Appendix I – 2022 Bat Acoustic Study

South Deuel Wind 2022 Bat Acoustic Study

March 31 – November 2, 2022

DEUEL HARVEST WIND ENERGY SOUTH LLC

South Deuel Wind

5/24/2024

South Deuel Wind 2022 Bat Acoustic Study

prepared for

DEUEL HARVEST WIND ENERGY SOUTH LLC
South Deuel Wind
Deuel County, South Dakota

Project No. 134150

5/24/2024

prepared by

Burns & McDonnell
Kansas City, Missouri

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
Detector	Wildlife Acoustics SM3BAT
kHz	kilohertz
MET towers	meteorological towers
NLCD	National Land Cover Dataset
Project	South Deuel Wind
SDGFP	South Dakota Game, Fish and Parks
SD	Secure Digital
USFWS	U.S. Fish & Wildlife Service
WEST	Western EcoSystems Technology, Inc.

1.0 INTRODUCTION

Deuel Harvest Wind Energy South LLC has proposed the development of South Deuel Wind (Project) in Deuel County, South Dakota. The Project Area (Figure 1-1) consists of approximately 34,339 acres of land, primarily in agricultural land use. This report documents the methods and results of the acoustic study performed for the Project in 2022.

The objective of this study was to assess the seasonal and spatial bat activity within the Project Area, consistent with the pre-construction site evaluation recommendations in the U.S. Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012). The study was conducted by Burns & McDonnell Engineering Company, Inc (Burns & McDonnell) between March 31 and November 2, 2022.

1.1 Ecological Setting

The Project Area is located within Ecoregions 46k (Prairie Coteau) and 46m (Big Sioux Basin) of the Northern Glaciated Plains, which spans across the eastern edge of South Dakota (Bryce et al. 1996). Both ecoregions have historically supported both tallgrass and shortgrass prairies. These native grasslands however, have been predominantly converted to agriculture croplands (Bryce et al. 1996), with soybeans (*Glycine max*) and corn (*Zea mays*) as the dominant crops (Miller 1997). The primary difference between the Prairie Coteau and Big Sioux Basin Ecoregions is that the Big Sioux has a well-developed drainage network, whereas the Prairie Coteau has no drainage pattern in the undulating landscape (Bryce et al. 1996).

According to the 2019 National Land Cover Dataset (NLCD) land cover classifications (USGS 2019), cultivated crops (73 percent) is the dominant land cover type in the Project Area (Table 1-1). Herbaceous is the second most common cover type at 16 percent (Table 1-1). The predominance of cultivated crops and introduced cool season grasses for forage has reduced and fragmented the extent of undisturbed or native habitats occurring within the Project Area.

Table 1-1: Land Cover Types within the South Deuel Wind Project Area in Deuel County, South Dakota

Cover Type	Acres	Percent
Cultivated crops	25,045	73
Grassland/Herbaceous	5,451	16
Emergent herbaceous wetlands	1,473	4
Developed, open space	1,045	3
Pasture/Hay	777	2
Deciduous forest	262	1
Open water	170	<1
Developed, low intensity	63	<1
Developed, medium intensity	37	<1
Mixed forest	5	<1
Woody wetlands	5	<1
Developed, high intensity	3	<1
Shrub/Scrub	1	<1
Total[a]	**34,339**	

Source: USGS 2019
[a] Sums of values may not add to total value shown, due to rounding.

1.2 Bat Species with Potential to Occur

Seven bat species may occur in eastern South Dakota (Table 1-2; Bat Conservation International 2022). One federally listed bat species has potential to occur in the Project Area: northern long-eared bat (*Myotis septentrionalis*). Northern long-eared bat is federally endangered. Little brown bat (*Myotis lucifugus*) is currently under review for federal listing, and tricolored bat (*Perimyotis subflavus*) has been proposed for listing as federally endangered. South Dakota Game, Fish, and Parks has not listed any bats as state-threatened or endangered. Potential for occurrence within the Project Area varies seasonally and is unique to each species. The following date ranges for each season have been chosen for the purposes of this study: spring, March 15 to May 15; summer, May 16 to August 15; fall, August 16 to November 15; and winter, November 16 to March 14.

