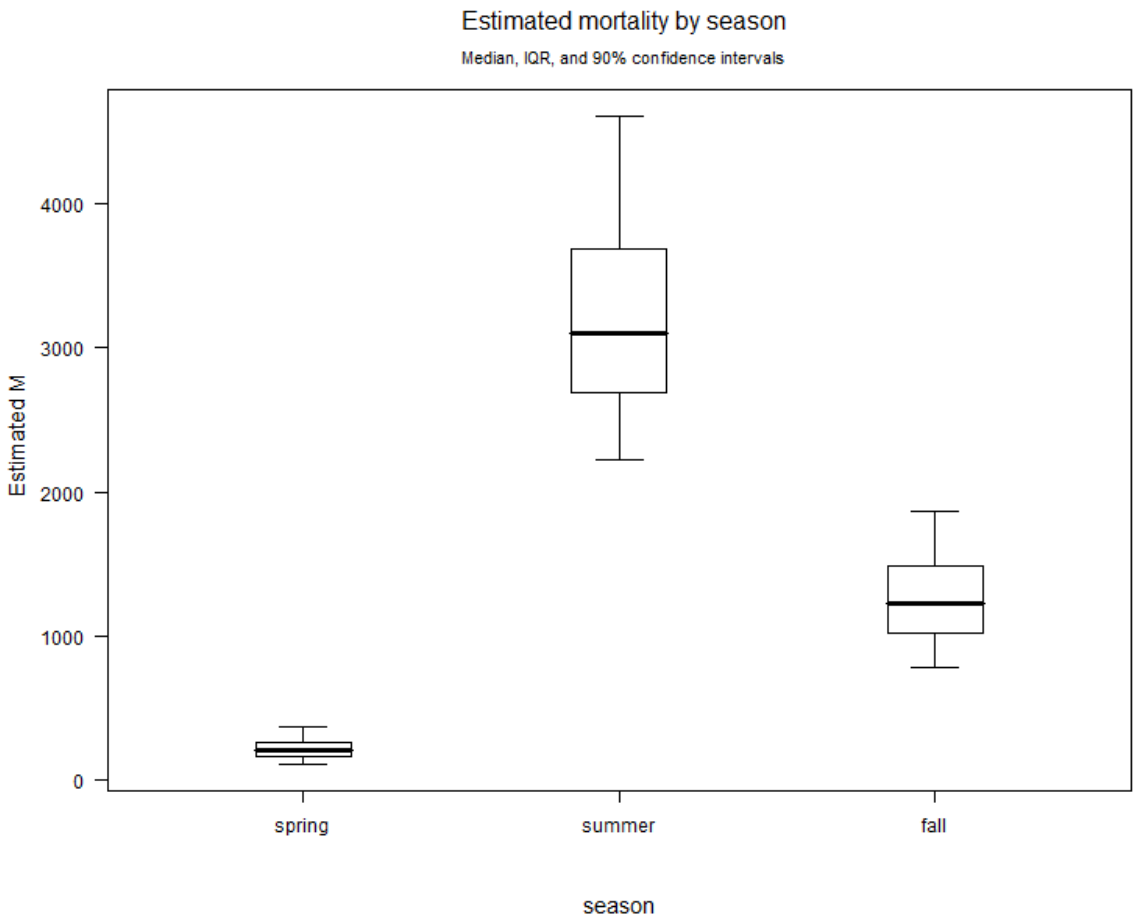

Figure 3-1. Seasonal all bat fatality estimates for 2022 at the Kings Point Wind Project.

3.2.4.2 Control Vs. Treatment Fatality Estimates

Annual fatality estimates were higher for control turbines (3.0 m/s cut-in) than for treatment turbines (5.0 m/s cut-in). Annual bat fatality was 2,848.99 (90% CI: 2,034.11 – 3,931.71) at control turbines and 1,759.14 (90% CI: 1224.15 – 2630.55) at treatment turbines. Per turbine estimates are 81.40 (90% CI: 58.12 – 112.33) for control turbines and 51.74 (90% CI: 36.00 – 77.37) for treatment turbines. Per MW estimates are 37.49 (90% CI: 26.76 – 51.73) for control turbines and 23.97 (90% CI: 16.68 – 35.84) for treatment turbines.

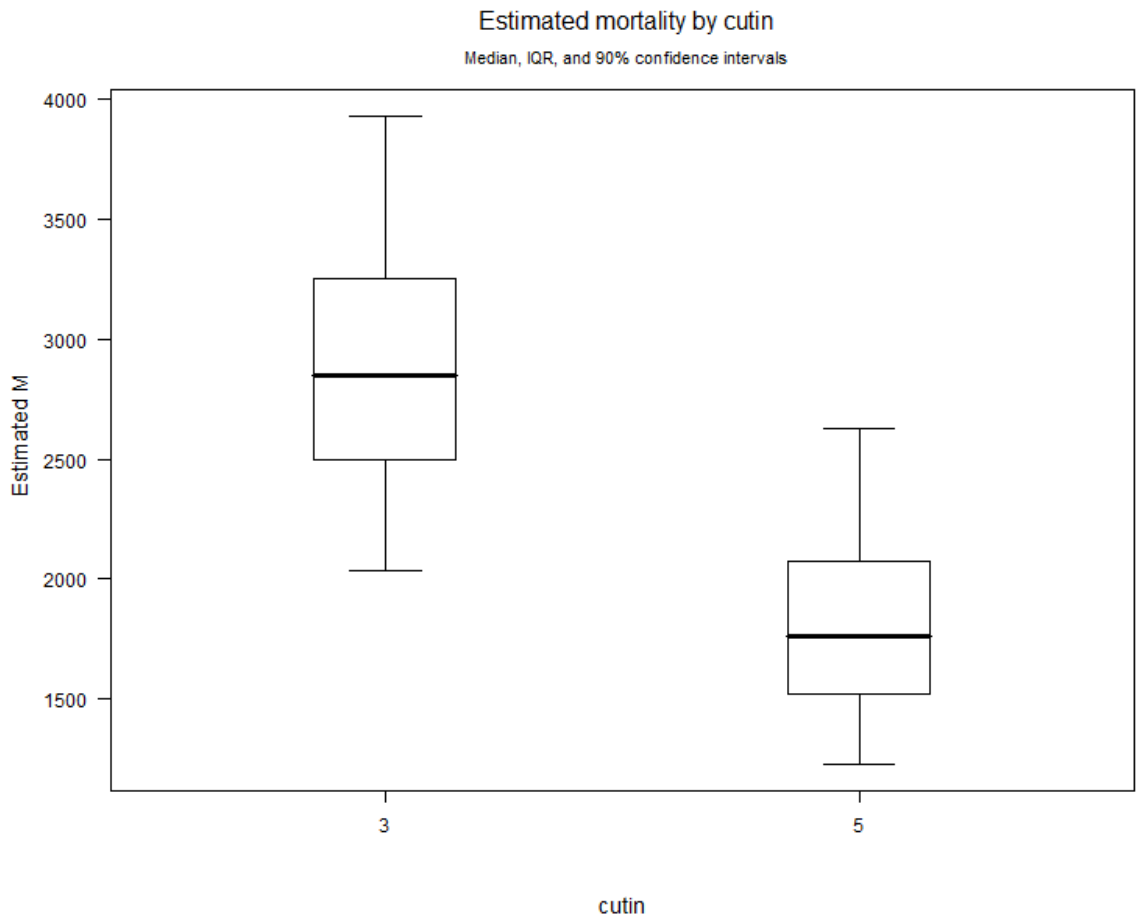

Figure 3-2. All bat fatality estimates at control (3 m/s) vs. treatment (5 m/s) turbines for 2022 at the Kings Point Wind Project.

3.2.5 Gray Bat Fatality Estimates

3.2.5.1 In-hand Fatalities

Stantec found five gray bats during post-construction fatality monitoring at Kings Point. No other federal or state endangered species were found. The locations of these five gray bat fatalities are shown in Appendix A, Figure A-8. Sex for all the gray bats found was confirmed to be female through genetic analysis (see Appendix C). Female gray bats were found on 6/29, 7/26, 7/28, 9/6, and 10/5. Gray bats were found at both control (n=3) and treatment turbines (n=2).

3.2.5.2 Evidence of Absence

The “Multiple Classes” module was used in EofA. Because searcher efficiency and carcass persistence varied by season and plot type, the module was run four times: once for each season (with separate

classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability (g) for the post-construction monitoring season (March 1 – November 15, 2022) was 0.124 (95% CI: 0.093 to 0.158); however, this varied by season as summarized in Table 3-7.

Table 3-7. Summary of detection probability (g) by season and overall, during 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Detection Probability (g) and 95% CI
Spring	0.143 (0.076 – 0.156)
Summer	0.117 (0.077 – 0.165)
Fall	0.149 (0.109 – 0.194)
Total/Overall	0.124 (0.093 – 0.158)

3.2.5.3 Fatality Estimates (M* and λ)

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2022}) and the annual take rate (λ) for gray bats based on the five gray bat carcasses found during monitoring. Results are summarized in Table 3-8.

Table 3-8. Summary of EofA outputs for gray bats from 2022 post-construction monitoring at the Kings Point Wind Project. Analysis done with α=0.5.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2022})	Annual Take Rate (λ) (95% CI)
Gray Bat	5	42	45.7 (15.2 – 94.72)

3.2.6 Acoustic Monitoring

3.2.6.1 2021 Monitoring

Bat detectors were installed on the nacelles of 15 WTGs and 20 m up on the mast of 5 WTGs at Kings Point. Installation occurred between August 4, 2021, and August 27, 2021, and detectors were demobilized for winter between November 17, 2021, and December 20, 2021.

Acoustic detectors recorded a total of 30,998 bat passes during 1,834 successful detector-nights (81% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 4.3 and 44.0 bat passes per detector-night, respectively, during the 2021 monitoring period (Table 3-9).

Table 3-9. Acoustic survey effort at the Kings Point Wind Project from August through November 2021.

[redacted]	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	4-Aug	18-Nov	107	189	159	7,368	68.9
[redacted]	20-Aug	20-Dec	123	5	12	529	4.3
[redacted]	20-Aug	17-Nov	70	4	1	185	2.6
[redacted]	4-Aug	20-Dec	122	217	167	4,377	35.9
[redacted]	20-Aug	20-Dec	0	-	-	-	-
[redacted]	4-Aug	20-Dec	119	210	107	3,415	28.7
[redacted]	19-Aug	10-Dec	114	4	6	453	4.0
[redacted]	18-Aug	9-Dec	114	8	7	456	4.0
[redacted]	18-Aug	18-Dec	123	3	8	469	3.8
[redacted]	12-Aug	20-Dec	14	0	0	14	1.0
[redacted]	20-Aug	4-Dec	73	11	1	442	6.1
[redacted]	4-Aug	20-Dec	121	188	159	4,800	39.7
[redacted]	26-Aug	18-Nov	69	5	1	308	4.5
[redacted]	26-Aug	10-Dec	107	1	0	300	2.8
[redacted]	27-Aug	18-Nov	84	1	4	440	5.2
[redacted]	19-Aug	5-Dec	109	1	2	498	4.6
[redacted]	4-Aug	25-Nov	114	166	179	5,684	49.9
[redacted]	27-Aug	5-Dec	95	1	2	286	3.0
[redacted]	19-Aug	30-Nov	32	1	3	329	10.3
[redacted]	19-Aug	20-Dec	124	1	1	645	5.2
Nacelle Detectors, 2021	-	-	1,251	46	48	5,354	4.3
Mid-tower Detectors, 2021	-	-	583	970	771	25,644	44.0
Total, 2021	-	-	1,834	1,016	819	30,998	16.9

3.2.6.2 2022 Monitoring

Acoustic detectors were redeployed on turbine nacelles in mid-February 2022 and mid-tower locations in mid-April, 2022 and demobilized between mid-November and early December 2022. Acoustic detectors

recorded a total of 46,374 bat passes during 3,431 successful detector-nights (68% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 4.0 and 37.2 bat passes per detector-night, respectively, during the 2022 monitoring period (Table 3-10).

Table 3-10. Acoustic survey effort at the Kings Point Wind Project from February through November 2022.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	19-Apr	17-Nov	202	307	93	7,229	35.8
[redacted]	28-Feb	27-Nov	273	7	12	1,414	5.2
[redacted]	28-Feb	27-Nov	193	6	8	642	3.3
[redacted]	19-Apr	17-Nov	202	437	173	8,488	42.0
[redacted]	15-Mar	27-Nov	141	5	8	640	4.5
[redacted]	19-Apr	17-Nov	192	282	119	5,990	31.2
[redacted]	20-Feb	27-Nov	190	1	3	576	3.0
[redacted]	8-Mar	27-Nov	261	3	1	95	0.4
[redacted]	19-Feb	27-Nov	102	3	1	695	6.8
[redacted]	11-Apr	27-Nov	123	0	5	588	4.8
[redacted]	15-Mar	27-Nov	77	5	2	247	3.2
[redacted]	19-Apr	17-Nov	191	253	201	7,801	40.8
[redacted]	15-Mar	27-Nov	108	2	3	678	6.3
[redacted]	15-Mar	27-Nov	102	3	3	623	6.1
[redacted]	16-Mar	27-Nov	147	4	4	535	3.6
[redacted]	16-Mar	27-Nov	251	2	6	1,259	5.0
[redacted]	19-Apr	17-Nov	199	165	150	7,130	35.8
[redacted]	27-Feb	27-Nov	178	1	3	628	3.5
[redacted]	16-Mar	27-Nov	106	0	2	815	7.7
[redacted]	19-Feb	27-Nov	193	0	0	301	1.6
Nacelle Detectors, 2022	-	-	2,445	42	61	9,736	4.0
Mid-tower Detectors, 2022	-	-	986	1,444	736	36,638	37.2
Total, 2022	-	-	3,431	1,486	797	46,374	13.5

3.2.6.3 Acoustic Results

Gray bats and tricolored bats were detected at most detectors during the 2021 and 2022 monitoring periods, with most detections occurring at mid-tower detectors (Figure 3-3).

