10(a)(1)(A) Permit # ESPER0011726
2023 Annual Report

Kings Point Wind Project and North Fork Ridge Wind Project
Barton, Dade, Jasper and Lawrence Counties, Missouri

Stantec

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Acronyms / Abbreviations

Acronym / Abbreviation	Full Name
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
ft	feet
GenEst	Generalized Estimator
g-value	detection probability
I	search interval
k	SE decay
Kings Point	Kings Point Wind Project
Liberty	The Empire District Electric Company d/b/a Liberty
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
WEST	Western EcoSystems Technology, Inc.
WTGs	Wind Turbine Generators
X_i	number of carcasses found within each distance band

1 Introduction

1.1 Project Description and History

The Empire District Electric Company d/b/a Liberty (Liberty) developed and is currently operating two wind power facilities in southwest Missouri. Kings Point Wind Project (Kings Point) is located in Barton, Dade, Jasper 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, Liberty 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, and the first full year of the study under the Permit began in March 2022. To date, two full years of the study have been completed which concludes Phase I of the study. Phase II of the study will include monitoring during 2024 and 2025. This report summarizes the second full year of operations and post-construction fatality monitoring at the Projects in 2023 and is intended to satisfy Condition L (Annual Reporting) of the Permit.

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 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) from 30 minutes before sunset to 30 minutes after sunrise each night. 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); Phase 1, Year 1

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). Results from the 2022 monitoring are available in Stantec (2023).

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 full 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

While the study was initially designed to focus on gray bat recovery, the study objectives are also applicable to tricolored bats (*Perimyotis subflavus*), which are expected to be listed as endangered by the USFWS in the fall of 2024. Where possible, results specific to tricolored bats are included in this report.

2 Methods

Survey methods for carcass searches, searcher efficiency (SE) trials, carcass persistence (CP) trials, and acoustic monitoring followed those specified in the Permit conditions, as outlined in the study plan (Stantec 2021), and through consultation with the USFWS. Notable revisions to methods from the initial study plan include an increased search effort characterized by more frequent searches, larger radius search plots, more cleared search plots and the addition of Western EcoSystems Technology, Inc. (WEST) as a collaborator bringing detection dog search teams to enhance the detection probability (g-value) and study design and statistical support. The methods and results presented here are comprehensive for the Stantec and WEST 2023 surveys, and additional information about search methods, SE and CP trials are available in Hale et al. (2024a, 2024b). 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, gray bat activity and tricolored bat activity at nacelle height on WTGs within 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 3 and October 31, 2023. 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) or (2) within an 80-m radius of turbines (80-m cleared plot) during spring, summer, and fall. WEST detection dog teams searched 15 80-m cleared plots at each project from July through September 30, 2023. 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 – 37 WTGs with road and pad searches, 32 WTGs with 80-m cleared plot searches; and
- North Fork Ridge – 37 WTGs with road and pad searches, 32 WTGs with 80-m cleared plot searches.

The 80-m cleared plots were mowed periodically with the goal of maintaining vegetation below 5 inches for plots searched by human searchers and below 10 inches for plots searched by detection dog teams during the survey period.

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. When carcass condition allowed, sex, age and reproductive status of the carcass were recorded. When possible, 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 bat carcasses unable to be identified to the species level were sent to a Stantec/WEST permitted bat biologist for positive visual identification, and carcasses were kept on-site. Bats that could not be positively identified and had potential to be a gray bat or tricolored bat were submitted to a USFWS-approved laboratory (the Dr. Jane Huffman Wildlife Genetics Institute at East Stroudsburg University or the Northern Arizona University's Bat Ecology and Genetics Lab) for identification and sex determination using molecular and genetic testing.

During searches, human searchers targeted a walking rate of approximately 45 to 60 m per minute while searching 3 m on either side of transects spaced 6 m apart within the search plots. Search methods for the detection dog search teams are described in Hale et al. (2024a, 2024b). 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 and Disposition (condition being a result of collision, disposition being a result of persistence on the ground. Conditions included complete, dismembered, injured, alive – uninjured while dispositions included states of decomposition or scavenging).
- Any notes on presumed cause of death

A digital photograph of bat carcasses next to a ruler for scale was taken before the carcasses were handled and removed. 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: (Stantec: 61201, 61202, 61203, 61204, 61205, 61206, and 61207; WEST: 62416, 62333, 62361, 62415, 62332, 62360, and 62362).

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.

During the year, turbines become non-operational for a variety of reasons including maintenance and damage. During scheduled site-wide non-operational periods, searches were suspended if the outage was planned for a period of time longer than the estimated carcass persistence. In practice, this has resulted in

suspending searches for week-long planned outages. For unplanned non-operational periods, searches typically continue despite non-operational turbines. These searches remain as part of the analytical search schedule if: the outage duration is shorter than the estimated carcass persistence, the search occurred on the first day of an extended outage, or the search occurred on the day an outage ended. All searches and calculated risk periods that occurred during the second through the last day of an extended outage are eliminated from analysis.

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 (i.e., blind trials). Bat carcasses collected during the 2022 and 2023 surveys were used for the trials.

All SE trial carcasses for human searchers 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 verify they were still available to be found. Trial carcasses removed prior to the scheduled search were not included in analyses. 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. Methods for the SE trials for the detection dog teams are presented in Hale et al. (2024a, 2024b).

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 or other means (e.g., mowed over, tilled under). Carcass persistence trials were randomly placed within the search plots and were conducted separately for the detection dog search teams and for the human search teams. 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

Carcasses indicated as intact, scavenged, or fur spot were considered still present and detectable for analysis while missing carcasses represented removals or absences.

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 to December 2021 and then redeployed for the 2022 season between February and November. Nacelle-height detectors were redeployed for the 2023 season between March 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 sunrise each night of each monitoring season. Detector locations are shown in Appendix A, Figures A-4 and A-5.

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 operational turbine 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 or search team, season (spring, summer, fall), or plot type (roads and pads, 80-m cleared plots). Trials across both projects were combined for each searcher or search team (i.e., SE was assumed to not vary by Project since searchers consistently and systematically searched turbines at both projects). SE decay (k) was fixed at 0.67. This value represents the decrease in searcher efficiency 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 5 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 5 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 or the probability that a carcass persists on the ground until the next search interval. 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 biologically reasonable, and the top model was chosen from the models within 5 ΔAIC of the top model based on AIC alone. Graphical evaluation involved looking at modeled persistence probabilities compared to the "step curve" and identifying models that appeared to have closest fit to decay pattern. Similarly, models that appeared to have comparable fit when visually inspected were evaluated for parsimoniousness. If two models had similar fits and were not practically different given their AIC's, the most parsimonious model was chosen. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.3 Density-weighted Proportion (DWP)

The density-weighted proportion (DWP), i.e. area correction factor, 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:

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

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

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

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

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 distance band $(\hat{p}(M_i))$ 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 turbine-specific searchable areas (eliminating unsearchable land cover types [e.g., trees, water]) within 80 m of the turbine base for 80-m cleared plots.

In 2023, DWP was re-calculated for turbines within each treatment type (e.g., 3.0 m/s and 5.0 m/s cut in speeds) separately.

2.2.4 Adjusted Fatality Estimates (GenEst)

GenEst was used to calculate overall fatality rates for the Projects (per turbine, per MW, for all operational turbines at Kings Point and 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 operational turbines, and "per MW estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the total MW of operational turbines for each project. Fatality estimates were split by season and by treatment type.

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 and tricolored bats (M and λ).

2.3.1 Estimation of Detection Probability (g)

For analysis of the 2023 data, Stantec used the “Multiple Class Module” to combine data from the three search classes (roads and pads, 80-m cleared plots searched by detection dog teams, 80-m cleared plots searched by humans) 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.
- 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 repeated for all plot types split by relevant seasons (depending on results of carcass persistence model input parameters) 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 weights column. This differs from the DWP area correction 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 total bat risk expected to fall within that class (i.e. DWP weight). The DWP weight was calculated for each of the plot types for each seasonal split, as well as for an “unsearched” class to account for carcasses that fall outside of the searched areas. The DWP weights of these classes must sum to one. The DWPs for searched areas 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 in addition to the proportion of total bat risk expected within that season. 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 and Tricolored Bat Fatalities

For analysis of the 2023 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 and tricolored 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 and for tricolored bats. Credible intervals were evaluated assuming α=0.8.

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 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 proposed endangered tricolored bat, 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, and operational treatment. We evaluated all turbine data files to determine whether detectors were functioning properly on a nightly basis.

Acoustic exposure refers to the subset of bat passes recorded when wind turbines are operating and is the metric by which we evaluated curtailment. To assess acoustic exposure, we obtained wind speed, temperature, and rotor speed data recorded at 10-minute intervals at each of the 15 turbines in which acoustic detectors were deployed. We loaded data into program R and calculated the number of bat passes per 10-minute interval for each turbine. We then categorized intervals as meeting or not meeting the criteria of each curtailment strategy as implemented and determined whether the turbine rotor speed was less than 1 revolution per minute (rpm) during the corresponding interval. This results in two distinct metrics for acoustic exposure; “measured exposure” indicates bat passes detected when turbine rotor speed was above 1 rpm and “simulated exposure” indicates bat passes detected when curtailment conditions were not met (in other words, when turbines should be spinning based on wind speed, temperature, and time of year). Simulated exposure enables comparing effectiveness of curtailment alternatives beyond those that were implemented, and to assess the reduction in risk relative to “normal” turbine operation. In this case, we simulated exposure for normally operating turbines to provide a baseline to which curtailment alternatives could be compared. A curtailment strategy titled “TCBA 10” was evaluated, which included a 10m/s cut-in speed during the high-risk period for tricolored bats (July 18 – September 7). TCBA 10 was evaluated based on site-specific data and was expected to achieve a greater than 60% reduction in exposure for gray bats and tricolored bats relative to normal turbine operation. See Section 3.4.1 (Table 3-20) for parameters.

For comparison to fatality data, we calculated the rate of measured exposure as the number of bat passes detected when turbine rotor speed exceeded 1 rpm divided by the number of detector-nights with valid data on a biweekly basis, pooling data across turbines and treatments at each site. We summed this biweekly rate across the monitoring to derive a metric of cumulative biweekly exposure, recognizing that acoustic exposure, like fatality risk, accumulates over time. We aggregated carcass data over the same biweekly intervals, pooling carcasses found at all searched turbines at each site, dividing by the number of turbine searches, and dividing by the mean density-weighted proportion calculated for each turbine to account for variation in search area.

3 Results

Fatality monitoring was completed for both Kings Point and North Fork Ridge. From April 3 – October 31, 2023, 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) from 30 minutes before sunset to 30 minutes after sunrise each night except for when mechanical issues or WTG maintenance occurred. Figures A-4 and A-5 (see Appendix A) show the control and treatment assignments for Kings Point and North Fork Ridge, respectively.

Notable WTG maintenance periods or WTG mechanical issues resulting in non-operational turbines at Kings Point include:

- A site-wide shutdown of the wind power facility from June 8 through the morning of June 19, 2023 (11 days) when none of the WTGs were operational; and
- One WTG (T-068) was non-operational from June 21 through the morning of August 31, 2023 (71 days) due to mechanical issues.

Notable WTG maintenance periods or WTG mechanical issues resulting in non-operational turbines at North Fork Ridge include:

- A site-wide shutdown of the wind power facility occurred from June 6 through the morning of June 22, 2023 (16 nights) when none of the wind turbines were operational;
- Five WTGs (T-019, T-045, T-061, T-072 and T-075) were non-operational for the entire survey season (April 3 through October 31, 2023);
- T-059 was non-operational from September 23 through October 31, 2023 (39 nights);
- T-039 was non-operational from October 13 – 26, 2023 (14 nights); and
- T-047 was non-operational from October 7 – 19, 2023 (13 nights).

3.1 Shared Results

Calculations for SE and DWP were shared between projects. Searchers rotated through turbine searches systematically at both projects and generally did not exclusively search only one of the projects. Therefore, searcher efficiency was evaluated and combined for both projects. Additionally, combining projects allowed for a more robust estimation of DWP.

3.1.1 Searcher Efficiency

SE trials were conducted during all three seasons (spring, summer, and fall) in 2023 and included a total of 398 trials. Data were analyzed in GenEst, with searcher, season, and plot type as the three potential predictor variables. The selected model included plot type as a factor (Appendix B, Table B-1). This

resulted in a total of three 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 was highest at 80-m cleared plots searched by detection dog teams (80.8%), followed by road and pad plots searched by humans (77.8%) and 80-m cleared plots searched by humans (60.3%, see Table 3-1).

Table 3-1. Searcher efficiency during 2023 post-construction monitoring at the Kings Point and North Fork Ridge Wind Projects.

Plot Type	Number of Trials	Searcher Efficiency (90% CI)
80-m Cleared Plot (Detection Dog Teams)	167	0.808 (0.753 – 0.854)
80-m Cleared Plot (Human Searchers)	141	0.603 (0.534 – 0.668)
Road and Pad (Human Searchers)	90	0.778 (0.698 – 0.842)

3.1.2 Density-weighted Proportion (DWP)

Stantec used the distribution of 195 bats found during standardized searches from previous year searches on road and pad and 100-m cleared plots at both Projects to calculate DWP for bat carcasses found at control turbines (3.0 m/s) and treatment turbines (5.0 m/s) – see Table 3-2 and Table 3-3.

Based on data from carcasses found, it is assumed that, on average, 90.2% of all bat carcasses fall within 80 m of the turbine base and within the 80-m cleared plot searches (~85% within plots of treatment turbines and ~95% of control turbines), and 9.8% fall beyond the 80-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), as well as removing unsearchable areas from full plots, 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 ranging from 72.9% to 95.6% and the DWP for road and pad turbines ranges from 3.6% to 9.1%.

Table 3-2. Calculation of the Density-weighted Proportion (DWP) for control turbines (3.0 m/s) at the Kings Point and North Fork Ridge Wind Projects based on bat carcasses found during the Permit period of 2021 and 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	3	49.9%	6.0	0.7%	0.7%
10-20	35	16.1%	217.9	24.7%	25.4%
20-30	7	15.1%	46.4	5.3%	30.6%
30-40	14	13.6%	102.6	11.6%	42.2%
40-50	24	12.1%	198.2	22.4%	64.7%
50-60	12	11.4%	104.8	11.9%	76.5%
60-70	9	10.8%	83.1	9.4%	86.0%
70-80	9	10.5%	85.3	9.7%	95.6%
80-90	4	10.3%	38.7	4.4%	100.0%
90-100	0	10.1%	0.0	0.0%	100.0%

Table 3-3. Calculation of the Density-weighted Proportion (DWP) for treatment turbines (5.0 m/s) at the Kings Point and North Fork Ridge Wind Projects based on bat carcasses found during the Permit period of 2021 and 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	1	49.9%	2.0	0.3%	0.3%
10-20	25	16.1%	155.7	25.6%	26.0%
20-30	6	15.1%	39.8	6.5%	32.5%
30-40	5	13.6%	36.7	6.0%	38.5%
40-50	8	12.1%	66.1	10.9%	49.4%
50-60	8	11.4%	69.9	11.5%	60.9%
60-70	10	10.8%	92.4	15.2%	76.1%
70-80	6	10.5%	56.9	9.4%	85.5%

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total	Cumulative Percent of Carcasses
80-90	5	10.3%	48.4	8.0%	93.5%
90-100	4	10.1%	39.7	6.5%	100.0%

3.2 Kings Point

3.2.1 Carcass Searches

A total of 6,713 searches were completed between April 3 and October 31, 2023. A summary of search effort by season with total numbers of bats found is presented in Table 3-4. A total of 1,081 bat carcasses were found during standardized carcass searches, and 19 bat carcasses were found incidentally.

Table 3-4. Summary of bat fatality monitoring completed between April 3 and October 31, 2023, 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 3 – May 31	1,128	3.57	58	3
Summer	June 1 – August 31	3,384	1.64	754	13
Fall	September 1 – October 31	2,201	1.91	269	3
Total	April 3 – October 31	6,713	2.05	1,081	19

3.2.2 Species Composition

Of the 1,081 bat carcasses found during standardized carcass searches, 10 were unidentified. The remaining individuals 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 3-5. Of the 1,081 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 858 individuals). The hoary bat (*Lasiurus cinereus*; 129 individuals) was the second most common species followed by evening bat (*Nycticieus humeralis*; 32 individuals). Silver-haired bats (*Lasionycteris noctivagans)* made up 0.8% (9) of overall carcasses. Gray bats and tricolored bats comprised 2.6% of total finds with 14 carcasses each.

Table 3-5. Summary of bat carcasses found during standardized carcass searches between April 3 and October 31, 2023 at the Kings Point Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat	0	9	1	10
Eptesicus fuscus	0.0%	1.2%	0.4%	0.9%
Eastern Red Bat	37	616	205	858
Lasiurus borealis	63.8%	81.8%	76.2%	79.3%
Evening Bat	8	12	12	32
Nycticeius humeralis	13.8%	1.6%	4.5%	3%
Gray Bat[1, 2]	0	10	4	14
Myotis grisescens	0.0%	1.3%	1.5%	1.3%
Hoary Bat[1]	7	91	31	129
Lasuirus cinereus	12.1%	12.1%	11.5%	12%
Silver-haired Bat[1]	4	1	4	9
Lasionycteris noctivagans	6.9%	0.1%	1.5%	0.8%
Tricolored Bat[1]	2	7	5	14
Perimyotis subflavus	3.4%	1.0%	1.8%	1.3%
Big Free-tailed Bat	0	1	0	1
Nyctinomops macrotis	0.0%	0.1%	0.0%	0.1%
Seminole Bat	0	1	1	2
Lasiurus seminolus	0.0%	0.1	0.4%	0.2%
Eastern Red or Seminole Bat	0	1	1	2
	0.0%	0.1%	0.4%	0.2%
Unidentified Bat	0	1	0	1
	0.0%	0.1%	0.0%	0.1%
Unidentified *Lasiurus* Bat	0	3	5	8
	0.0%	0.4%	1.8%	0.7%

Species	Spring	Summer	Fall	Total
Unidentified Non-*Myotis*	0 0.0%	1 0.1%	0 0.0%	1 0.1%
Total	58 5.3%	754 69.8%	269 24.9%	1,081

[1]Missouri Department of Conservation Species of Conservation Concern

[2]State and Federal listed Endangered

3.2.3 Carcass Persistence

CP was tested using 82 bat carcasses across the 3 seasons, with a minimum of 10 trials for each combination of plot type and season. The top models for CP in GenEst included lognormal and loglogistic distributions with no effects for season or plot type (Appendix B, Table B-2). We selected the model with the lowest AIC which was a lognormal distribution and no effect for plot type or season. Median carcass persistence was 4.59 days (90%CI: 3.57 – 5.91).

3.2.4 Adjusted Fatality Estimates - GenEst

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 DWP area corrections.

3.2.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 1,081 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 (1,929 bats), followed by fall (676 bats), and lowest in the spring (274 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 2,875 bats (90% CI: 2522 – 3294) across all 69 turbines between April 3 and October 31, 2023 – equivalent to 42 bats/turbine (90% CI: 37 – 48) or 19 bats/MW (90% CI: 17 – 22).

Table 3-6. Bat fatality rates by season estimated using GenEst from the 2023 post-construction monitoring data at the Kings Point Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities (90% CI)
Spring	April 3 – May 31	273.89 (178.33 – 401.47)	3.97 (2.58 – 5.82)	1.83 (1.19 – 2.69)
Summer	June 1 – August 31	1,928.80 (1,659.60 – 2,231.07)	27.95 (24.05 – 32.33)	12.91 (11.11 – 14.93)
Fall	September 1 – October 31	676.17 (530.19 – 844.67)	9.80 (7.68 – 12.24)	4.53 (3.55 – 5.65)
Annual	April 3 – October 31	2,874.68 (2,522.60 – 3,294.28)	41.66 (36.56 – 47.74)	19.24 (16.88 – 22.05)

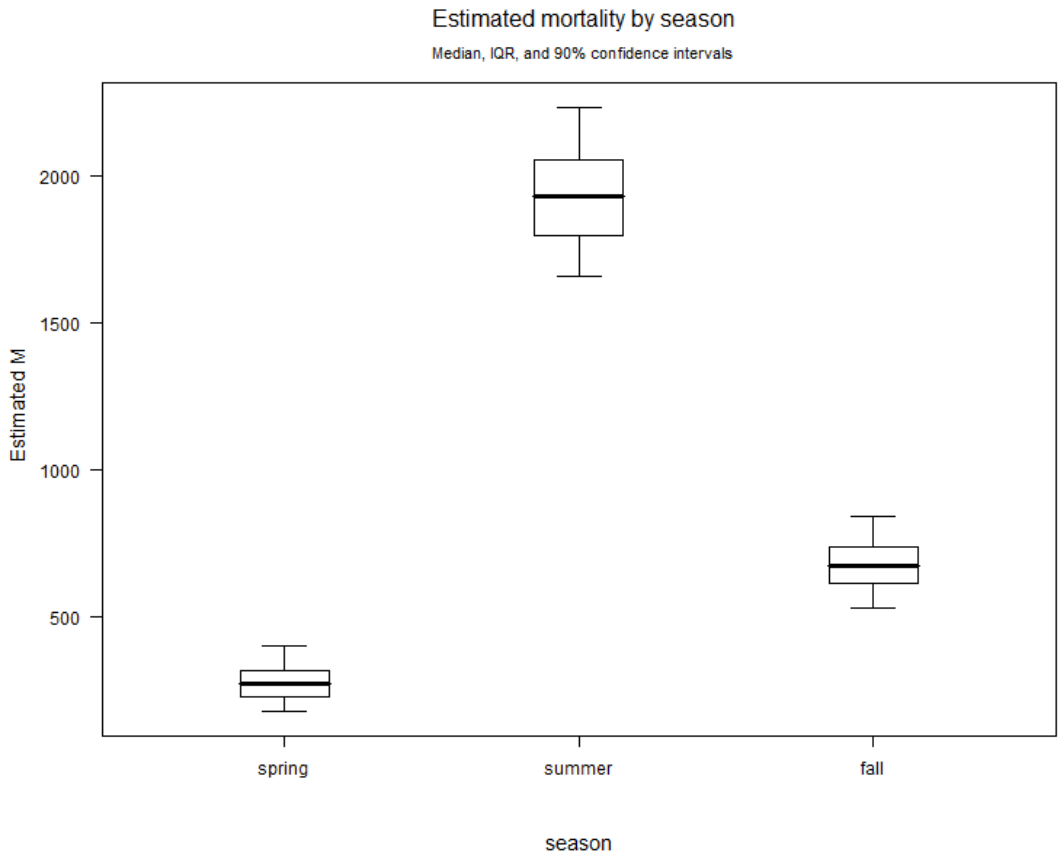

Figure 3-1. Seasonal all bat fatality estimates for 2023 at the Kings Point Wind Project.

