Bat Acoustic Study

Bat Acoustic Study for the Bitter Root Wind Energy Project Yellow Medicine County, Minnesota and Deuel County, South Dakota

Final Report

April 2 – November 1, 2016

Prepared for:
Flying Cow Wind, LLC

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1 INTRODUCTION

Flying Cow Wind, LLC is considering the development of the Bitter Root Wind Energy Project (Project) in Medicine County, Minnesota and Deuel County, South Dakota (Figure 1). To support development of the Project, Flying Cow Wind, LLC contracted Western Ecosystems Technology, Inc. (WEST) to conduct a bat acoustic survey in the Project area following the study recommendations in the U.S. Fish and Wildlife Service's (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012), as well as the Minnesota Department of Natural Resource's (MNDNR) and the Minnesota Department of Commerce's (MNDOC) *Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota* (MNDNR 2014).

Study objectives were to: 1) estimate levels of bat activity at meteorological (met) towers and ground locations within the Project area; 2) estimate activity levels for bats with high-frequency (HF) and low-frequency (LF) calls; and 3) analyze potential correlations between bat activity and the following weather variables: wind speed and temperature. The following report describes the results of a bat acoustic survey conducted in the Project area from April 2 to November 1, 2016.

2 STUDY AREA

The proposed Project area encompasses 41,281 acres (ac; 64.50 square mi [mi^2]) in Yellow Medicine County, Minnesota and Deuel County, South Dakota (Figure 1). The Project occurs in the Northern Glaciated Plains Ecoregion (US Environmental Protection Agency [USEPA] 2013), characterized by flat to rolling hills of glaciated till plains. Much of the region was originally dominated by trembling aspen (*Populus tremuloides*), oak groves, mixed tall shrubs, and intermittent fescue (*festuca spp.*) grasslands. Today, most of the area has been cleared for farms producing corn (*Zea mays*), soybeans (*Glycine max*), and livestock (USEPA 2013).

Many smaller streams in this ecoregion have been tilled, ditched, and tied into existing drainage systems, resulting in a reduction in wetland and aquatic habitats (USEPA 2013). A few streams are present in and adjacent to the Project area, including Lazarus Creek running from the east side of the Project to South Slough Lake, along with Lake Cochrane, Lake Oliver and Culver Lake in the western portion of the Project area, and Cobb Creek to the north (Figure 1).

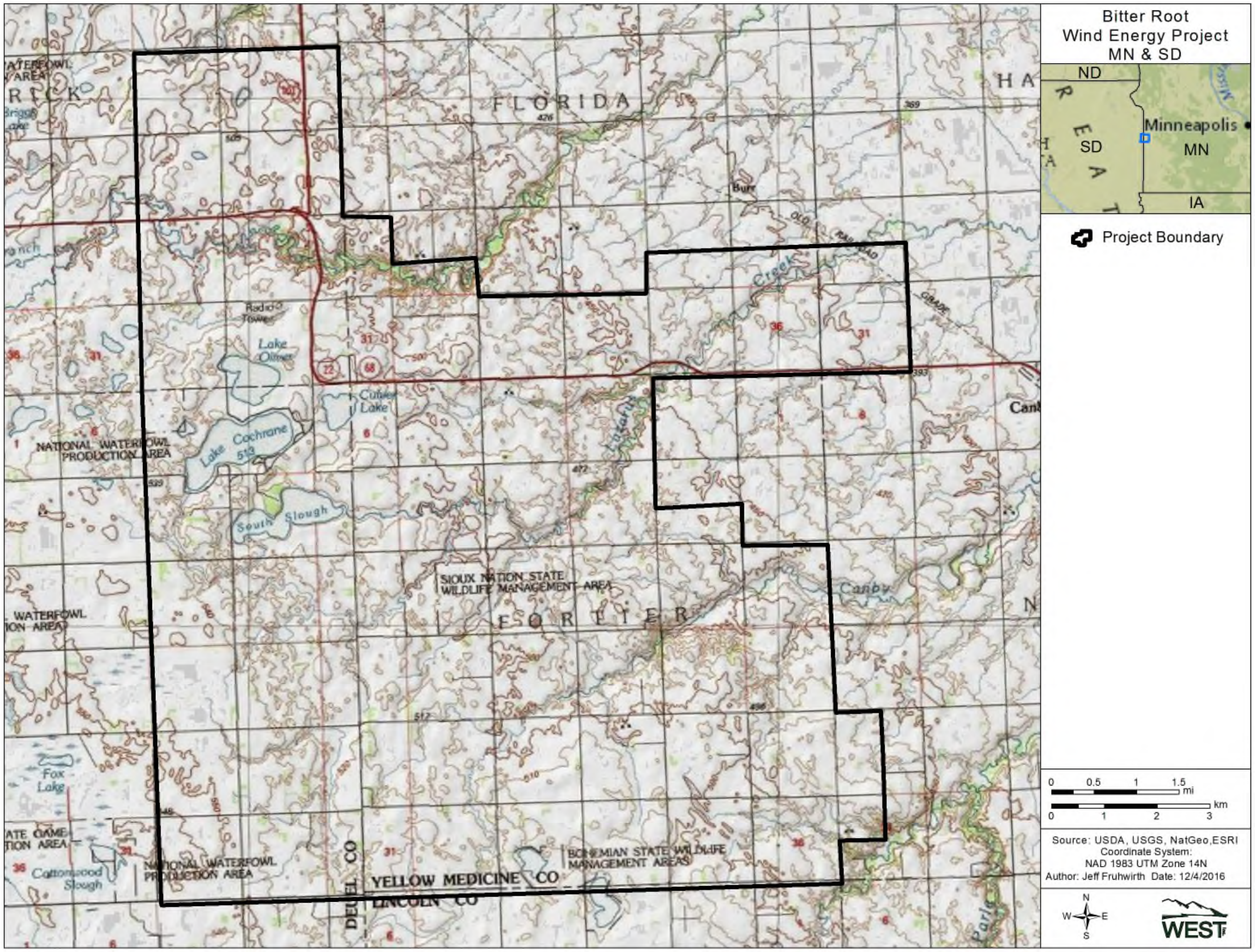

Figure 1. Location of the Bitter Root Wind Energy Project in Yellow Medicine County, Minnesota and Deuel County, South Dakota.