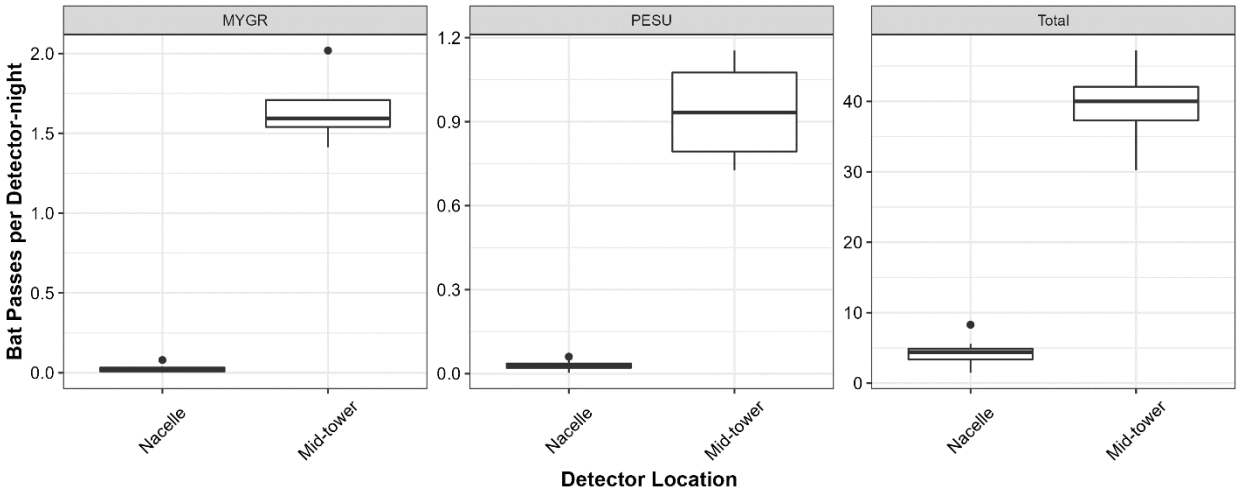

Figure 3-3. Gray bat (MYGR), tricolored bat (PESU), and all bat passes (Total) recorded per detector night at nacelle-mounted versus mid-tower detectors during 2021 and 2022 monitoring at the Kings Point Wind Project. Note differing y-axis scales among plot facets.

Acoustic bat activity followed similar seasonal patterns at nacelle and mid-tower detectors, with a slight peak in activity in mid-May and a pronounced peak in mid-August (Figure 3-4). Although timing of bat activity varied among nights, overall timing of bat activity peaked 1–3 hours after sunset at nacelle and mid-tower detectors for all bat species and the subset of passes identified as gray bats and tricolored bats (Figure 3-5, Figure 3-6, Figure 3-7).

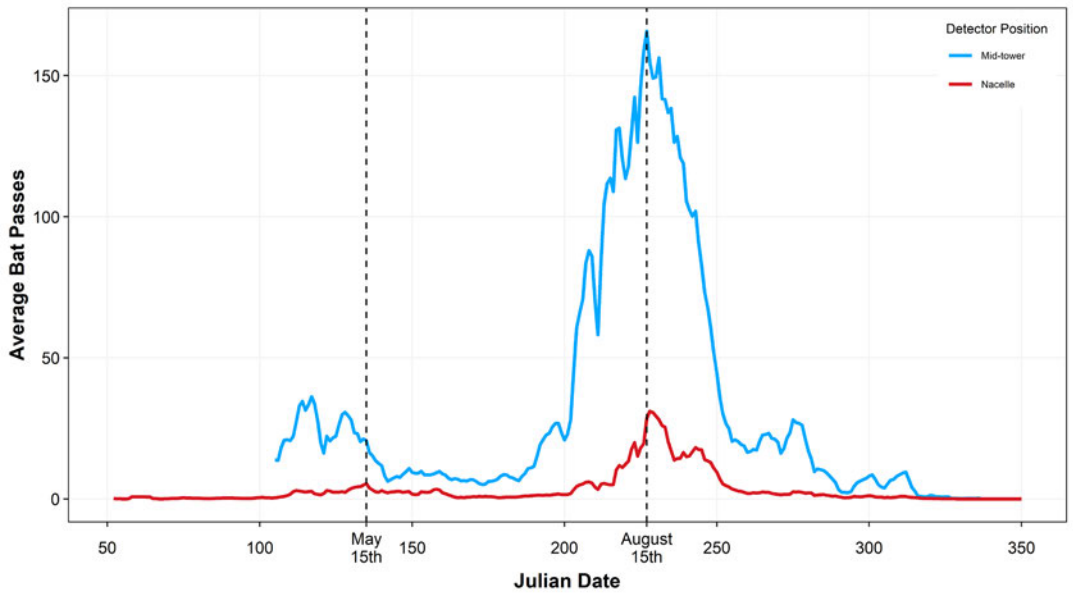

Figure 3-4. 7-day moving average (BP/DN) of acoustic bat activity (all species) detected during the 2021 and 2022 monitoring periods at the Kings Point Wind Project. Data from both years were combined and displayed by Julian date (days since January 1; May 15th and August 15th are displayed on the figure for reference to bat maternity season).

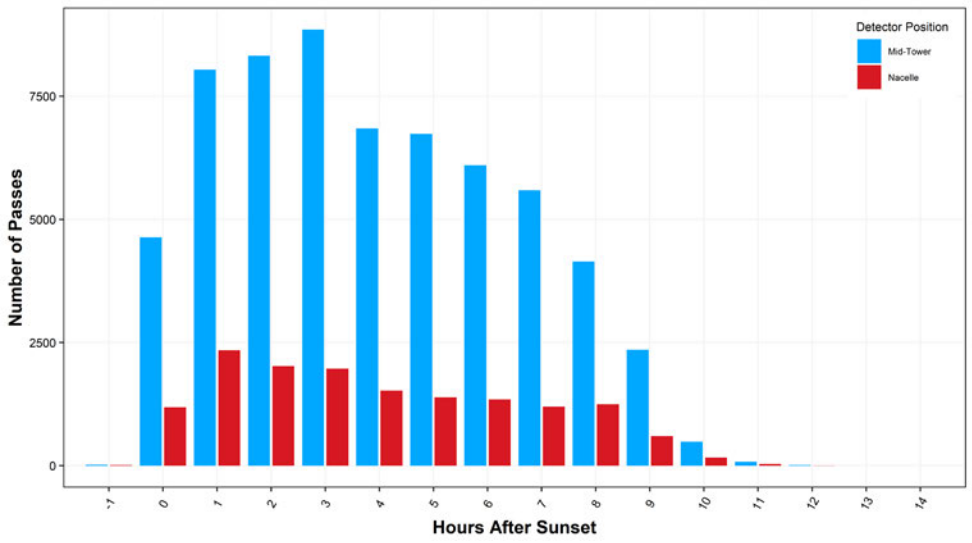

Figure 3-5. Nightly timing of total bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the Kings Point Wind Project.

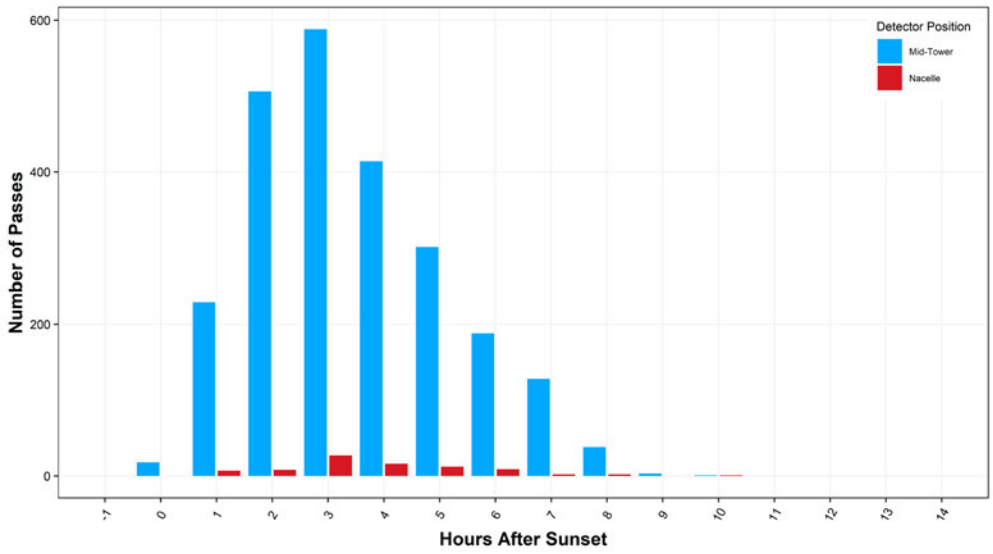

Figure 3-6. Nightly timing of gray bat (*Myotis grisescens*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the Kings Point Wind Project.

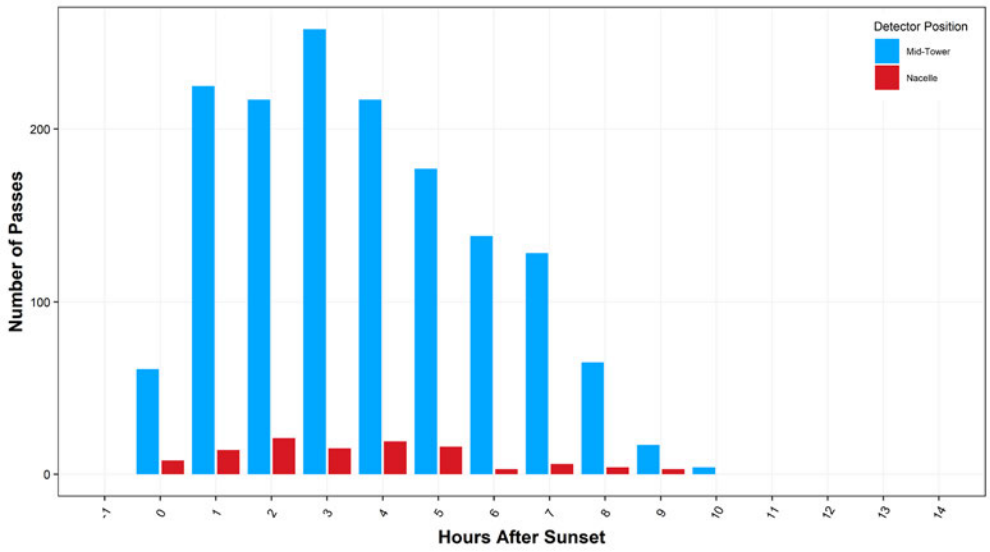

Figure 3-7. Nightly timing of tricolored bat (*Perimyotis subflavus*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the Kings Point Wind Project.

Temperature, wind speed, and turbine rotor speed data were available during 10-minute intervals in which 75,227 bat passes (97% of 77,327 total bat passes) were detected at Kings Point in 2021 and 2022. We used these data to evaluate the distribution of bat activity as a function of temperature and wind speed and to calculate the percent and rate (passes per detector night) of bat passes exposed to turbine

operation. Most bat passes occurred during relatively warm conditions with wind speeds less than 8 m/s (Figure 3-8, Figure 3-9, Figure 3-10).

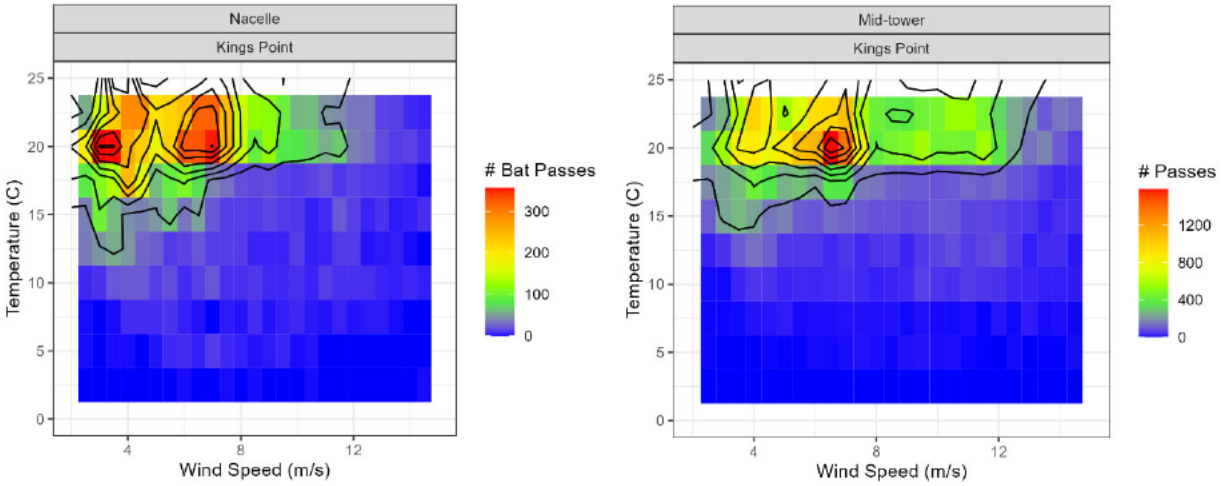

Figure 3-8. Distribution of all bat passes (all species) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project.