Table 1-2: Bat Species Listed by Call Frequency Group and Seasons of Potential Occurrence in the Project Area

Common Name	Scientific Name	Seasons of Potential Occurrence in the Project Area			
		Spring	Summer	Fall	Winter
High-frequency (≥30 kiloHertz [kHz])					
Eastern red bat	*Lasiurus borealis*	X	X	X	--
Little brown bat	*Myotis lucifugus*	X	X	X	--
Northern long-eared bat[a]	*Myotis septentrionalis*	X	X	X	--
Tricolored bat	*Perimyotis subflavus*	X	X	X	--
Low-frequency (<30 kHz)					
Big brown bat	*Eptesicus fuscus*	X	X	X	--
Hoary bat	*Lasiurus cinereus*	X	X	X	--
Silver-haired bat	*Lasionycteris noctivagans*	X	X	X	--

Sources: Bat Conservation International 2022
(a) Federally endangered

2.0 METHODS

2.1 Field Methods

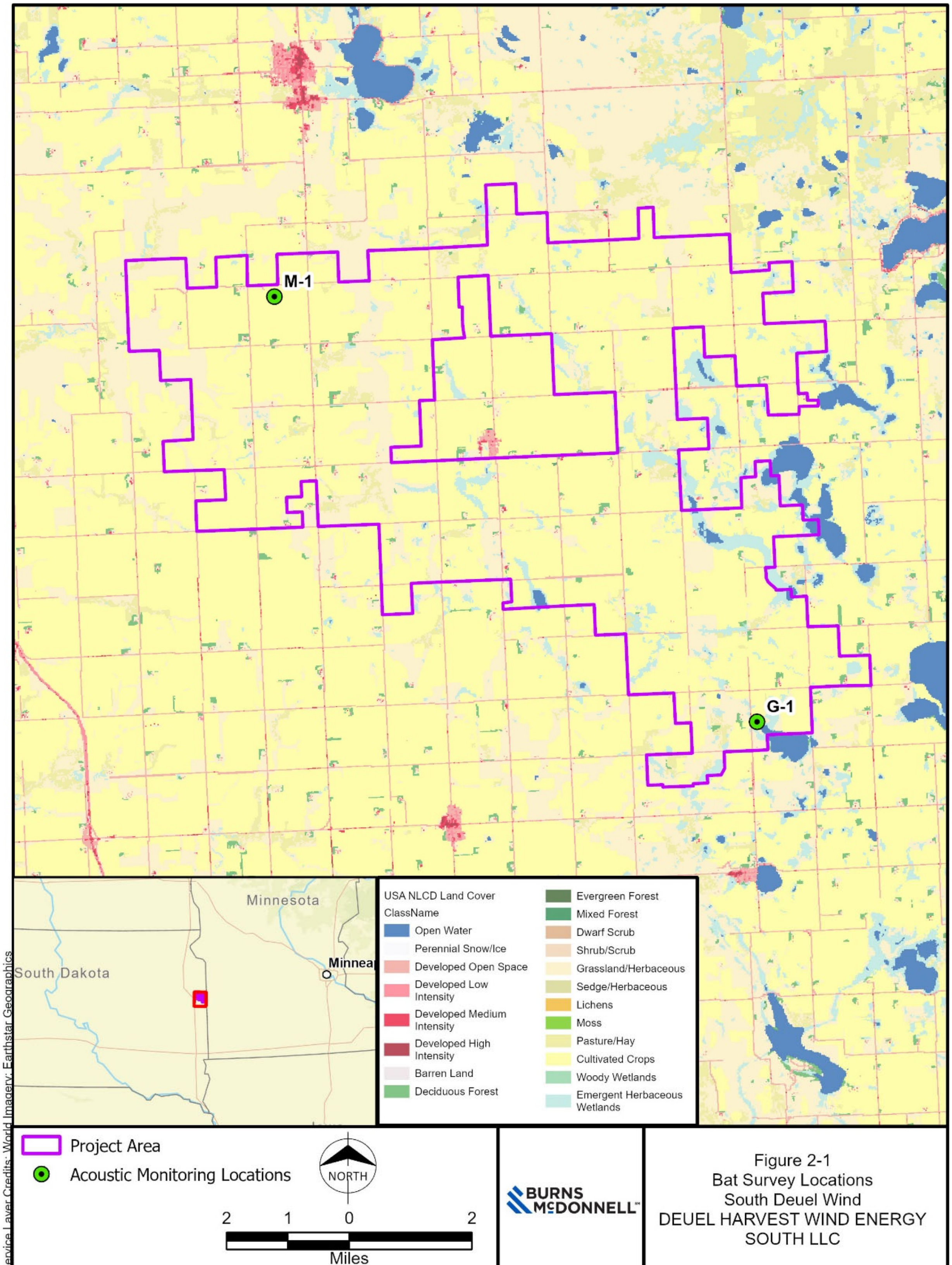
Acoustic bat surveys for the Project were conducted at two monitoring locations within the Project Area (Figure 2-1; Photographs A-1 and A-2 in Appendix A) from March 31 through November 2, 2022. Monitoring locations were chosen for the purpose of sampling bat activity at different heights and habitat types. Detector M-1 was deployed on a MET tower in an open crop field with a microphone at a height of approximately 3 meters (M-1L) and a microphone at a height of approximately 45 meters (M-1H). The MET tower location was the same as the location monitored in previous studies. Detector G-1 was deployed with a temporary mast at a height of 3 meters in a hay field along a windbreak of eastern redcedar.