3.2.4.2 Control Vs. Treatment Fatality Estimates

Annual fatality estimates were higher for control turbines (3.0 m/s cut-in) than at treatment turbines (5.0 m/s cut-in); however, the difference was not significant. Annual bat fatality was 1,516.80 (90% CI: 1,306.39 – 1,779.54) at control turbines and 1,339.77 (90% CI: 1,111.81 – 1,618.07) at treatment turbines (see Figure 3-2). Per turbine estimates are 43.34 (90% CI: 37.33 – 50.84) for control turbines and 39.41 (90% CI: 32.70 – 47.59) for treatment turbines. Per MW estimates are 19.96 (90% CI: 17.19 – 23.42) for control turbines and 18.25 (90% CI: 15.15 – 22.04) for treatment turbines.

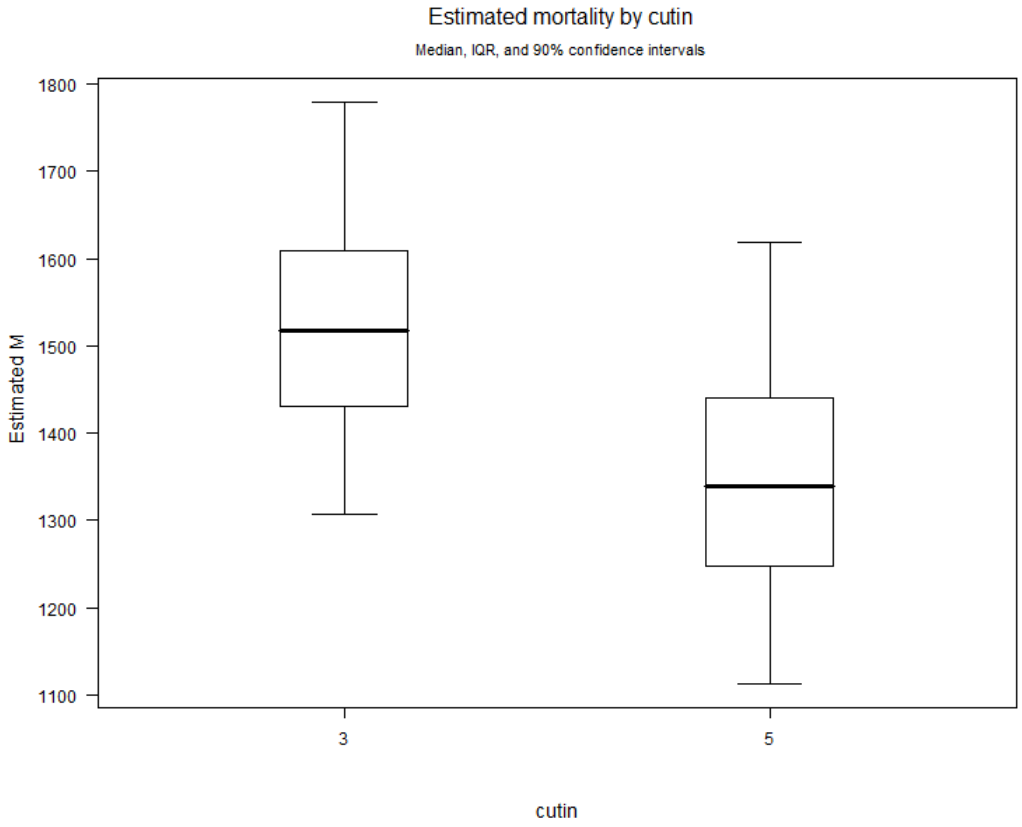

Figure 3-2. All bat fatality estimates at control (3 m/s) vs. treatment (5 m/s) turbines for 2023 at the Kings Point Wind Project.

3.2.5 Gray Bat and Tricolored Bat Fatality Estimates - EofA

3.2.5.1 In-hand Fatalities

Stantec and WEST found 14 gray bats and 14 tricolored bats during standardized searches at Kings Point. An additional gray bat was found as an incidental observation (i.e. outside the survey plot) and was not included in fatality estimates. No other federal or state endangered species were found. The locations of the gray bat and tricolored bat fatalities are shown in Appendix A, Figure A-4. See Table 3-7 for a summary of the details for gray bats and tricolored bats found.

Table 3-7. Gray bats and tricolored bats found during 2023 at the Kings Point Wind Project.

Species	Date Found	Est. Time Since Death	Season	Turbine	Sex	Plot Type	Cut-in Speed
Gray Bat	4/24/2023	2-4 days	Spring	Turbine 026	Female	80-m Human	5
	7/11/2023	0-1 days	Summer	Turbine 119	Male	80-m Detection Dog	5
	7/15/2023	0-1 days	Summer	Turbine 114	Female	80-m Detection Dog	3
	7/25/2023	<1 day	Summer	Turbine 028	Female	80-m Human	5
	7/31/2023	2-4 days	Summer	Turbine 025	Female	80-m Human	3
	7/31/2023	2-3 days	Summer	Turbine 080	Male	80-m Detection Dog	5
	8/01/2023	2-4 days	Summer	Turbine 017	Female	80-m Human	5
	8/10/2023	0-1 days	Summer	Turbine 008	Female	80-m Detection Dog	5
	8/18/2023	<1 day	Summer	Turbine 126	Female	80-m Human	3
	8/24/2023	0-1 days	Summer	Turbine 080	Male	80-m Detection Dog	5
	8/31/2023	<1 day	Summer	Turbine 030	Female	80-m Human	5
	9/7/2023	0-1 days	Fall	Turbine 114	Female	80-m Detection Dog	3
	9/12/2023	4-7 days	Fall	Turbine 080	Female	80-m Detection Dog	5
	9/18/2023	0-1 days	Fall	Turbine 056	Male	80-m Detection Dog	3
	9/19/2023	2-3 days	Fall	Turbine 060	Female	80-m Detection Dog	3
Tricolored Bat	5/09/2023	2-4 days	Spring	Turbine 028	Female	80-m Human	5
	5/18/2023	<1 day	Spring	Turbine 035	Female	80-m Human	3
	7/24/2023	0-1 days	Summer	Turbine 010	Male	80-m Detection Dog	3
	8/8/2023	2-3 days	Summer	Turbine 114	Female	80-m Detection Dog	3
	8/17/2023	2-3 days	Summer	Turbine 074	Male	80-m Detection Dog	3
	8/21/2023	2-3 days	Summer	Turbine 074	Male	80-m Detection Dog	3
	8/22/2023	2-3 days	Summer	Turbine 080	Female	80-m Detection Dog	5
	8/24/2023	2-3 days	Summer	Turbine 114	Male	80-m Detection Dog	3

Species	Date Found	Est. Time Since Death	Season	Turbine	Sex	Plot Type	Cut-in Speed
	8/26/2023	2-3 days	Summer	Turbine 008	Female	80-m Detection Dog	5
	9/1/2023	2-3 days	Fall	Turbine 114	Male	80-m Detection Dog	3
	9/1/2023	unknown	Fall	Turbine 063	Male	80-m Detection Dog	5
	9/2/2023	2-3 days	Fall	Turbine 008	Female	80-m Detection Dog	5
	9/11/2023	2-3 days	Fall	Turbine 008	Male	80-m Detection Dog	5
	9/15/2023	2-3 days	Fall	Turbine 026	Male	80-m Detection Dog	5

3.2.5.2 Evidence of Absence

The “Single Classes” module was used in EofA to calculate strata-specific detection probabilities. Because searcher efficiency varied by plot type and carcass persistence did not vary by plot type or season, the module was run seven times: once for each plot type for the periods of time those plot types were applicable (e.g., road and pad plots and cleared plots April through June). Arrival proportions assumed 5% of annual fatalities occur before or after the survey window so the first and last seasons were assigned a 7.5% arrival proportion (which averages to 5% of 3 seasons); the middle seasons were assigned an arrival proportion of one. DWP weights in the comprehensive Multiple Class execution accounted for the proportion of fatalities occurring in a given season, the proportion of fatalities falling within the plot type, and the proportion of the project represented by that plot type (e.g., 5% of fatalities occurring on average, on roads and pads; at roads and pads which represent 37/69 [53%] of the project; during the spring/early summer season which represents ~10% of annual fatalities; all results in a spring time road and pad DWP weight of ~0.003). A Multiple Class Module screen shot is available in Figure B-1 (see Appendix B).

3.2.5.3 Detection Probability (g)

The detection probability (g) for the post-construction monitoring season (March 1 – November 15, 2023) was 0.325 (95% CI: 0.308 – 0343); which when combined with the g-value for 2022 (0.124) averages 0.225 for Phase I of the study.

Fatality Estimates (M* and λ)

Analysis in the EofA “Multiple Years Module” included calculation of the annual take estimate (M_{2023}) and the annual take rate (λ) for gray bats and tricolored bats based on the 14 carcasses found for each species during standardized monitoring and the detection probability (g) from the 2023 study. Results are summarized in Table 3-8.

Table 3-8. Summary of EofA outputs for gray bats from 2023 post-construction monitoring at the Kings Point Wind Project. Analysis done with α=0.8.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2023})	Annual Take Rate (λ) (95% CI)
Gray Bat	14	52	44.6 (24.6 – 70.54)
Tricolored Bat	14	52	44.6 (24.6 – 70.54)

3.2.6 Acoustic Monitoring

3.2.6.1 2021 and 2022 Monitoring

The results of the acoustic monitoring from 2021 and 2022 are available in the 2022 annual report (Stantec 2023) but were combined where applicable with the 2023 data to provide a comprehensive analysis of acoustic bat activity as it relates to exposure and bat fatality.

3.2.6.2 2023 Monitoring

Acoustic detectors were deployed on turbine nacelles in early March 2023 and demobilized in mid-November 2023. Detectors were deployed at the same turbines as were monitored during the 2021 and 2022 surveys except for Turbine 126, which was scheduled for maintenance during the survey and the detector slated to be deployed on that turbine was moved to Turbine 128. Mid-tower detectors were also deployed at 10 turbines at Kings Point in mid-August 2023 as part of a supplementary study, but results have not been analyzed at the time of this report. Acoustic detectors recorded a total of 13,988 bat passes during 3,179 successful detector-nights (85% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) recorded 4.4 bat passes per detector-night during the 2023 monitoring period (Table 3-9).

Table 3-9. Acoustic survey effort at the Kings Point Wind Project from March through November 2023.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	#Passes, Species of Interest		Total Bat Passes	Overall Rate (bat passes/DN)
				Gray Bat	Tricolored Bat		
Turbine 008 Nacelle	1-Mar	16-Nov	249	11	3	1,102	4.4
Turbine 017 Nacelle	2-Mar	15-Nov	247	10	0	1,092	4.4
Turbine 025 Nacelle	17-Apr	15-Nov	142	0	2	953	6.7
Turbine 026 Nacelle	2-Mar	15-Nov	188	7	3	997	5.3
Turbine 035 Nacelle	7-Mar	16-Nov	243	6	0	958	3.9
Turbine 044 Nacelle	13-Mar	16-Nov	122	5	4	194	1.6
Turbine 056 Nacelle	15-Mar	16-Nov	235	6	2	1,212	5.2
Turbine 060 Nacelle	10-Mar	16-Nov	218	4	4	1,264	5.8
Turbine 063 Nacelle	10-Mar	16-Nov	241	6	3	980	4.1
Turbine 068 Nacelle	8-Mar	19-Nov	141	0	0	232	1.6
Turbine 080 Nacelle	20-Mar	19-Nov	234	4	1	1,194	5.1
Turbine 091 Nacelle	15-Mar	19-Nov	213	4	3	840	3.9
Turbine 114 Nacelle	15-Mar	19-Nov	238	8	3	839	3.5
Turbine 124 Nacelle	22-Mar	19-Nov	231	0	3	1,242	5.4
Turbine 128 Nacelle	16-Mar	19-Nov	237	1	0	889	3.8
Total, 2023	**1-Mar**	**19-Nov**	**3,179**	**72**	**31**	**13,988**	**4.4**

3.2.6.3 Acoustic Results

Acoustic bat activity followed similar seasonal patterns during the 2021, 2022, and 2023 monitoring periods, although the peak in biweekly bat activity occurred slightly earlier in the late-summer/early-fall season in 2023 than in 2021 or 2022 (Figure 3-3). Although timing of bat activity varied among nights, overall timing of bat activity during each monitoring year peaked 2–4 hours after sunset at nacelle and mid-tower detectors for all bat species and for the subset of passes identified as gray bats and tricolored

bats (Figure 3-4, Figure 3-5). Additional figures showing activity trends of other species recorded are available in Appendix C.

Temperature, wind speed, and turbine rotor speed data measured at nacelle height were available during 10-minute intervals in which 89,081 bat passes (97% of 91,388 total bat passes) were detected at Kings Point in 2021 through 2023. 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 3-6). Gray bats and tricolored bats were distributed during somewhat higher wind speeds at mid-tower versus nacelle height detectors and tricolored bats tended to be active during higher wind speeds than gray bats at both nacelle and mid-tower detectors (Figure 3-7, Figure 3-8).

Acoustic monitoring at Kings Point in 2021 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, and 2023, 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 (Figure 3-10) to turbine operation (exposed passes are defined as those detected when 10-minute turbine rotor speed exceeded 1 rpm). In 2022, control turbines exposed ~81.9% of bat activity while treatment turbines exposed ~55.7%. The 2022 proportions are comparable to 2023 where Stantec measured 84.0% of bat passes exposed at control turbines and 51.0% exposed at treatment turbines (Figure 3-9). The 5.0 m/s treatment blanket curtailment strategy resulted in exposure of 51–55% 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 control turbines (Appendix C, Figure 3-10). Exposure of gray bat and tricolored bat passes to turbine operation generally followed similar trends among treatments at both detector positions during each year (Table 3-10, Figure 3-10).

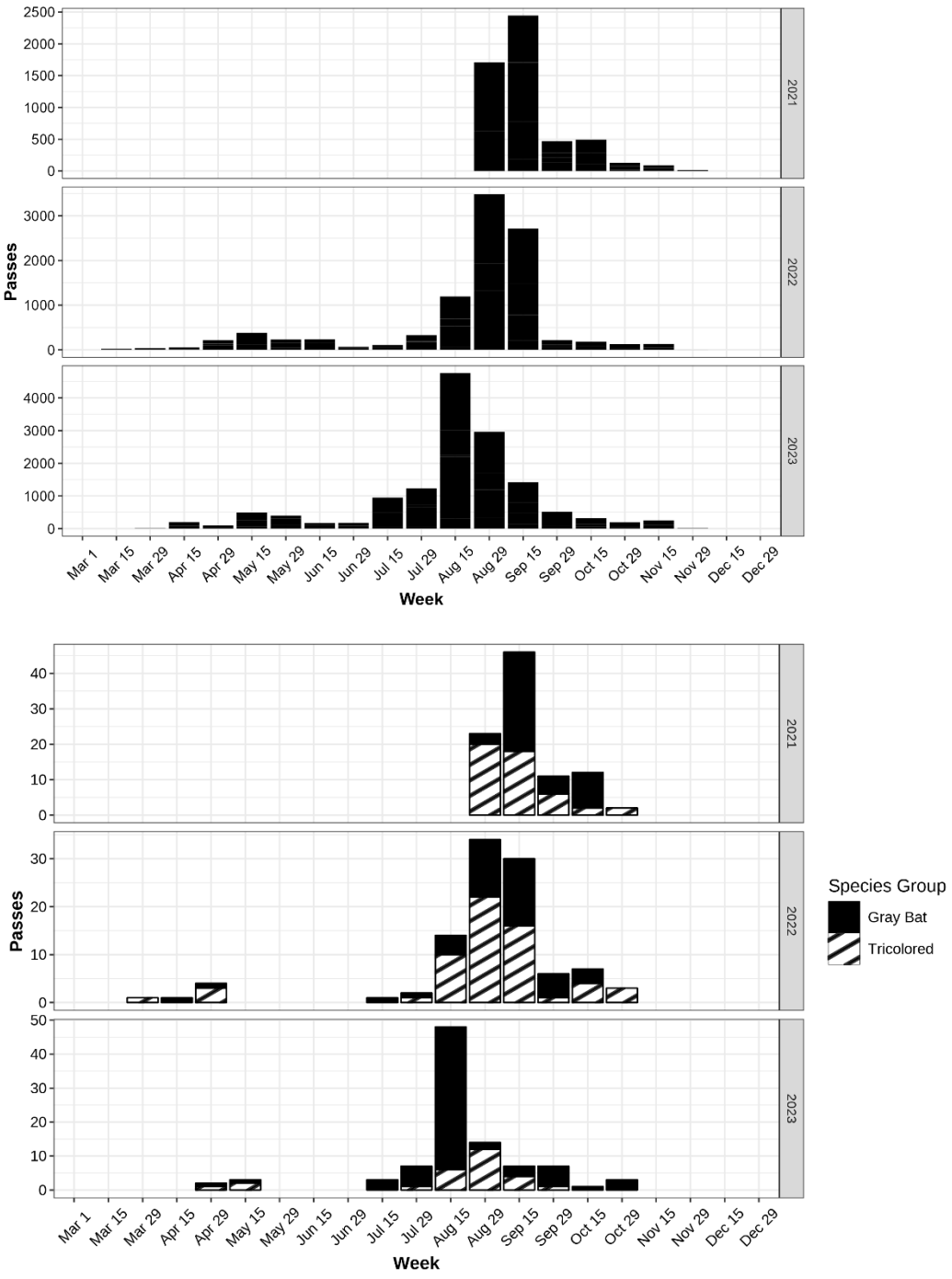

Figure 3-3. Biweekly acoustic bat activity for all bats (upper plot) and for gray bats and tricolored bats only (lower plot) detected at nacelle-height detectors during the 2021, 2022, and 2023 monitoring periods at the Kings Point Wind Project.

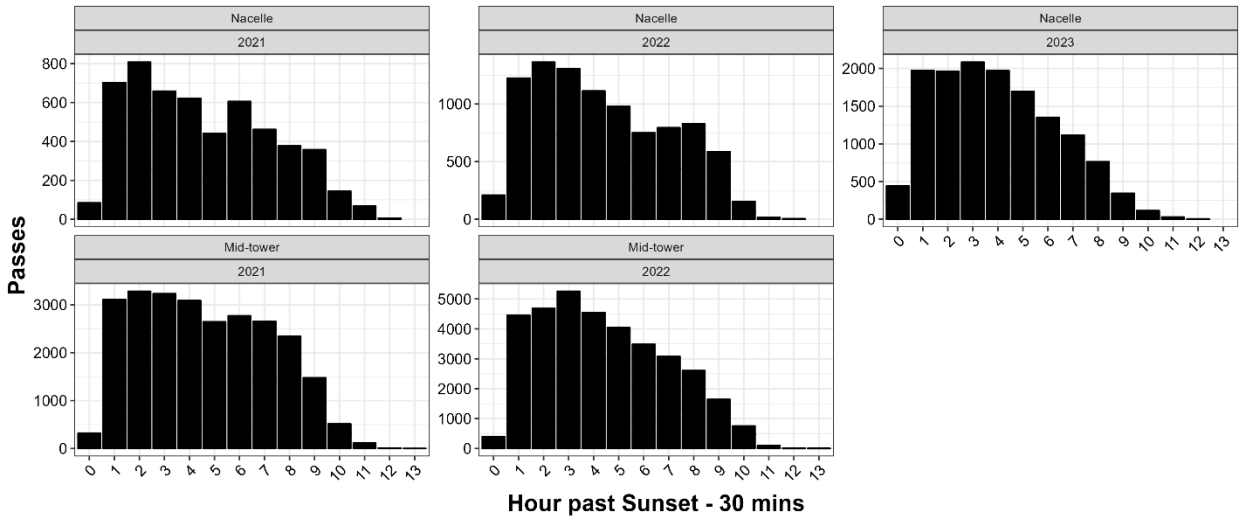

Figure 3-4. Nightly timing of total bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021–2023 monitoring periods at the Kings Point Wind Project. Note that data from mid-tower detectors were not available for 2023.

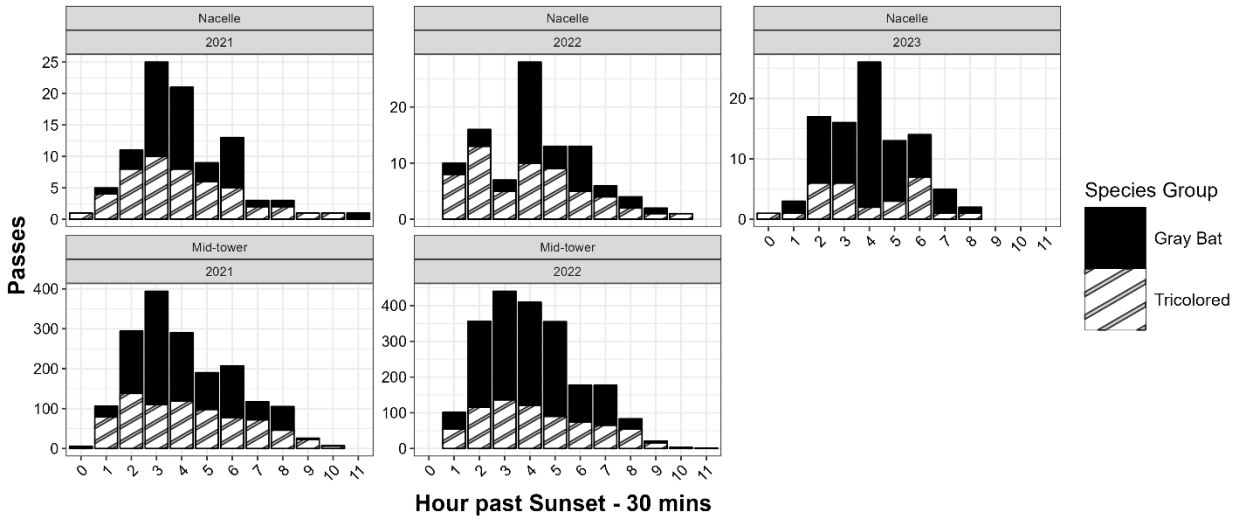

Figure 3-5. Nightly timing of gray bat and tricolored bat activity (by hour past sunset-30 minutes) detected at nacelle and mid-tower detectors during the 2021–2023 monitoring periods at the Kings Point Wind Project. Note that data from mid-tower detectors were not available for 2023.