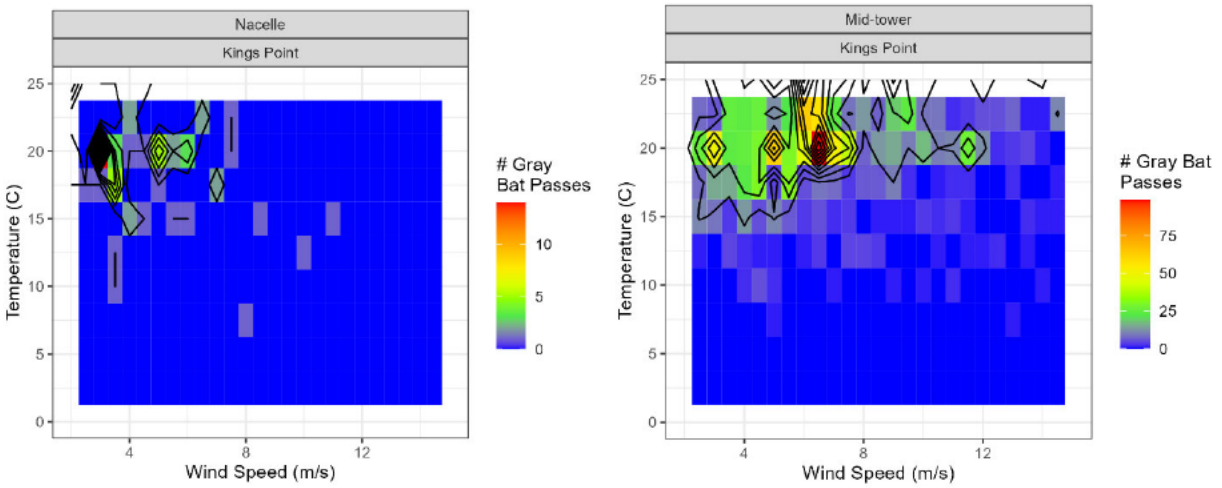

Figure 3-9. Distribution of gray bat passes (*Myotis grisescens*) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project.

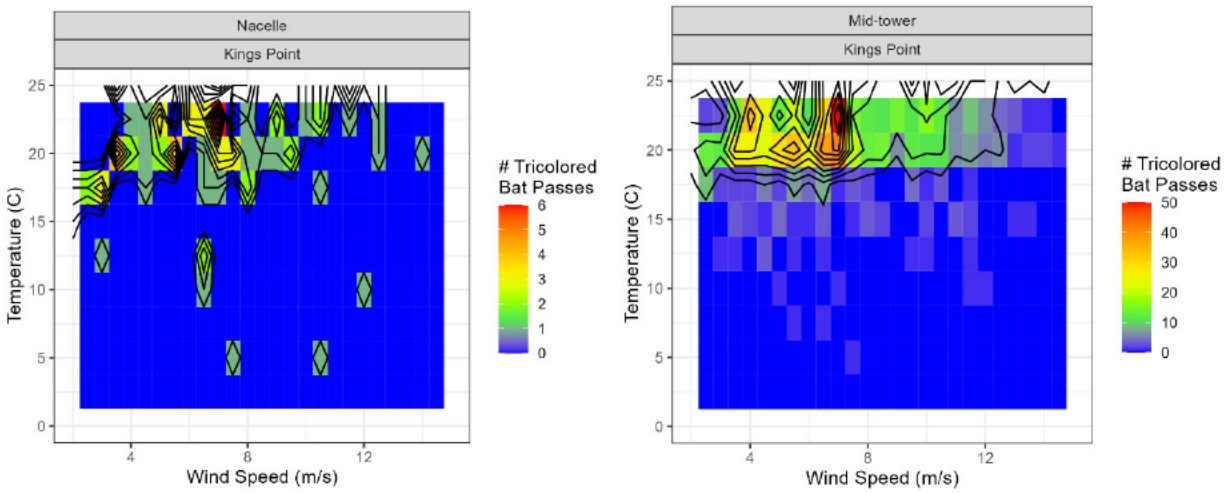

Figure 3-10. Distribution of tricolored bat passes (*Perimyotis subflavus*) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project.

Acoustic monitoring at Kings Point in 2021 and 2022 encompassed periods in which three turbine operational treatments were implemented. Before September 7, 2021, all turbines were operated according to an interim (TAL) curtailment strategy with an 8 m/s cut-in speed. From September 7 – October 31, 2021 and April 1–October 31, 2022, approximately half of the 69 turbines (n = 34) were operated according to a treatment blanket curtailment strategy with 5.0 m/s cut-in speed, and the remaining 35 turbines were feathered below manufacturer's cut-in speed (3.0 m/s) to provide an operational control. The 15 turbines monitored for acoustic bat activity included 8 from the treatment group (5.0 m/s) and 7 from the control group (3.0 m/s).

The interim (TAL) curtailment strategy implemented before September 7, 2021 exposed 23% of bat passes recorded at nacelles and 47% of bat passes recorded at mid-tower detectors to turbine operation (exposed passes are defined as those detected when 10-minute turbine rotor speed exceeded 1 rpm). The 5.0 m/s treatment blanket curtailment strategy resulted in exposure of 53–55% of bat passes detected at nacelles and 57–65% of passes detected at mid-tower units in 2021 and 2022 compared to exposure of 82–87% of passes detected at feathered control turbines (Table 3-11, Figure 3-11). Exposure of gray bat and tricolored bat passes to turbine operation generally followed similar trends among treatments at both detector positions during the 2021 and 2022 monitoring period (Table 3-11).

Table 3-11. Acoustic exposure of gray bat (MYGR), tricolored bat (PESU), and all bat passes to turbine operation (detection when turbine rotor speed > 1 rpm) associated with operational treatments implemented during the 2021 and 2022 monitoring period at the Kings Point Wind Energy Project.

Year	Detector Position	Treatment	# Turb.	Bat Passes MYGR	Bat Passes PESU	Total Bat Passes	Exposed Bat Passes (%) MYGR	Exposed Bat Passes (%) PESU	Total Exposed Bat Passes (%)
2021	Nacelle	8.0 m/s interim TAL	15	22	36	3,756	0 (0%)	15 (42%)	867 (23%)
2021	Nacelle	5.0 m/s Treatment	8	16	7	971	6 (38%)	4 (57%)	514 (53%)
2021	Nacelle	3.0 m/s Control	6	8	5	564	5 (63%)	4 (80%)	469 (83%)
2021	Mid-tower	8.0 m/s interim TAL	5	710	700	21,173	235 (33%)	254 (36%)	10,005 (47%)
2021	Mid-tower	5.0 m/s Treatment	3	171	37	2,467	117 (68%)	24 (65%)	1,403 (57%)
2021	Mid-tower	3.0 m/s Control	2	87	34	1,795	83 (95%)	31 (91%)	1,535 (86%)
2022	Nacelle	5.0 m/s Treatment	8	26	35	5693	9 (35%)	26 (74%)	3,147 (55%)
2022	Nacelle	3.0 m/s Control	7	12	22	3427	5 (42%)	15 (68%)	2,798 (82%)
2022	Mid-tower	5.0 m/s Treatment	3	807	408	19,952	476 (59%)	276 (68%)	12,999 (65%)
2022	Mid-tower	3.0 m/s Control	2	589	318	14,681	511 (87%)	284 (89%)	12,742 (87%)

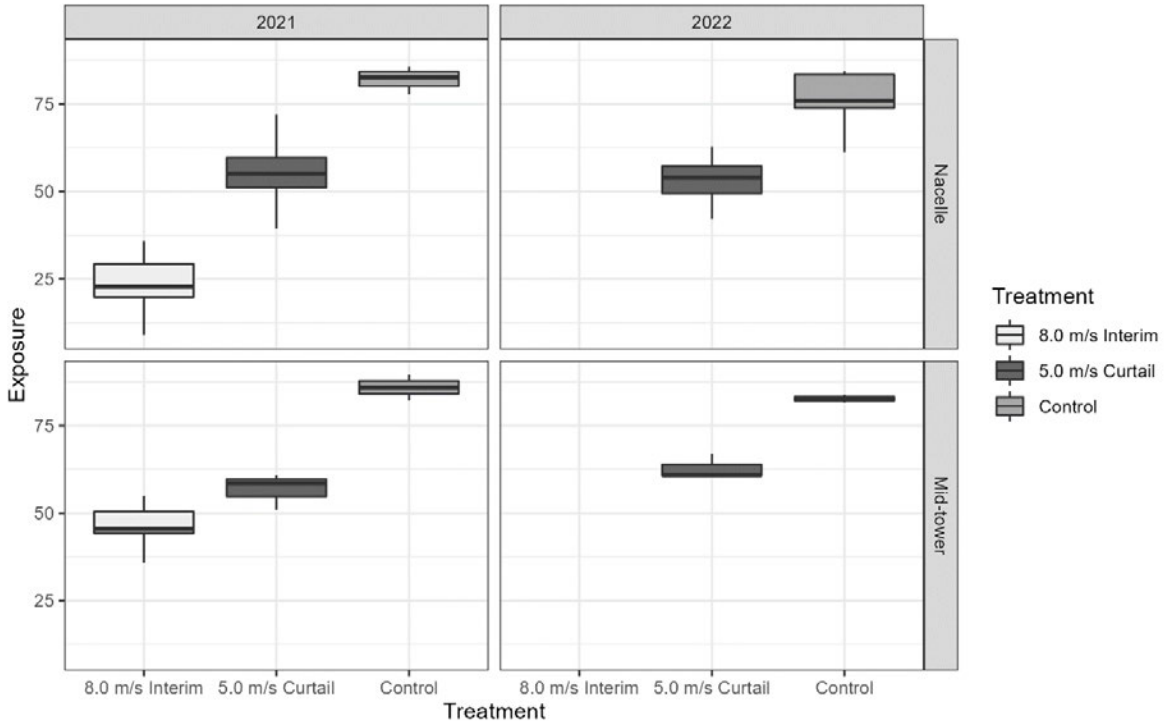

Figure 3-11. Acoustic exposure (percent of bat passes detected when turbine rotor speed was 1 rpm or greater) by operational treatment and detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project. Note that the 8.0 m/s treatment did not occur in 2022.

3.3 NORTH FORK RIDGE

3.3.1 Carcass Searches

A total of 5,930 searches were conducted between April 4 and October 31, 2022, at the North Fork Ridge Wind Project. A summary of search effort by season with total numbers of bats found is presented in Table 3-12. A total of 255 bat carcasses were found during standardized carcass searches, and 3 bat carcasses were found incidentally.

Table 3-12. Summary of post-construction monitoring conducted between April 4 and October 31, 2022, at the North Fork Ridge Wind Project.

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Spring	April 4 – May 31	1,718	2.33	19	0
Summer	June 1 – August 31	2,515	2.52	206	2
Fall	September 1 – October 31	1,697	2.48	30	1
Total	April 4 – October 31	5,930	2.46	255	3

3.3.2 Species Composition

Of the 255 bat carcasses found during standardized carcass searches, the most common species was the eastern red bat (204 individuals; 80%). The hoary bat (32 individuals; 12.5%) was the second most common species. Next were the big brown bat (8) evening bat (5) and silver-haired bat (4). Lastly, one gray bat and one tri-colored bat were found during standard carcass searches. A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-13.

Table 3-13. Summary of bat carcasses found during standardized carcass searches between April 4 and October 31, 2022 at the North Fork Ridge Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat *Eptesicus fuscus*	0 0.0%	7 3.4%	1 3.3%	8 3.1%
Eastern Red Bat *Lasiurus borealis*	11 57.9%	172 83.5%	21 70.0%	204 80.0%
Evening Bat *Nycticeius humeralis*	2 10.5%	2 1.0%	1 3.3%	5 2.0%
Gray Bat[1, 2] *Myotis grisescens*	0 0.0%	0 0.0%	1 3.3%	1 0.4%
Hoary Bat[1] *Lasuirus cinereus*	4 21.1%	23 11.2%	5 16.7%	32 12.5%
Silver-haired Bat[1] *Lasionycteris noctivagans*	2 10.5%	1 0.5%	1 3.3%	4 1.6%
Tricolored Bat[1] *Perimyotis subflavus*	0 0.0%	1 0.5%	0 0.0%	1 0.4%

Species	Spring	Summer	Fall	Total
Total	19 7.5%	206 80.8%	30 11.8%	255

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

3.3.3 Carcass Persistence

The top five models for CP in GenEst included weibull and exponential distributions, with effects of season and/or plot type (Appendix B, Table B-3). The best model was a Weibull distribution with no effect of plot type or season. We selected this model since it had the lowest AIC and was parsimonious.

CP was tested using 61 carcasses (~10 per plot type per season) and median persistence for the year was 2.38 days (90% CI: 1.74 to 3.22). The results presented in Table 3-14 below are for a model (ΔAICc 1.81) which shows variability in CP between seasons and plot types (Appendix B, Table B-3). Table 3-14 is for reference only and was not used in the final model.

Table 3-14. Carcass persistence during 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	20	2.68 (1.91 – 3.70)
Summer	20	2.22 (1.55 – 3.07)
Fall	21	2.55 (1.86 – 3.44)

3.3.4 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat fatality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.3.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 255 carcasses were found during standardized searches. The total estimated fatality for all bats was highest during the summer season (2,265 bats), followed by spring (365 bats), and lowest in the fall (321 bats) as summarized in Table 3-15 and Figure 3-12. Annual fatality estimates, combining all seasons, results in an overall bat fatality estimate of 2,968 bats (90% CI: 2,340 – 3,785) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 43 bats/turbine (90% CI: 34 – 55) or 20 bats/MW (90% CI: 16 – 25).

