APPENDIX M – 2017 BAT ACOUSTIC STUDY

Deuel County Wind Energy Project: North Deuel 2017 Bat Acoustic Study

Deuel Harvest Wind Energy LLC

North Deuel Bat Acoustic Study

Final
1/31/2018

Deuel County Wind Energy Project: North Deuel 2017 Bat Acoustic Study

prepared for

Deuel Harvest Wind Energy LLC
North Deuel Bat Acoustic Study
Deuel County, South Dakota

Project No. 99578

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
Burns & McDonnell	Burns & McDonnell Engineering Company, Inc.
Deuel Wind	Deuel Harvest Wind Energy LLC
kHz	kilohertz
MET towers	meteorological towers
Project	Deuel County North Area
SDGFP	South Dakota Game, Fish and Parks
WEST	Western EcoSystems Technology, Inc.

1.0 INTRODUCTION

Deuel Harvest Wind Energy LLC (Deuel Wind) has proposed the development of the Deuel County North Area (Project) as part of the Deuel County Wind Energy Project in Deuel County, South Dakota. The Project area (Figure 1-1) consists of approximately 135,050 acres of land (including 72,737 acres in the Deuel North area and 62,313 acres in the Deuel South area), primarily in agricultural land use. South Dakota Game, Fish and Parks (SDGFP) requested 2 years of bat acoustic surveys for the Deuel North and Deuel South projects to assess the annual variation of bat activity during fall migration (SDGFP, 2017). Acoustic monitoring was conducted in 2016 (Western EcoSystems Technology, Inc. [WEST], 2017). In 2017, Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) was contracted to conduct the second year of acoustic bat monitoring for Deuel North and Deuel South. The objectives of this study were to assess the annual variation of bat activity during fall migration, and to characterize seasonal bat activity within the Project area and between Deuel North and Deuel South. Bat surveys conducted for Deuel South are summarized in a separate report (Burns & McDonnell, 2018).

Previous bat monitoring efforts for Deuel North included the use of an Anabat SD1 ultrasonic bat detector placed on a stand at a height of 1.5 meters above ground on a forest edge between April 13 and November 3, 2016 (WEST, 2017). Overall bat activity (± standard error) was estimated as 26.8 ± 2.3 passes per detector-night, with weekly bat activity peaking at 69.7 passes per detector-night between September 17 and 23. Bat activity was higher in the summer (38.1 ± 3.5 passes per detector-night) than in the spring (7.6 ± 1.4 passes per detector-night) or fall (21.5 ± 3.3 passes per detector- night). Habitat surrounding the detector location included a woodlot edge, wetland, and travel corridor, where bat activity would be expected to be much higher than in open field habitat. Monitoring of bat activity for the Project in 2017 was conducted from the same location as in 2016, over the 3-month period including July to October.