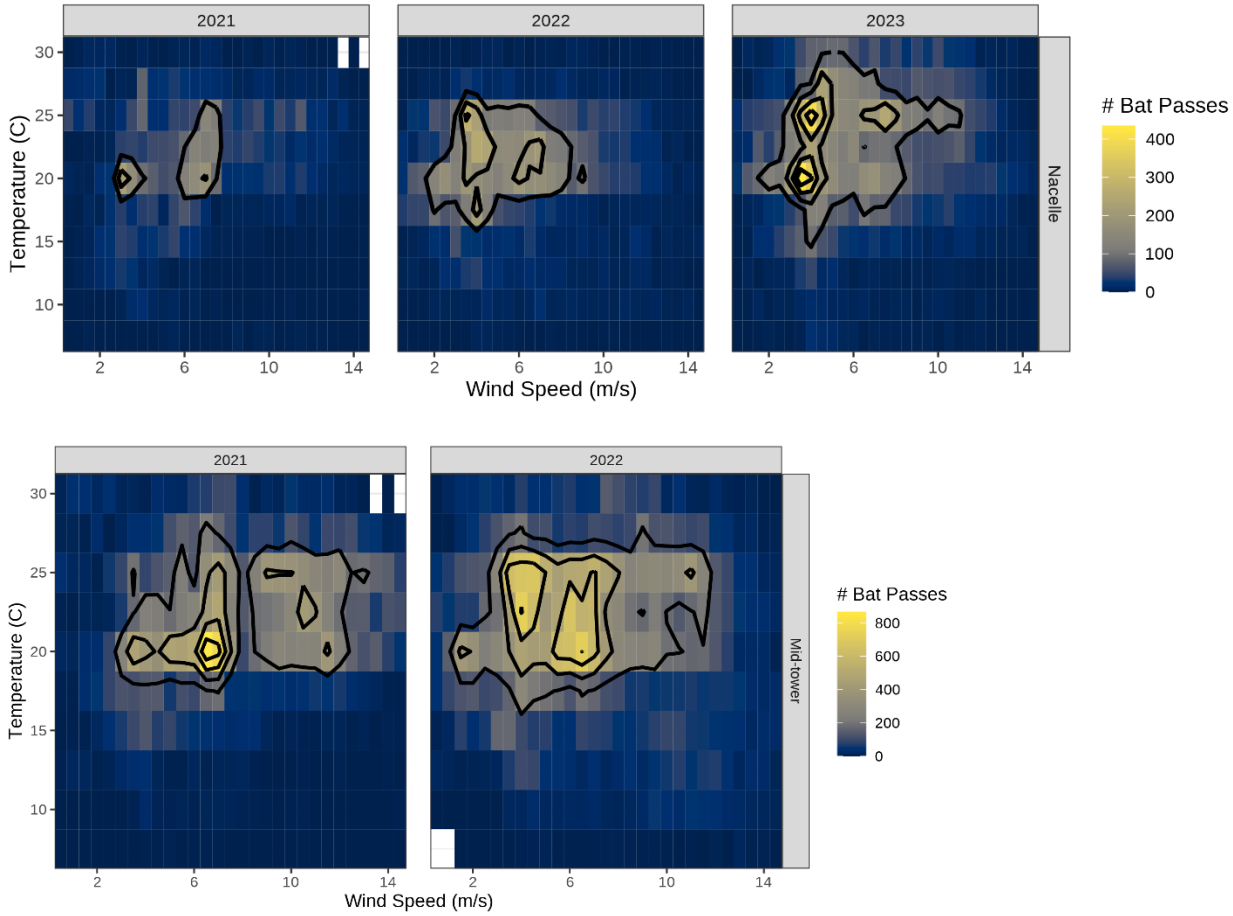

Figure 3-6. Distribution of all bat passes (all species) as a function of wind speed and temperature recorded at nacelle-height (upper panels) and mid-tower detectors (lower panels) by year at the Kings Point Wind Project. Note that data from mid-tower detectors were not available for 2023.

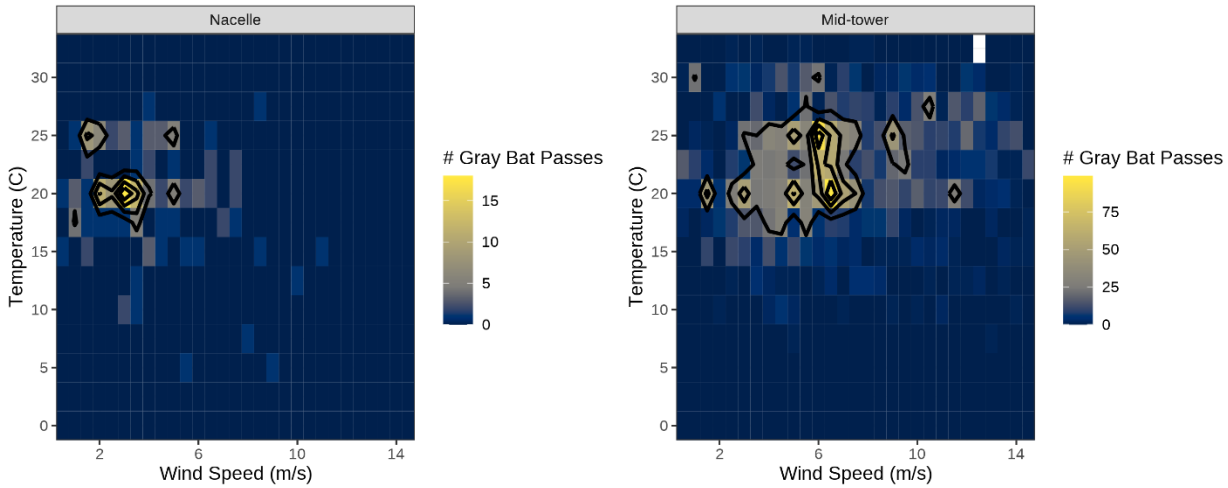

Figure 3-7. Distribution of gray bat passes as a function of wind speed and temperature by detector position during 2021–2023 acoustic monitoring at the Kings Point Wind Project. Note that data from mid-tower detectors were not available for 2023.

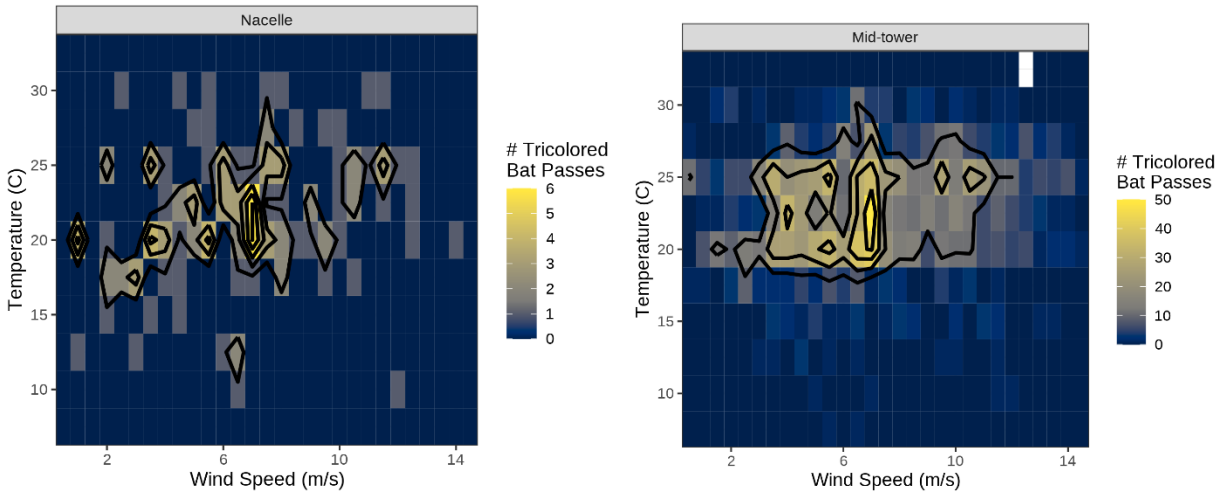

Figure 3-8. Distribution of tricolored bat passes as a function of wind speed and temperature by detector position during 2021–2023 acoustic monitoring at the Kings Point Wind Energy Project. Note that data from mid-tower detectors were not available for 2023.

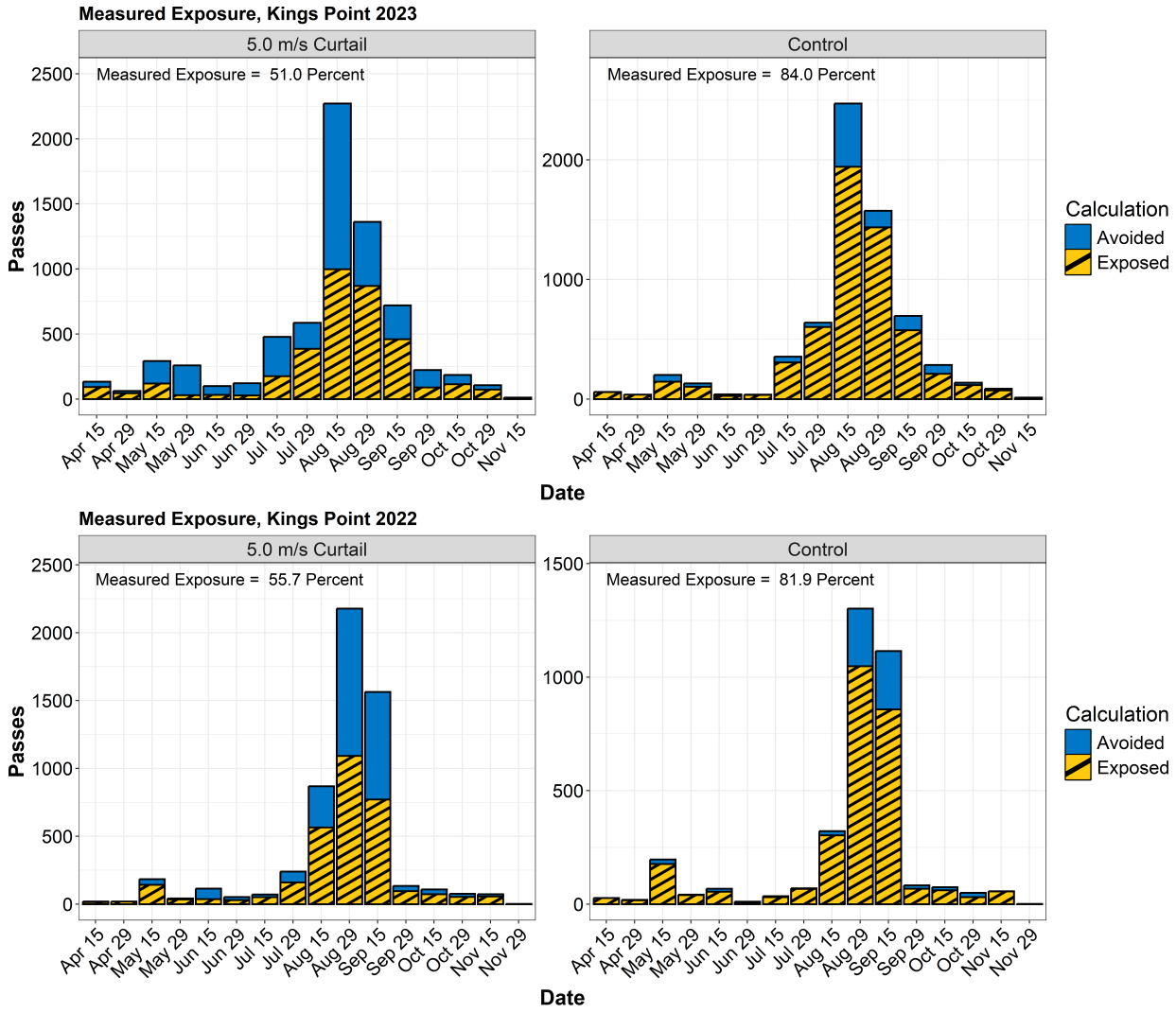

Figure 3-9. Biweekly distribution of bat activity and acoustic exposure recorded in 2022 and 2023 by nacelle height detectors at turbines operating with 3.0 m/s (control) and 5.0 m/s (curtailed) cut-in speeds the Kings Point Wind Project.

Table 3-10. 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, 2022, and 2023 monitoring period at the Kings Point 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 interim TAL	14	22	36	3,756	0 (0%)	15 (42%)	867 (23%)
2021	Nacelle	5.0 m/s Treatment	8	16	7	1,001	6 (38%)	4 (57%)	540 (54%)
2021	Nacelle	3.0 m/s Control	6	8	5	585	5 (63%)	4 (80%)	487 (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	2,550	117 (68%)	24 (65%)	1,479 (58%)
2021	Mid-tower	3.0 m/s Control	2	89	34	1,853	85 (96%)	31 (91%)	1,587 (86%)
2022	Nacelle	5.0 m/s Treatment	8	26	35	5,747	9 (35%)	26 (74%)	3,199 (56%)
2022	Nacelle	3.0 m/s Control	7	12	22	3,474	5 (42%)	15 (68%)	2,845 (82%)
2022	Mid-tower	5.0 m/s Treatment	3	807	409	20,172	476 (59%)	277 (68%)	13,218 (66%)
2022	Mid-tower	3.0 m/s Control	2	589	318	14,846	511 (87%)	284 (89%)	12,849 (87%)
2023	Nacelle	5.0 m/s Treatment	8	43	16	6,907	7 (16%)	14 (88%)	3,525 (51%)
2023	Nacelle	3.0 m/s Control	7	29	14	6,765	16 (55%)	11 (79%)	5,682 (84%)

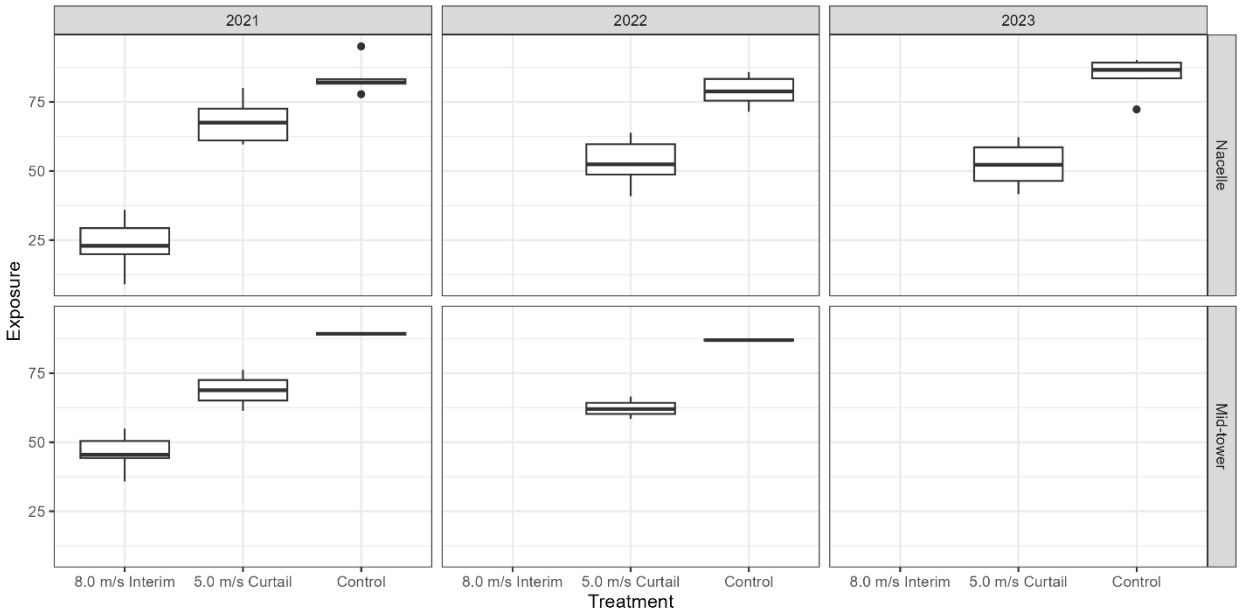

Figure 3-10. Acoustic exposure (percent of bat passes detected when turbine rotor speed was 1 rpm or greater) by operational treatment and detector position during 2021–2023 acoustic monitoring at the Kings Point Wind Project. Note that the 8.0 m/s treatment did not occur in 2022 or 2023 and data from mid-tower detectors were not available in 2023.

3.3 North Fork Ridge

3.3.1 Carcass Searches

A total of 6,194 searches were completed between April 3 and October 31, 2023, at the North Fork Ridge Wind Project. A summary of search effort by season with total numbers of bats found is presented in Table 3-11. A total of 878 bat carcasses were found during standardized carcass searches, and 12 bat carcasses were found incidentally.

Table 3-11. Summary of post-construction monitoring completed between April 3 and October 31, 2023, 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 3 – May 31	1,124	3.36	47	1
Summer	June 1 – August 31	3,027	1.62	576	2

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Fall	September 1 – October 31	2,043	1.88	255	9
Total	April 3 – October 31	6,194	2.02	878	12

3.3.2 Species Composition

There were 878 bat carcasses found during standardized carcass searches including 4 that could not be identified to species. The most common species was the eastern red bat (723 individuals; 82.3%), and the hoary bat (89 individuals; 10.1%) was the second most common species. Next were the evening bat (27) big brown bat (12) and silver-haired bat (8). Lastly, five gray bats and five tri-colored bats were found during standard carcass searches. A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-12.

Table 3-12. Summary of bat carcasses found during standardized carcass searches between April 3 and October 31, 2023 at the North Fork Ridge Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat	0	10	2	12
Eptesicus fuscus	0.0%	1.7%	0.8%	1.4%
Eastern Red Bat	32	487	204	723
Lasiurus borealis	68.1%	84.6%	80.0%	82.3%
Evening Bat	9	9	9	27
Nycticeius humeralis	19.1%	1.6%	3.5%	3.1%
Gray Bat[1, 2]	0	3	2	5
Myotis grisescens	0.0%	0.5%	0.8%	0.6%
Hoary Bat[1]	6	59	24	89
Lasuirus cinereus	12.8%	10.2%	9.4%	10.1%
Silver-haired Bat[1]	0	1	7	8
	0.0%	0.2%	2.7%	0.9%

Species	Spring	Summer	Fall	Total
Lasionycteris noctivagans				
Tricolored Bat[1] ***Perimyotis subflavus***	0 0.0%	3 0.5%	2 0.8%	5 0.6%
Seminole Bat ***Lasiurus seminolus***	0 0.0%	3 0.5%	0 0.0%	3 0.3%
Eastern Red or Seminole Bat	0 0.0%	0 0.0%	2 0.8%	2 0.2%
Unidentified *Lasiurus* Bat	0 0.0%	1 0.2%	3 1.2%	4 0.5%
Total	47 5.4%	576 65.6%	255 29%	878

[1]**Missouri Department of Conservation Species of Conservation Concern**

[2]**State and Federal listed Endangered**

3.3.3 Carcass Persistence

CP was tested using 80 bat carcasses including 10 per plot type per season. The top models for CP in GenEst included Weibull and exponential distributions with effects for season (Appendix B, Table B-3). The selected model had the lowest AIC and was an exponential distribution with effects for season. Median carcass persistence was similar during spring and summer (4.29 days and 4.57 days) but was lower during the fall (2.38 days). Table 3-13 shows the median and 90% confidence intervals for each season.

Table 3-13. Carcass persistence during 2023 post-construction monitoring at the North Fork Ridge Wind Project.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	20	4.29 (2.96 – 6.23)
Summer	30	4.57 (3.36 – 6.22)
Fall	30	2.38 (1.76 – 3.23)

3.3.4 Adjusted Fatality Estimates - GenEst

Fatality rate estimates were calculated in GenEst 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, 878 bat carcasses were found during standardized searches. The total estimated fatality for all bats was highest during the summer season (1,892 bats), followed by fall (737 bats), and lowest in the spring (274 bats) as summarized in Table 3-14 and Figure 3-11. Annual fatality estimates, combining all seasons, results in an overall bat fatality estimate of 2,925 bats (90% CI: 2,541 – 3,366) across all 64 operational turbines between April 3 and October 31, 2023 – equivalent to 44 bats/turbine (90% CI: 40 – 53) or 21 bats/MW (90% CI: 18 – 24).

Table 3-14. Bat fatality rates by season from 2023 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	April 3 – May 31	274.08 (152.42 – 435.18)	4.28 (2.38 – 6.80)	1.98 (1.10 – 3.14)
Summer	June 1 – August 31	1,891.63 (1,590.82 –	29.56 (24.86 – 35.22)	13.67 (11.49 – 16.29)
Fall	September 1 – October 31	737.14 (555.30 – 970.04)	11.52 (8.68 – 15.16)	5.33 (4.01 – 7.01)
Annual	April 4 – October 31	2,925.32 (2,540.98 – 3,365.74)	45.71 (39.70 – 52.59)	21.14 (18.36 – 24.32)

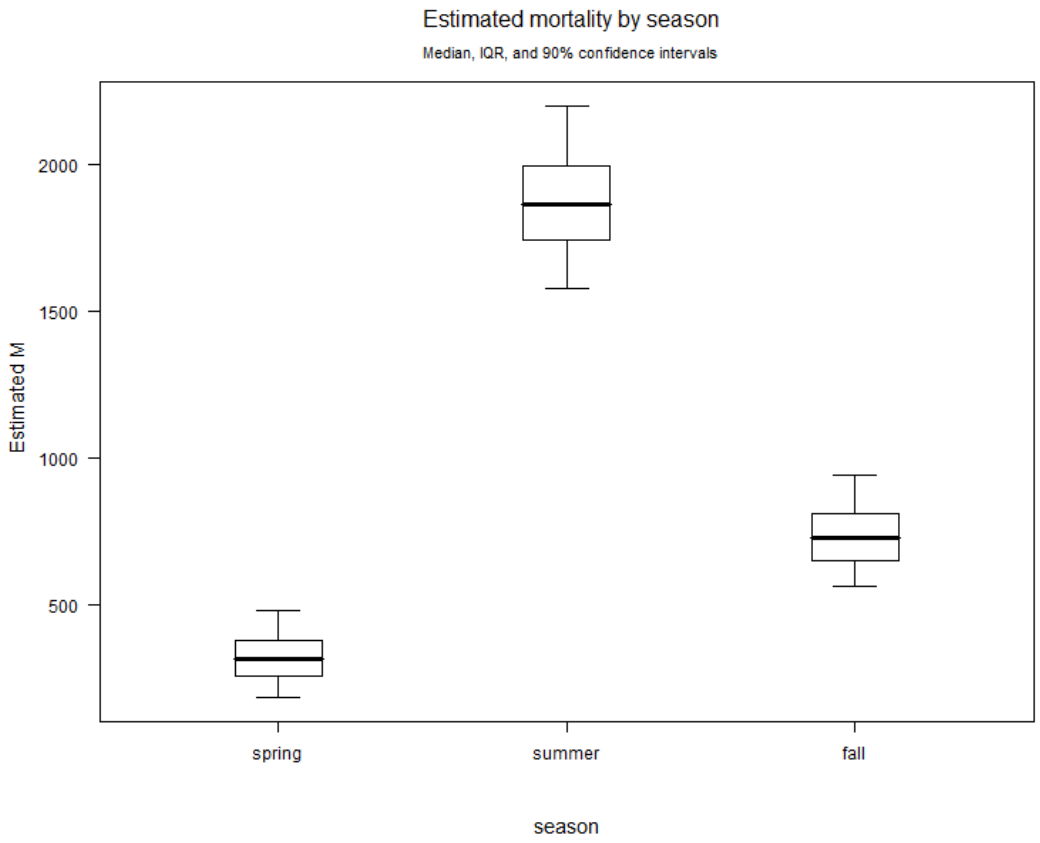

Figure 3-11. Seasonal all bat fatality estimates for 2023 at the North Fork Ridge Wind Project.