Table 3-15. Bat fatality rates by season from 2022 post-construction monitoring at the North Fork Ridge Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	364.64 (179.77 – 635.35)	5.28 (2.61 – 9.21)	2.44 (1.20 – 4.25)
Summer	June 1 – August 31	2,265.05 (1,723.34 – 2,977.34	32.83 (24.98 – 43.16)	15.16 (11.54 – 19.93)
Fall	September 1 – November 15	320.61 (165.54 – 511.43)	4.65 (2.40 – 7.41)	2.15 (1.11 – 3.42)
Annual	March 1 – November 15	2,967.78 (2,339.95 – 3,784.5)	43.01 (33.91 – 54.85)	19.86 (15.66 – 25.33)

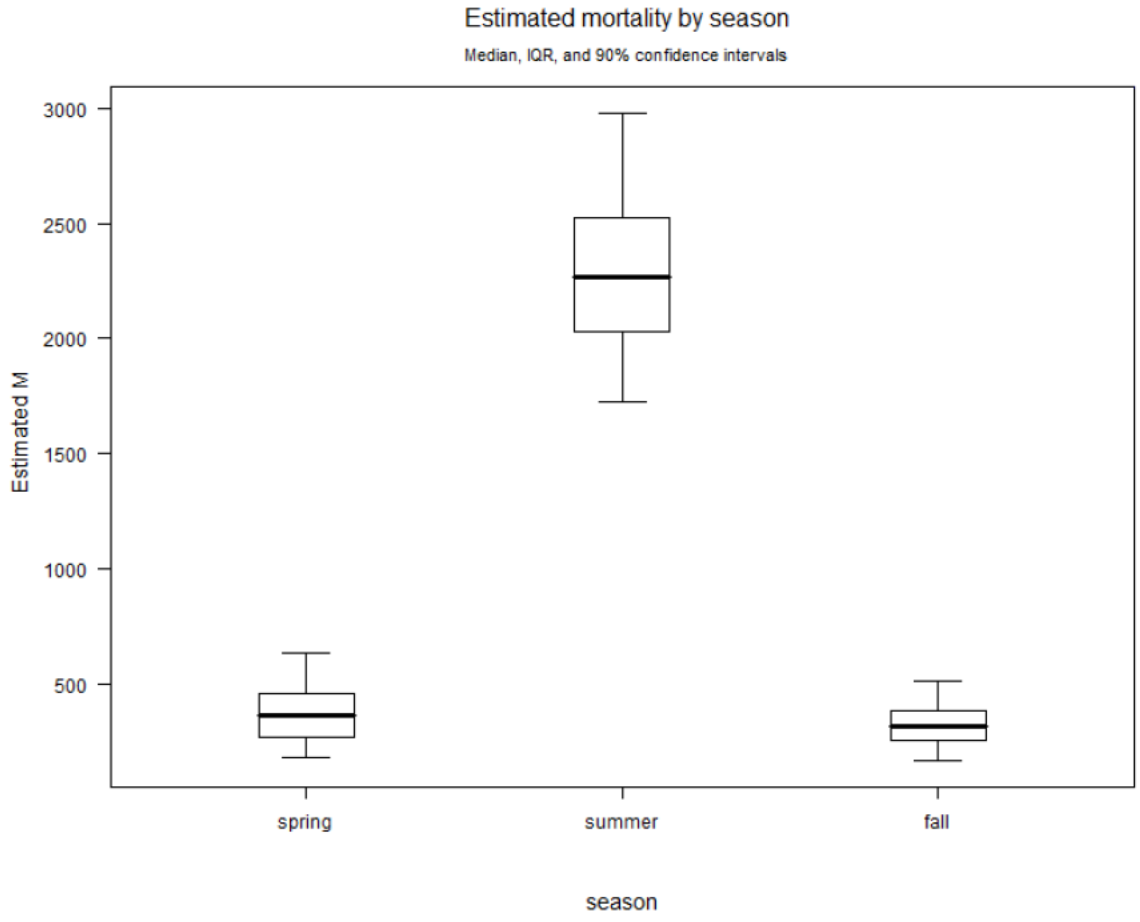

Figure 3-12. Seasonal all bat fatality estimates for 2022 at the North Fork Ridge Wind Project.

3.3.4.2 Control Vs. Treatment Fatality Estimates

Annual fatality estimates were higher for control turbines (3.0 m/s cut-in) than for treatment turbines (5.0 m/s cut-in). Estimated annual bat fatality was 1,688.75 (90% CI: 1,258.2 – 2,260.17) at control turbines and 1,266.91 (90% CI: 930.79 – 1,694.62) at treatment turbines (Figure 3-13). Per turbine estimates are 48.25 (90% CI: 35.95 – 64.58) for control turbines and 37.26 (90% CI: 27.38 – 49.84) for treatment turbines. Per MW estimates are 22.22 (90% CI: 16.56 – 29.74) for control turbines and 17.26 (90% CI: 12.68 – 23.09) for treatment turbines.

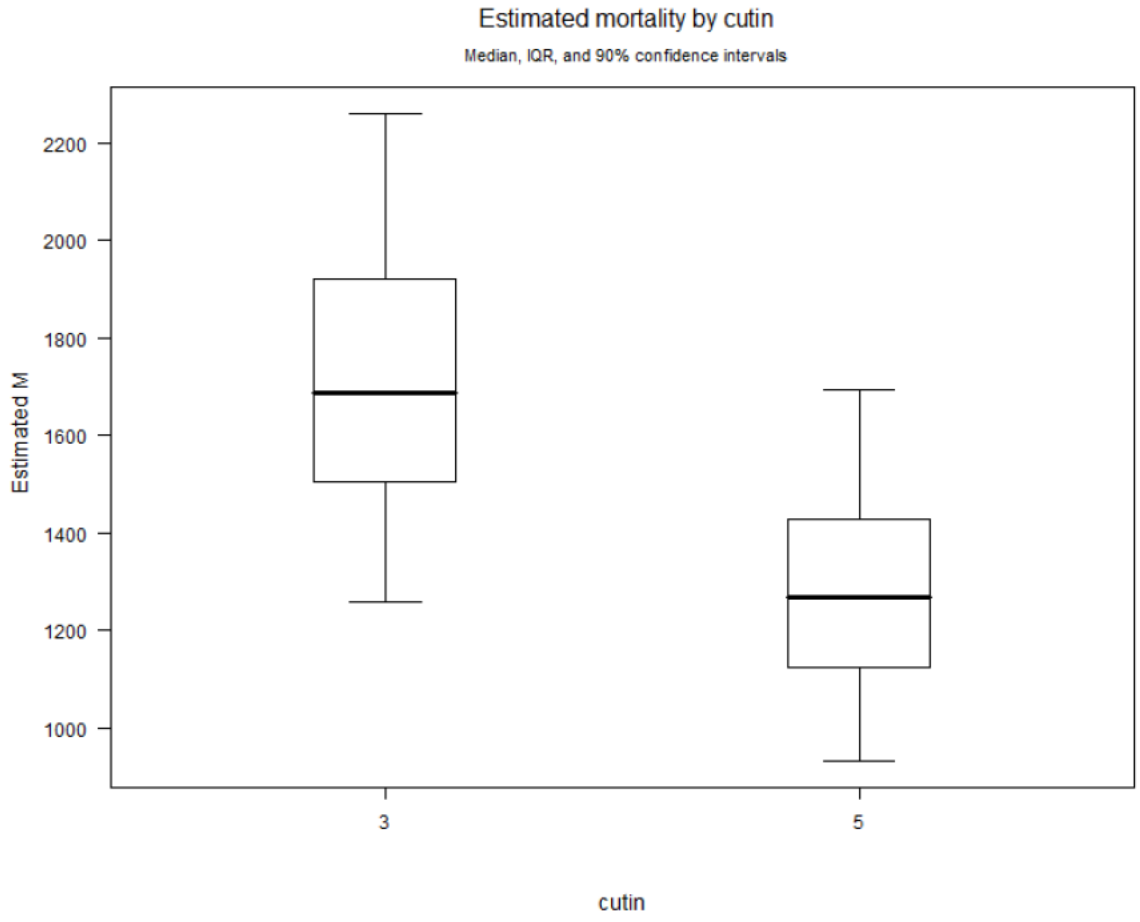

Figure 3-13. All bat fatality estimates at control (3 m/s) vs. treatment (5 m/s) turbines for 2022 at the North Fork Ridge Wind Project.

3.3.5 Gray Bat Fatality Estimates

3.3.5.1 In-hand Fatalities

Stantec found one female gray bat at T103 (treatment turbine) on 9/15/2022 during post-construction fatality monitoring at North Fork Ridge (Appendix A, Figure A-9). No other federal or state endangered species were found.

3.3.5.2 Evidence of Absence

The "Multiple Classes" module was used in EofA. Because searcher efficiency varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability (g) for the post-construction monitoring season (March 1 through November 15, 2022) was 0.143 (95% CI: 0.118 to 0.171); however, this varied by season as summarized in Table 3-16.

Table 3-16. Summary of detection probability (g) by season and overall, during 2022 post-construction monitoring at the North Fork Ridge Wind Project.

Season	Detection Probability (g) and 95% CI
Spring	0.177 (0.132 – 0.226)
Summer	0.147 (0.115 – 0.181)
Fall	0.112 (0.079 – 0.149)
Total/Overall	0.143 (0.118 – 0.171)

3.3.5.3 Fatality Estimates (M* and λ)

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2022}) and the annual take rate (λ) for gray bats based on the one gray bat carcass found during monitoring. Results are summarized in Table 3-17.

Table 3-17. Summary of EofA outputs for gray bats from 2022 post-construction monitoring at the North Fork Ridge Wind Project. Analysis done with α=0.5.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2022})	Annual Take Rate (λ) (95% CI)
Gray Bat	1	8	10.6 (0.755 – 33.4)

3.3.6 Acoustic Monitoring

3.3.6.1 2021 Monitoring

Bat detectors were installed on the nacelles of 15 WTGs and 20 m up on the mast of 5 WTG's at North Fork Ridge. Installation occurred between August 4, 2021 and August 23, 2021, and detectors were demobilized for winter between December 20, 2021 and early January 2022 (though data analysis here is limited to the period through December 31, 2021).

Acoustic detectors recorded a total of 31,799 bat passes during 2,367 successful detector-nights (88% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 3.7 and 43.2 bat passes per detector-night, respectively, during the 2021 monitoring period (Table 3-18).

Table 3-18. Acoustic survey effort at the North Fork Ridge Wind Project from August through November 2021.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	23-Aug	31-Dec	131	0	3	277	2.1
[redacted]	20-Aug	31-Dec	134	0	7	273	2.0
[redacted]	23-Aug	31-Dec	131	0	4	259	2.0
[redacted]	4-Aug	20-Dec	115	19	158	3278	28.5
[redacted]	23-Aug	31-Dec	131	0	1	231	1.8
[redacted]	4-Aug	20-Dec	113	23	128	4107	36.3
[redacted]	24-Aug	31-Dec	130	0	3	260	2.0
[redacted]	20-Aug	31-Dec	82	0	1	296	3.6
[redacted]	20-Aug	31-Dec	134	0	1	333	2.5
[redacted]	18-Aug	31-Dec	136	0	5	514	3.8
[redacted]	20-Aug	31-Dec	134	0	2	495	3.7
[redacted]	20-Aug	31-Dec	134	1	6	383	2.9
[redacted]	3-Aug	20-Dec	118	20	116	5257	44.6
[redacted]	16-Aug	31-Dec	100	0	3	758	7.6

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	19-Aug	31-Dec	135	0	3	429	3.2
[redacted]	4-Aug	20-Dec	123	37	238	6194	50.4
[redacted]	16-Aug	31-Dec	78	1	12	1070	13.7
[redacted]	4-Aug	20-Dec	116	113	512	6414	55.3
[redacted]	20-Aug	31-Dec	58	4	3	534	9.2
[redacted]	20-Aug	31-Dec	134	0	2	437	3.3
Nacelle Detectors, 2021	-	-	1,782	6	56	6,549	3.7
Mid-tower Detectors, 2021	-	-	585	212	1,152	25,250	43.2
Total, 2021	-	-	2,367	218	1,208	31,799	13.4

3.3.6.2 2022 Monitoring

Acoustic detectors were redeployed on turbine nacelles in mid-February 2022 and mid-tower locations in mid-April, 2022 and demobilized between mid-November and early December 2022. Acoustic detectors recorded a total of 55,919 bat passes during 3,510 successful detector-nights (69% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 3.6 and 48.5 bat passes per detector-night, respectively, during the 2022 monitoring period (Table 3-19). Gray bats and tricolored bats were detected at most detectors during the 2022 monitoring period, with most detections occurring at mid-tower detectors (Table 3-19).