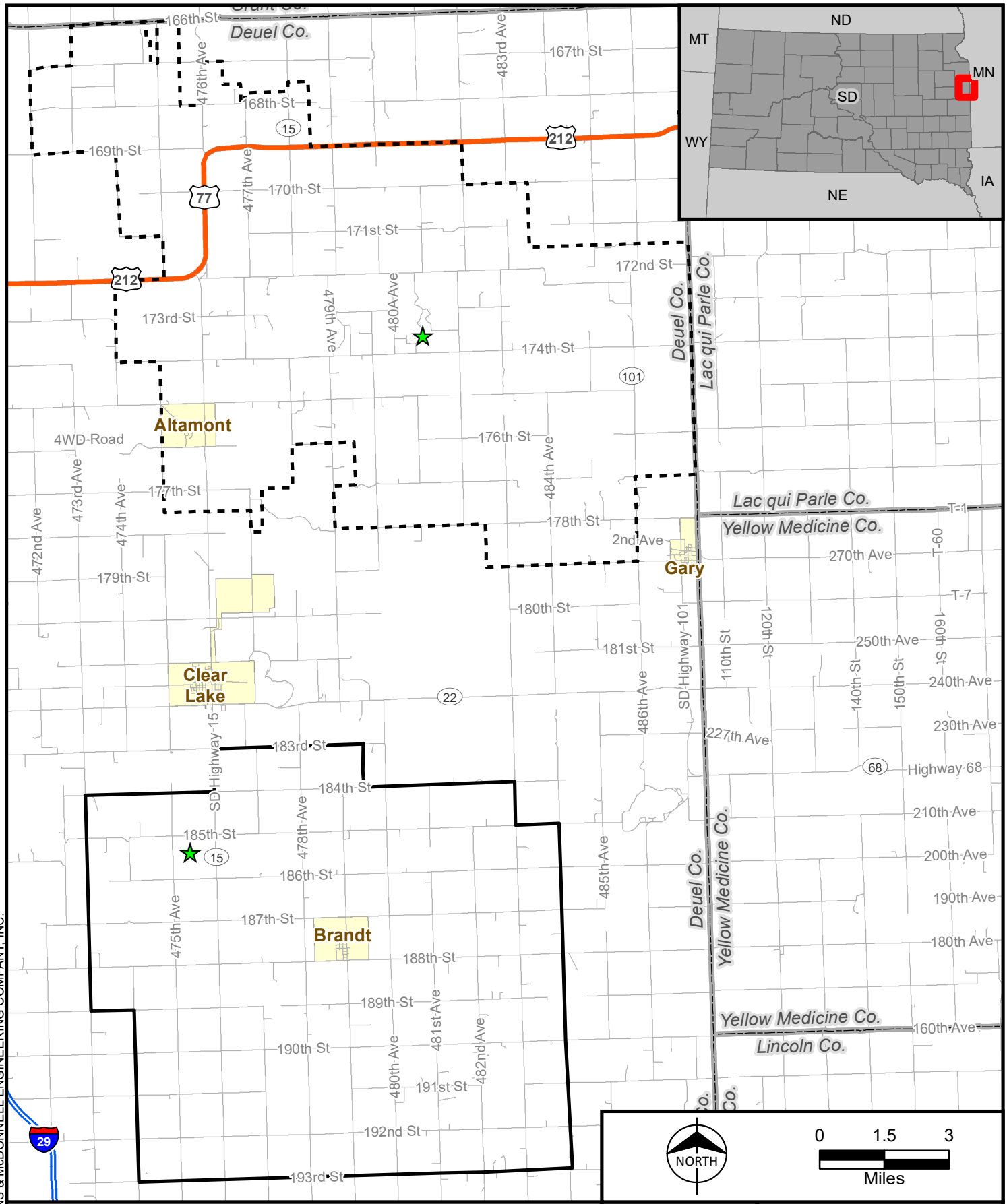

Figure 1-1
Bat Survey Locations
Deuel Wind Project
Deuel Wind Energy, LLC

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Path: Z:\Clients\ENS\Invenergy\99578_DeuelAvian\Studies\Geospatial\DataFiles\ArcDocs\Bat Report\Figure 1-1 - Bat Survey Locations.mxd jjmaine 12/8/2017

Source: ESRI, Burns & McDonnell Engineering Company, Inc.

Issued: 12/8/2017

2.0 METHODS

Burns & McDonnell deployed one Wildlife Acoustics SM3BAT recording device on one location in the Deuel North area (Figure 1-1). The detector was located adjacent to a lake along a potential bat travel corridor between two forested areas. This was the same location monitored for the Project in 2016 (WEST, 2017).

To characterize bat use of the Project area, one ultrasonic microphone was deployed at approximately 3 meters above ground. Burns & McDonnell conducted acoustic surveys during the timeframe of July 20 through October 17, 2017.

The detector was programmed to record calls nightly from 0.5 hour before sunset through 0.5 hour after sunrise. SM3BAT ultrasonic detectors record in full-spectrum and use omni-directional microphones. Because the previous bat study at this facility used Anabat detectors with directional microphones (WEST, 2017), a directional horn was attached to the microphone in 2017. The directional horns constrict the cone of detection, making the data more comparable to the study conducted in 2016. Acoustic files were retrieved, and the detector was inspected monthly to verify proper functioning. Acoustic spectrographs were reviewed periodically by a biologist to verify that bat calls were being recorded. Settings on the acoustic detector were optimized for recording bats, so that an accurate assessment of overall bat activity could be provided for each night (Appendix A).

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. A filter was designed in Analook to remove noise files and partial calls. Bat passes were defined as at least two individual calls within 1 second. Bat passes were not identified to species, but were split into high-frequency (minimum frequency > 30 kilohertz [kHz]) and low-frequency (minimum frequency < 30 kHz) species groups. Patterns of bat activity, high-frequency calls (e.g., northern long-eared bat [*Myotis septentrionalis*], little brown bat [*Myotis lucifugus*], 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 3-month monitoring period.