One Wildlife Acoustics SM3BAT (detector) with omnidirectional microphones was deployed at each monitoring location. The MET tower monitoring location included microphones connected to ground-based detectors via 50-meter and 3-meter cables and attached to the MET tower to achieve the 45-meter and 3-meter heights. The microphone at the ground-based monitoring location was elevated to a height of approximately 3 meters on an extendable fiberglass pole and connected via a 3-meter cable. Wildlife Acoustics SMM-U1 microphones were used for all locations. These microphones are designed to be weather-resistant and do not require additional weatherproofing. Because the first bat study at this facility used Anabat detectors with directional microphones (Western EcoSystems Technology, Inc. [WEST] 2017), directional horns were attached to the microphones in 2017 and 2022. The directional horns constrict the cone of detection, making the data more comparable to the study conducted in 2016.

Each detector was tested to confirm proper functioning during deployment. Detectors were turned on to verify that power was being supplied to the detector. The recording start date and time were also verified. Data files were retrieved the day after initial setup to confirm that the detector was functioning the first night.

Each detector was powered by one 12-volt battery, which was charged daily by a small solar panel. Files were recorded on a Secure Digital (SD) card. Data download and system maintenance were performed approximately monthly. Proper functioning of the detectors and their mounting hardware was tested and confirmed at each visit. The detector was programmed to record calls nightly from 0.5 hour before sunset through 0.5 hour after sunrise.

Figure 2-1: Bat Acoustic Survey Locations



Source: ESRI and Burns & McDonnell

Issued: 9/14/2023

2.2 Data Analysis Methods

The following sections include a description of the data analyses for the Project.

2.2.1 Acoustic File Filtering

An index of bat activity was calculated by summing the number of bat passes per detector-night (Hayes 1997). A bat pass was defined as a sequence of two or more call pulses given by an individual bat separated by ≥1 second from the next sequence (White and Gehrt 2001). An index of activity is used since individual bats are not identifiable and cannot be quantified using passively recorded acoustic data.

Full spectrum audio files were converted to zero-cross format using Kaleidoscope Pro to make the data more comparable to recordings from Anabat detectors, such as those used in the 2016 study. The default filter in the Kaleidoscope bat classifier (Bats of North America 5.4.0) was used to remove noise files and partial calls. Bat passes were defined as at least two individual calls with a minimum 500 millisecond intersyllable gap, a minimum frequency of 8 kilohertz (kHz), and a maximum frequency of 120 kHz.

2.2.2 Acoustic File Classification

Bat passes were viewed in Kaleidoscope to note potential *Myotis* and *Perimyotis* calls, remove additional noise files from analysis, and to sort bat call files into high-frequency (minimum frequency > 30 kHz) and low-frequency (minimum frequency < 30 kHz) species groups. High-frequency calls were reviewed by a qualified biologist trained in acoustic bat identification to determine potential occurrence of northern long-eared bat, little brown bat (*Myotis lucifugus*), and tricolored bat (*Perimyotis subflavus*). Bat passes were also separated between high-elevation and low-elevation microphones, although it is possible that some bat calls were detected on high and low microphones simultaneously. Patterns of bat activity, high-frequency calls (e.g., northern long-eared bat, little brown bat, tricolored bat, and eastern red bat [*Lasiurus borealis*]), and low-frequency calls (e.g., big brown bat [*Eptesicus fuscus*], silver-haired bat [*Lasionycteris noctivagans*], and hoary bat [*Lasiurus cinereus*]) were assessed for the 7-month monitoring period.