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 1,724.84 (90% CI: 1,436.17 – 2,058.19) at control turbines and 1,185.91 (90% CI: 964.73 – 1,466.13) at treatment turbines (Figure 3-12). Per turbine estimates are 52.27 (90% CI: 43.52 – 62.37) for control turbines and 38.26 (90% CI: 31.12 – 47.29) for treatment turbines. Per MW estimates are 24.16 (90% CI: 20.11 – 28.83) for control turbines and 17.70 (90% CI: 14.40 – 21.88) for treatment turbines.

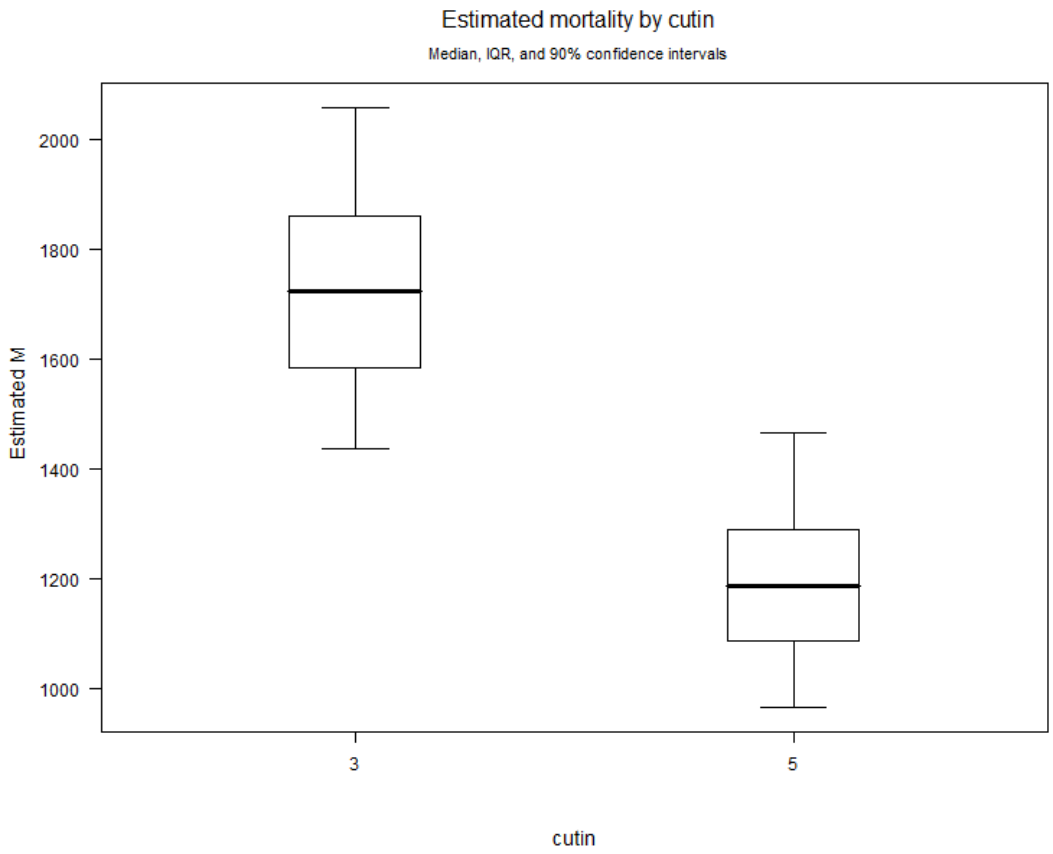

Figure 3-12. All bat fatality estimates at control (3 m/s) vs. treatment (5 m/s) turbines for 2023 at the North Fork Ridge Wind Project.

3.3.5 Gray Bat and Tricolored Bat Fatality Estimates - EofA

3.3.5.1 In-hand Fatalities

Stantec and WEST found 5 gray bats and 5 tricolored bats in 2023 during standardized searches at North Fork Ridge (Appendix A, Figure A-5). A summary of the details for the gray bats and tricolored bats found is available in Table 3-15.

Table 3-15. Gray bats and tricolored bats found during 2023 at the North Fork Ridge Wind Project.

Species	Date Found	Est. Time Since Death	Season	Turbine	Sex	Plot Type	Cut-in Speed
Gray Bat	7/18/2023	2-3 days	Summer	Turbine 041	Female	80-m Detection Dog	3
	08/21/2023	<1 day	Summer	Turbine 094	Female	80-m Human	3
	8/29/2023	2-3 days	Summer	Turbine 011	Male	80-m Detection Dog	5
	9/18/2023	2-3 days	Fall	Turbine 103	Male	80-m Detection Dog	5
	10/10/2023	>7 days	Fall	Turbine 044	Unknown	80-m Human	3
Tricolored Bat	7/17/2023	unknown	Summer	Turbine 093	Male	80-m Detection Dog	5
	08/15/2023	<1 day	Summer	Turbine 089	Female	80-m Human	5
	8/25/2023	2-3 days	Summer	Turbine 031	Female	80-m Detection Dog	5
	09/05/2023	4-7 days	Fall	Turbine 001	Female	Road and Pad	3
	09/05/2023	>7 days	Fall	Turbine 044	Female	80-m Detection Dog	3

3.3.5.2 Evidence of Absence

The “Single Classes” module was used in EofA to estimate strata-specific detection probabilities. Because searcher efficiency varied by plot type and carcass persistence varied by season, the module was run 12 times: once for each plot type for each season (e.g., road and pad plots and cleared plots in spring). Arrival proportions assumed 5% of annual fatalities occur before or after the survey window so the first and last seasons were assigned a 7.5% arrival proportion (which averages to 5% of 3 seasons); the middle seasons were assigned an arrival proportion of one. DWP in the comprehensive Multiple Class execution accounted for the proportion of fatalities occurring in a given season, the proportion of fatalities falling within the plot type, and the proportion of the project represented by that plot type (e.g., 5% of fatalities occurring on average, on roads and pads; at roads and pads which represent 37/69 [53%] of the project; during the spring/early summer season which represents ~10% of annual fatalities; all results in a

spring time road and pad DWP of ~0.003). A Multiple Classes Module screen shot is presented in Figure B-2 (Appendix B).

3.3.5.3 Detection Probability (g)

The detection probability (g) for the post-construction monitoring season (March 1 through November 15, 2023) was 0.319 (95% CI: 0.304 – 0.334); which when compared to the g-value for 2022 (0.143) is an average of 0.231 for Phase I of the study.

3.3.5.4 Fatality Estimates (M* and λ)

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2023}) and the annual take rate (λ) for the gray bats and tricolored bats found during standardized searches and the overall detection probability from the 2023 study. Results are summarized in Table 3-16.

Table 3-16. Summary of EofA outputs for gray bats and tricolored bats from 2023 post-construction monitoring at the North Fork Ridge Wind Project. Analysis done with α=0.8.

Species	Number of detected fatalities (X)	Annual Take Estimate (M2023)	Annual Take Rate (λ) (95% CI)
Gray Bat	5	21	17.2 (5.98 – 37.41)
Tricolored Bat	5	21	17.2 (5.98 – 37.41)

3.3.6 Acoustic Monitoring

3.3.6.1 2021 and 2022 Monitoring

The results of the acoustic monitoring from 2021 and 2022 are available in the 2022 annual report (Stantec 2023) but were combined where applicable with the 2023 data to provide a comprehensive analysis of acoustic bat activity as it relates to exposure and bat fatality.

3.3.6.2 2023 Monitoring

Acoustic detectors were deployed on turbine nacelles in late February 2023 and demobilized in mid-November 2023. Mid-tower detectors were not deployed at North Fork Ridge in 2023. Acoustic detectors recorded a total of 6,901 bat passes during 2,090 successful detector-nights (52% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) recorded 3.3 bat passes per detector-night during the 2023 monitoring period (Table 3-17).

Table 3-17. Acoustic survey effort at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri from March through November 2023.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	#Passes, Species of Interest		Total Bat Passes	Overall Rate (bat passes/DN)
				Gray Bat	Tricolored Bat		
Turbine 002 Nacelle	24-Feb	14-Nov	65	0	0	98	1.5
Turbine 009 Nacelle	24-Feb	14-Nov	0	NA	NA	NA	NA
Turbine 013 Nacelle	24-Feb	14-Nov	180	0	2	679	3.8
Turbine 017 Nacelle	24-Feb	14-Nov	214	4	3	956	4.5
Turbine 024 Nacelle	23-Feb	14-Nov	66	0	0	350	5.3
Turbine 032 Nacelle	25-Feb	20-Nov	94	0	0	24	0.3
Turbine 041 Nacelle	24-Feb	20-Nov	93	0	0	95	1.0
Turbine 058 Nacelle	25-Feb	20-Nov	254	0	1	251	1.0
Turbine 059 Nacelle	25-Feb	20-Nov	104	1	3	745	7.2
Turbine 061 Nacelle	24-Feb	19-Nov	113	0	0	223	2.0
Turbine 069 Nacelle	24-Feb	20-Nov	255	5	0	666	2.6
Turbine 078 Nacelle	24-Feb	20-Nov	255	11	6	1,147	4.5
Turbine 084 Nacelle	24-Feb	20-Nov	0	NA	NA	NA	NA
Turbine 093 Nacelle	25-Feb	22-Nov	141	1	15	538	3.8
Turbine 103 Nacelle	23-Feb	21-Nov	256	0	6	1,129	4.4
Total, 2023			**2,090**	**22**	**36**	**6,901**	**3.3**

3.3.6.3 Acoustic Results

Acoustic bat activity followed similar seasonal patterns during the 2021, 2022, and 2023 monitoring periods, although the peak in biweekly bat activity occurred slightly earlier in the late-summer/early-fall season in 2023 than in 2021 or 2022 (Figure 3-13). Although timing of bat activity varied among nights, overall timing of bat activity during each monitoring year 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 3-14, Figure 3-15). Additional figures showing activity trends of other species recorded are available in Appendix C.

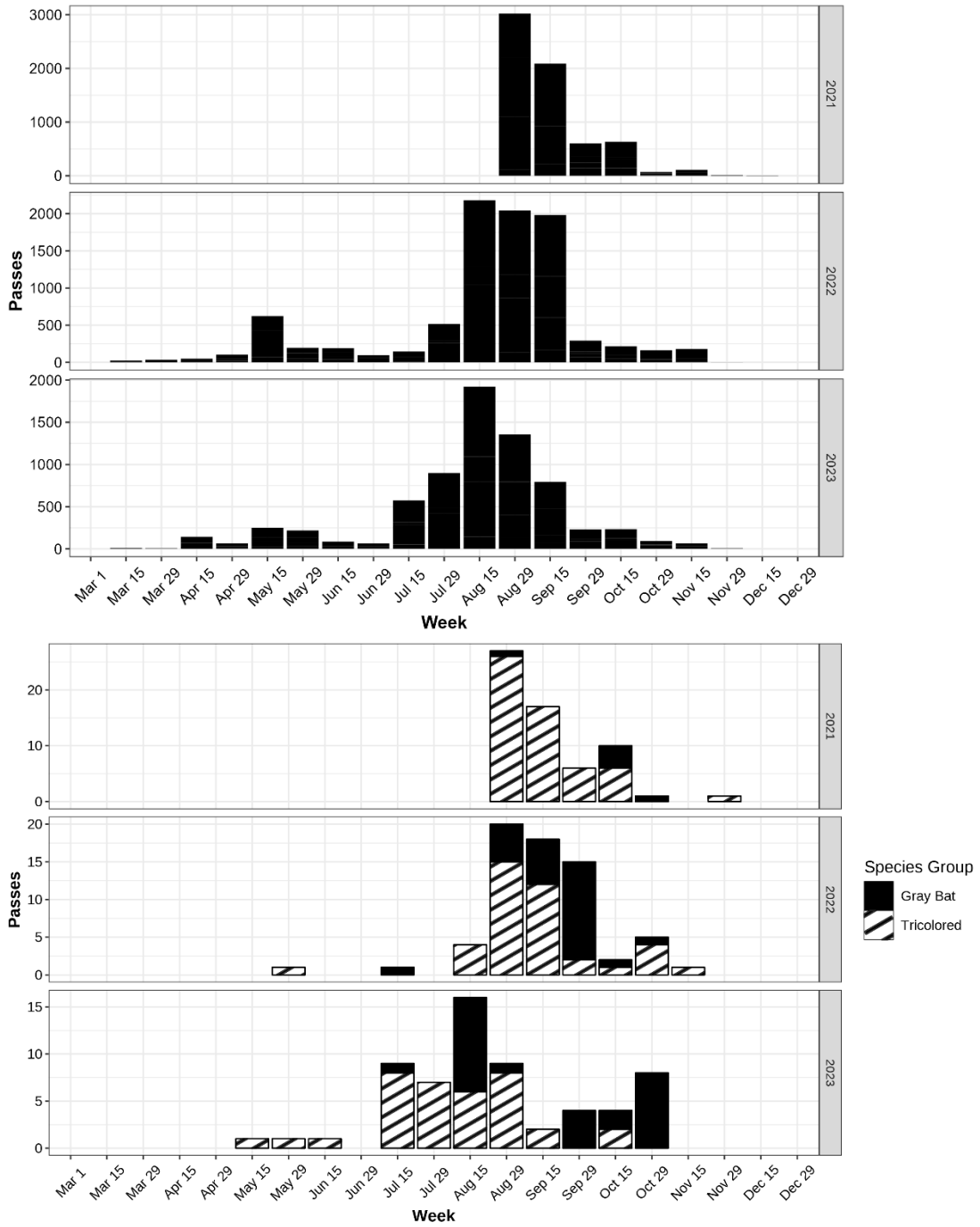

Figure 3-13. Biweekly acoustic bat activity by species group (upper plot) and for gray bats and tricolored bats (lower plot) detected at nacelle-height detectors during the 2021, 2022, and 2023 monitoring periods at the North Fork Ridge Wind Project. Spring/Summer monitoring did not occur in 2021.

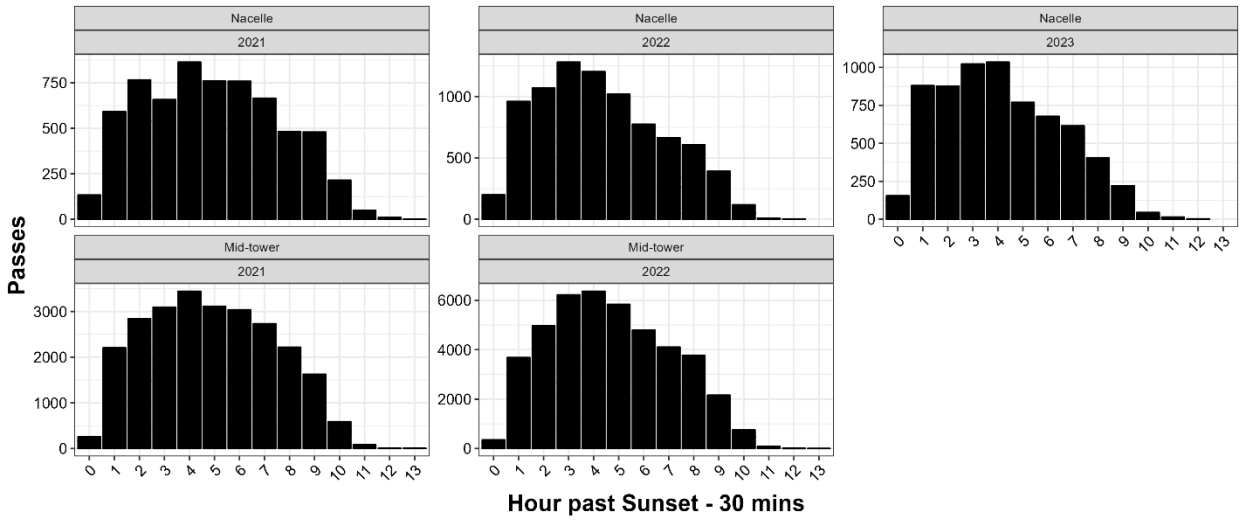

Figure 3-14. Nightly timing of total bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021–2023 monitoring periods at the North Fork Ridge Wind Project. Note that data from mid-tower detectors were not available for 2023.

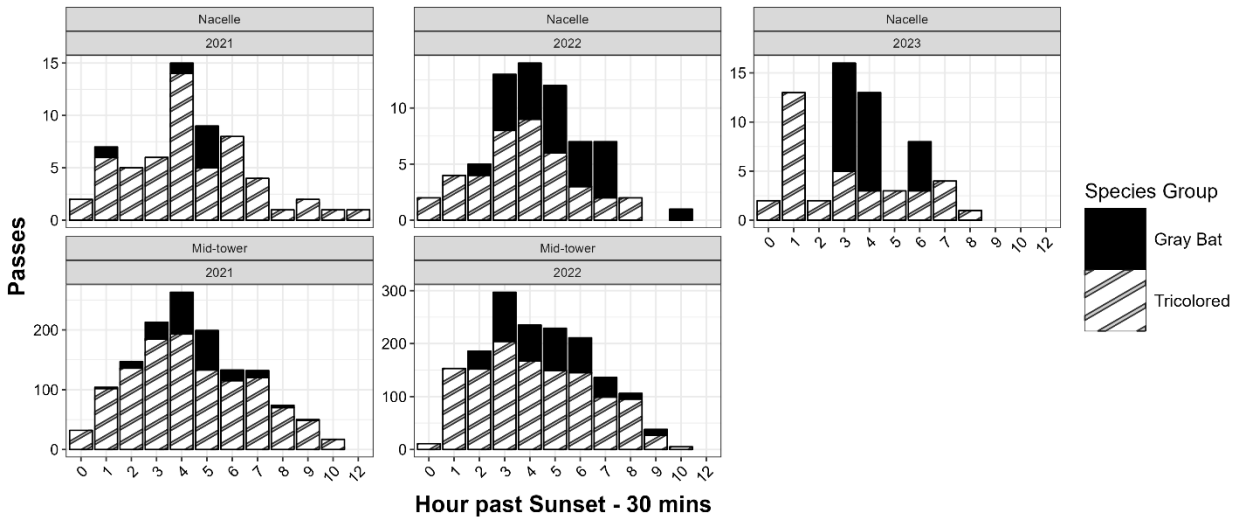

Figure 3-15. Nightly timing of gray bat and tricolored bat activity (by hour past sunset-30 minutes) detected at nacelle and mid-tower detectors during the 2021–2023 monitoring periods at the North Fork Ridge Wind Project. Note that data from mid-tower detectors were not available for 2023.