Table 3-19. Acoustic survey effort at the North Fork Ridge Wind Project from February through December 2022.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	28-Feb	20-Nov	266	4	13	1,380	5.2
[redacted]	28-Feb	6-Dec	123	0	2	203	1.7
[redacted]	28-Feb	20-Nov	181	0	2	258	1.4
[redacted]	19-Apr	12-Nov	206	40	216	7,202	35.0
[redacted]	28-Feb	27-Nov	217	0	0	215	1.0
[redacted]	19-Apr	9-Nov	203	90	238	10,371	51.1
[redacted]	28-Feb	6-Dec	282	11	0	1,752	6.2
[redacted]	28-Feb	20-Nov	208	2	2	999	4.8
[redacted]	28-Feb	27-Nov	273	1	8	948	3.5
[redacted]	28-Feb	6-Dec	89	1	1	152	1.7
[redacted]	2-Mar	20-Nov	225	2	3	450	2.0
[redacted]	28-Feb	21-Nov	91	0	0	88	1.0

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Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	19-Apr	9-Nov	160	20	149	8,213	51.3
[redacted]	2-Mar	21-Nov	114	3	0	176	1.5
[redacted]	2-Mar	20-Nov	81	0	0	240	3.0
[redacted]	19-Apr	6-Nov	199	76	190	12,244	61.5
[redacted]	28-Feb	21-Nov	267	2	4	1,640	6.1
[redacted]	19-Apr	7-Nov	199	204	662	8,856	44.5
[redacted]	28-Feb	21-Nov	19	0	0	107	5.6
[redacted]	2-Mar	6-Dec	107	1	5	425	4.0
Nacelle Detectors, 2022	-	-	2,543	27	40	9,033	3.6
Mid-tower Detectors, 2022	-	-	967	430	1,455	46,886	48.5
Total, 2022	-	-	3,510	457	1,495	55,919	15.9

3.3.6.3 Acoustic Results

Gray bats and tricolored bats were detected at most detectors during the 2021 and 2022 monitoring periods, with most detections occurring at mid-tower detectors (Figure 3-14).

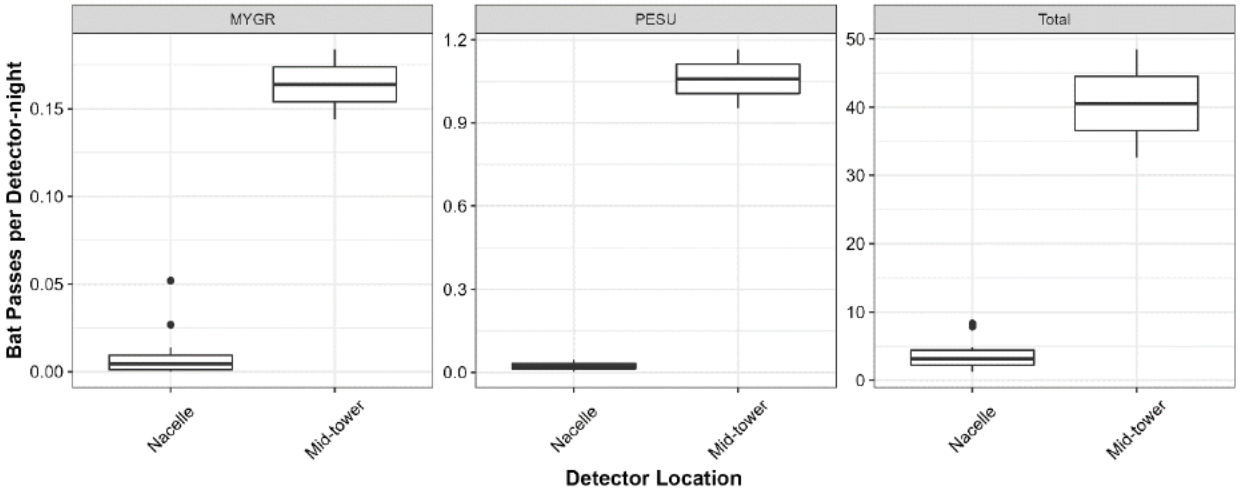

Figure 3-14. Gray bat (MYGR), tricolored bat (PESU), and all bat passes (Total) recorded per detector night at nacelle-mounted versus mid-tower detectors during 2021 and 2022 monitoring at the North Fork Ridge Wind Project. Note differing y-axis scales among plot facets.

Acoustic bat activity followed similar seasonal patterns at nacelle and mid-tower detectors, with a slight peak in activity in mid-May and a pronounced peak in mid-August (Figure 3-15). Although timing of bat activity varied among nights, overall timing of bat activity peaked 1–3 hours after sunset at nacelle and mid-tower detectors for all bat species and the subset of passes identified as gray bats and tricolored bats (Figure 3-16, Figure 3-17, Figure 3-18).

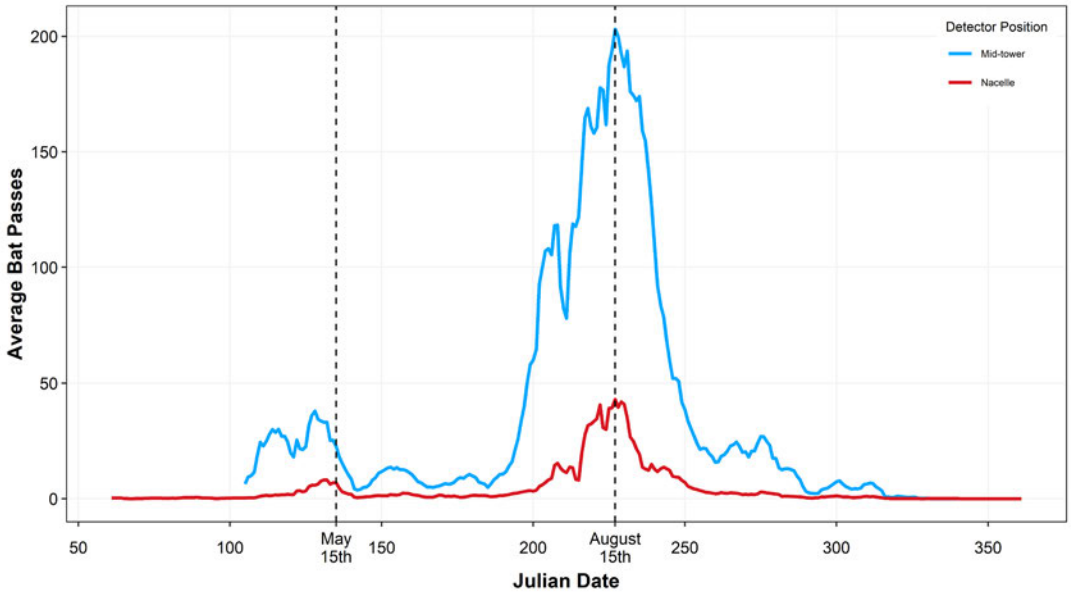

Figure 3-15. 7-day moving average (BP/DN) of acoustic bat activity (all species) detected during the 2021 and 2022 monitoring periods at the North Fork Ridge Wind Project. Data from both years were combined and displayed by Julian date (days since January 1; May 15th and August 15th are displayed on the figure for reference to bat maternity season).

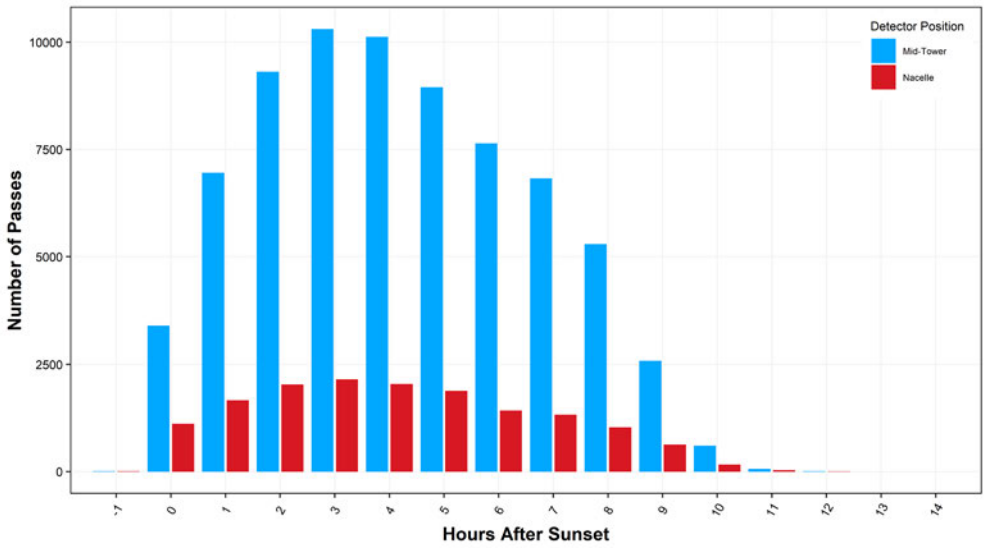

Figure 3-16. Nightly timing of total bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods the North Fork Ridge Wind Project.

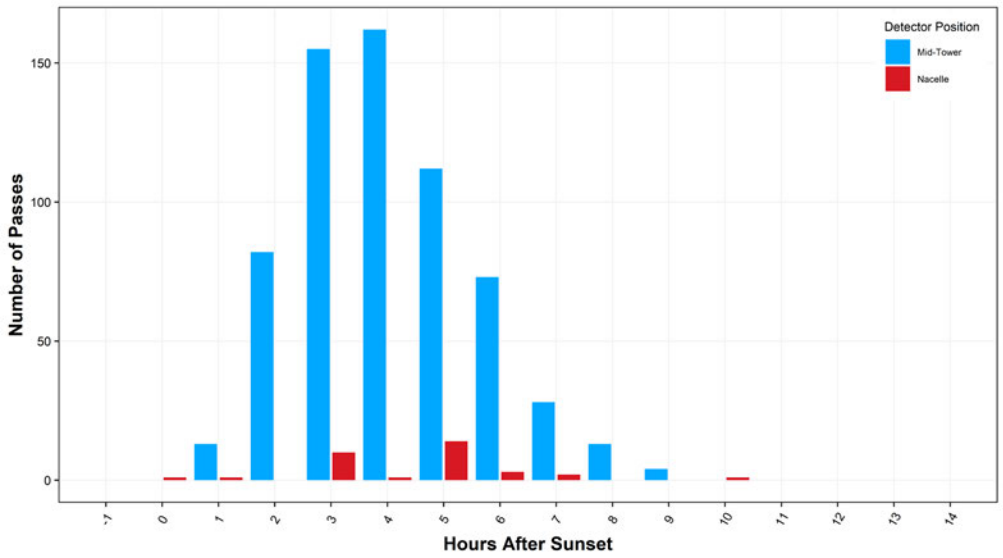

Figure 3-17. Nightly timing of gray bat (*Myotis grisescens*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the North Fork Ridge Wind Project.

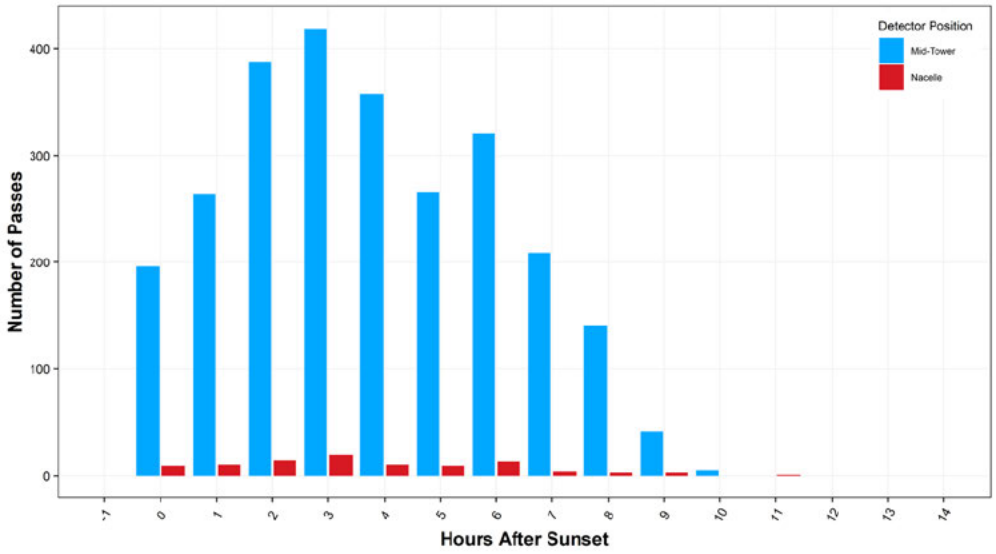

Figure 3-18. Nightly timing of tricolored bat (*Perimyotis subflavus*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the North Fork Ridge Wind Project.

Temperature, wind speed, and turbine rotor speed data were available during 10-minute intervals in which 83,048 bat passes (95% of 87,718 total bat passes) were detected at North Fork Ridge in 2021 and 2022. We used these data to evaluate the distribution of bat activity as a function of temperature and wind speed and to calculate the percent and rate (passes per detector night) of bat passes exposed to turbine operation. Most bat passes occurred during relatively warm conditions with wind speeds less than 8 m/s (Figure 3-19, Figure 3-20, Figure 3-21).

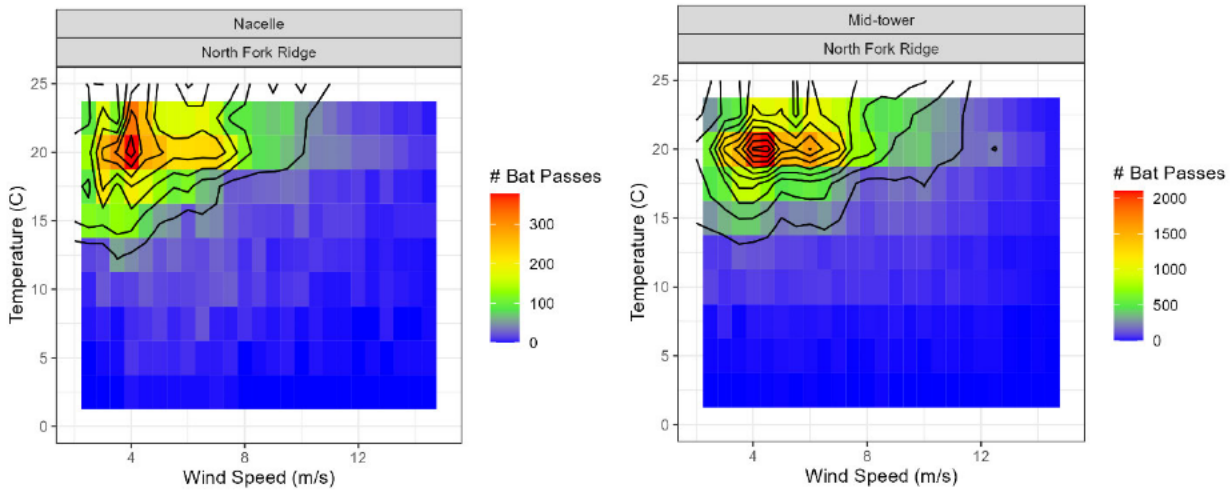

Figure 3-19. Distribution of all bat passes (all species) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Project.