3.0 RESULTS AND DISCUSSION

3.1 Data Collection Summary

Bat acoustic surveys were initiated on March 31, 2022 and concluded on November 2, 2022. The three microphones were operating for 216 calendar nights. Table 3-1 summarizes the sampling effort for each microphone. Across all microphones, a total of 648 detector-nights were completed. A total of 6,536 bat passes were recorded, resulting in an average of 10.1 bat passes per detector night across the Project Area.

Table 3-1: Project Data Collection Summary for the Bat Acoustic Study, March 31 – November 2, 2022

Monitoring Location	Latitude and Longitude	No. Nights Deployed	No. Complete Detector-Nights[a]	Dates of Incomplete Detector Nights[b]	No. Bat Passes Recorded
M-1H	44.700311 -96.694424	216	216	0	1,158
M-1L	44.700311 -96.694424	216	216	0	1,247
G-1	44.594084 -96.539327	216	216	0	4,131

(a) Total number of nights that equipment functioned and recorded for the entire night
(b) Nights when recording did not occur or was interrupted before a complete night of survey was completed

3.2 Bat Activity Summary

The following sections provide results from the analysis of bat activity during the monitoring period.

3.2.1 Spatial Variation in Bat Activity

Detections of high-frequency bat passes and low-frequency bat passes were greatest at site G-1, which was a monitoring at a height of 3 meters in a hay field along a windbreak of eastern red cedar (*Juniperus virginiana*) (Table 3-2).

Table 3-2: Comparison of Bat Activity by Frequency Group Across Habitat Types and Detector Heights, March 31, 2022 – November 2, 2022

Monitoring Location	Habitat Type	Detector Height	No. HF Bat Passes/Detector Night	No. LF Bat Passes/Detector Night	Total Bat Passes/Detector Night
M-1L	Cultivated Crops	Low	0.4	5.3	5.8
M-1H	Cultivated Crops	High	0.3	5.0	5.4
G-1	Grassland/Herbaceous	Low	1.0	18.1	19.1
Subtotal Cultivated Crops			0.4	5.2	5.6
Subtotal Grassland/Herbaceous			1.0	18.1	19.1
Subtotal High			0.3	5.0	5.4
Subtotal Low			0.7	11.7	12.4
Total Across All Detectors			0.6	9.5	10.1

HF = High Frequency; LF = Low Frequency

3.2.2 Temporal Variation in Bat Activity

Relative bat activity was observed to be highest in the summer, when the average index of bat activity was observed to be 48.6 bat passes per detector night (Table 3-3, Figure 3-1). The season of highest relative activity for high frequency bat species was summer, averaging 3.1 bat passes per detector night across the season. The season of highest relative activity for low frequency bat species was also summer, averaging 45.5 bat passes per detector night across the season.