Temperature, wind speed, and turbine rotor speed data recorded at nacelle height were available during 10-minute intervals in which 89,709 bat passes (95% of 94,531 total bat passes) were detected at Kings Point in 2021 through 2023. 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 3-16). Gray bats and tricolored bats were distributed during somewhat higher wind speeds at mid-tower versus nacelle height detectors and tricolored bats tended to be active during higher wind speeds than gray bats at both nacelle and mid-tower detectors (Figure 3-17, Figure 3-18)

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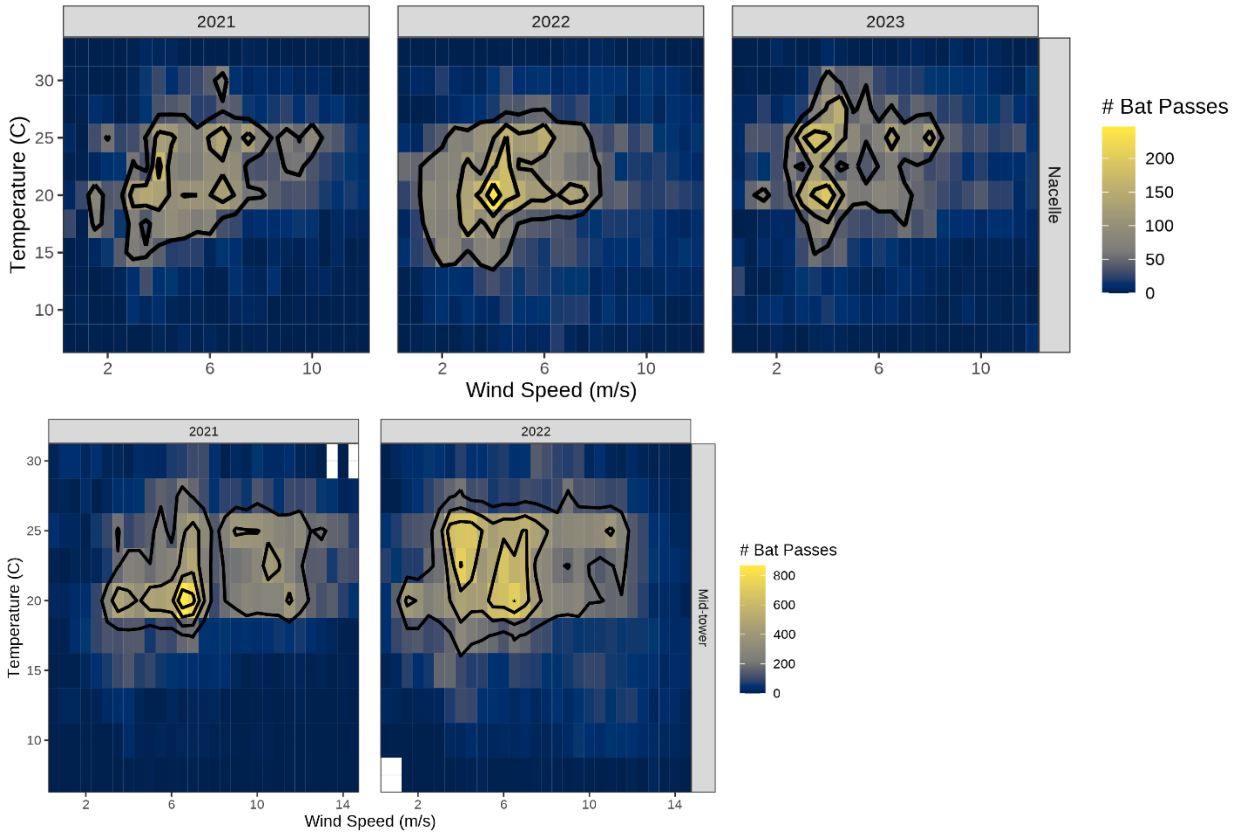

Figure 3-16. Distribution of all bat passes (all species) as a function of wind speed and temperature recorded at nacelle-height (upper panels) and mid-tower detectors (lower panels) by year at the North Fork Ridge Wind Project. Black contour lines represent data within each 25% percentile. Note that data from mid-tower detectors were not available for 2023

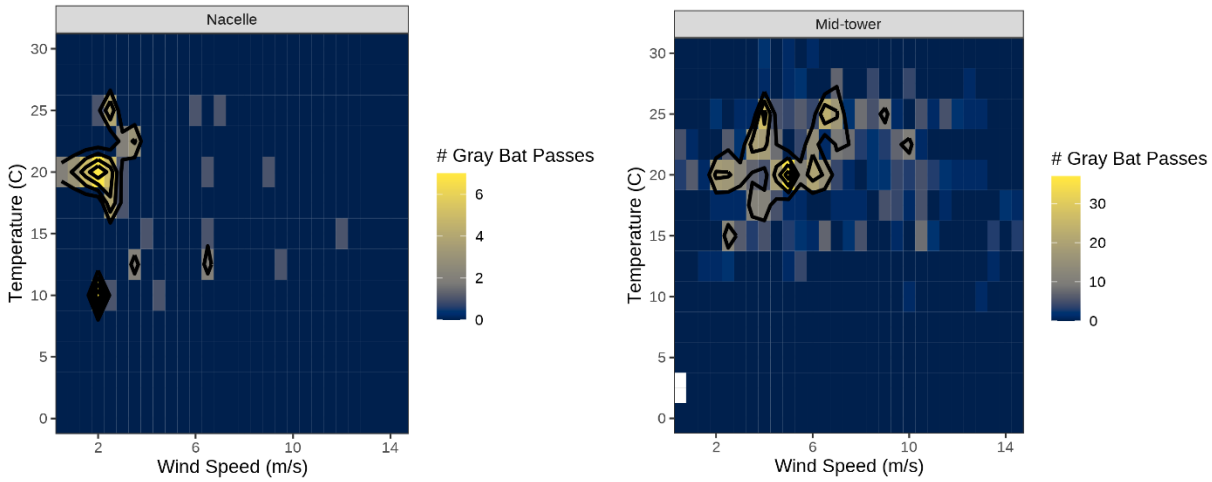

Figure 3-17. Distribution of gray bat passes as a function of wind speed and temperature by detector position during 2021–2023 acoustic monitoring at the North Fork Ridge Wind Project. Black contour lines represent data within each 25% percentile. Note that data from mid-tower detectors were not available for 2023.

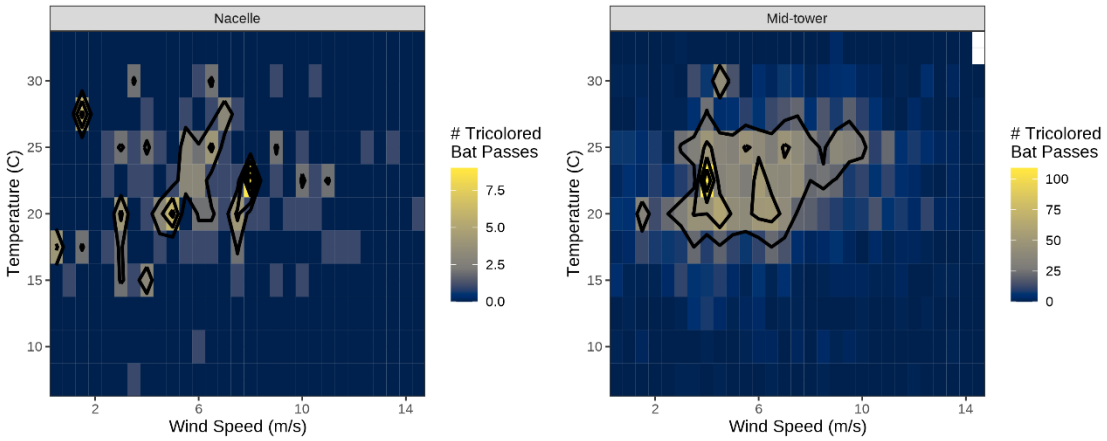

Figure 3-18. Distribution of tricolored bat passes as a function of wind speed and temperature by detector position during 2021–2023 acoustic monitoring at the North Fork Ridge Wind Project. Black contour lines represent data within each 25% percentile. Note that data from mid-tower detectors were not available for 2023.

Acoustic monitoring at North Fork Ridge in 2021–2022 encompassed periods in which three turbine operational treatments were implemented. Before August 30, 2021[1], all turbines were operated according to an interim (TAL) curtailment strategy with an 8 m/s cut-in speed. From August 30–November 17, 2021 and April 1–October 31, 2022 and 2023, 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 15% of bat passes recorded at nacelles and 34% 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). In 2022, control turbines exposed 78.6% of bat activity while treatment turbines exposed 46.6%. The 2022 proportions are comparable to 2023 where Stantec measured 81.0% of bat passes exposed at control turbines and 43.7% exposed at treatment turbines (Figure 3-19). The 5.0 m/s treatment blanket curtailment strategy resulted in exposure of 44–67% of bat passes detected at nacelles and 54–69% of passes detected at mid-tower units in 2021 and 2022 compared to exposure of 79–87% of passes detected at control turbines (Table 3-18, Figure 3-20). Exposure of gray bat and tricolored bat passes to turbine operation generally followed similar trends among treatments at both detector positions during each year, although a lower percentage of gray bat passes were exposed to turbine operation than tricolored bats.

[1] The 2022 report incorrectly stated that the interim period ended on September 7, 2021 and also used that date in calculations for acoustic exposure per treatment. Table 3-18 has been updated to reflect the correct transition date.

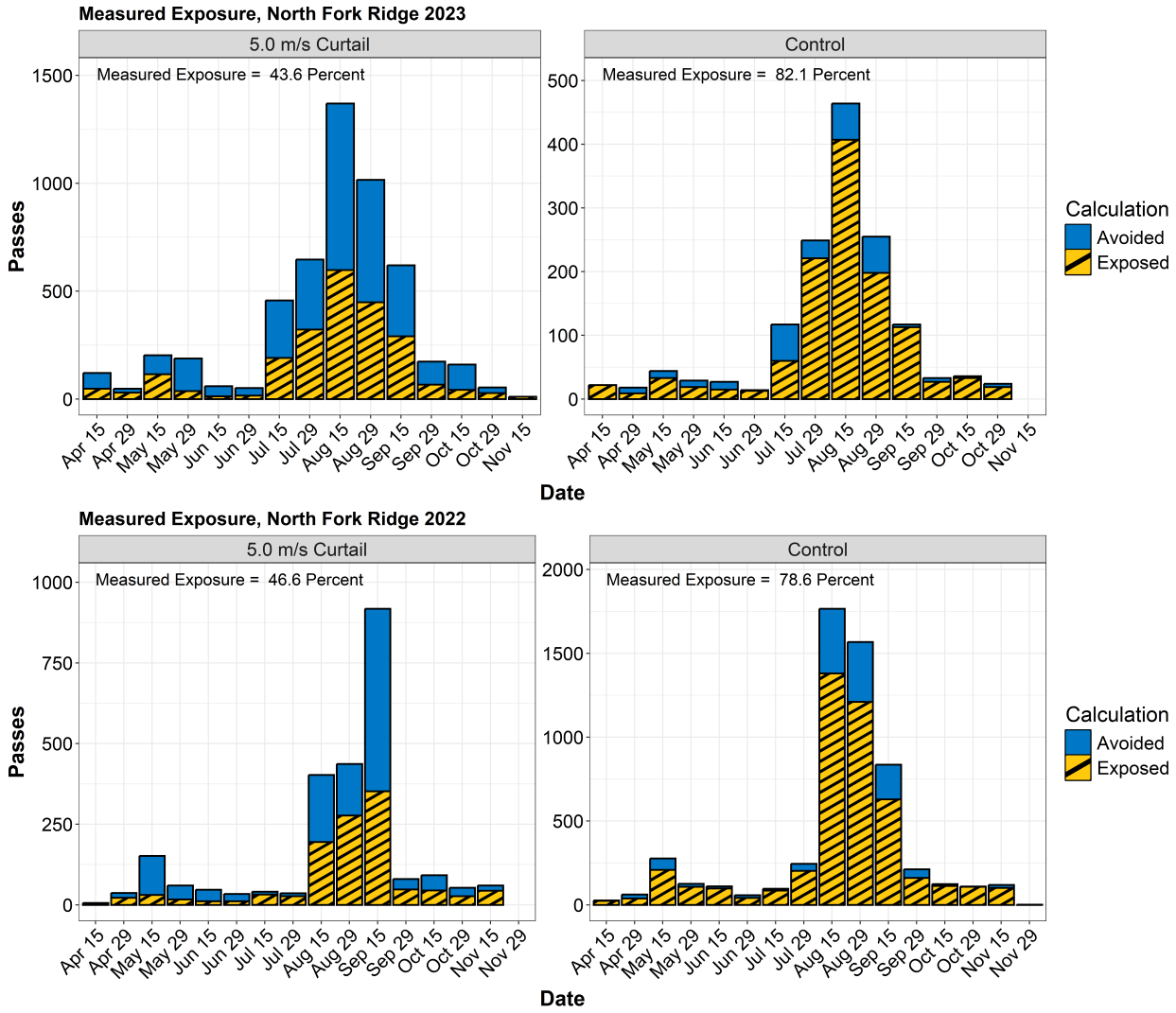

Figure 3-19. Biweekly distribution of bat activity and acoustic exposure recorded in 2022 and 2023 by nacelle height detectors at turbines operating with 3.0 m/s (control) and 5.0 m/s (curtailed) cut-in speeds at the North Fork Ridge Wind Project.

Table 3-18. 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	27	3,169	0 (0%)	4 (15%)	461 (15%)
2021	Nacelle	5.0 m/s Treatment	8	5	9	1,828	0 (0%)	7 (78%)	1,1239 (68%)
2021	Nacelle	3.0 m/s Control	7	0	19	1,438	0 (0%)	17 (89%)	1,254 (87%)
2021	Mid-tower	8.0 m/s TAL	5	74	990	18,793	20 (27%)	252 (25%)	6,473 (34%)
2021	Mid-tower	5.0 m/s Treatment	3	100	119	3,824	62 (62%)	84 (71%)	2,634 (69%)
2021	Mid-tower	3.0 m/s Control	2	38	43	2,632	34 (0%)	41 (95%)	2,290 (87%)
2022	Nacelle	5.0 m/s Treatment	8	8	10	2,456	1 (13%)	8 (80%)	1,144 (47%)
2022	Nacelle	3.0 m/s Control	7	19	30	5,738	9 (47%)	29 (97%)	4,512 (79%)
2022	Mid-tower	5.0 m/s Treatment	3	247	815	22,303	140 (57%)	428 (53%)	12,026 (54%)
2022	Mid-tower	3.0 m/s Control	2	153	391	20,816	129 (84%)	307 (79%)	18,003 (86%)
2023	Nacelle	5.0 m/s Treatment	8	22	33	5,180	1 (13%)	19 (86%)	2,259 (44%)
2023	Nacelle	3.0 m/s Control	5	0	3	1,449	0 (0%)	3 (100%)	1,189 (82%)

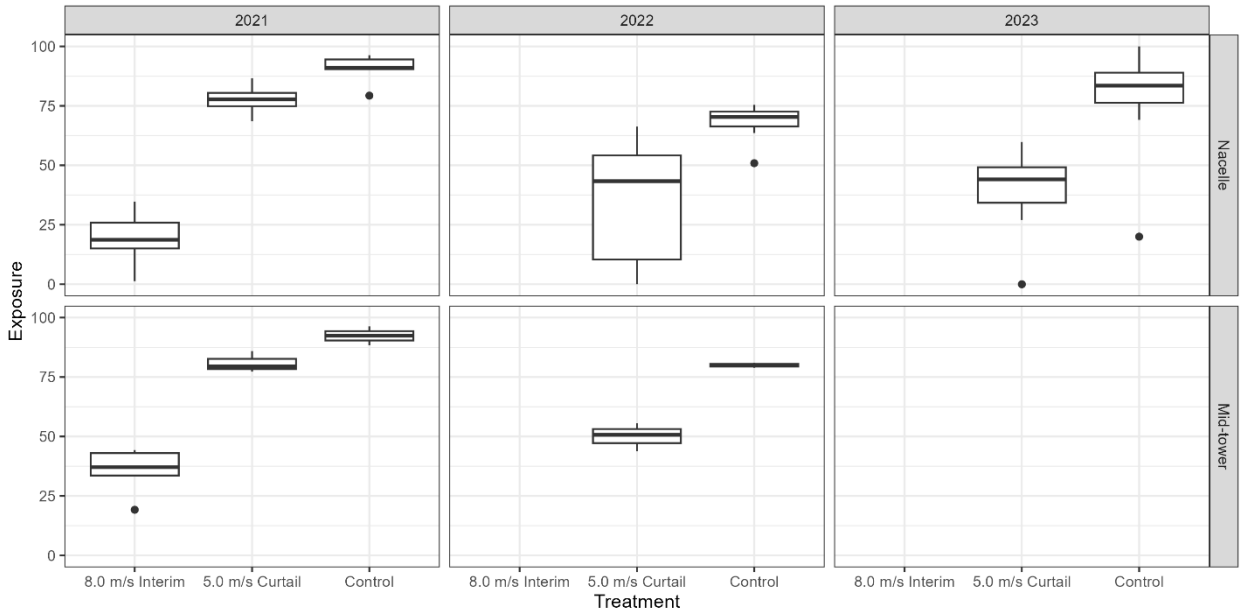

Figure 3-20. Acoustic exposure (percent of bat passes detected when turbine rotor speed was 1 rpm or greater) by operational treatment and detector position during 2021–2023 acoustic monitoring at the North Fork Ridge Wind Project. Note that the 8.0 m/s treatment did not occur in 2022 or 2023, and mid-tower detectors were not deployed in 2023.

3.4 Acoustic Exposure and Fatality

The median bat fatality estimate for the blanket 5.0 m/s curtailment treatment at Kings Point was 15.5% lower than the 3.0 m/s control group in 2022 and 11.7% lower than the control treatment 2023. At North Fork Ridge, the median bat fatality estimate at the 5.0 m/s curtailment treatment was 25.0% lower than the control treatment in 2022 and 31.2% lower than the control group in 2023 (Table 3-19). The percent of bat passes exposed to turbine operation was 32% and 39% lower with curtailment relative to control at Kings Point in 2022 and 2023, respectively. At North Fork Ridge, the 5.0 m/s curtailment strategy reduced the percent of bat passes exposed to turbine operation by 41% in 2022 and 47% in 2023 based on nacelle-height data (Table 3-19). Overall, the percent of passes exposed to turbine operation was similar between sites and years for each curtailment treatment.

Bat activity levels and the corresponding rate of acoustic exposure following relatively consistent seasonal patterns at Kings Point and North Fork Ridge in 2022 and 2023 (Figure 3-13 and Figure 3-19), with the seasonal distribution of bat carcasses following a similar pattern. The biweekly rate of bat passes exposed to turbine operation explained a significant amount of variation in the area-corrected number of bat carcasses found per turbine search when fatalities and acoustic data were pooled across turbines (Figure 3-21). This temporal relationship was similar between projects. Seasonal patterns were similar between nacelle height and mid-tower detectors in 2022, but data from mid-tower detectors were

not available for 2023. The cumulative biweekly exposure of bat activity, derived by summing biweekly rates of acoustic exposure, was also positively correlated with estimated bat fatality rates when summarized by treatment, site, and year (Figure 3-21). This treatment level relationship was similar between projects.

Table 3-19. Estimated bat fatality and acoustic exposure during the 2022 and 2023 monitoring period at the Kings Point and North Fork Ridge Wind Projects.

Site	Year	Treatment	# Bat Carcasses	Median Fatality Est.	Nacelle Acoustic		Mid-tower Acoustic	
					Exposed Passes/DN	Percent	Exposed Passes/DN	Percent
Kings Point	2022	Control	150	2,186	2.1	81.6%	36.2	86.8%
		Treatment	123	1,848	2.0	55.3%	24.7	65.2%
	2023	Control	602	1,517	4.1	83.4%	-	-
		Treatment	479	1,340	2.3	51.0%	-	-
North Fork Ridge	2022	Control	170	1,689	3.2	78.6%	48.6	86.5%
		Treatment	85	1,267	0.7	46.0%	21.9	53.9%
	2023	Control	521	1,725	0.9	82.1%	-	-
		Treatment	357	1,186	1.5	43.6%	-	-

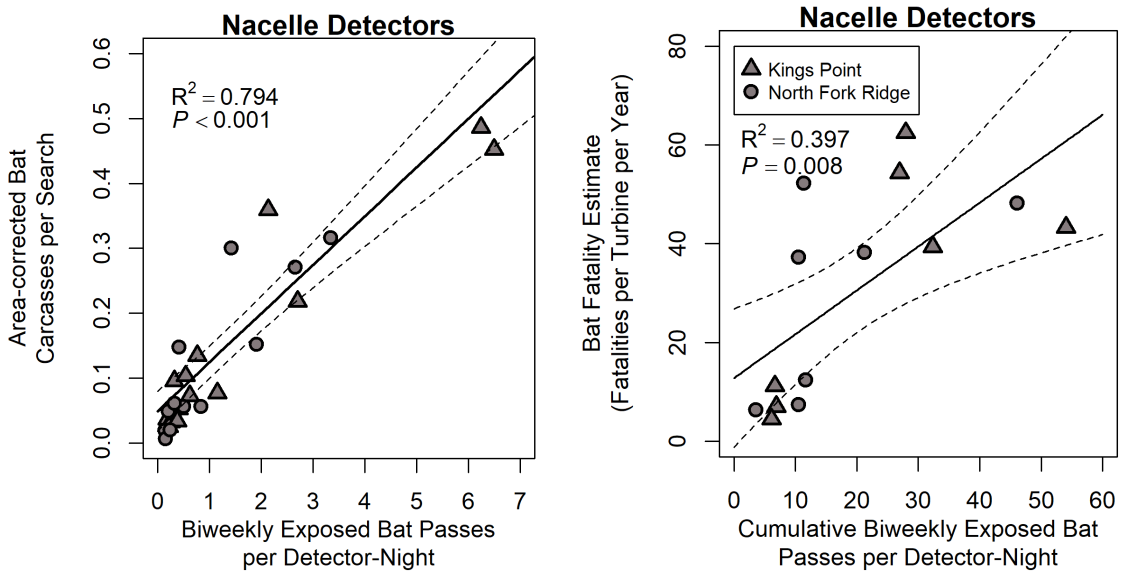

Figure 3-21. Bat fatality as a function of acoustic exposure summarized per turbine at a biweekly level (left) and per treatment (right) based on nacelle-height monitoring in 2022 and 2023 monitoring at the Kings Point and North Fork Ridge Wind Energy Projects.

3.4.1 Alternative Curtailment Evaluation

Based on a comparison of the alignment between measured and simulated exposure (Figure 3-22) curtailment treatments operated as assigned. Simulated and measured acoustic exposure measured at nacelle-height detectors (2022 and 2023) and mid-tower detectors (2022) were closely aligned, indicating that turbines generally operated according to the parameters of their corresponding curtailment treatment.

Combining datasets from nacelle-height detectors in 2022 and 2023, 95.4% of bat passes recorded at Kings Point and 90.3% of bat passes recorded at North Fork Ridge would have been exposed to turbine operation had turbines been operated without feathering below manufacturer's cut-in speed (which reduced exposure to 89.0% at Kings Point and 84.4% at North Fork Ridge (Figure 3-23). Simulated acoustic exposure for all bat passes for the 5.0 m/s curtailment strategy was 57.2% at Kings Point and 50.1% at North Fork Ridge, and the interim 8.0 m/s curtailment strategy reduced exposure to 25.0% at Kings Point and 19.3% at North Fork Ridge (Figure 3-20). Simulated acoustic exposure was also calculated at the species level for gray (Figure 3-24) and tricolored bats (Figure 3-25). Simulated acoustic exposure for gray bat passes for the 5.0 m/s curtailment strategy was 23.6% at Kings Point and 12.2% at North Fork Ridge, and the TCBA 10 curtailment strategy simulated exposure was 26.4% at Kings Point and 18.4% at North Fork Ridge. Simulated acoustic exposure calculated for tricolored bat passes for the 5.0 m/s curtailment strategy was 65.9% at Kings Point and 65.8% at North Fork Ridge, and the TCBA 10 curtailment strategy simulated exposure at 22.4% at Kings Point and 30.3% at North Fork Ridge. The TCBA 10 curtailment strategy when compared to 5.0 m/s curtailment strategy reduced simulated acoustic exposure for bats overall and tricolored bats at both sites and increased acoustic exposure for gray bats at both sites.