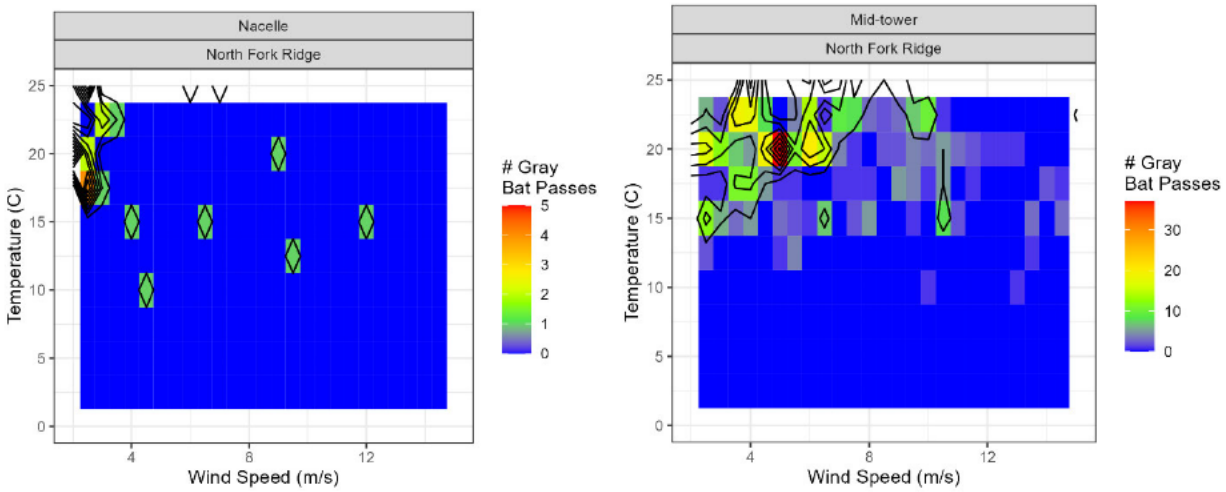

Figure 3-20. Distribution of gray bat passes (Myotis grisescens) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Project.

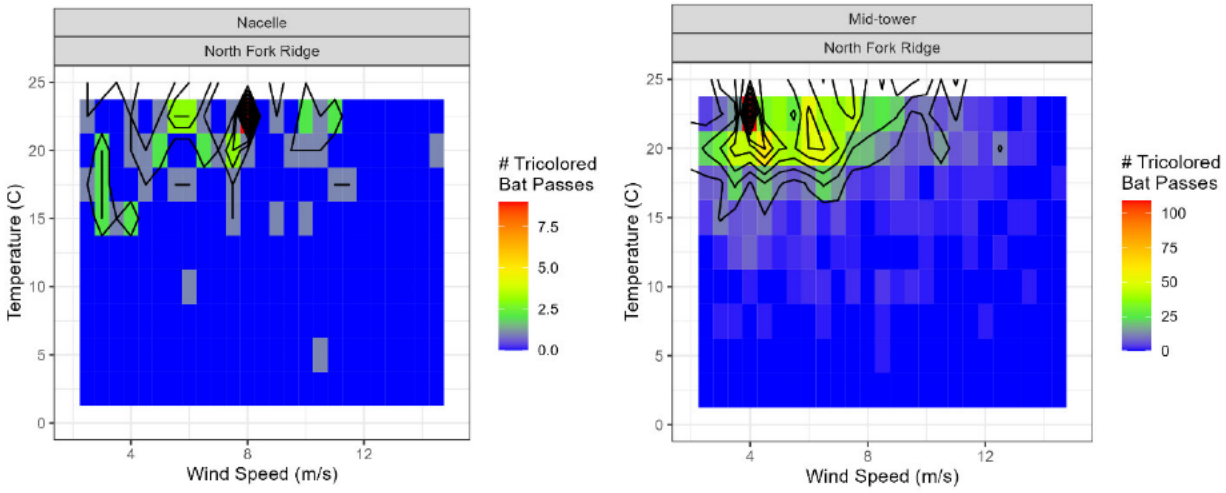

Figure 3-21. Distribution of tricolored bat passes (Perimyotis subflavus) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Project.

Acoustic monitoring at North Fork Ridge in 2021 and 2022 encompassed periods in which three turbine operational treatments were implemented. Before August 30, 2021, all turbines were operated according to an interim (TAL) curtailment strategy with an 8 m/s cut-in speed. From August 30 – October 31, 2021 and April 1–October 31, 2022, approximately half of the 69 turbines (n = 34) were operated according to a

treatment blanket curtailment strategy with 5.0 m/s cut-in speed, and the remaining 35 turbines were feathered below manufacturer's cut-in speed (3.0 m/s) to provide an operational control. The 15 turbines monitored for acoustic bat activity included 8 from the treatment group (5.0 m/s) and 7 from the control group (3.0 m/s).

The interim (TAL) curtailment strategy implemented before August 30, 2021 exposed 38% of bat passes recorded at nacelles and 40% of bat passes recorded at mid-tower detectors to turbine operation (exposed passes are defined as those detected when 10-minute turbine rotor speed exceeded 1 rpm). The 5.0 m/s blanket curtailment strategy resulted in exposure of 46–55% of bat passes detected at nacelles and 54–61% of passes detected at mid-tower units in 2021 and 2022 compared to exposure of 79–86% of passes detected at feathered control turbines (Table 3-20,Figure 3-22). Exposure of gray bat and tricolored bat passes to turbine operation generally followed similar trends among treatments at both detector positions during the 2021 and 2022 monitoring period (Table 3-20).

Table 3-20. Acoustic exposure of gray bat (MYGR), tricolored bat (PESU), and all bat passes to turbine operation (detection when turbine rotor speed > 1 rpm) associated with operational treatments implemented during the 2021 and 2022 monitoring period at the North Fork Ridge Wind Project.

Year	Detector Position	Treatment	# Turb.	Bat Passes MYGR	Bat Passes PESU	Total Bat Passes	Exposed Bat Passes (%) MYGR	Exposed Bat Passes (%) PESU	Total Exposed Bat Passes (%)
2021	Nacelle	8.0 m/s TAL	15	1	39	4,666	0 (0%)	16 (41%)	1,771 (38%)
2021	Nacelle	5.0 m/s Treatment	8	5	7	957	0 (0%)	5 (71%)	529 (55%)
2021	Nacelle	3.0 m/s Control	7	0	8	738	n/a	6 (75%)	587 (80%)
2021	Mid-tower	8.0 m/s TAL	5	112	1051	20,651	51 (46%)	311 (30%)	8,193 (40%)
2021	Mid-tower	5.0 m/s Treatment	3	76	75	2,658	45 (59%)	42 (56%)	1,609 (61%)
2021	Mid-tower	3.0 m/s Control	2	24	25	1,688	20 (83%)	23 (92%)	1,387 (82%)
2022	Nacelle	5.0 m/s Treatment	8	8	9	2,410	1 (13%)	7 (78%)	1,108 (46%)
2022	Nacelle	3.0 m/s Control	7	19	30	5,654	9 (47%)	29 (97%)	4,441 (79%)
2022	Mid-tower	5.0 m/s Treatment	3	247	814	22,190	140 (57%)	427 (52%)	11,926 (54%)
2022	Mid-tower	3.0 m/s Control	2	153	390	20,628	129 (84%)	306 (78%)	17,825 (86%)

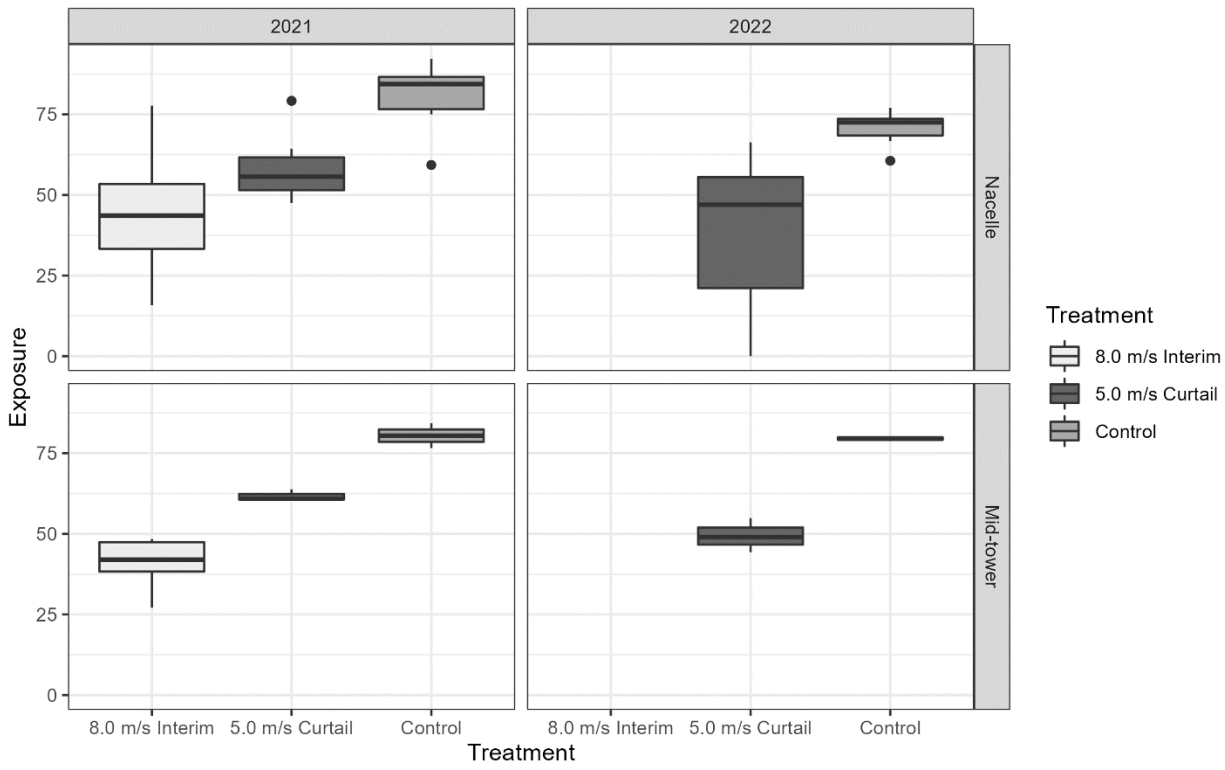

Figure 3-22. Acoustic exposure (percent of bat passes detected when turbine rotor speed was 1 rpm or greater) by operational treatment and detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Energy Project. Note that the 8.0 m/s treatment did not occur in 2022.

3.4 ACOUSTIC EXPOSURE AND FATALITY

The median bat fatality for the blanket 5.0 m/s curtailment treatment was 38% and 25% lower than that for the feathered control strategy at Kings Point and North Fork Ridge, respectively, during the 2022 monitoring period. For the same period, percent of bat passes exposed to turbine operation was 32% and 40% lower at the 5.0 m/s curtailment strategy than the feathered control at Kings Point and North Fork Ridge, respectively, based on nacelle-height acoustic detectors (Table 3-21). Mid-tower detectors documented a 25% decrease in exposure at Kings Point and 38% decrease in exposure at North Fork Ridge at the 5.0 m/s treatment compared to the feathered control strategy. Overall, the percent of bat passes exposed to turbine operation was similar between the two Projects for corresponding treatments (Table 3-21).

Table 3-21. Estimated bat fatality and acoustic exposure during the 2022 monitoring period at the Kings Point and North Fork Ridge Wind Projects.

Site	Treatment	# Bat Carcasses	Median Fatality Est.	Nacelle Acoustic Exposure Exposed Passes/DN	Nacelle Acoustic Exposure Percent	Mid-tower Acoustic Exposure Exposed Passes/DN	Mid-tower Acoustic Exposure Percent
Kings Point	Control (3.0 m/s)	150	2,849	1.73	82.0%	17.42	86.9%
Kings Point	Treatment (5.0 m/s)	123	1,759	1.6	55.9%	12.24	65.5%
North Fork Ridge	Control (3.0 m/s)	170	1,689	1.95	78.8%	23.18	86.5%
North Fork Ridge	Treatment (5.0 m/s)	85	1,267	0.84	47.1%	11.66	53.9%

Bat activity levels and the corresponding rate of acoustic exposure varied substantially among weeks, following consistent seasonal patterns at Kings Point and North Fork Ridge in 2022, with the highest levels occurring in mid-August through mid-September (Figure 3-23, Figure 3-24).