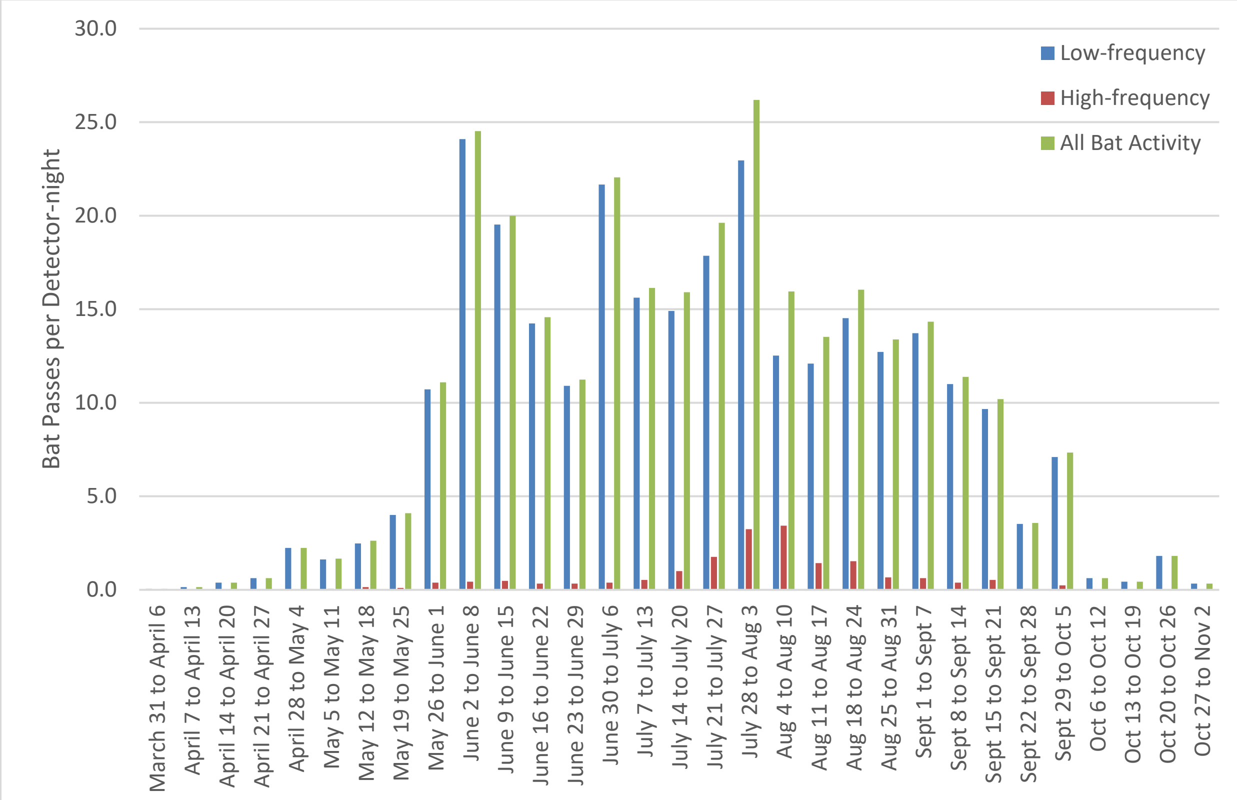
The highest observed overall relative bat activity occurred during the week of July 28 – August 3 (Table 3-3, Figure 3-1). The highest observed relative activity for low frequency bat species occurred during the week of June 2 to June 8 (Table 3-3, Figure 3-1). The highest observed relative activity for high frequency bat species occurred during the week of August 4 to August 10 (Table 3-3, Figure 3-1). No potential *Myotis* or *Perimyotis* calls were identified in the analysis.

Table 3-3: Seasonal Mean Bat Activity in the Project Area, March 31, 2022 – November 2, 2022