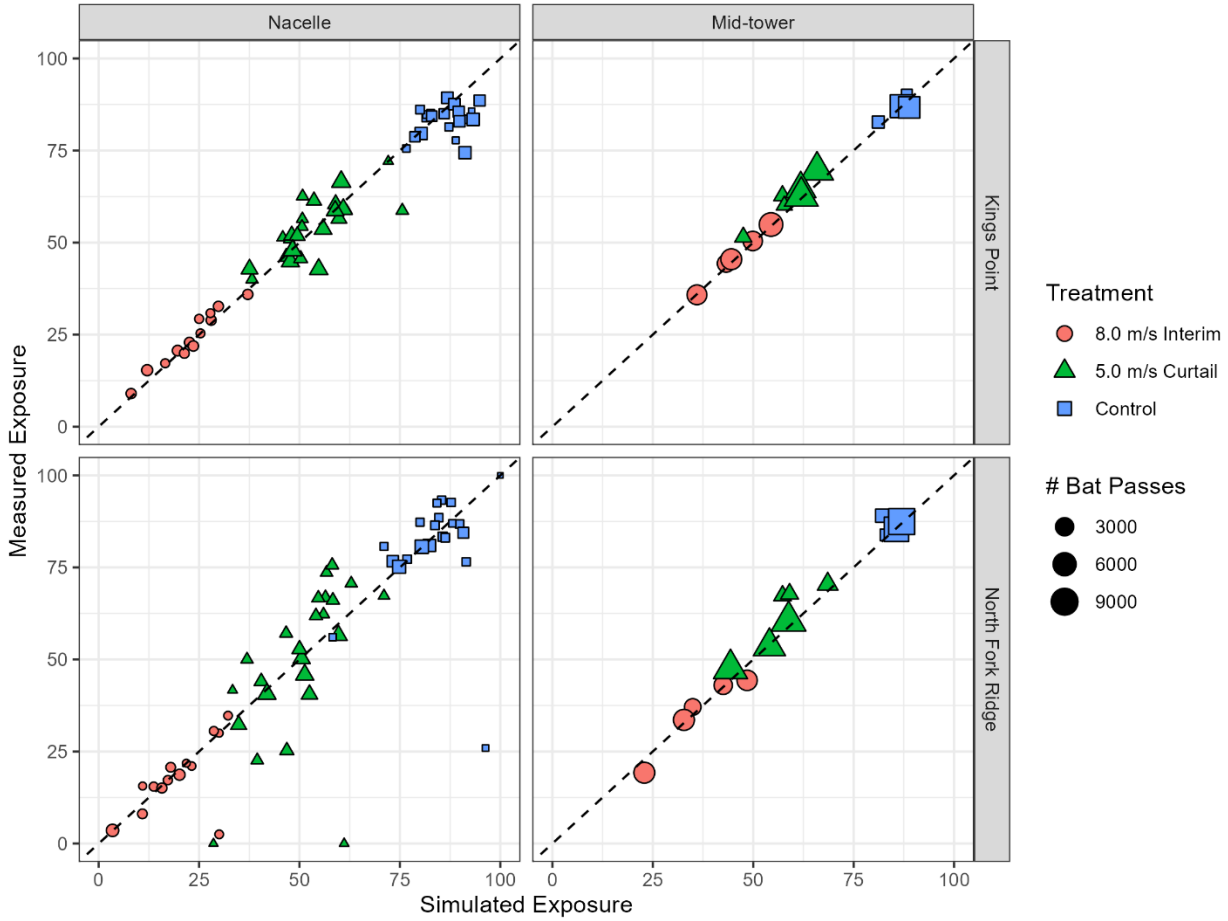

Figure 3-22. Measured versus simulated acoustic exposure calculated per turbine and treatment based on nacelle height and mid-tower acoustic monitoring at Kings Point and North Fork Ridge Wind Energy Projects in 2022 and 2023.

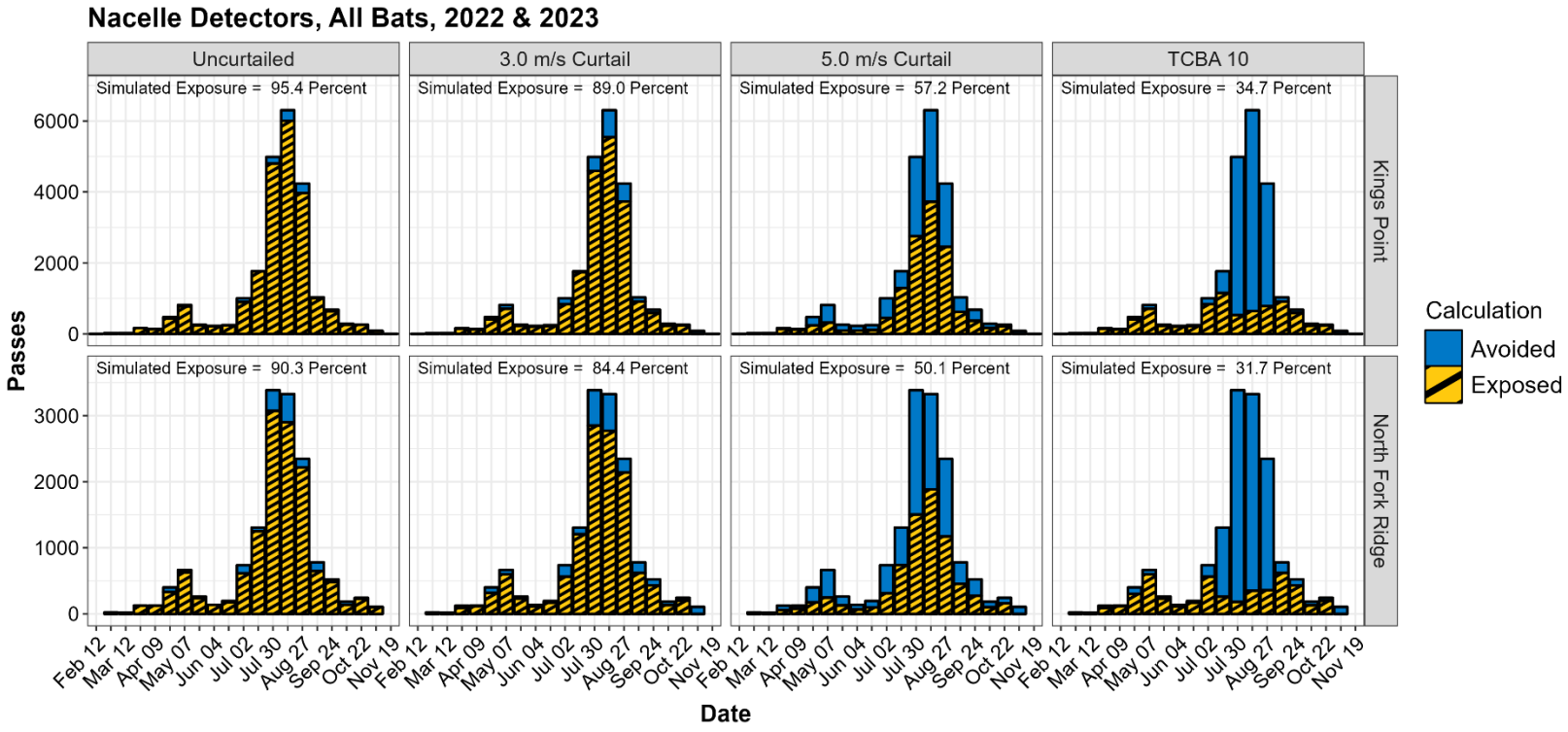

Figure 3-23. Biweekly acoustic exposure (bat passes detector when turbine rotor speed was 1 rpm or greater) simulated by operational treatment and detector position based on nacelle height monitoring in 2022 and 2023 at Kings Point and North Fork Ridge Wind Projects.

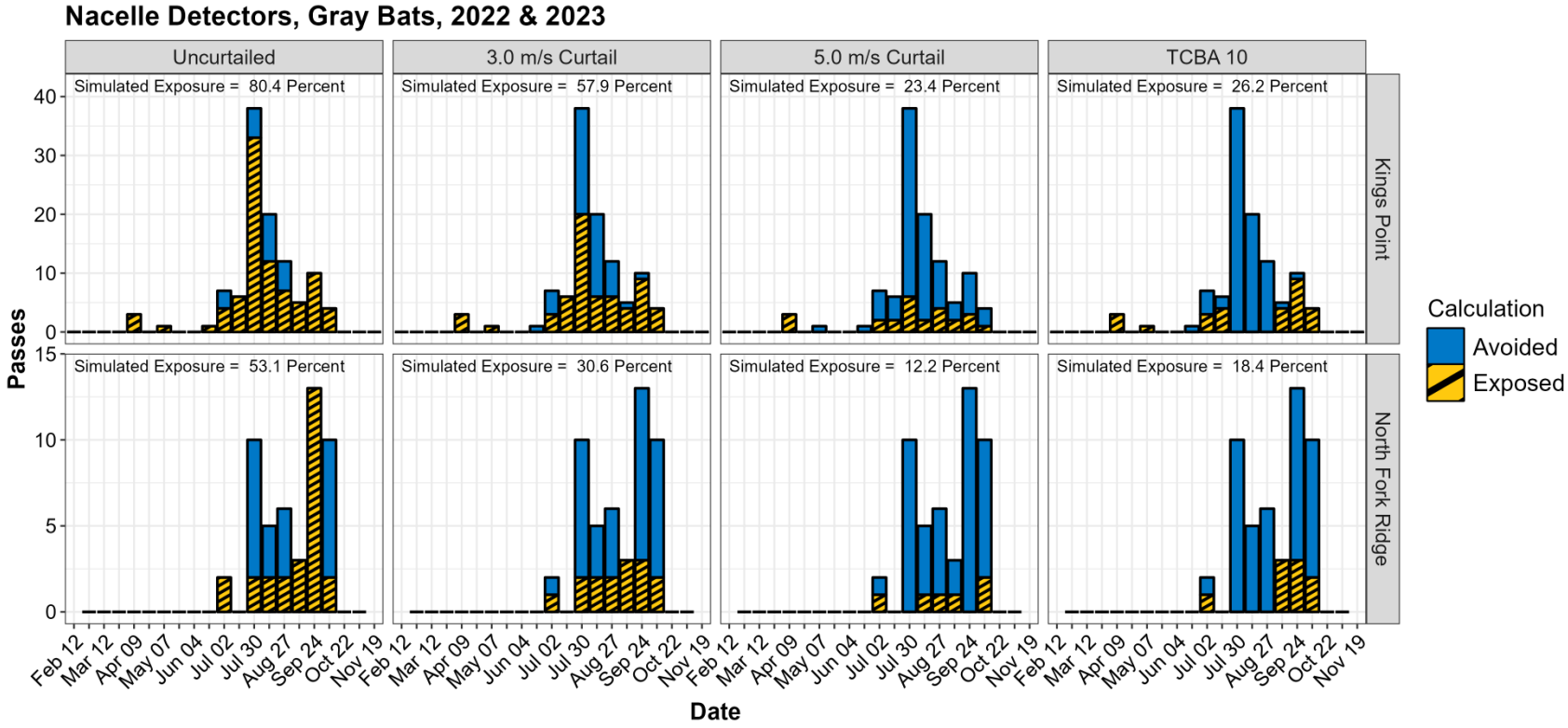

Figure 3-24. Biweekly acoustic exposure (bat passes recorded when turbine rotor speed was 1 rpm or greater) for gray bats simulated by operational treatment and detector position based on nacelle height monitoring in 2022 and 2023 at Kings Point and North Fork Ridge Wind Projects.

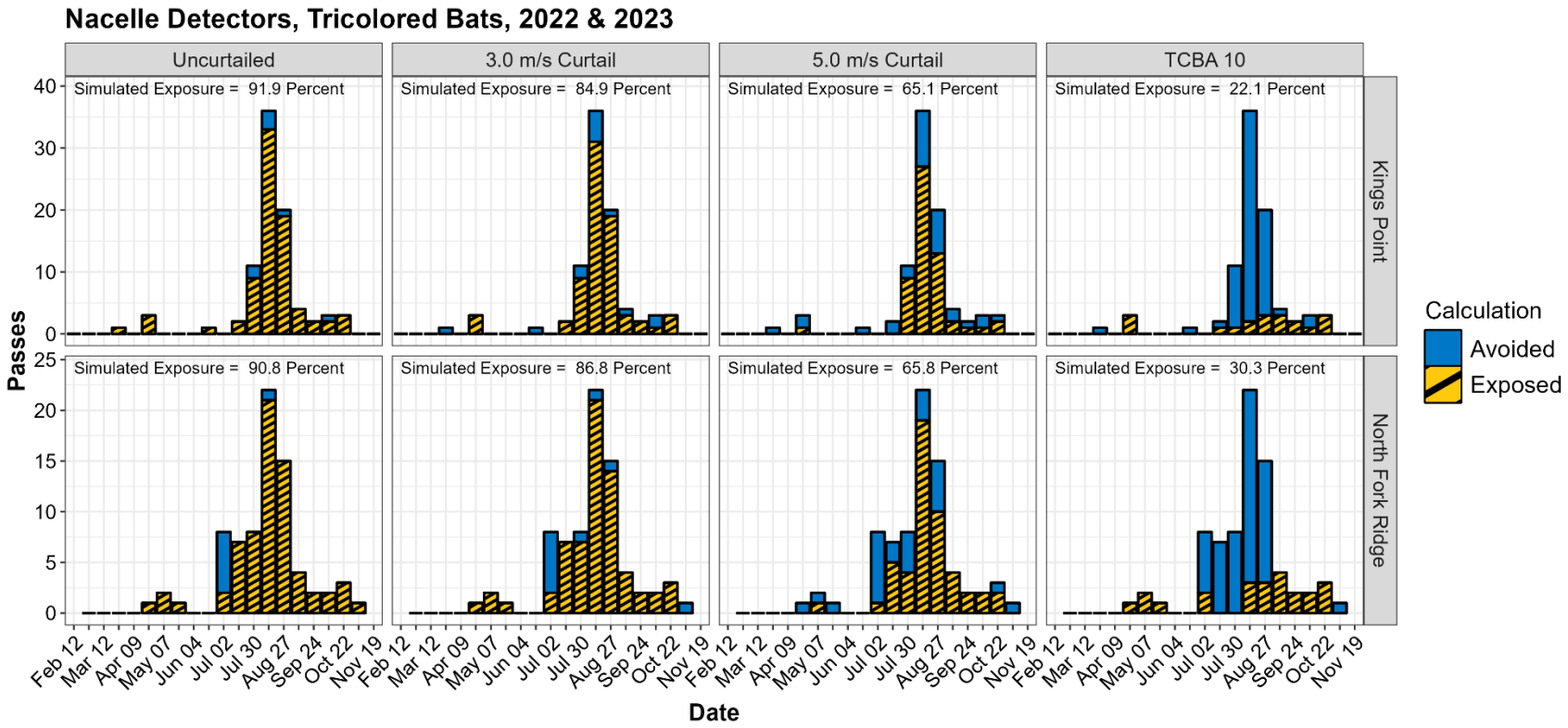

Figure 3-25. Biweekly acoustic exposure (bat passes recorded when turbine rotor speed was 1 rpm or greater) for tricolored bats simulated by operational treatment and detector position based on nacelle height monitoring in 2022 and 2023 at Kings Point and North Fork Ridge Wind Projects.

Table 3-20. Parameters of site-specific curtailment strategy (TCBA 10) designed to reduce acoustic exposure by 60% relative to uncurtailed turbine operation at the Kings Point and North Fork Ridge Wind Projects.

Date Range	Cut-in Wind Speed*		Temperature Threshold
	Kings Point	North Fork Ridge	
Apr 1 – Jul 18	3 m/s	3 m/s	10° C
Jul 18 – 25	3 m/s	10 m/s	10° C
Jul 25 – Sep 7	10 m/s	10 m/s	10° C
Sep 7 – Oct 31	3 m/s	3 m/s	10° C

* Cut-in speeds to be implemented from 30 minutes before sunset until 30 minutes after sunrise each night during the 3 m/s curtailment periods and from 30 minutes after sunset until 30 minutes before sunrise each night during the 10 m/s curtailment periods.

4 Discussion

This report includes the results of the post-construction fatality monitoring and acoustic monitoring from 2021 through 2023 and concludes Phase I of the study. The study is ongoing, and additional data will be collected in 2024 and 2025 which will further inform the study objectives outlined for Phase II including a test of a revised curtailment strategy designed to achieve a greater than 60% reduction in bat fatalities.

Gray bat fatalities have been observed during all seasons (spring, summer, fall) of the study and are highest during late summer/early fall. The 2023 surveys included the first observed fatalities of gray bats during the spring season, which may have been a result of a higher detection probability (g-value > 0.31 for both projects) compared to previous years when detection probabilities were lower (<0.14). Maternity colonies are present in proximity to the Projects, which may explain the prevalence of females as observed fatalities.

- Biweekly bat acoustic activity for all bats followed similar seasonal trends at both projects across the three years of sampling. Acoustic activity is relatively low from March through early July, with a sharp increase in mid-July, a peak in mid-August before levels drop again in mid-September (Appendix C, Figures 1 and 2).
- Fatality rates of gray bats and tricolored bats at both Projects followed a similar seasonal trend as the bat acoustic activity, with few fatalities in early spring and most occurring from mid-July to mid-September (Section 3.2.5, Section 3.3.5; Table 3-7, Table 3-15).
- There is a strong relationship between fatality and acoustic exposure temporally at the turbine and at the treatment level (Section 3.4; Figure 3-21).
- Evaluation of the proposed TCBA 10 curtailment strategy lowered simulated acoustic exposure for all bats and tricolored bats but increased acoustic exposure for gray bats (Section 3.4.1; Figure 3-23, Figure 3-24, Figure 3-25).

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 4-1). Annual gray bat take rates have been 2-5 times higher at Kings Point compared to North Fork Ridge, but the difference between the Project's median annual fatality rates was least pronounced in 2023. Take rates at both Projects were higher in 2022 and 2023 than they were in 2021 which is likely due to differences in the curtailment strategy.

Table 4-1. Summary of turbine-related gray bat fatality rates from 2021, 2022 and 2023 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)
Kings Point	2023	5 m/s, 3 m/s	44.6 (24.6 – 70.54)
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)
North Fork Ridge	2023	5 m/s, 3 m/s	17.2 (5.98 – 37.41)

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 (See Section 3.4). Bat fatality and acoustic exposure were strongly correlated at the biweekly level, suggesting that variation in acoustic exposure provides a useful indicator of fatality risk on fine temporal scales (Figure 3-21).

Acoustic monitoring in 2022 and 2023 provides a strong 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 deployed in 2022 also 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 2024 and 2025 will enable more rigorous evaluation of relationships between acoustic exposure and bat fatality rates on multiple temporal and spatial scales.

5 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.

Hale, A., L. Voorhees, A. Ciecka, F. Kulzer, and D. Riser-Espinoza. 2024a. Post-Construction Monitoring Study for the Kings Point Wind Project, Barton, Dade, Jasper, and Lawrence counties, Missouri. Draft Report: July 1 – September 30, 2023. Prepared for Empire District – Liberty Utilities (Central Region), Joplin, Missouri. Prepared by Western EcoSystems Technology, Inc. (WEST), Bloomington, Indiana. January 31, 2024.

Hale, A., L. Voorhees, A. Ciecka, F. Kulzer, and D. Riser-Espinoza. 2024b. Post-construction Monitoring Study for the North Fork Ridge Wind Project, Barton and Jasper Counties, Missouri. Draft Report: July 1 – September 30, 2023. Prepared for Empire District – Liberty Utilities (Central Region), Joplin, Missouri. Prepared by Western EcoSystems Technology, Inc. (WEST). Bloomington, Indiana. January 31, 2024.

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

Stantec. 2023. 10(a)(1)(A) Permit # ESPER0011726 Annual Report - 2022. Prepared for: Empire District Electric Company. January 31, 2023.

Appendix A Figures

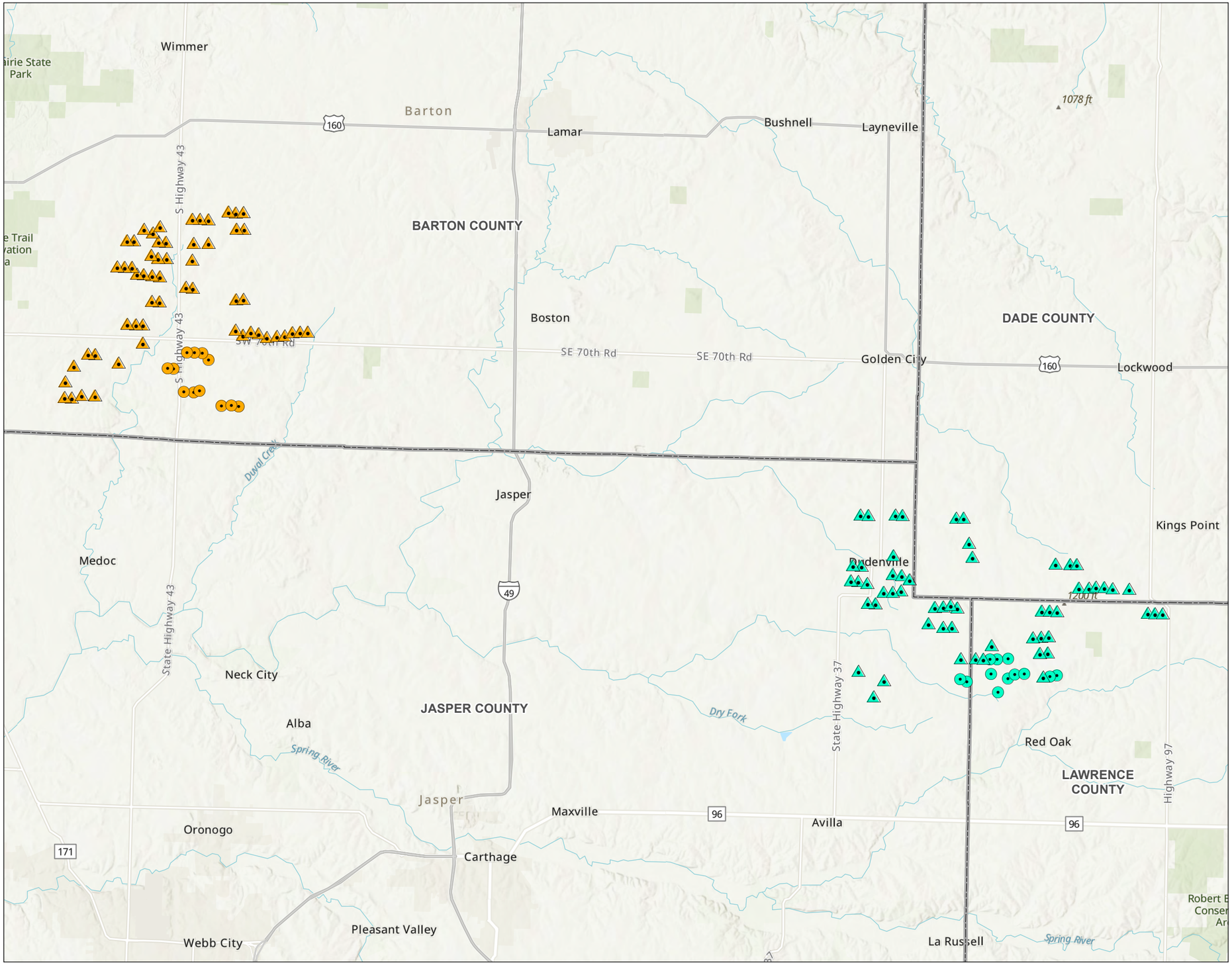


Figure No.