According to the 2011 National Land Cover Database (NLCD; Homer et al. 2015), the majority (91.8%) of the Project area consists of cultivated croplands (i.e., agriculture), herbaceous (grasslands), hay and pasture, and developed areas (Table 1, Figure 2). Corn and soybean are the most common crops. Open water comprises 3.9% of the Project area, emergent herbaceous wetlands comprise 2.9%, and deciduous forest comprises 1.3%. Shrub/scrub and woody wetlands each comprise less than 1.0% of the Project area. The remaining land cover types collectively comprise less than 0.1% of the Project area. During the summer, area bats may roost in caves, mines, trees (e.g., foliage, hollows, cracks/crevices, under loose bark), and buildings. Suitable summer roosting habitat for tree-roosting bats is limited to trees or wooded areas generally found within isolated woodlots, shelterbelts, or stream corridors. Some bat species may use buildings in the Project area for roosting and likely forage over cropland. Bats that remain over the winter may hibernate in caves or mines.

Table 1. 2011 National Land Cover Database land cover types within the Bitter Root Wind Energy Project.

Cover Type	Acres	Percent (%)
Cultivated Crops	18,523.1	44.9
Herbaceous	8,998.3	21.8
Hay/Pasture	8,658.8	21.0
Developed, Open Space	1,655.1	4.0
Open Water	1,615.4	3.9
Emergent Herbaceous Wetlands	1,207.4	2.9
Deciduous Forest	516.6	1.3
Developed, Low Intensity	44.8	0.1
Shrub/Scrub	27.0	0.1
Woody Wetlands	22. 9	0.1
Developed, Medium Intensity	5.9	<0.1
Barren Land	5.7	<0.1
Developed, High Intensity	0.2	<0.1
Total	**41,280.9**	**100**

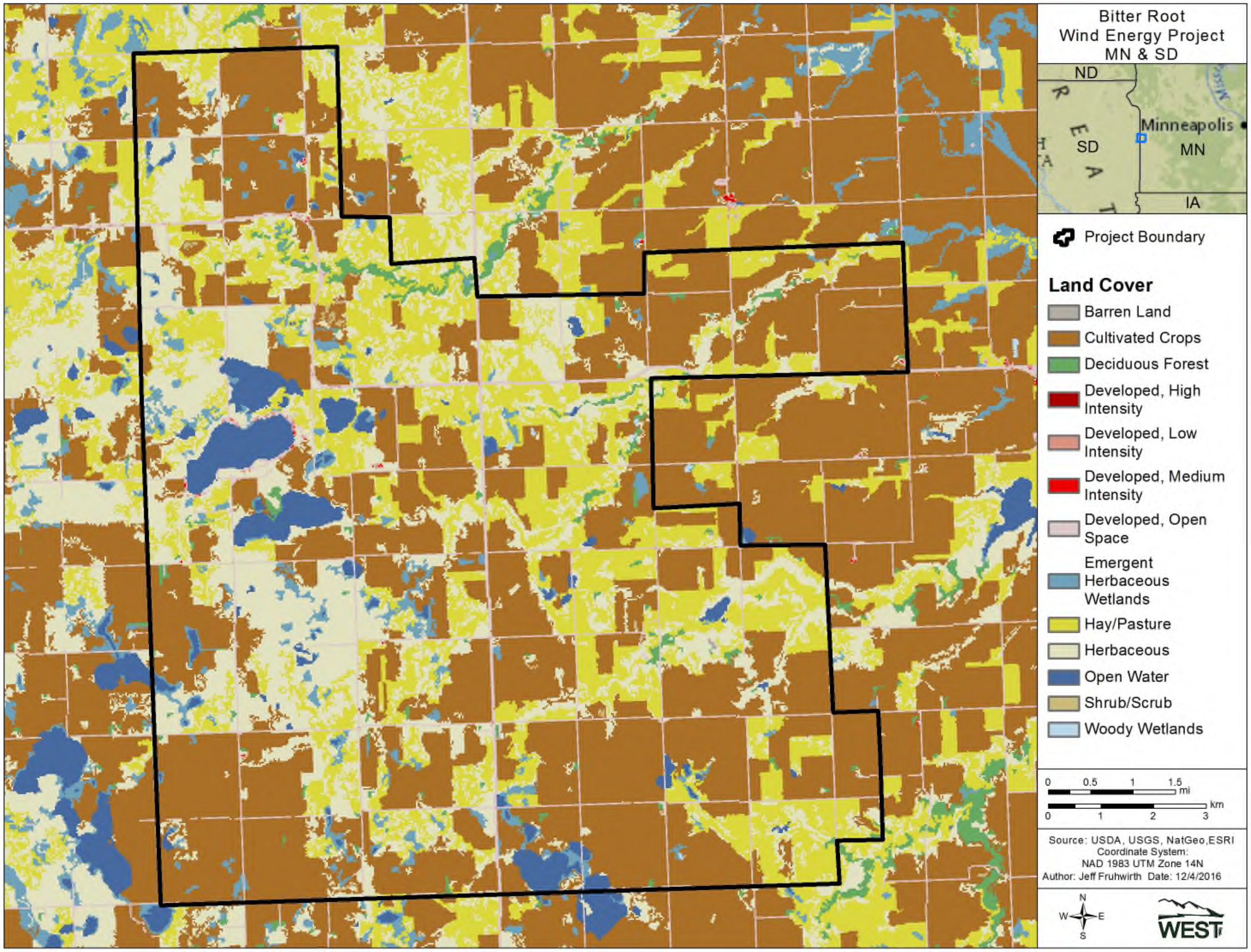

Figure 2. National Land Cover Database land cover types within and adjacent to the Bitter Root Wind Energy Project in Yellow Medicine County, Minnesota and Deuel County, South Dakota.