	Survey Week	M-1L			M-1H			G-1		
		LF	HF	Total	LF	HF	Total	LF	HF	Total
Spring*	March 31 to April 6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
	April 7 to April 13	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4
	April 14 to April 20	0.3	0.0	0.3	0.6	0.0	0.6	0.3	0.0	0.3
	April 21 to April 27	0.4	0.0	0.4	1.3	0.0	1.3	0.1	0.0	0.1
	April 28 to May 4	2.4	0.0	2.4	1.0	0.0	1.0	3.3	0.0	3.3
	May 5 to May 11	2.6	0.0	2.6	2.0	0.1	2.1	0.3	0.0	0.3
	May 12 to May 18	3.9	0.4	4.3	1.9	0.0	1.9	1.7	0.0	1.7
	Spring Mean	**1.3**	**0.1**	**1.3**	**0.9**	**0.0**	**0.9**	**5.0**	**0.0**	**5.0**
Summer*	May 19 to May 25	2.6	0.1	2.7	1.3	0.0	1.3	8.1	0.1	8.3
	May 26 to June 1	3.9	0.4	4.3	2.4	0.4	2.9	25.9	0.3	26.1
	June 2 to June 8	3.9	0.7	4.6	2.9	0.0	2.9	65.6	0.6	66.1
	June 9 to June 15	5.1	0.7	5.9	2.7	0.3	3.0	50.7	0.4	51.1
	June 16 to June 22	1.0	0.1	1.1	1.7	0.0	1.7	40.0	0.9	40.9
	June 23 to June 29	3.6	0.1	3.7	1.6	0.0	1.6	27.6	0.9	28.4
	June 30 to July 6	13.6	0.7	14.3	6.0	0.0	6.0	45.4	0.4	45.9
	July 7 to July 13	16.6	0.1	16.7	10.3	0.1	10.4	20.0	1.3	21.3
	July 14 to July 20	17.4	0.7	18.1	13.4	0.4	13.9	13.9	1.9	15.7
	July 21 to July 27	13.3	0.9	14.1	13.9	0.1	14.0	26.4	4.3	30.7
	July 28 to Aug 3	12.4	1.9	14.3	13.1	1.6	14.7	43.3	6.3	49.6
	Aug 4 to Aug 10	4.9	1.6	6.4	15.1	1.9	17.0	17.6	6.9	24.4
	Aug 11 to Aug 17	3.7	0.4	4.1	14.1	2.3	16.4	18.4	1.6	20.0
	Summer Mean	**7.8**	**0.7**	**8.4**	**7.3**	**0.5**	**7.8**	**30.4**	**1.9**	**32.4**
Fall*	Aug 18 to Aug 24	12.0	0.9	12.9	14.1	2.0	16.1	17.4	1.7	19.1
	Aug 25 to Aug 31	10.0	1.1	11.1	8.0	0.3	8.3	20.1	0.6	20.7
	Sept 1 to Sept 7	10.4	0.6	11.0	7.0	0.3	7.3	23.7	1.0	24.7
	Sept 8 to Sept 14	8.7	0.6	9.3	8.3	0.0	8.3	16.0	0.6	16.6
	Sept 15 to Sept 21	6.6	0.9	7.4	4.4	0.4	4.9	18.0	0.3	18.3
	Sept 22 to Sept 28	2.6	0.0	2.6	3.0	0.0	3.0	5.0	0.1	5.1
	Sept 29 to Oct 5	2.0	0.3	2.3	1.1	0.1	1.3	18.1	0.3	18.4
	Oct 6 to Oct 12	0.9	0.0	0.9	0.0	0.0	0.0	1.0	0.0	1.0
	Oct 13 to Oct 19	0.0	0.0	0.0	0.7	0.0	0.7	0.6	0.0	0.6
	Oct 20 to Oct 26	0.4	0.0	0.4	2.7	0.0	2.7	2.3	0.0	2.3
	Oct 27 to Nov 2	0.3	0.0	0.3	0.3	0.0	0.3	0.4	0.0	0.4
	Fall Mean	**4.9**	**0.4**	**5.3**	**4.7**	**0.3**	**5.1**	**11.4**	**0.4**	**11.8**
	Annual Mean	**5.3**	**0.4**	**5.8**	**5.0**	**0.3**	**5.4**	**18.1**	**1.0**	**19.1**

LF = Mean low frequency bat passes per detector night for a given survey week or season.
HF = Mean high frequency bat passes per detector night for a given survey week or season.
Total = All bat passes per detector night for a given survey week or season.
*Seasons defined in Section 1.2.

Figure 3-1: Weekly Bat Activity Observed in the South Deuel Wind Project Area, March 31, 2022 – November 2, 2022



3.3 Comparison to Previous Studies

Acoustic monitoring was previously conducted in 2016 (WEST 2017) and 2017 (Burns & McDonnell 2018). In 2016, bat monitoring efforts for the Project included the use of Anabat SD1 ultrasonic bat detectors placed on a meteorological (MET) tower at heights of approximately 1.5 meters and 45 meters above ground between April 13 and November 3, 2016 (WEST 2017). In 2016, overall bat activity (± standard error) was estimated at 1.7 ± 0.2 passes per detector-night, with weekly bat activity peaking at 7.1 passes per detector-night between July 30 and August 5. Bat activity was higher in the summer (May 16 to August 15; 2.6 ± 0.3 passes per detector-night) than in the spring (April 13 to May 15; 0.5 ± 0.1 passes per detector-night) or fall (August 16 to November 3; 1.1 ± 0.2 passes per detector-night). Habitat surrounding the detector location included open fields with few trees, where bat activity was expected to be lower than more forested habitat.