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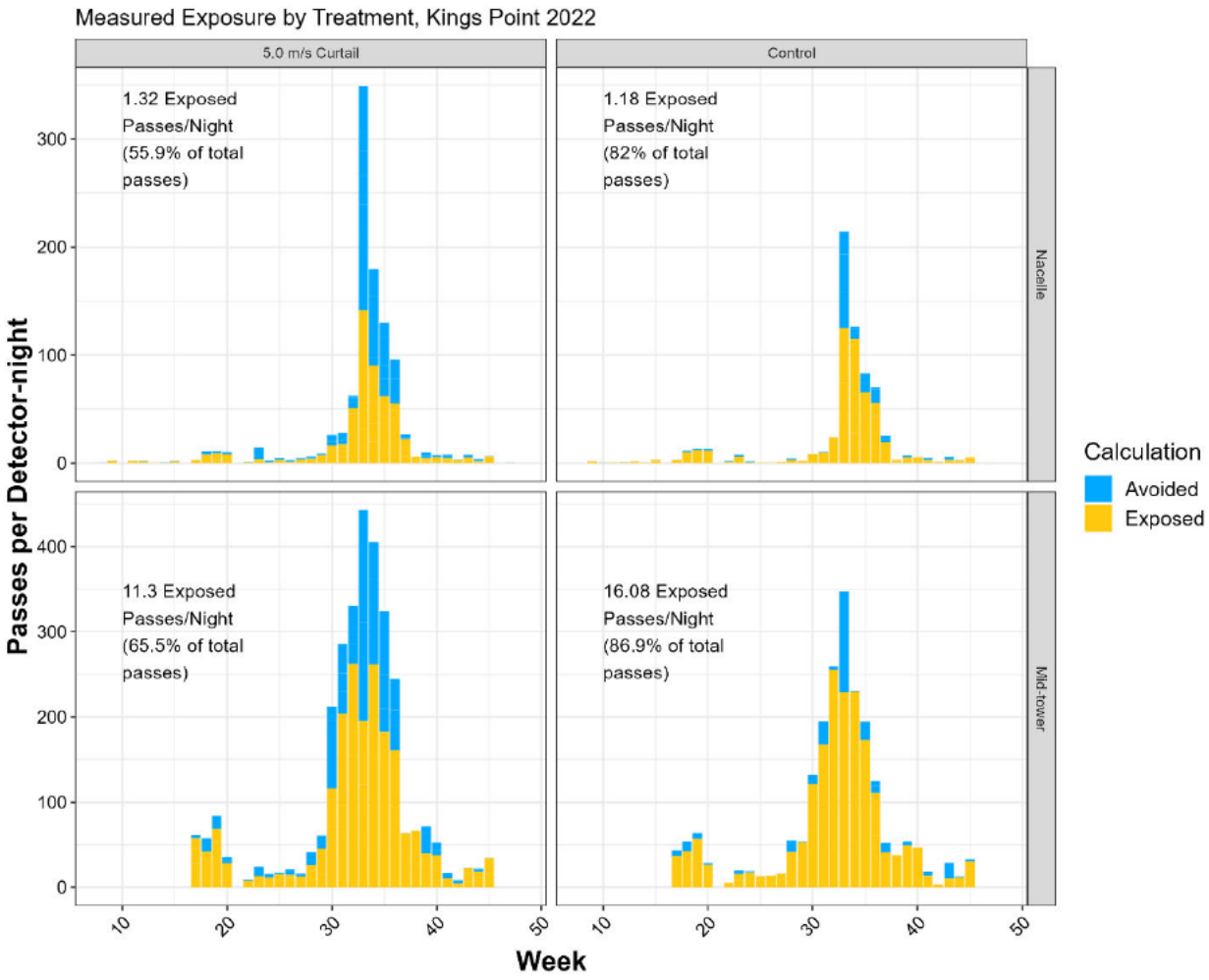


Figure 3-23. Rate of acoustic exposure (bat passes detected when turbine rotor speed was 1 rpm or greater) calculated per detector-night on a weekly basis by operational treatment and detector position during 2022 acoustic monitoring at the Kings Point Wind Energy Project.

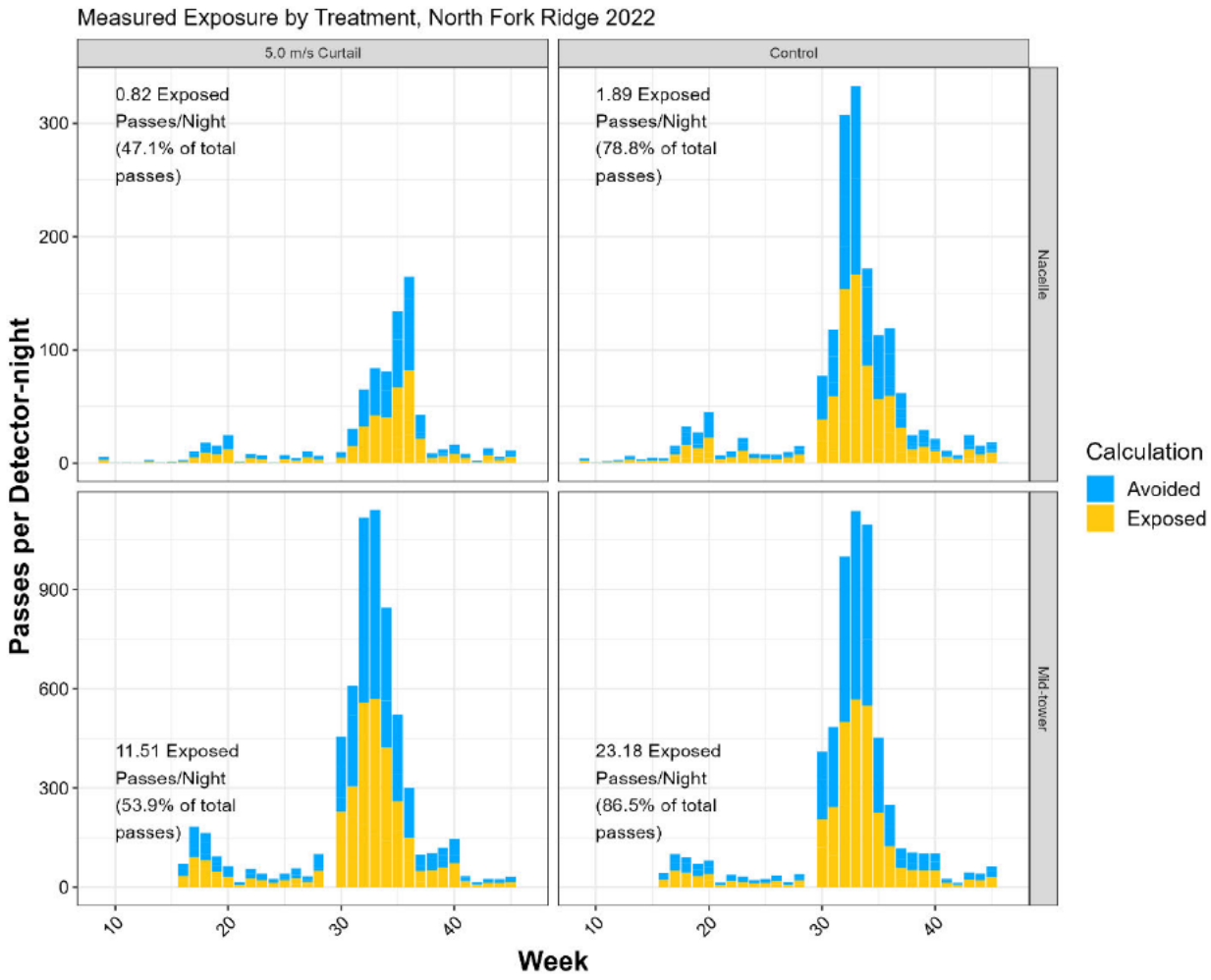


Figure 3-24. Rate of acoustic exposure (bat passes detected when turbine rotor speed was 1 rpm or greater) calculated per detector-night on a weekly basis by operational treatment and detector position during 2022 acoustic monitoring at the North Fork Ridge Wind Energy Project. The gap in data during week 29 was due to a project-wide shutdown that prevented collection of weather and turbine rpm data with which to determine acoustic exposure.

The amount of exposed bat activity measured per week explained a significant amount of variation in the number of bat carcasses found per turbine search when fatalities and acoustic data were pooled across turbines (Figure 3-25). The relationship was similar between Projects and was evident using datasets from nacelle and mid-tower acoustic detectors.

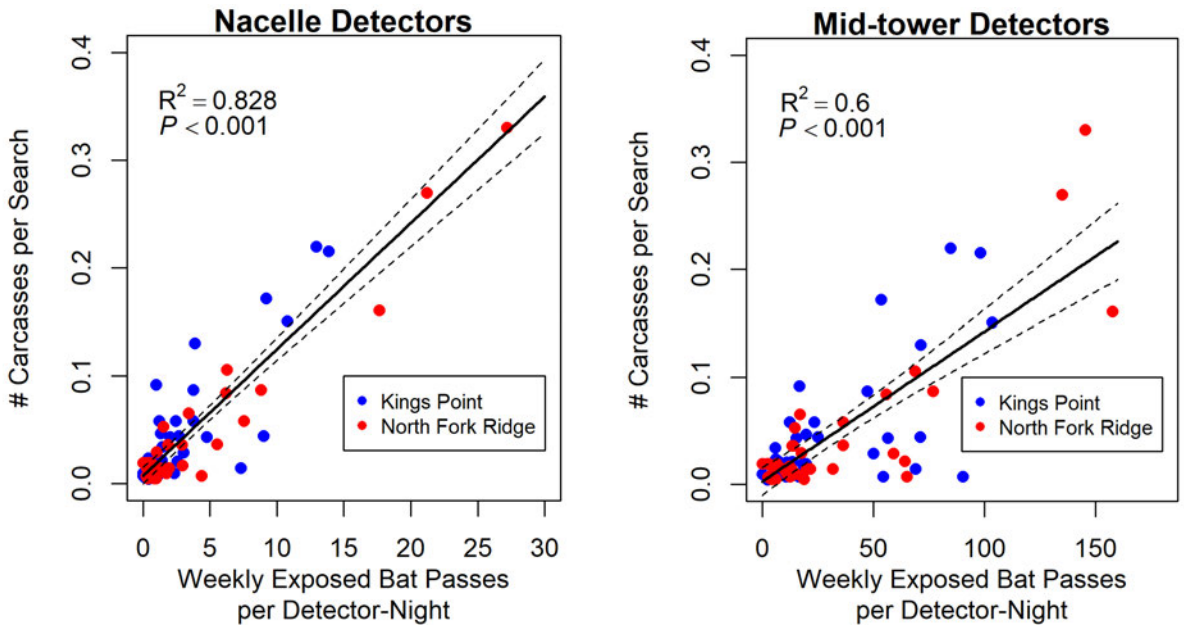


Figure 3-25. Bat carcasses found per search per week as a function of the number of bat passes exposed to turbine operation per week during 2022 monitoring at the Kings Point and North Fork Ridge Wind Energy Projects.

The number of bat carcasses found per turbine, when multiplied by the number or searches and the density-weighted proportion of carcass distribution at corresponding turbines to generate, also showed a positive relationship with the exposed rate of bat passes measured per turbine, although this relationship was weaker than the correlation between weekly exposure and carcass counts (Figure 3-26).

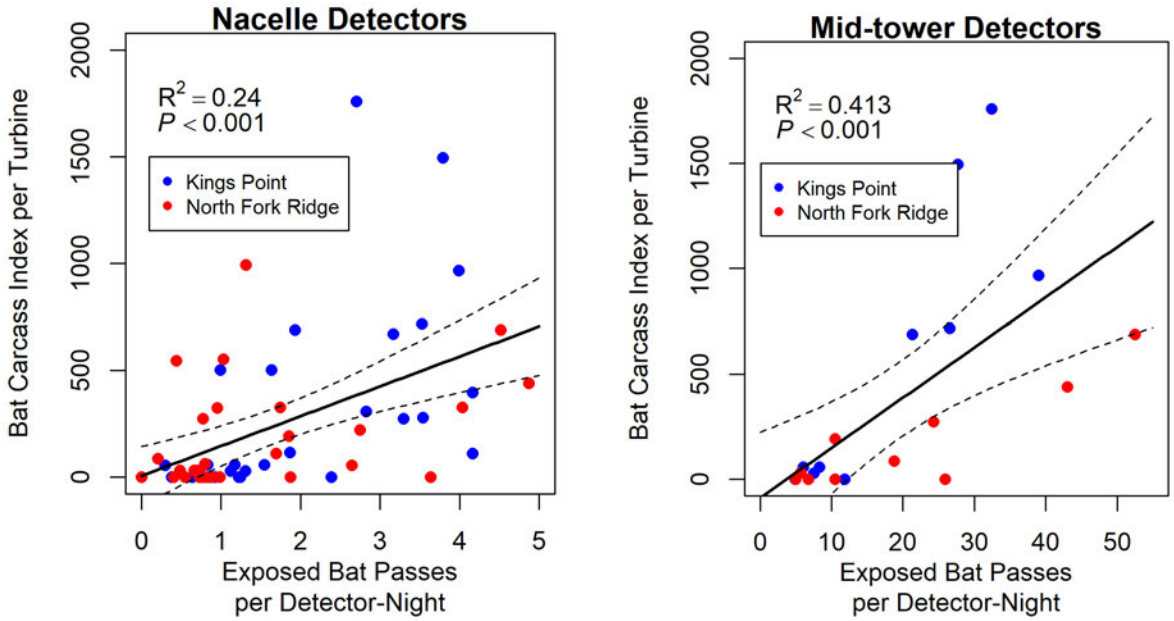


Figure 3-26. Index of bat carcasses per turbine as a function of the number of bat passes exposed to turbine operation per week during 2022 monitoring at the Kings Point and North Fork Ridge Wind Energy Projects.

4.0 DISCUSSION

This report includes the results of the 2022 post-construction fatality monitoring, and the results of the 2021 and 2022 acoustic survey. These surveys are ongoing, and additional data will be collected in 2023-2025 which will further inform the study objectives. Although only one full year of monitoring has been completed for the study (2022; Phase 1, Year 1), results from monitoring in 2021 and 2022 provide insight about gray bat activity and fatality at two operational wind farms. Ten gray bat fatalities have been recorded at the Projects in 2021 and 2022 (Table 4-1).