Seven bat species occur in Minnesota and thirteen bat species occur in South Dakota (Bat Conservation International [BCI] 2017; SDGFP 2017), seven of which have potential ranges that overlap with the Project area (Table 2). Of these seven, the only state or federal protected species is the northern long-eared bat (*Myotis septentrionalis*), a federal threatened species (International Union for Conservation of Nature [IUCN] 2016; USFWS 2016).

Table 2. Bat species with potential to occur within the Bitter Root Wind Energy Project, categorized by echolocation call frequency.

Common Name and Frequency Group (kilohertz [kHz])	Scientific Name
High-Frequency (> 30 kHz)	
eastern red bat	*Lasiurus borealis*
little brown bat	*Myotis lucifugus*
northern long-eared bat[1]	*Myotis septentrionalis*
tri-colored bat	*Perimyotis subflavus*
Low-Frequency (< 30 kHz)	
big brown bat	*Eptesicus fuscus*
silver-haired bat	*Lasionycteris noctivagans*
hoary bat	*Lasiurus cinereus*

[1] federal threatened species (USFWS 2016)

3 METHODS

3.1 Acoustic Monitoring

3.1.1 Survey Stations

Bat activity was recorded at seven stations (Figure 3) using AnaBat SD1 ultrasonic bat detectors (Titley Electronics Pty Ltd., New South Wales, Australia). Four detectors were paired at two met towers (stations BR4g/BR4r and BR5g/BR5r) located in agricultural fields. The first detector at each tower was placed approximately 1.5 meters (m; 5 feet [ft]) above ground level (AGL), and the second detector at each met tower was placed at rotor-swept height (RSH), approximately 45 m (148 ft) AGL (Figure 3). Three additional ground stations (BR1g, BR2g, and BR3g), with one detector per station, were installed in agricultural fields throughout the Project area at approximately 1.5 m AGL to provide additional spatial coverage. Station BR1g was originally deployed in pasture and moved to met tower station BR5g on June 9, 2016. The two raised met tower units, BR4r and BR5r, were deployed on June 10, 2016 (Figure 3).

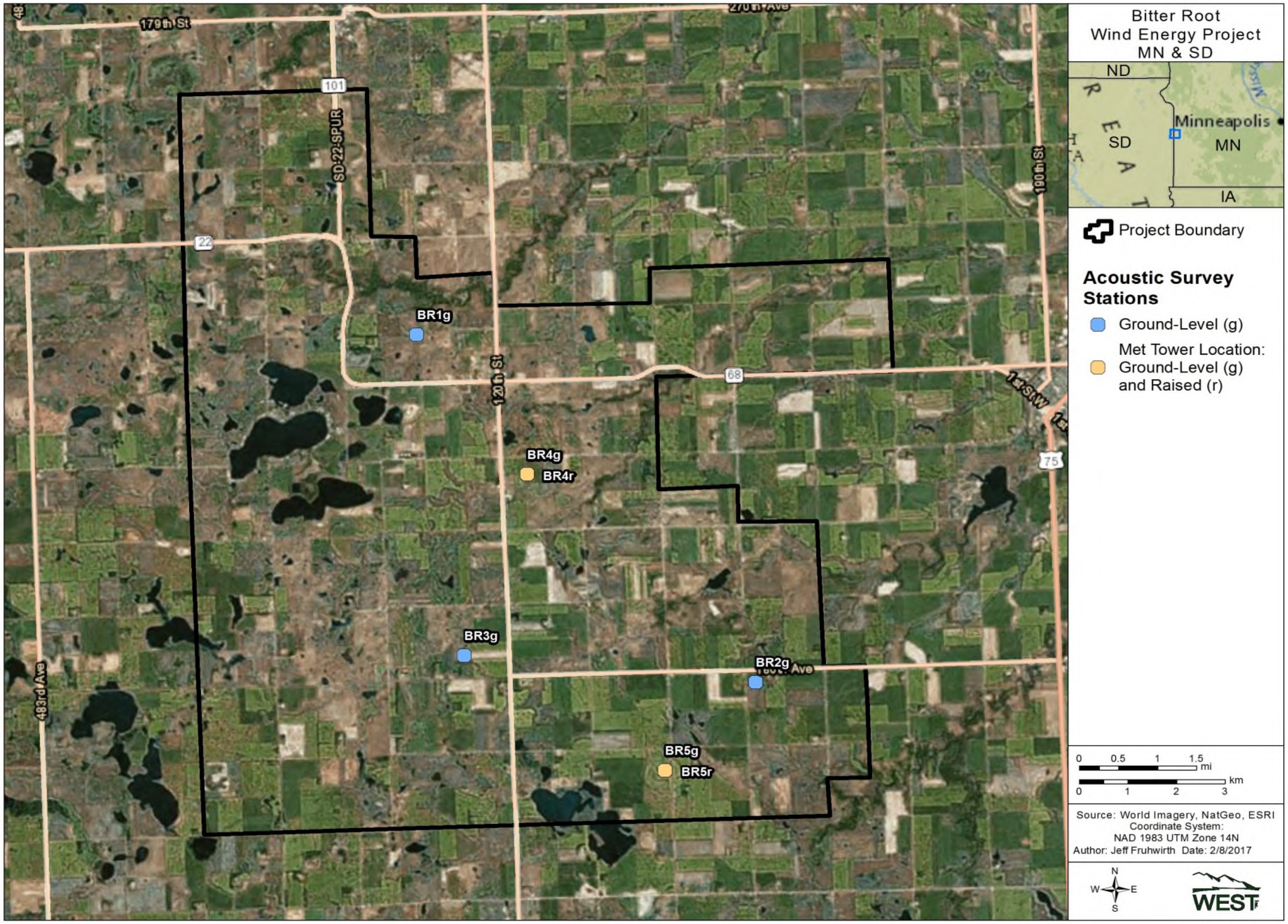

Figure 3. Location of bat acoustic survey stations in the Bitter Root Wind Energy Project in Yellow Medicine County, Minnesota and Deuel County, South Dakota.