Monitoring of bat activity for the Project in 2017 was conducted from the same MET tower as in 2016, using a Wildlife Acoustics SM3BAT detector with ultrasonic microphones at approximately 3 meters and 45 meters above ground. Acoustic monitoring in 2017 occurred from July 20 to October 17, 2017. Overall bat activity during this timeframe was estimated at 5.3 ± 1.4 passes per detector-night. Activity was higher during the summer (July 20 – August 15; 11.8 passes/detector-night), and lower during the fall (August 16 – October 16; 2.5 passes/detector-night).

The overall bat activity level for this Project during the 2022 study period was 10.1 passes/detector-night. This is higher than the estimates from the 2017 study (5.3 passes/detector-night) (Burns & McDonnell 2018) and the 2016 study (1.7 passes/detector-night) (WEST 2017), although the dates of the study period differed between each study. This increase could be due to placing an additional detector in a ‘potentially suitable habitat’ area (the windbreak of eastern redcedar). A detector was placed in this location to get a better idea of bat usage through varying land types within the Project Area, in addition to open crop fields. The study conducted in 2016 sampled activity between April 13 and November 3, but a subset of the weekly data from July 16 to October 14 was used for comparative purposes here to correspond to the July 20 to October 16 period sampled in 2017. A subset of weekly data from the MET tower in 2022 between July 14 and October 12 was also used to compare to the two previous studies. Activity during the comparable study periods increased 84 percent from 2016 to 2017 and 73 percent from 2017 to 2022. Most of the increase in activity was from low-frequency species, which increased approximately 98 percent from 2016 to 2017 and 86 percent from 2017 to 2022 (Figure 4-1). High-frequency activity increased approximately 29 percent from 2016 to 2017 and declined approximately 6 percent from 2017 to 2022. Summer activity increased approximately 100 percent from 2016 to 2017, while fall activity increased approximately 60 percent from 2016 to 2017 (Figure 4-2). From 2017 to 2022, summer activity increased approximately 13 percent while fall activity increased approximately 162 percent.

Figure 3-2: Frequency Composition of Bat Activity between 2016, 2017, and 2022 on the South Deuel Wind MET tower