3.0 RESULTS

The ultrasonic detector and microphone were set on July 20, 2017, and were removed on October 17, 2017. The detector was operating for 89 detector-nights. A total of 4,196 bat passes were recorded, for a mean activity level (± standard error) of 47.1 ± 5.0 passes per detector-night. Most of the bat passes (54 percent) were from high-frequency species, while low-frequency species made up 46 percent of the passes. Weekly bat activity (7-day averages) ranged from 1.0 pass per detector-night between October 12 and 16 (the end of the study), to 95.4 passes per detector-night between August 10 and 16 (Figure 3-1). Activity was higher during the summer (July 20 – August 15; 91.6 passes/detector-night), and lower during the fall (August 16 – October 16; 27.8 passes/detector-night). Start and end dates of the seasons were selected to correspond to those included in the 2016 study. Figure 3-2 shows average seasonal bat activity.

Figure 3-1: Weekly Means of Bat Activity at Deuel North in 2017

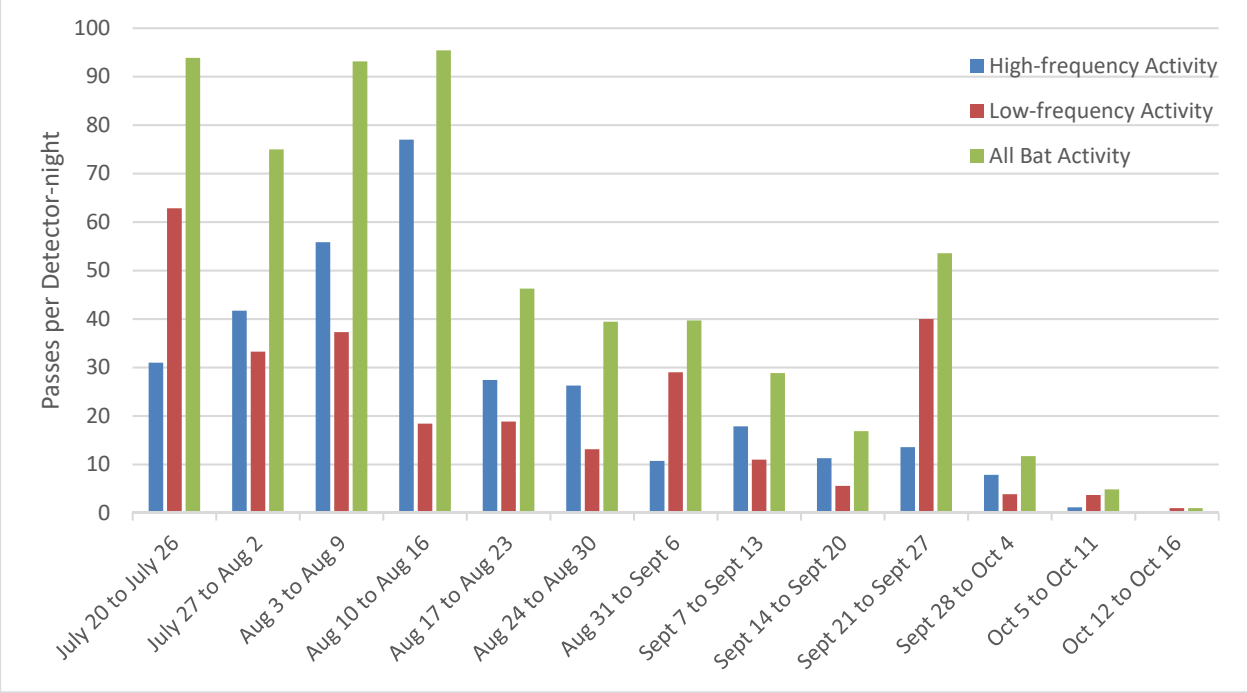
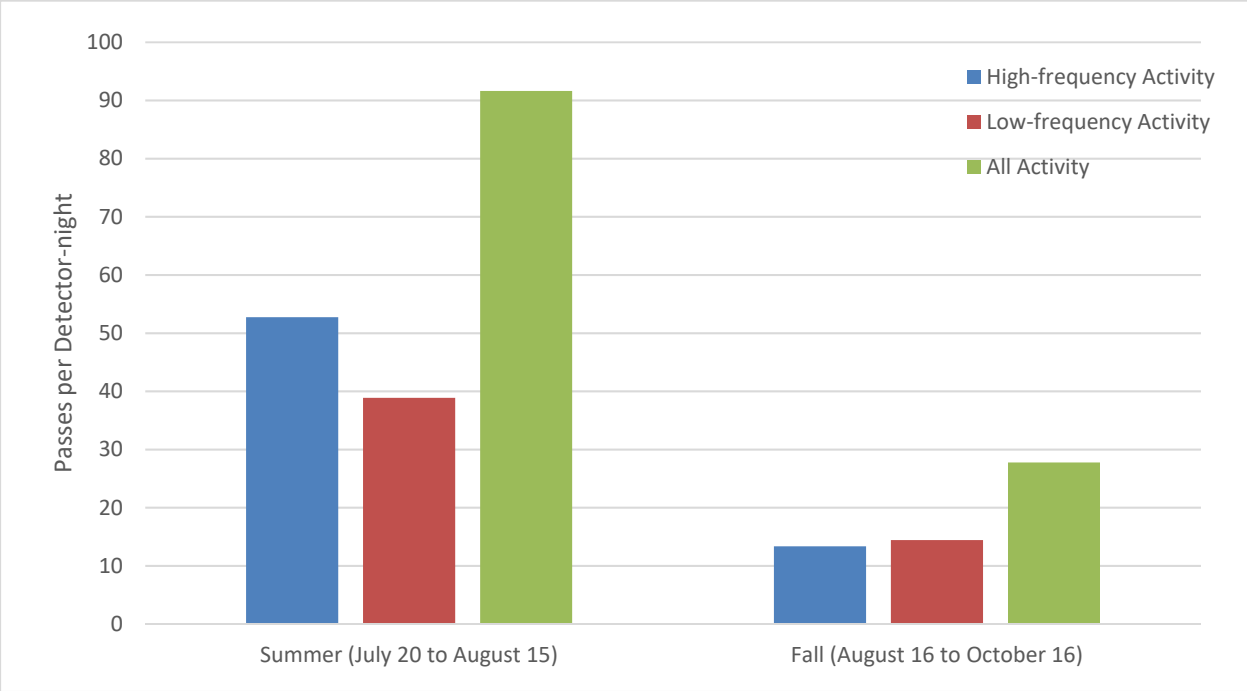