A-1

Title

Kings Point and North Fork Ridge Wind Project Locations

Client/Project 193708398

Liberty
Kings Point Wind Project
North Fork Ridge 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

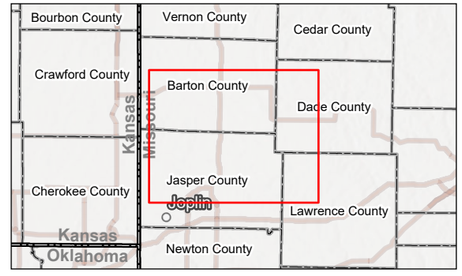
0 1.5 3 Miles

(At original document size of 11x17)
1:190,080

Legend

Kings Point Wind Turbine
- Vestas 110 2.0 MW
- Vestas 120 2.2 MW

North Fork Ridge Wind Turbine
- Vestas 110 2.0 MW
- Vestas 120 2.2 MW



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

Stantec

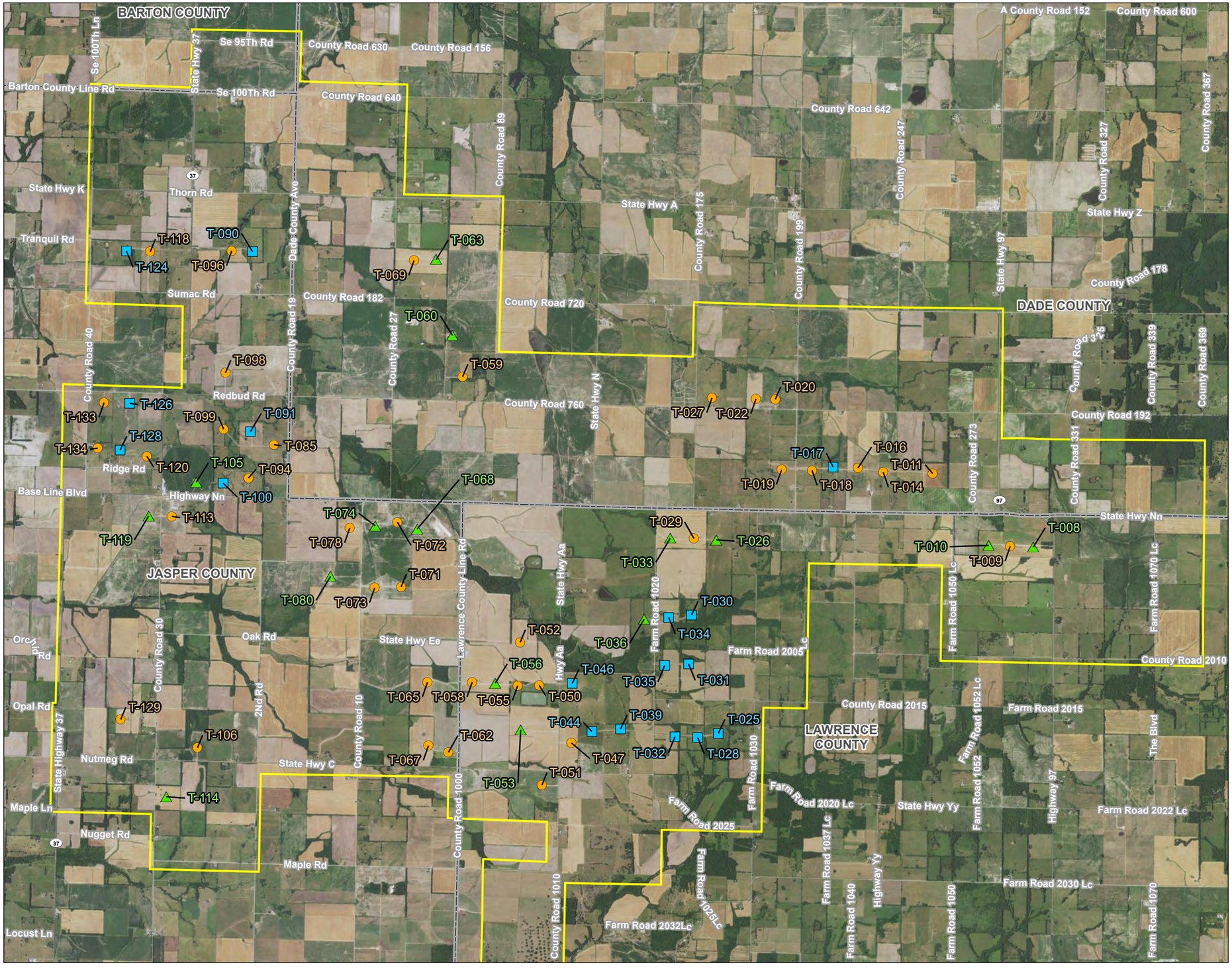


Figure No.

A-2

Title

Post Construction Fatality Monitoring Turbine Plot Type – 2023

Client/Project
Liberty
Kings Point Wind Project

193708398

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

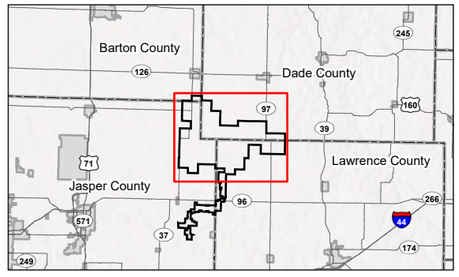
Prepared by SR on 2023-11-17
TR by SP on 2023-09-15
IR by JF on 2023-09-15

N

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

Legend

- Project Boundary
- Turbine
- Search Plot Type
  - 80-m Cleared Plot (Human Searchers)
  - 80-m Cleared Plot (Dog Searchers)
  - Road and Pad (Human Searchers)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

Stantec

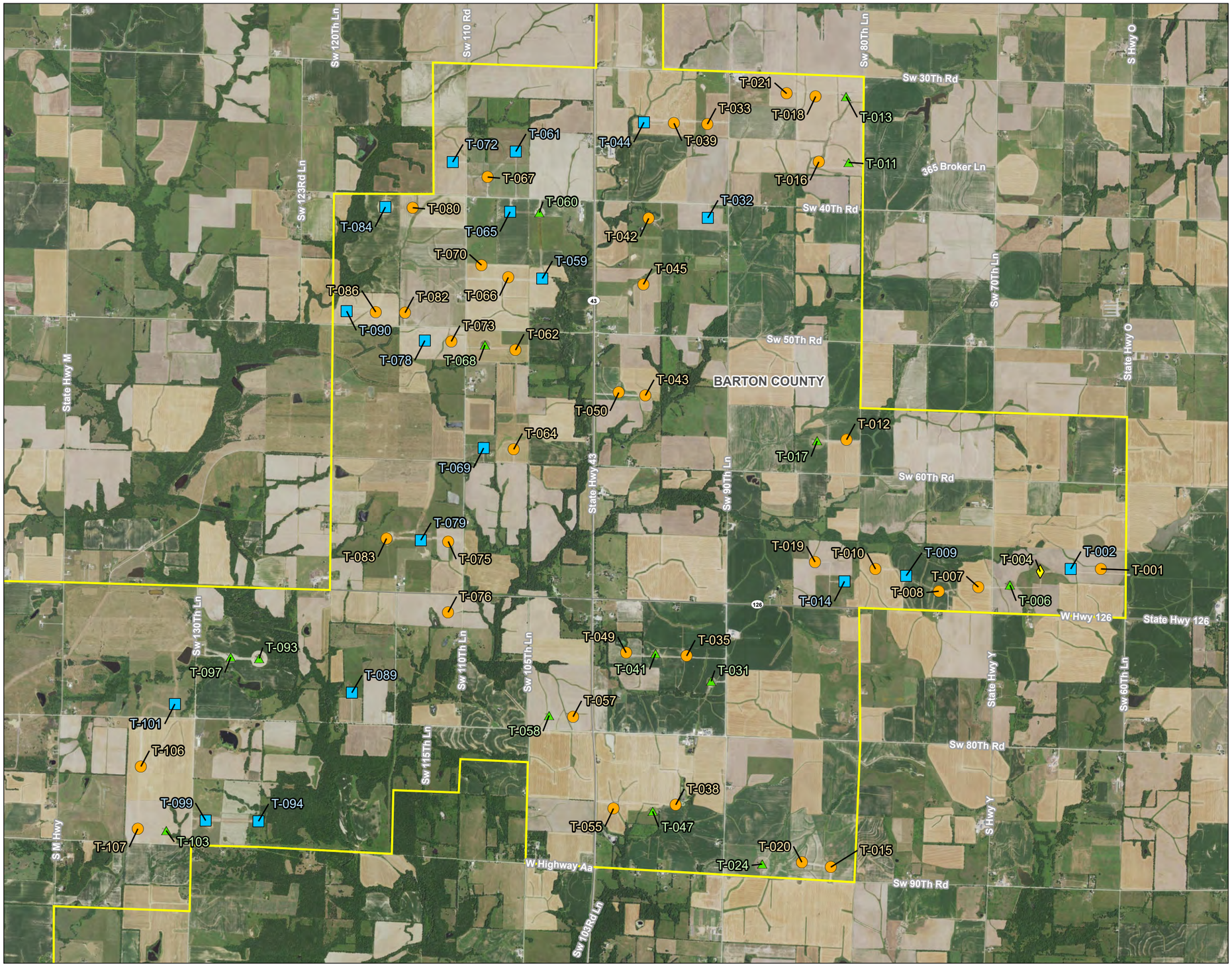


Figure No.

A-3

Title

Post Construction Fatality Monitoring
Turbine Plot Type - 2023

Client/Project 193708398

Liberty
North Fork Ridge Wind Project

Project Location
Barton and Jasper Co., MO

Prepared by SR on 2023-11-17
TR by SP on 2023-09-15
IR by JF on 2023-09-15

N

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

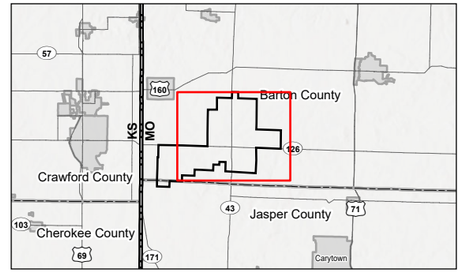
Legend

- Project Boundary

Turbine

Search Plot Type

- 80-m Cleared Plot (Human Searchers)
- 80-m Cleared Plot (Dog Searchers)
- Road and Pad (Human Searchers)
- Road and Pad (Human Searchers) converted to 80-m Cleared Plot (Dog Searchers)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

Stantec

Figure No.

A-4

Title

Kings Point Turbine Curtailment 2023 Gray Bat and Tricolored Bat Carcass Observations

Client/Project

Liberty
Kings Point Wind Project

193708398

Project Location

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

Prepared by SR on 2023-11-17
TR by SP on 2023-09-15
IR by JF on 2023-09-15

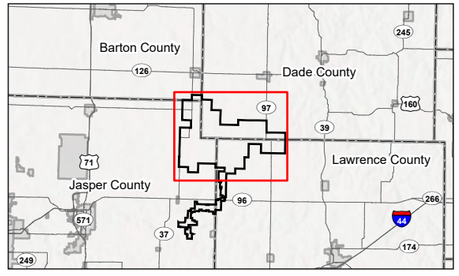
N

0 0.5 1 Miles

(At original document size of 11x17)
1:63,360

Legend

- Project Boundary
- Turbine
- Detector Type and Cut in Speed
  - No Bat Detector - Control Cut-in Speed (3m/s)
  - Nacelle-mounted - Control Cut-in Speed (3m/s)
  - No Bat Detector - Treatment Cut-in Speed (5m/s)
  - Nacelle-mounted - Treatment Cut-in Speed (5m/s)
- Gray Bat Carcass Observed
- Tricolored Bat Carcass Observed



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

Stantec

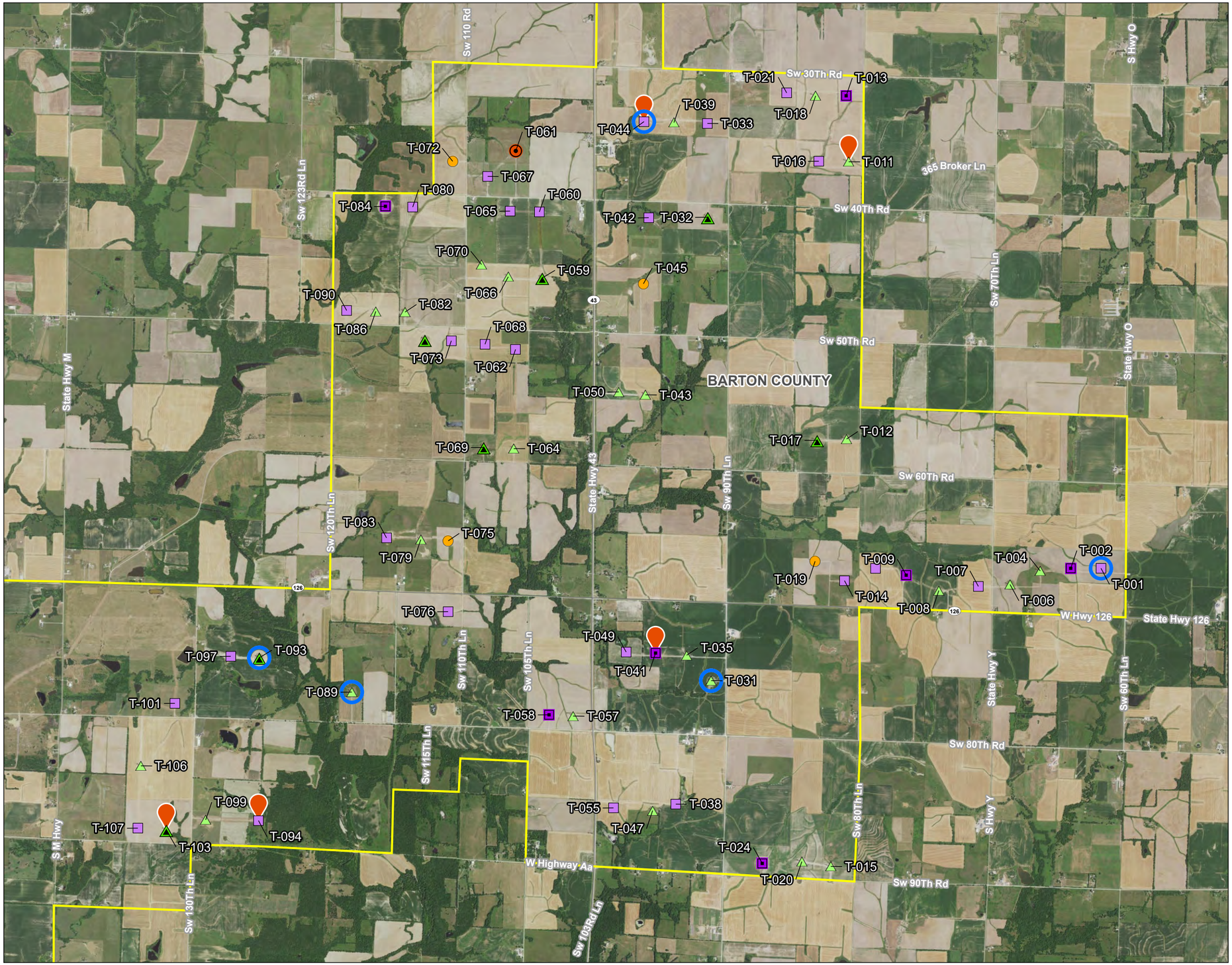


Figure No.

A-5

Title

North Fork Ridge Turbine Curtailment 2023 Gray Bat and Tricolored Bat Carcass Observations

Client/Project

Liberty
North Fork Ridge Wind Project

193708398

Project Location

Barton and Jasper Co., MO

Prepared by SR on 2023-11-17
TR by SP on 2023-09-15
IR by JF on 2023-09-15

N

0 2,000 4,000 US Feet

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

Legend

- Project Boundary
- Turbine
- Detector Type and Cut in Speed
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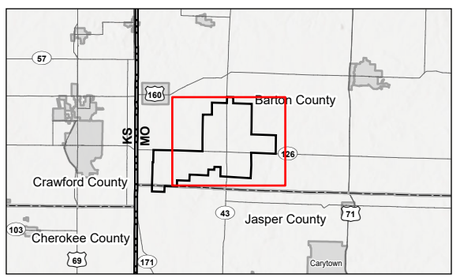
  - Nacelle-mounted - No Searches (Turbine Non-Operational)
  - No Bat Detector - Control Cut-in Speed (3m/s)
  - Nacelle-mounted - Control Cut-in Speed (3m/s)
  - No Bat Detector - Treatment Cut-in Speed (5m/s)
  - Nacelle-mounted - Treatment Cut-in Speed (5m/s)
- Gray Bat Carcass Observed
- Tricolored Bat Carcass Observed



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1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

Stantec

Appendix B GenEst and EofA Model Results

Table B-1. Model comparison results for searcher efficiency trials conducted 2023 at the Kings Point and North Fork Ridge Wind Projects. Selected model shown in bold.

p Formula	k Formula	AICc	deltaAICc
p ~ plot_type	**k fixed at 0.67**	**454.05**	**0**
p ~ plot_type + season	k fixed at 0.67	455.56	1.51
p ~ constant	k fixed at 0.67	467.35	13.3
p ~ season	k fixed at 0.67	470.94	16.89
p ~ searcher	k fixed at 0.67	478.68	24.63

Table B-2. Model comparison results for carcass persistence trials conducted in 2023 at the Kings Point Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
lognormal	**l ~ constant**	**s ~ constant**	**396.57**	**0**
loglogistic	l ~ constant	s ~ constant	396.67	0.1
lognormal	l ~ constant	s ~ plot_type	397.69	1.12
loglogistic	l ~ plot_type	s ~ constant	398.29	1.72
loglogistic	l ~ constant	s ~ plot_type	398.33	1.76
lognormal	l ~ plot_type	s ~ constant	398.44	1.87
lognormal	l ~ plot_type	s ~ plot_type	399.81	3.24
lognormal	l ~ season	s ~ constant	400.04	3.47
lognormal	l ~ constant	s ~ season	400.08	3.51
loglogistic	l ~ plot_type	s ~ plot_type	400.22	3.65
loglogistic	l ~ season	s ~ constant	400.27	3.7
loglogistic	l ~ constant	s ~ season	400.28	3.71
lognormal	l ~ plot_type + season	s ~ constant	401.43	4.86
lognormal	l ~ constant	s ~ plot_type + season	401.59	5.02
weibull	l ~ constant	s ~ constant	401.61	5.04
loglogistic	l ~ plot_type + season	s ~ constant	401.96	5.39
loglogistic	l ~ constant	s ~ plot_type + season	402.24	5.67

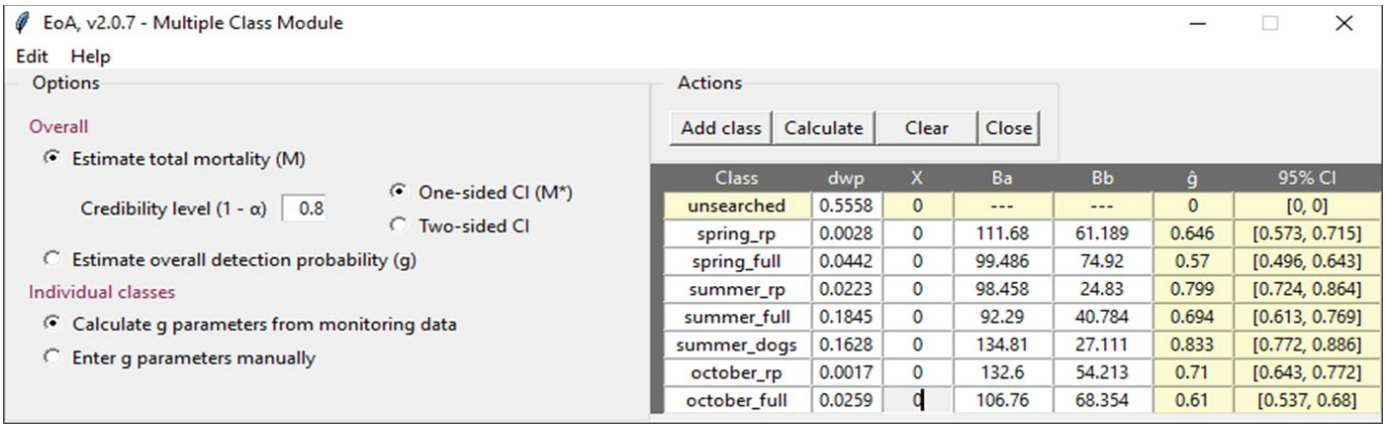
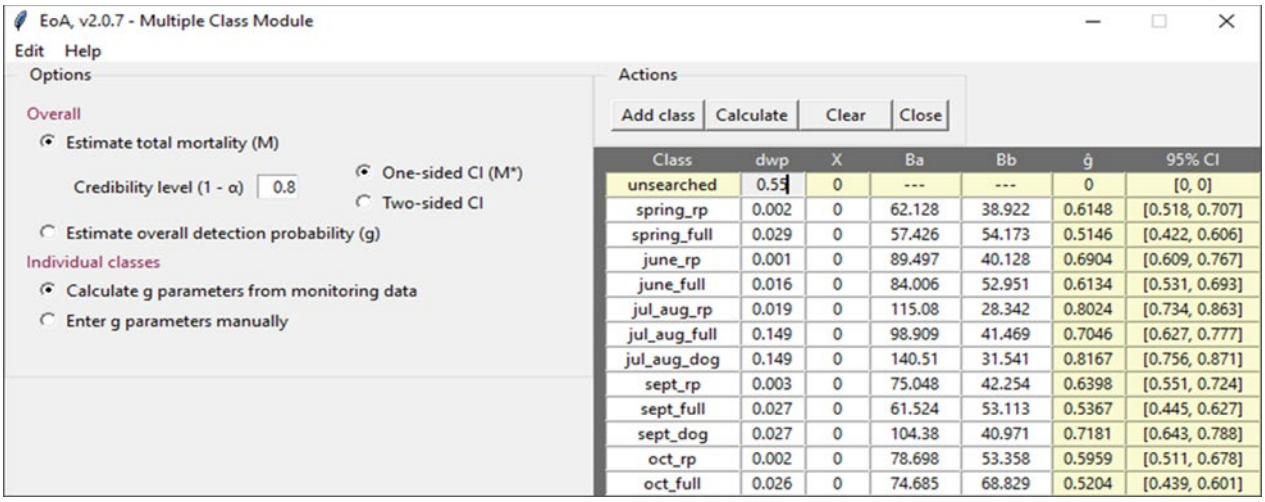


Figure B-1 – Evidence of Absence Multiple Class Module inputs for annual g-value estimates for the Kings Point Wind Project.