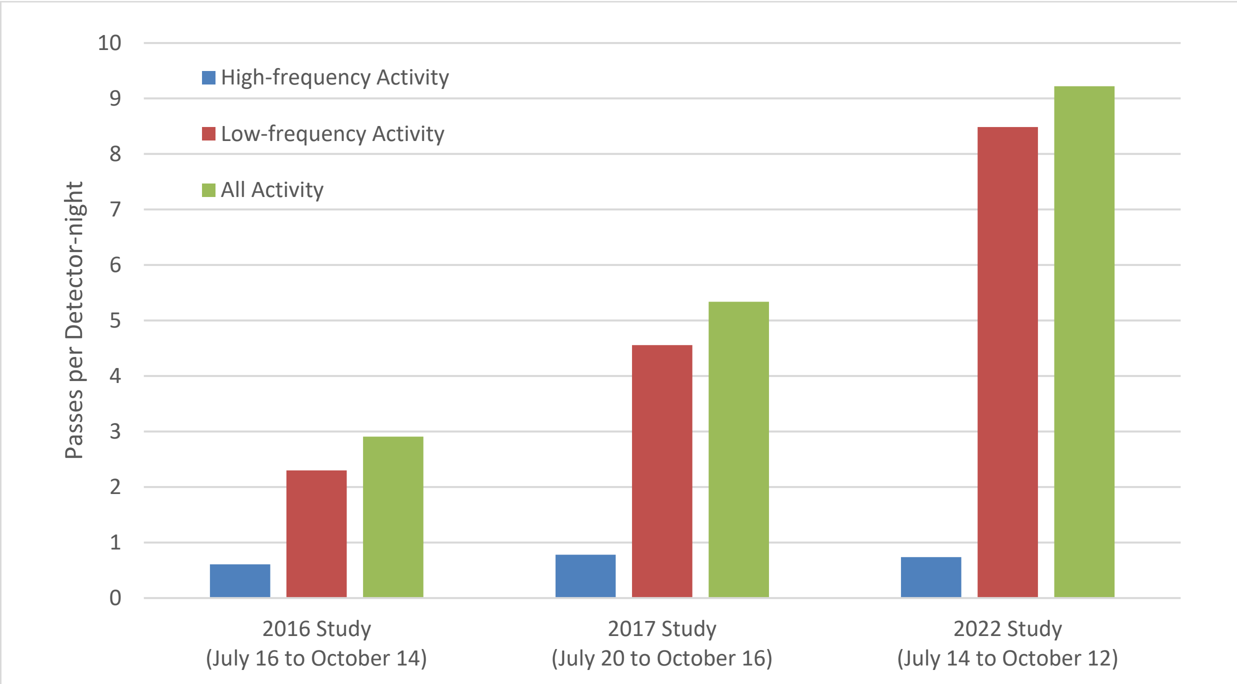
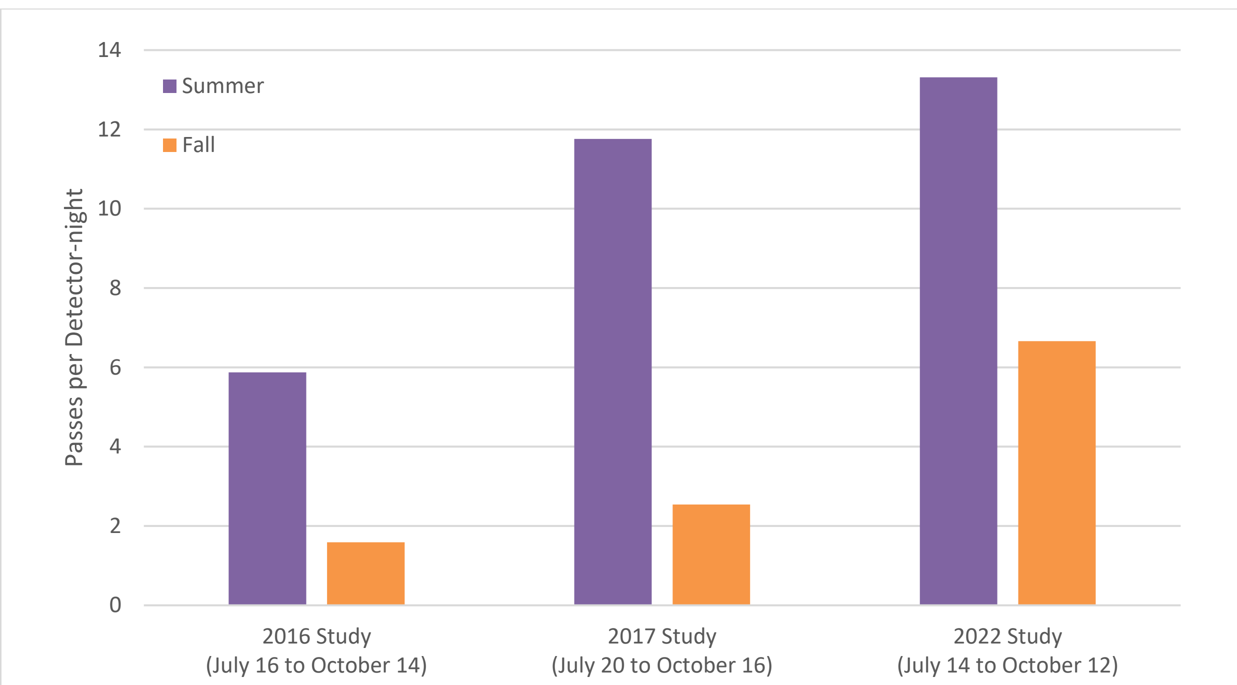


Figure 3-3: Seasonal Patterns of Bat Activity Between 2016, 2017, and 2022 at the Project MET Tower



The differences in bat activity between the three years may reflect changes in local bat populations, weather conditions more suitable for recording bats, altered insect distributions, or a variety of other ecological factors. Additionally, some differences may be explained by the equipment used in the two years. Zero-cross detectors (such as those used in the 2016 study) can detect bats over less airspace and generally record fewer calls than full-spectrum detectors, such as those used in the 2017 study (Adams et al. 2012). Differences in equipment used may not explain the entirety of the increase in activity due to the similar equipment used in 2017 and 2022.

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APPENDIX A - ACOUSTIC DETECTOR PHOTOGRAPHS

Photograph A-1: View of acoustic site M-1 in an agricultural field, facing southwest.

Photograph A-2: View of acoustic site G-1 in a windrow within a hay field, facing northeast.

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