AnaBat units were placed in plastic weather-tight containers with microphones extended through openings in the side of the containers. Microphones were encased in 45-degree angle poly-vinyl chloride (PVC) tubes. AnaBat microphones installed at the RSH were connected to 50-m (164-ft) long audio cables installed on met towers; detector units were placed near the bases of met towers. Elevated microphones were protected by Bat-Hat weatherproof housing modified1 by replacing Plexiglas reflector plates with 45-degree angle PVC elbows. This modification ensured recorded calls were comparable with data collected at ground detectors.

3.1.2 Survey Schedule

Bat activity was surveyed from April 2 to November 1, 2016 at stations BR2g, BR3g, and BR4g. A detector was deployed at station BR1g on April 2, and was moved to station BR5g on June 9. Raised stations BR4r and BR5r were deployed on June 10 and, along with station BR5g, were surveyed until November 1, 2016. Survey time extended from approximately 30 minutes (min) before sunset to 30 min after sunrise.

3.2 Data Collection and Call Analysis

AnaBat detectors use a broadband, high-frequency microphone to detect bat echolocation calls (bat calls). Incoming bat calls are digitally processed and stored on a high-capacity compact flash (CF) card. To standardize the acoustic sampling effort across the Project area, AnaBat units were calibrated and sensitivity levels were set to six (Larson and Hayes 2000), a level that balanced the goal of recording bat calls against the need to reduce interference from other sources of ultrasonic noise (Brooks and Ford 2005). The resulting files were viewed in Analook© software as digital sonograms that show changes in bat call frequency over time. Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g., wind, insects) and to identify the call frequency group.

For each station, bat calls were visually sorted by a bat acoustic expert into two groups based on their minimum frequency. Species with HF calls, such as eastern red bat (*Lasiurus borealis*), little brown bat (*Myotis lucifugus*), northern long-eared bat, and tri-colored bat (*Perimyotis subflavus*) have minimum frequencies above 30 kilohertz (kHz). Species with LF calls, such as big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*L. cinereus*), typically emit echolocation calls with minimum frequencies below 30 kHz (Table 2).

3.3 Statistical Analysis

The standard metric used for measuring bat activity is the number of bat passes per detector-night (Kunz et al. 2007). A bat pass was defined as a sequence of at least two bat calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980). A detector-night was defined as one detector operating for one entire night, from approximately 30 min before sunset to 30 min after sunrise. Bat passes per detector-night were calculated for all bats (based on the number of bat passes per detector-night where the

1 The Bat-Hat was altered because detectors protected by a PVC elbow yield higher quality calls than those protected by an un-modified Bat-Hat (Britzke et al. 2010)

detectors were operating for the complete night) and separately for HF and LF call groups. Bat pass rates represent indices of bat activity and do not represent numbers of individuals.

Temporal variation in bat activity was compared among the spring (April 2 – May 15), summer (May 15 – August 15), and fall (August 16 – November 1), as well as the fall migration period (July 30 – October 14). Temporal variation in bat activity was also evaluated on a weekly basis. The period of peak sustained bat activity was defined as the 7-day period with the highest average bat activity for each of the frequency classes (i.e., HF, LF) and the summed total. All averages of bat activity recorded at multiple detectors or across multiple dates were calculated as un-weighted averages of total bat activity (per night) at each detector. When appropriate, a standard error was calculated using bootstrapping. In those cases, 200 bootstrap samples were selected with replacement from the pool of nights with functional detectors and a standard error was calculated from the bootstrap samples.

3.4 Weather Analysis

Potential correlations between bat activity and weather variables (wind speed, temperature, and relative humidity) collected on an hourly basis were assessed. Hourly weather variables were averaged on a nightly basis to match the bat pass data (i.e., restricted to 30 min before sunset and 30 min after sunrise). Bat passes per detector-night were assessed per wind speed and temperature categories across all stations and distributed by the number of nights throughout the study duration. The average wind speed and temperature were recorded from met towers at approximately 25 m (82 ft) and 3 m (10 ft) AGL, respectively. Bat passes per detector-night were also assessed by humidity category (percent relative humidity, obtained from the National Weather Service at the Myers Field Airport, located approximately 4.8 km [3.0 mi] northwest of the Project) and distributed by the number of nights throughout the study duration.

Average nightly weather data were compared to bat passes per detector-night for all bats and for HF and LF. In addition, correlations (Pearson product-moment coefficient) between total nightly bat activity and each weather variable were calculated. Significant correlations were defined using a probability value of 0.10.

4 RESULTS

4.1 Bat Acoustic Surveys

Bat activity was monitored for a total of 1,077 detector-nights from April 2 to November 1, 2016 (Table 3). Detectors recorded 9,744 bat passes for a mean (± standard error) of 9.39 ± 0.58 bat passes per detector-night (Table 3). Ground-level detectors recorded 7,472 bat passes during 791 detector-nights. Raised detectors recorded 2,272 bat passes during 286 detector-nights (Table 3).

AnaBat units operated correctly for 94.5% of the sampling period. Figure 4 summarizes the number of detector-nights each AnaBat detector station was operational by week. Data loss was primarily due to CF memory cards exceeding their memory capacity before detectors were serviced (conducted on a weekly basis) or because batteries died early.

4.1.1 Spatial Variation

Bat activity within the Project area ranged between 6.05 ± 0.52 and 21.14 ± 1.73 bat passes per detector-night (Table 3, Figure 5). Activity at ground stations (9.98 ± 0.63 bat passes per detector-night) was higher on average compared to raised stations (7.94 ± 0.77 bat passes per detector-night; Figure 6); however, this was largely due to ground station BR5g which recorded nearly three times the activity than other ground stations (21.14 ± 1.73 bat passes per detector-night; Table 3; Figure 5). Among the raised stations, station BR4r recorded 7.31 ± 0.86 bat passes per detector-night, and station BR5r recorded 8.57 ± 0.79 bat passes per detector-night (Table 3, Figure 5).

Table 3. Results of bat acoustic surveys conducted within the Bitter Root Wind Energy Project from April 2 to November 1, 2016. Bat passes are separated by call frequency: high frequency (HF) and low frequency (LF).