Table B-3. Model comparison results for carcass persistence trials conducted in 2023 at the North Fork Ridge Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
exponential	**l ~ season**	**NULL**	**366.34**	**0**
weibull	l ~ season	s ~ constant	368.33	1.99
exponential	l ~ constant	NULL	368.86	2.52
exponential	l ~ plot_type + season	NULL	369.69	3.35
weibull	l ~ constant	s ~ constant	370.13	3.79
lognormal	l ~ season	s ~ constant	371.36	5.02
exponential	l ~ plot_type	NULL	371.8	5.46
weibull	l ~ plot_type + season	s ~ constant	371.85	5.51
weibull	l ~ season	s ~ season	371.88	5.54



Class	dwp	X	Ba	Bb	ĝ	95% CI
unsearched	0.55	0	---	---	0	[0, 0]
spring_rp	0.002	0	62.128	38.922	0.6148	[0.518, 0.707]
spring_full	0.029	0	57.426	54.173	0.5146	[0.422, 0.606]
june_rp	0.001	0	89.497	40.128	0.6904	[0.609, 0.767]
june_full	0.016	0	84.006	52.951	0.6134	[0.531, 0.693]
jul_aug_rp	0.019	0	115.08	28.342	0.8024	[0.734, 0.863]
jul_aug_full	0.149	0	98.909	41.469	0.7046	[0.627, 0.777]
jul_aug_dog	0.149	0	140.51	31.541	0.8167	[0.756, 0.871]
sept_rp	0.003	0	75.048	42.254	0.6398	[0.551, 0.724]
sept_full	0.027	0	61.524	53.113	0.5367	[0.445, 0.627]
sept_dog	0.027	0	104.38	40.971	0.7181	[0.643, 0.788]
oct_rp	0.002	0	78.698	53.358	0.5959	[0.511, 0.678]
oct_full	0.026	0	74.685	68.829	0.5204	[0.439, 0.601]

Figure B-2 – Evidence of Absence Multiple Class Module inputs for annual g-value estimates for the North Fork Ridge Wind Project.

Appendix C Acoustic Bat Activity Figures

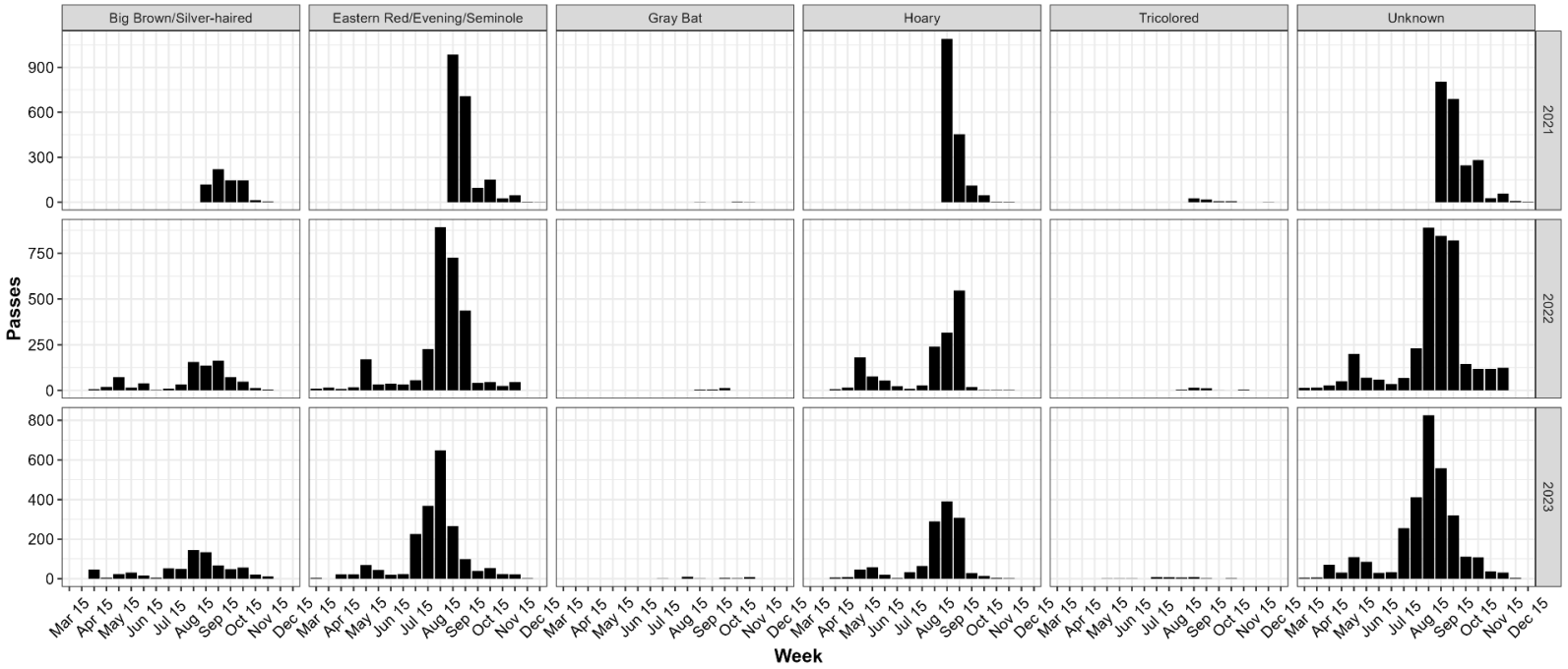


Figure 1 - Biweekly acoustic bat activity for each species/species group detected at nacelle-height detectors during the 2021, 2022, and 2023 monitoring periods at the Kings Point Wind Project.

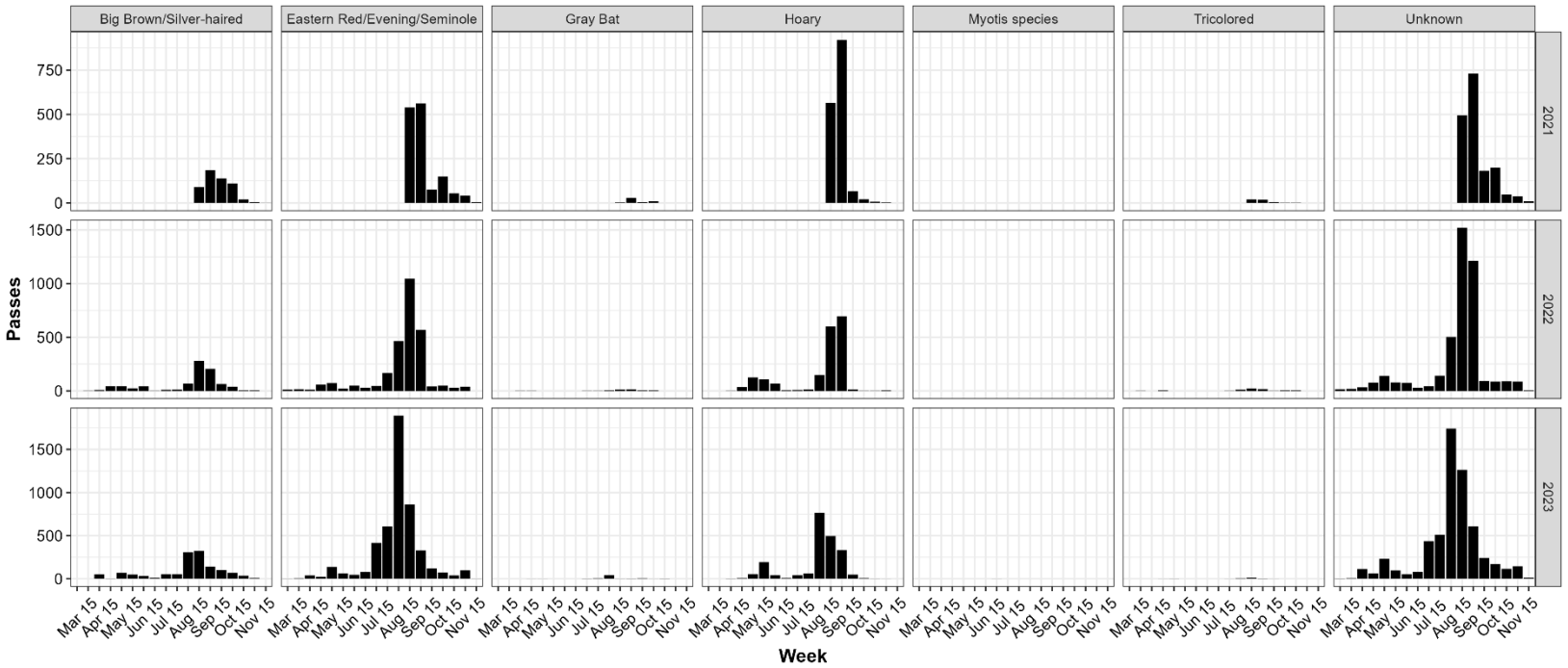


Figure 2 - Biweekly acoustic bat activity for each species/species group detected at nacelle-height detectors during the 2021, 2022, and 2023 monitoring periods at the North Fork Ridge Wind Project.

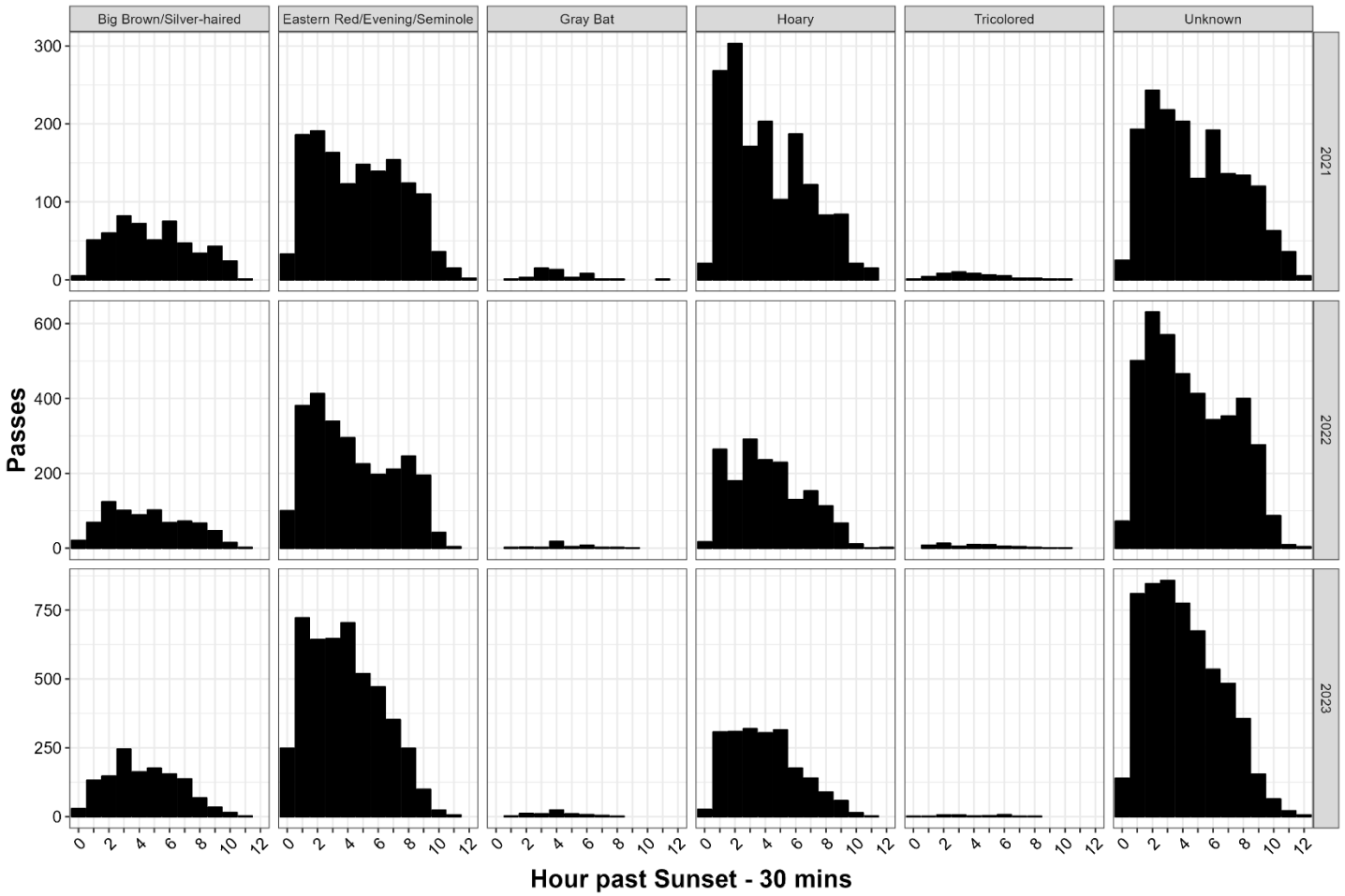


Figure 3 - Nightly timing of species/species group activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021–2023 monitoring periods at the Kings Point Wind Project. Note that data from mid-tower detectors were not available for 2023.

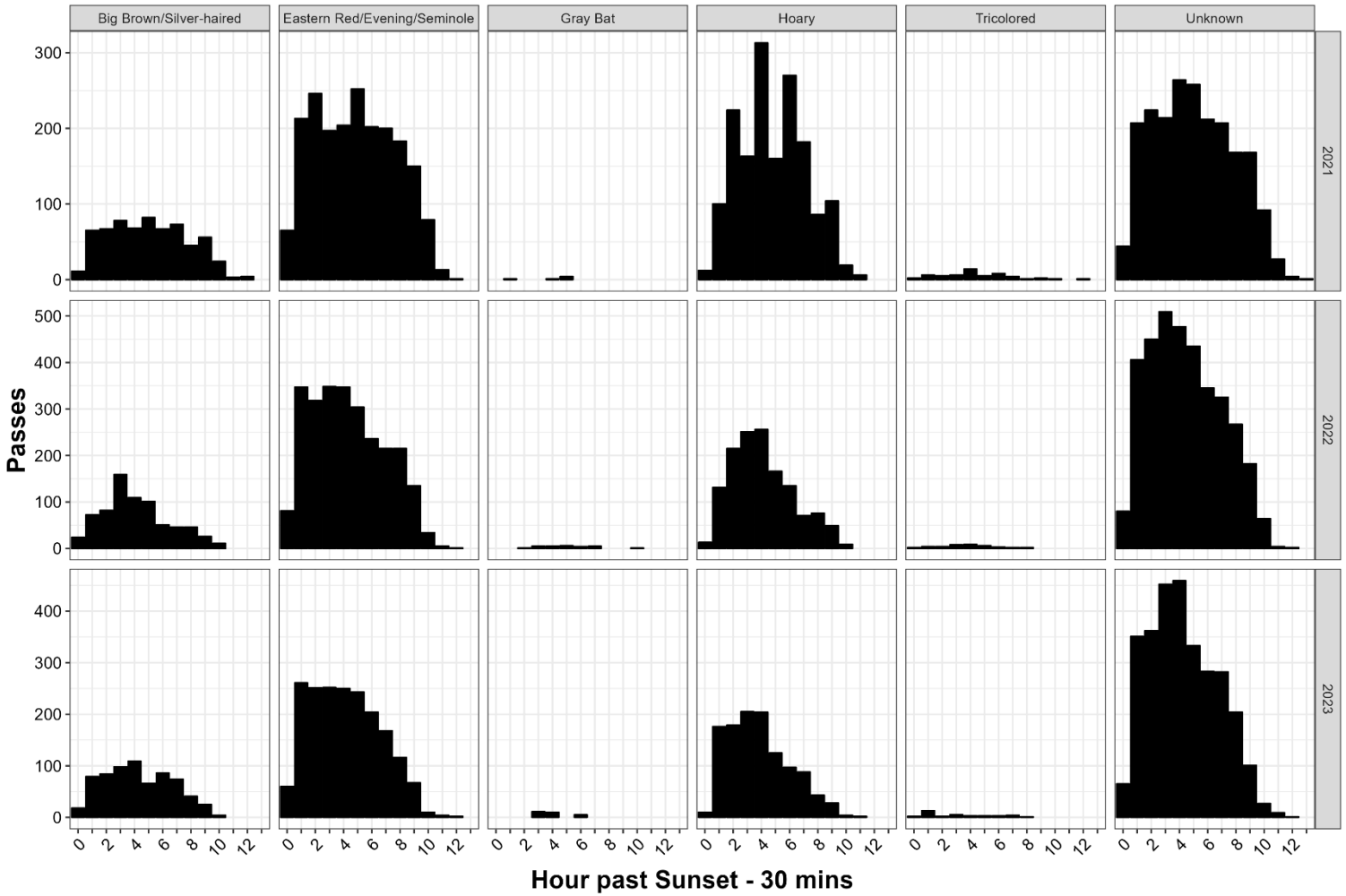


Figure 4 - Nightly timing of species/species group activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021–2023 monitoring periods at the North Fork Ridge Wind Project. Note that data from mid-tower detectors were not available for 2023.

Appendix D Genetics Results

DR. JANE HUFFMAN WILDLIFE GENETICS INSTITUTE
EAST STROUDSBURG UNIVERSITY, 562 INDEPENDENCE ROAD, SUITE 114,
EAST STROUDSBURG, PA 18301
570-422-7892

DNA EVALUATION REPORT

November 9, 2023

Submitted by:
Amanda Hale
Western EcoSystems Technology
415 W. 17th St. Suite 200
Cheyenne WY, 82001

Laboratory ID # WY-UNK-NF-088 – REPORT 2
Services Requested: Species Identification and Gender Identification
Date Received at DNA Lab: September 13, 2023

Description of Sample Submitted: Samples were submitted to the Dr. Jane Huffman Wildlife Genetics Institute on September 13, 2023. Samples included: (Items 12-25) all items submitted for analysis were labeled WY-UNK-NF-088 with unique numbers, each sample item highlighted in detail within Table 1.

Summary of Methods: Samples submitted to the Dr. Jane Huffman Wildlife Genetics Institute were evaluated. Following laboratory standards of practice, a DNA extraction was performed using a Qiagen DNeasy Blood and Tissue kit. To confirm species, a portion of the mitochondrial cytochrome oxidase subunit 1 (CO1) gene and cytochrome b (cytb) gene were targeted. Successful sequence fragments were analyzed using the National Centers for Biotechnology Information (BLAST) database and Barcode of Life Database (BOLD). To determine gender, the zinc finger Y-chromosomal protein (ZFY) gene was used to target the Y chromosome. Successful amplification of Y chromosome was visualized using gel electrophoresis.

Summary of Results and Conclusion: To confirm species, DNA was successfully extracted from sample items 12-25. Final DNA analysis, species identification, and gender identification is highlighted in detail within Table 1.

Table 1: Results of species and gender identification for sample items 12-25 submitted for testing.

Lab ID	Casualty ID	Species ID	Gender
WY-UNK-NF-088-12	20230424_T-026_1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-13	20230509_T-028_1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-088-14	20230518_T-035_2	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-088-15	20230725_T-028_1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-16	20230731_T-025_1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-17	20230801_T-017_2	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-18	20230818_T-031_2	*Lasiurus borealis* (Eastern red bat)	N/A
WY-UNK-NF-088-19	20230818_T-126_2	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-20	20230831_T-030_1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-21	20230901_T-046_1	*Lasiurus seminolus* (Seminole bat)	N/A
WY-UNK-NF-088-22	20230815_T-089_2	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-088-23	20230821_T-094_1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-088-24	20230905_T-001_1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-088-25	20230905_T-044_3	*Perimyotis subflavus* (Tricolored bat)	Female

Nicole L. Clumm, DHSc, C.W.F.S.
Certified Wildlife Forensic Scientist
Laboratory Director
Dr. Jane Huffman Wildlife Genetics Institute

Samantha Marin, BS, C.W.F.S.
Certified Wildlife Forensic Scientist
Wildlife Laboratory Technician
Dr. Jane Huffman Wildlife Genetics Institute

NORTHERN ARIZONA UNIVERSITY

School of Forestry

Bat Genetic ID Results

Client: Adam Rusk (Adam.Rusk@stantec.com), Stantec. Invoice number 20231110_3.

Samples: We received 3 bat samples for Sanger sequencing. After DNA extraction, we PCR-amplified bat DNA using our Species from Feces primers (Walker et al. 2016, 2019). The sample sequenced successfully. All non-template controls were negative for amplification and the positives controls amplified and sequenced correctly.

Sequencing: 11/20/2023

Report date: 11/21/2023

Sample name	BEGL.ID	Genetic ID
T-101_1	STC73	*Lasiurus borealis*
T-009_1	STC74	*Nycticeius humeralis*
T-044_1	STC75	*Myotis grisescens*

Bat Ecology & Genetics Lab, School of Forestry, NAU, P.O. Box 15018, Flagstaff, AZ 86011