Figure 3-2: Seasonal Means of Bat Activity at Deuel North in 2017



4.0 DISCUSSION

The overall bat activity level for this Project during the 2017 study period was 47.1 ± 5.0 passes/detector-night. This is higher than the estimate from a similar subset of data from the previous study of 34.2 ± 5.5 passes/detector-night (WEST, 2017). 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. Most of the increase in activity from 2016 to 2017 was from low-frequency species, which increased approximately 96 percent from 11.1 passes per detector-night in 2016 to 21.8 passes per detector-night in 2017 (Figure 4-1). High-frequency activity increased approximately 10 percent from 23.1 passes per detector-night in 2016 to 25.3 passes per detector-night in 2017. Summer activity increased approximately 100 percent from 2016 to 2017, while fall activity decreased approximately 4 percent from 2016 to 2017 (Figure 4-2).

Figure 4-1: Frequency Composition of Bat Activity between 2016 and 2017 at Deuel North

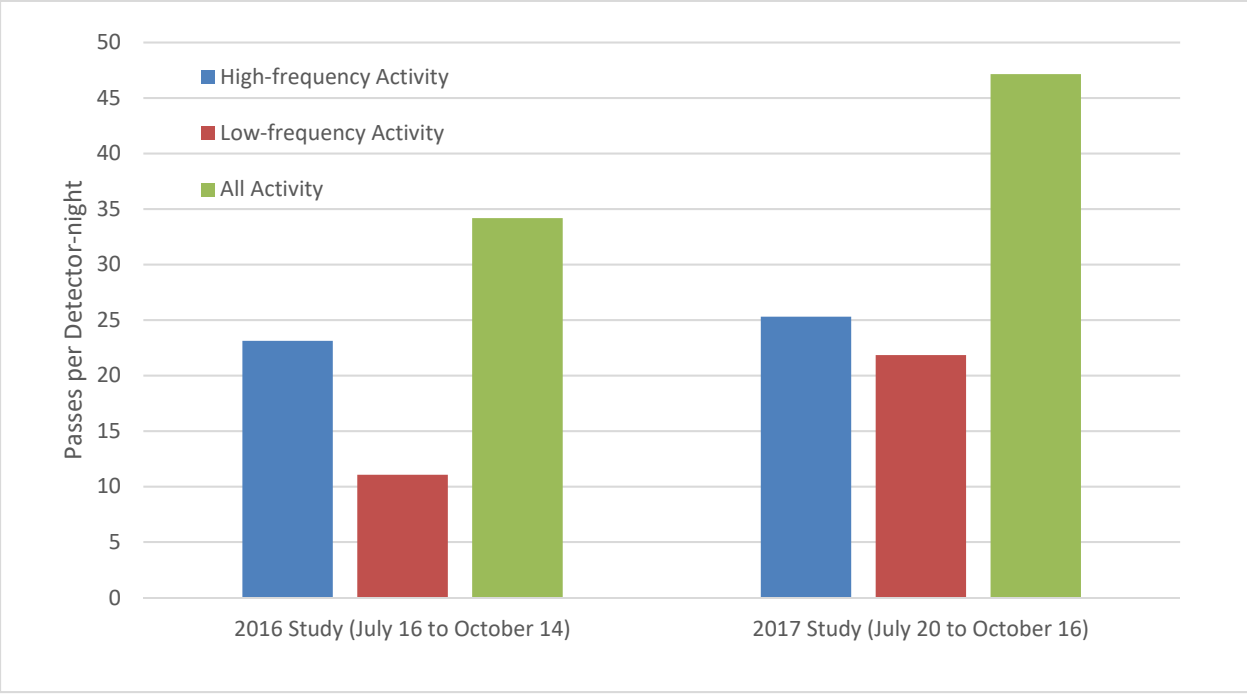
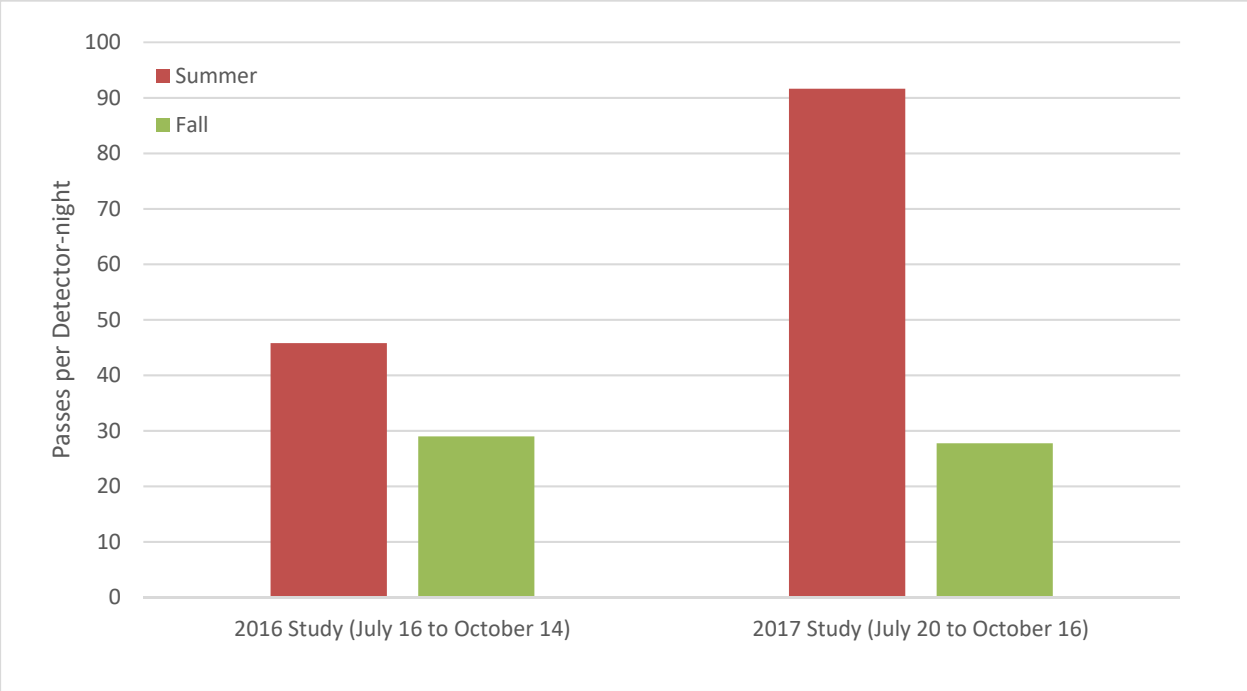


Figure 4-2: Seasonal Patterns of Bat Activity between 2016 and 2017 at Deuel North



The differences in bat activity between the two 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. Anabat and other 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 are unlikely to explain the 38 percent increase in activity from 2016 to 2017 (Figure 4-2) because a directional horn used was on the microphone in 2017 to limit differences in microphone directionality between the two years.