AnaBat Station	Location	Habitat	# of HF Bat Passes	% of HF Bat Passes	# of LF Bat Passes	% of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/ Night
BR1g	ground	Pasture	6	1.0	620	99.0	626	68	9.21 ± 1.57
BR2g	ground	Agriculture	61	5.4	1,067	94.6	1,128	177	6.37 ± 0.62
BR3g	ground	Agriculture	73	6.4	1,064	93.6	1,137	188	6.05 ± 0.52
BR4g	ground	Agriculture	213	14.1	1,303	85.9	1,516	213	7.12 ± 0.73
BR4r	raised	Agriculture	136	13.1	902	86.9	1,038	142	7.31 ± 0.86
BR5g	ground	Agriculture	262	8.5	2,803	91.5	3,065	145	21.14 ± 1.73
BR5r	raised	Agriculture	93	7.5	1,141	92.5	1,234	144	8.57 ± 0.79
	Total Ground		615	8.2	6,857	91.8	7,472	791	9.98 ± 0.63
	Total Raised		229	10.1	2,043	89.9	2,272	286	7.94 ± 0.77
	Total		**844**	**8.7**	**8,900**	**91.3**	**9,744**	**1,077**	**9.39 ± 0.58**

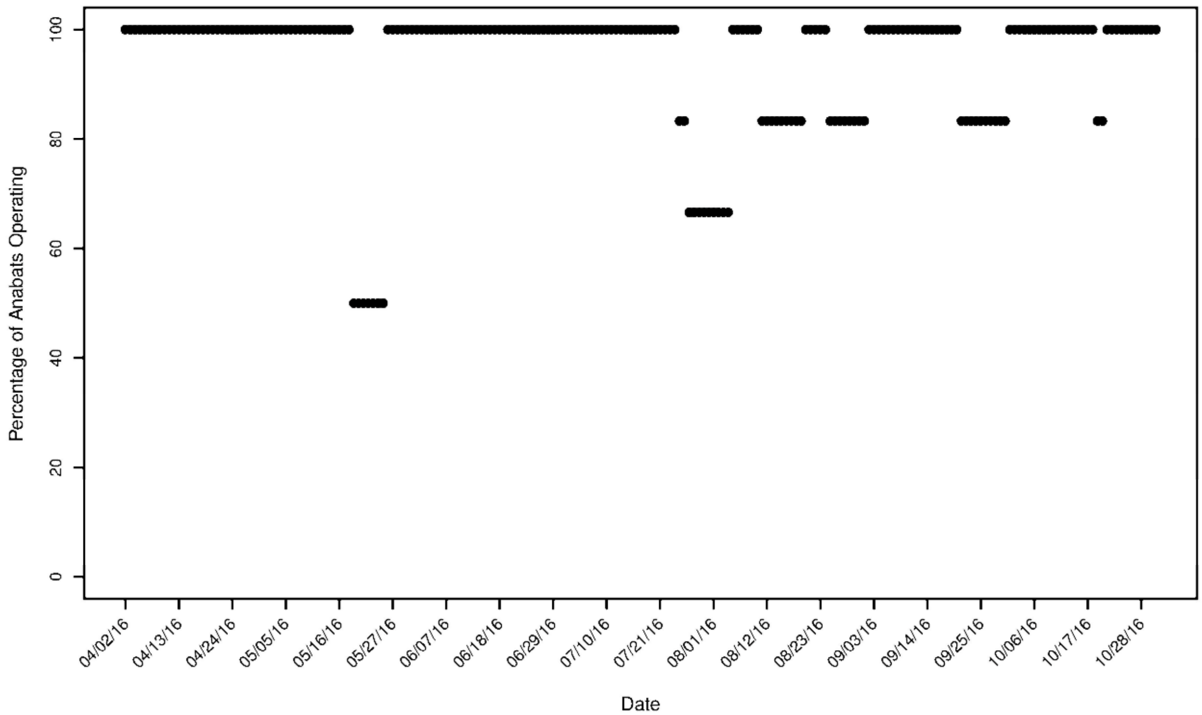

Figure 4. Operational status of bat detectors (n = 7) at the Bitter Root Wind Energy Project from April 2 to November 1, 2016.

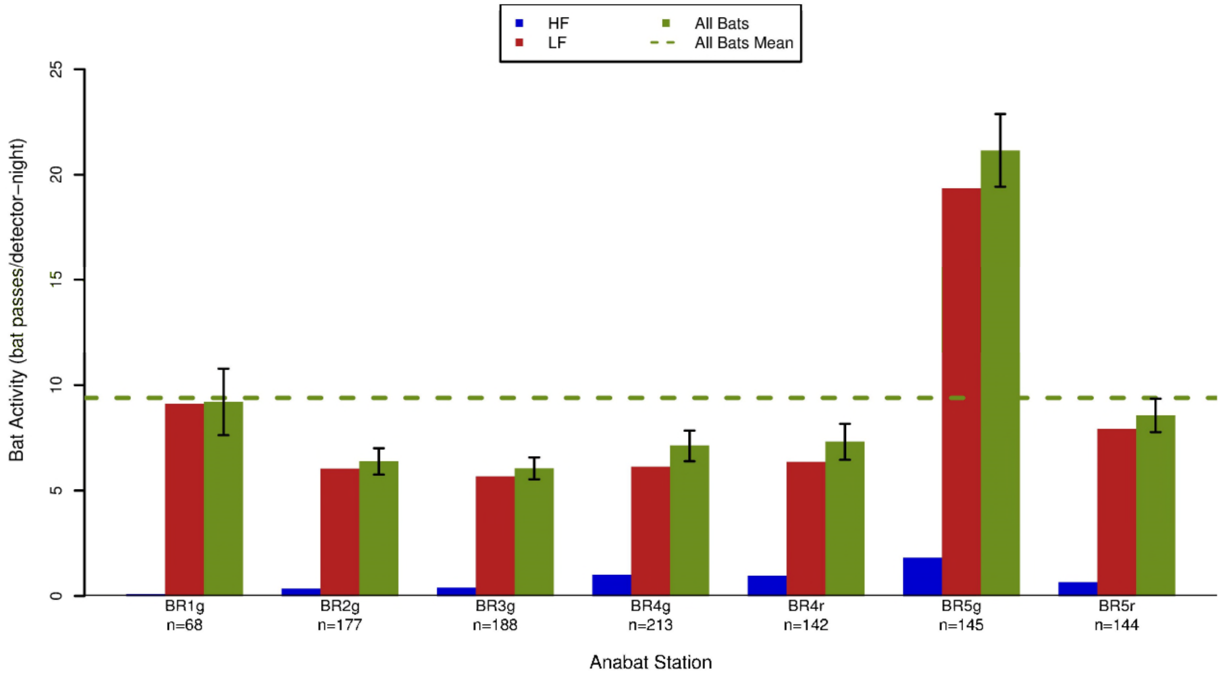

Figure 5. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night (n) recorded at AnaBat stations in the Bitter Root Wind Energy Project from April 2 to November 1, 2016. The bootstrapped standard errors are represented by black error bars on the "All Bats" columns.