Table 4-1. Summary of gray bat fatalities observed in 2021 and 2022 at Kings Point Wind Project and North Fork Ridge Wind Project

Project	Date	Turbine	Treatment	Sex
Kings Point	8/16/2021	[redacted]	8.0 m/s	Female
Kings Point	9/16/2021		5.0 m/s	Female
Kings Point	9/23/2021		3.0 m/s	Male
Kings Point	9/24/2021		5.0 m/s	Female
Kings Point	6/29/2022		3.0 m/s	Female
Kings Point	7/26/2022		3.0 m/s	Female
Kings Point	7/28/2022		5.0 m/s	Female
Kings Point	9/6/2022		5.0 m/s	Female
Kings Point	10/5/2022		3.0 m/s	Female
North Fork Ridge	9/15/2022		5.0 m/s	Female

The gray bat fatality trend can be summarized as being highest during late summer and fall and mostly composed of females (90%). Maternity colonies are present in proximity to the Projects, which may explain the prevalence of females as observed fatalities. No gray bat fatalities were observed during the spring season (April 1 – May 31), 40% of fatalities occurred during the summer season (June 1 – August 31) and 60% of the fatalities occurred during the fall season (September 1 – October 31).

4.1 TURBINE-RELATED FATALITY RATES FOR GRAY BATS

Annual turbine-related gray bat fatality rates varied by year and by Project and ranged from 7.66 gray bats at North Fork Ridge in 2021 to 45.7 gray bats at Kings Point in 2022 (Table 4-2). Annual gray bat take rates have been 4-5 times higher at Kings Point compared to North Fork Ridge. Take rates at both Projects were higher in 2022 than they were in 2021 which is likely due to differences in the curtailment strategy.

Table 4-2. Summary of turbine-related gray bat fatality rates from 2021 and 2022 at Kings Point Wind Project and North Fork Ridge Wind Project.

Project	Year	Curtailment	Annual Take Rate
Kings Point	2021	8 m/s, 5 m/s, 3 m/s	38.6 (11.40 – 82.62)
Kings Point	2022	5 m/s, 3 m/s	45.7 (15.2 – 94.72)
North Fork Ridge	2021	8 m/s, 5 m/s, 3 m/s	7.66 (0.01 – 38.88)
North Fork Ridge	2022	5 m/s, 3 m/s	10.6 (0.755 – 33.4)

4.2 RELATIONSHIP BETWEEN EXPOSED BAT ACTIVITY AND FATALITY

Acoustic detectors deployed at 15 turbines at Kings Point and 15 turbines at North Fork Ridge documented pronounced seasonal patterns in bat activity that were consistent between sites and provided a quantitative metric of exposure that was positively correlated with bat fatality rates on multiple temporal and spatial scales. At both sites, curtailing turbine operation at wind speeds below 5.0 m/s reduced estimated bat fatality rates and the percent of bat passes exposed to turbine operation by a similar relative margin (See Section 3.4). Bat fatality and acoustic exposure were strongly correlated at the weekly level, suggesting that variation in acoustic exposure provides a useful indicator of fatality risk on fine temporal scales (Figure 3-25). The positive relationship between acoustic exposure and bat fatality on a per-turbine basis also suggests that acoustic exposure may be useful for understanding variation in risk on spatial scales, although this relationship was weaker, potentially due to the large number of factors that could affect spatial variation in risk to bats.

Acoustic monitoring in 2021 and 2022 provides an early indication that acoustic exposure is a useful indicator of risk to bats that can be analyzed at fine temporal scales and on a species-specific basis. Although monitoring has focused on nacelle-height detectors, mid-tower detectors provided a useful supplement and yielded substantially higher sample sizes for rare species. Mid-tower detectors confirmed that substantially more bat activity occurs near ground level compared to at nacelle height, aligning with results from similar surveys conducted at other wind projects (Stantec, unpublished data) and in pre-construction surveys. Additional monitoring at Kings Point and North Fork Ridge from 2023 through 2025 will enable more rigorous evaluation of relationships between acoustic exposure and bat fatality rates on multiple temporal and spatial scales.

5.0 REFERENCES

Dalthorp, D., M. Huso, and D. Dail. 2017. Evidence of Absence (v2.0) Software User Guide: U.S. Geological Survey Data Series 1055, 109 p.. https://doi.org/10.3133/ds1055.

Dalthorp, D.H., J. Simonis, L. Madsen, M.M. Huso, P. Rabie, J.M. Mintz, R. Wolpert, J. Studyvin, F. Korner-Nievergelt. 2018. Generalized Mortality Estimator (GenEst) - R code & GUI: U.S. Geological Survey Software Release. Available at https://doi.org/10.5066/P9O9BATL.

Stantec. 2021. 10(a)(1)(A) Permit Application Study Plan - Kings Point & North Fork Ridge Wind Projects. *Activity-based Informed Curtailment Study*. Prepared for: Kings Point Wind Project, LLC, North Fork Ridge Wind Project, LLC. February 2, 2021.

Stantec. 2022. 10(a)(1)(A) Permit # ESPER0011726 Annual Report - 2021. Prepared for: Empire District Electric Company. January 31, 2022.

Appendix A FIGURES

[redacted]

Dis

V:\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro\NorthForkRidge_PCM_Pro.aprx Revised: 2022-04-28 By: slberry

[redacted]

t

193708398

022-01-27
022-01-28
022-01-28

[redacted]

Figure No.
A-4

Title
Kings Point Turbine Operational Curtailment

Client/Project 193708398
Empire District Electric Company
Kings Point Wind Project

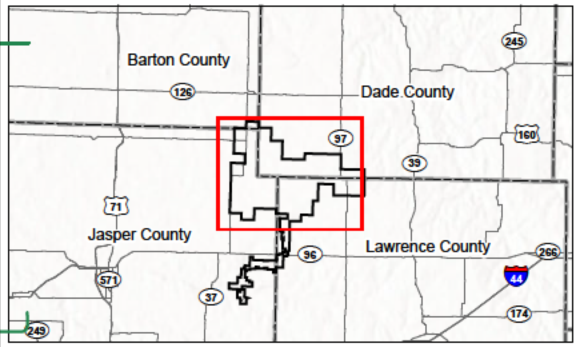
Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0 5 1 Miles
(At original document size of 11x17)
1 63,360

Legend
Project Boundary
Turbine
Cut-in Speed
Control (3 m/s)
Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Figure No.

A-5

Title

North Fork Ridge Turbine Operational Curtailment

Client/Project 193708398

Empire District Electric Company
North Fork Ridge Wind Project

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000 US Feet

(At original document size of 11x17)
1:48,000

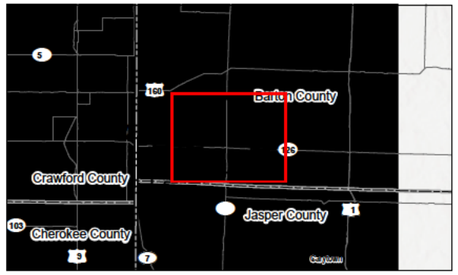
Legend

- Project Boundary

Turbine

Cut-in Speed

- Control (3 m/s)
- Treatment (5 m/s)



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Figure No.
A-6

Title
Kings Point Post Construction Fatality Monitoring Turbine Bat Detector Type

Client/Project
Empire District Electric Company
Kings Point Wind Project

193708398

Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

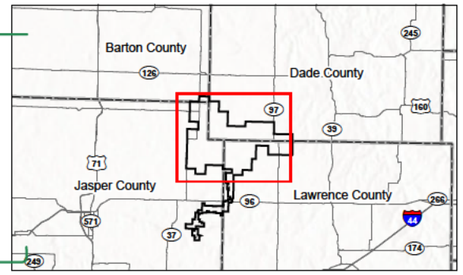
Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0.5 1 Miles
(At original document size of 11x17)
1 63,360

Legend
- Project Boundary

Turbine
Detector Type
- Nacelle
- Nacelle and Mid-Tower
- No Detector



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Figure No.

A-7

Title

North Fork Ridge Post Construction Fatality Monitoring Turbine Bat Detector Type

Client/Project

193708398

Empire District Electric Company
North Fork Ridge Wind Project

Project Location

Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000 US Feet

(At original document size of 11x17)
1:48,000

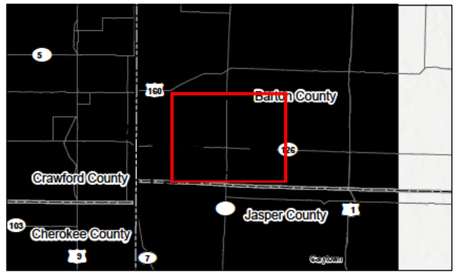
Legend

- Project Boundary

Turbine

Detector Type

- Nacelle
- Nacelle and Mid-Tower
- No Detector



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

[redacted]

Figure No.
A-8

Title
Kings Point Post Construction Fatality Monitoring Gray Bat Observations

Client/Project 193708398
Empire District Electric Company
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

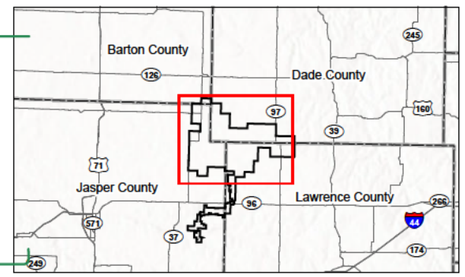
Prepared by SP on 2023-01-26
TR by ML on 2023-01-26
IR by XX on 2023-XX-XX

N

0 0.5 1 Miles
(At original document size of 11x17)
1 63,360

Legend
- Project Boundary
- Gray Bat Observation

Turbine
Cut-in Speed
- Control (3 m/s)
- Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Figure No.
A-9

Title
North Fork Ridge Post Construction Fatality Monitoring Gray Bat Observations

Client/Project
Empire District Electric Company
North Fork Ridge Wind Project

193708398

Project Location
Barton and Jasper Co., MO

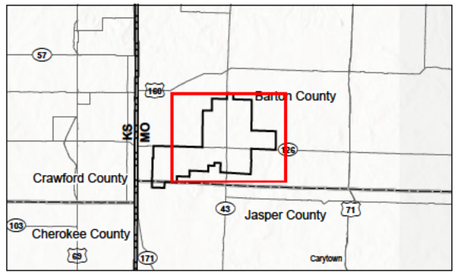
Prepared by SP on 2023-01-26
TR by ML on 2023-01-26
IR by XX on 2023-XX-XX

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000

Legend
- Project Boundary
- Gray Bat Observation

Turbine
Cut-in Speed
- Control (3 m/s)
- Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Appendix B GENEST MODEL RESULTS

Table B-1. Model comparison results for searcher efficiency trials conducted 2022 at the Kings Point and North Fork Ridge Wind Projects. Selected model shown in bold.

p Formula	k Formula	AICc	deltaAICc
p ~ searcher + plot_type + season + plot_type:season	**k fixed at 0.67**	**578.93**	**0**
p ~ searcher + plot_type + season	k fixed at 0.67	580.61	1.68
p ~ plot_type + season	k fixed at 0.67	582.93	4

Table B-2. Model comparison results for carcass persistence trials conducted in 2022 at the Kings Point Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
weibull	**l ~ season**	**s ~ season**	**259.98**	**0**
exponential	l ~ plot_type + season	NULL	260.27	0.29
exponential	l ~ season	NULL	260.29	0.31
exponential	l ~ plot_type * season	NULL	261.87	1.89
weibull	l ~ plot_type + season	s ~ constant	262.18	2.2
weibull	l ~ plot_type * season	s ~ season	262.36	2.38
weibull	l ~ plot_type + season	s ~ season	262.38	2.4
weibull	l ~ season	s ~ constant	262.38	2.4
weibull	l ~ season	s ~ plot_type + season	262.55	2.57
weibull	l ~ plot_type * season	s ~ constant	263.31	3.33

Table B-3. Model comparison results for carcass persistence trials conducted in 2022 at the North Fork Ridge Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
weibull	**l ~ constant**	**s ~ constant**	**262.92**	**0**
exponential	l ~ constant	NULL	262.93	0.01
weibull	l ~ constant	s ~ plot_type	264.72	1.8
weibull	l ~ constant	s ~ season	264.73	1.81
exponential	l ~ plot_type	NULL	265.04	2.12
weibull	l ~ plot_type	s ~ constant	265.12	2.2
exponential	l ~ season	NULL	265.88	2.96
weibull	l ~ season	s ~ constant	266.31	3.39

Appendix C GENETICS RESULTS

NORTHERN ARIZONA UNIVERSITY

School of Forestry

Genetic Species ID Results

Client: Adam Rusk (Adam.Rusk@stantec.com), Stantec. Invoice 20221209_4.

Samples: We received eight bat samples. After DNA extraction, we PCR-amplified the DNA using our Species from Feces primers (Walker et al. 2016, 2019). We sequenced and identified species using NCBI BLAST. All non-template controls were negative for amplification and the positives controls amplified and sequenced correctly.

Sequencing: 01/09/2023

Report date: 01/12/2023

Results:

Number	Sample Name	Sex	Species
1	20220812-T-090-02	Male	Eptesicus fuscus
2	20220524-T-013-01	Male	Lasionycteris noctivagans
3	20220915-T-013-01	Female	
4	20220728-T-053-01	Female	
5	20220629-T-118-01	Female	
6	20220906-T-080-01	Female	
7	20221005-T-069-01	Female	
8	20220726-T-056-01	Female	