Bat monitoring was also conducted in the Deuel South area in 2017 and is discussed more extensively in a separate report (Burns & McDonnell, 2018). The methods, equipment, and sampling dates were identical between the two locations, except that the sampling location at Deuel South was on a meteorological tower (MET tower) and was in a more open area. The Deuel South site was sampled with two microphones at heights of 3 meters and 45 meters above ground. Bat activity was much lower in Deuel South (5.3 ± 1.4 passes per detector-night) than in Deuel North (47.1 ± 5.0 passes per detector-night). Patterns of bat activity over time also differed between the two sites. The detector at Deuel South recorded peak activity for the week beginning on July 20, followed by a steady decline in weekly activity until the end of the study. At Deuel North, activity was relatively high at the beginning of the study, but

peaked for the week beginning on August 10. The composition of the bat community also differed between sites. At Deuel North, most of the activity (54 percent) was from high-frequency species, while at Deuel South, most of the activity (85 percent) was from low-frequency species. Given the differences in the habitat between the Deuel North and Deuel South acoustic sites, it was expected that Deuel North would experience much higher levels of activity and a different community of bat species.

5.0 REFERENCES

Adams, A.M., M.K. Jantzen, R.M Hamilton, and M.B. Fenton. 2012. Do you hear what I hear? Implications of detector selection for acoustic monitoring of bats. *Methods in Ecology and Evolution* 3:992-998

Burns & McDonnell. 2018. *Deuel County Wind Energy Project: South Deuel 2017 Bat Acoustic Study*. A report prepared for Deuel Harvest Wind Energy LLC.

SDGFP. 2017. Request noted within Agency Coordination Meeting Notes for the Deuel Wind Project: Invenergy, SDGFP, and USFWS in Pierre, South Dakota, May 25, 2017.

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APPENDIX A - DATA TABLES

Appendix A – Data Tables

Table A-1: Detector Settings for Acoustic Monitoring at Deuel North

Setting Type	Setting
Detector model	Wildlife Acoustics SM3BAT
Number of recording channels	1
Microphone height	3 meters
Nightly recording time	0.5 hour before sunset to 0.5 hour after sunrise
Recording format	Full spectrum .wav
Sample rate	256 kHz
High-pass filter	16 kHz
Gain	12 dB
Minimum frequency	16 kHz
Maximum frequency	192 kHz
Minimum duration	1.5 ms
Maximum duration	200 ms

Table A-2: Bat Activity Between Seasons at Deuel North

Season	High-frequency Passes	Low-frequency Passes	Total Passes	Detector-nights	Passes/Detector Night ± Standard Error
Summer	1424	1050	2474	27	91.6 ± 7.3
Fall	828	894	1722	62	27.8 ± 4.6
Total	2252	1944	4196	89	47.1 ± 5.0

Table A-3: Weekly Bat Activity at Deuel North

Week	HF Activity[a, b]	HF Percentage[a]	LF Activity[a, b]	LF Percentage[a]	All Bat Activity[b]
July 20 to July 26	31.0	33.0%	62.9	67.0%	93.9
July 27 to Aug 2	41.7	55.6%	33.3	44.4%	75.0
Aug 3 to Aug 9	55.9	60.0%	37.3	40.0%	93.1
Aug 10 to Aug 16	77.0	80.7%	18.4	19.3%	95.4
Aug 17 to Aug 23	27.4	59.3%	18.9	40.7%	46.3
Aug 24 to Aug 30	26.3	66.7%	13.1	33.3%	39.4
Aug 31 to Sept 6	10.7	27.0%	29.0	73.0%	39.7
Sept 7 to Sept 13	17.9	61.9%	11.0	38.1%	28.9
Sept 14 to Sept 20	11.3	66.9%	5.6	33.1%	16.9
Sept 21 to Sept 27	13.6	25.3%	40.0	74.7%	53.6
Sept 28 to Oct 4	7.9	67.1%	3.9	32.9%	11.7
Oct 5 to Oct 11	1.1	23.5%	3.7	76.5%	4.9
Oct 12 to Oct 16	0.0	0.0%	1.0	0.0%	1.0

(a) HF = High-frequency; LF = Low-frequency
(b) Activity is measured in passes per detector-night

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