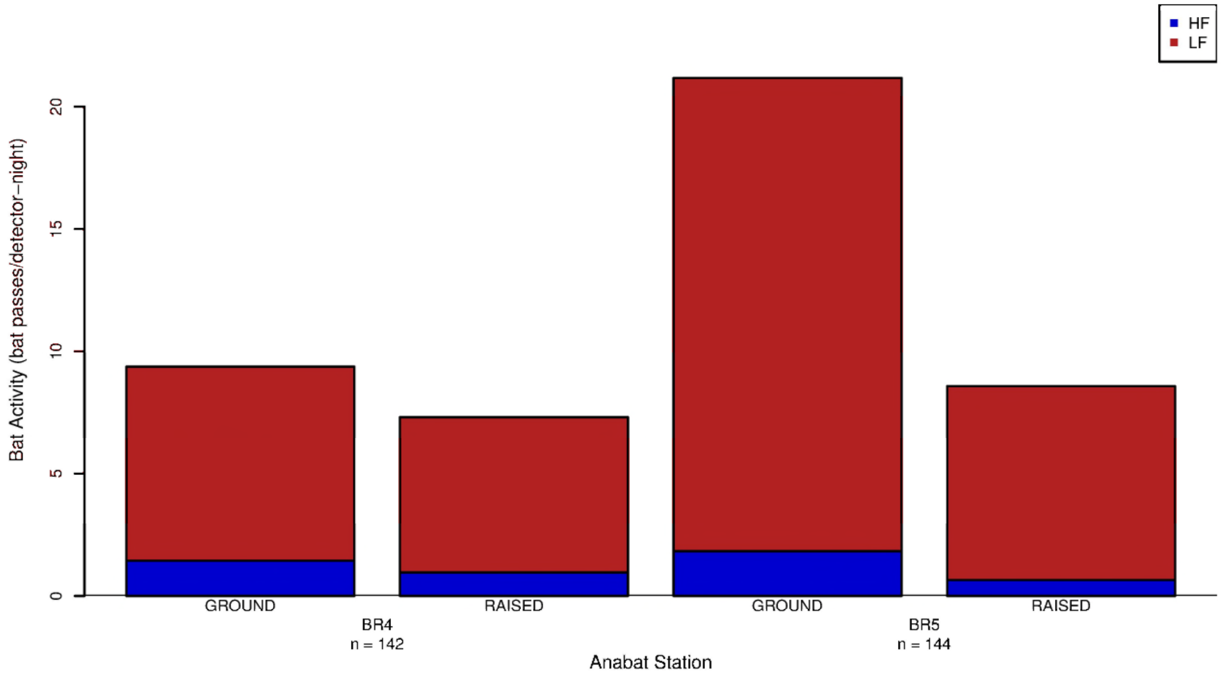

Figure 6. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night (n = number of nights with both detectors functioning) recorded at paired AnaBat detectors in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

4.1.2 Frequency Group Composition

More LF bat passes (91.3% of all bat passes recorded) were recorded at all stations than were HF bat passes (8.7%; Table 3). LF bat passes comprised 91.8% and 89.9% of all bat passes recorded at ground and raised stations, respectively, while HF bat passes comprised 8.2% and 10.1% of all bat passes recorded at ground and raised stations, respectively (Table 3).

4.1.3 Temporal Variation

For all bat species, overall bat activity was highest in the summer (14.53 ± 0.86 bat passes per detector-night), followed by the Fall Migration Period (9.22 ± 0.87 bat passes per detector-night), fall (5.95 ± 0.85 bat passes per detector-night), and spring (3.30 ± 0.61 bat passes per detector-night; Table 4).

Weekly acoustic activity for all bats at all stations peaked from July 29 – August 4 (24.39 bat passes per detector-night). Activity for HF bats peaked from July 18 – July 24 (2.76 bat passes per detector-night), while activity for LF bats peaked later, from July 29 – August 4 (21.86 bat passes per detector-night; Table 5, Figure 8). Overall bat activity then gradually decreased through the end of the study period, with another pulse of activity in mid-September (Figure 8).

Weekly activity at paired detectors at met towers was higher at ground detectors than at raised detectors throughout the study period (Figure 9).

Table 4. The number of bat passes per detector-night recorded at ground and raised AnaBat stations by season in the Bitter Root Wind Energy Project from April 2 to November 1, 2016[1], reported for all bats (AB) and separated by call frequency: high frequency (HF) and low frequency (LF).

Station	Call Frequency	Spring Apr 14 – May 31	Summer June 1 – July 15	Fall July 16 – Nov 14	Fall Migration Period Jul 30 – Oct 14
BR1g	LF	5.25	16.21	--	--
	HF	0.00	0.25	--	--
	AB	5.25	16.46	--	--
BR2g	LF	3.30	9.39	3.85	4.45
	HF	0.00	0.39	0.54	0.62
	AB	3.30	9.78	4.39	5.08
BR3g	LF	2.86	11.10	2.05	2.65
	HF	0.00	0.39	0.62	0.77
	AB	2.86	11.49	2.67	3.42
BR4g	LF	1.77	8.96	5.21	8.25
	HF	0.00	1.49	0.99	1.73
	AB	1.77	10.45	6.19	9.97
BR4r	LF	--	9.27	3.75	6.68
	HF	--	1.27	0.68	1.05
	AB	--	10.54	4.43	7.73
BR5g	LF	--	27.46	12.16	18.66
	HF	--	2.09	1.56	2.18
	AB	--	29.54	13.71	20.84
BR5r	LF	--	12.43	4.00	7.48
	HF	--	1.03	0.31	0.81
	AB	--	13.46	4.31	8.29
Ground Totals	LF	3.30 ± 0.56	14.62 ± 0.84	5.82 ± 0.83	8.50 ± 0.89
	HF	0.00 ± 0.00	0.92 ± 0.09	0.93 ± 0.12	1.33 ± 0.12
	AB	3.30 ± 0.56	15.54 ± 0.86	6.74 ± 0.91	9.83 ± 0.96
Raised Totals	LF	--	10.85 ± 1.06	3.87 ± 0.74	7.08 ± 0.97
	HF	--	1.15 ± 0.16	0.50 ± 0.10	0.93 ± 0.14
	AB	--	12.00 ± 1.19	4.37 ± 0.79	8.01 ± 1.05
Overall	**LF**	3.30 ± 0.61	13.54 ± 0.81	5.17 ± 0.78	8.03 ± 0.80
	HF	0.00 ± 0.00	0.99 ± 0.10	0.78 ± 0.10	1.19 ± 0.10
	AB	3.30 ± 0.61	14.53 ± 0.86	5.95 ± 0.85	9.22 ± 0.87

[1] BR1g was deployed on April 2 and moved to BR5g on June 9, 2016. BR4r and BR5r were deployed on June 10, 2016.

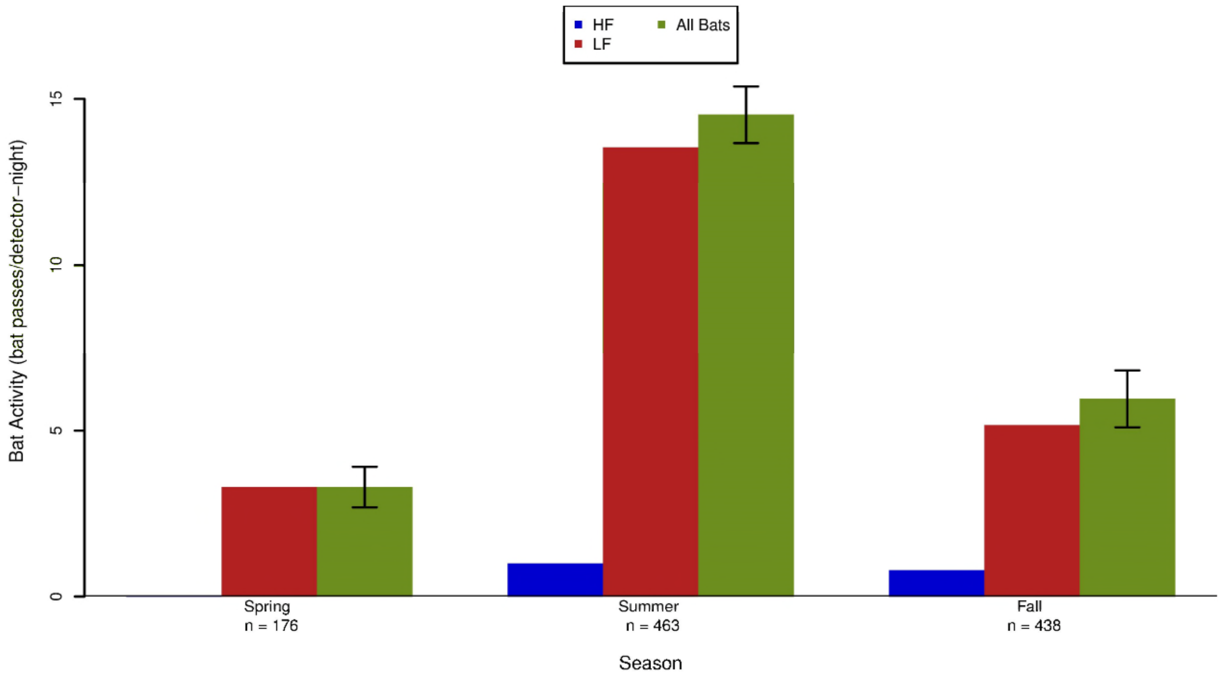

Figure 7. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Bitter Root Wind Energy Project from April 2 to November 1, 2016.

Table 5. Periods of peak activity for high-frequency (HF), low-frequency (LF), and all bats at the Bitter Root Wind Energy Project from April 2 to November 1, 2016.

Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
HF	July 18	July 24	2.76
LF	July 29	August 4	21.86
All Bats	**July 29**	**August 4**	**24.39**

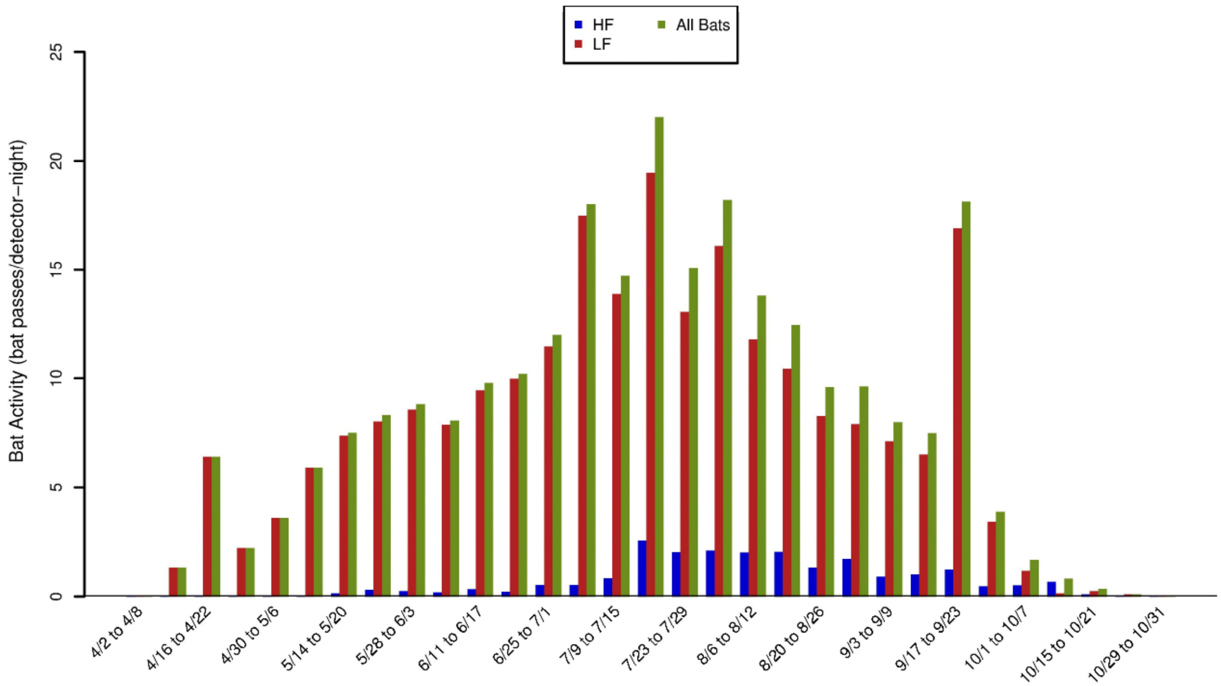

Figure 8. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Bitter Root Wind Energy Project from April 2 to November 1, 2016.

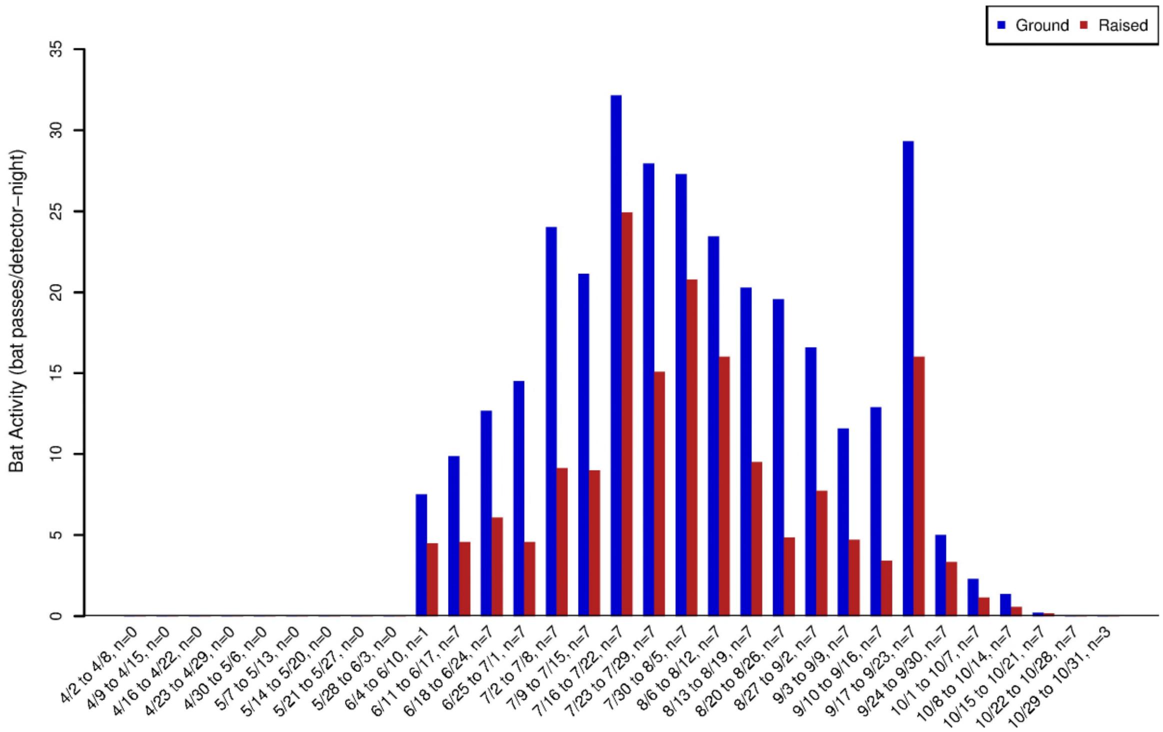

Figure 9. Weekly patterns of bat activity recorded at ground and raised meteorological tower stations at the Bitter Root Wind Energy Project from April 2 to November 1, 2016 (n refers to the number of nights that at least one pair of ground and raised detectors were both operating during a week).

4.2 Weather Analysis

4.2.1 Wind Speed Association

Nightly wind speed over the survey period ranged from nearly zero to over 8 meters/second (m/s; 18 miles/hour [mph]; Table 6). Bat passes per detector-night were distributed by the number of nights and wind speed category. The majority of nights fell within the 2-4 m/s (5-9 mph) wind speed category, with 99 total nights and 10.2 passes per detector-night for all bats (Table 6, Figure 10). The number of bat passes per detector-night decreased (0.9 passes per detector-night) for all bats as wind speeds increased (6-8 m/s; 13-18 mph; Table 6, Figures 10 and 11). Bat passes per detector-night and wind speed were negatively correlated (Pearson product-moment correlation coefficient=-0.18, p=0.010), indicating a negative association between bat activity and wind speed.

Table 6. Distribution of nights and bat passes per detector-night by wind speed category for high-frequency (HF), low-frequency (LF), and all bats (AB) at the Bitter Root Wind Energy Project from April 2 to November 1, 2016.

Wind Speed Category (meters/second)	Wind Speed Category (miles/hour)	Number of Nights	Nights[1] (% composition)	Bat Passes per Detector-Night		
				HF	LF	AB
0 to 2	0 to 5	62	29.1	0.9	9.0	9.9
2 to 4	5 to 9	99	46.5	0.8	9.3	10.2
4 to 6	9 to 13	35	16.4	0.4	6.2	6.7
6 to 8	13 to 18	9	4.2	0.1	0.8	0.9
no data	no data	8	3.8	0.3	3.6	3.9

[1] Nights (% composition) refers to the percentage of nights classified within each wind speed category.

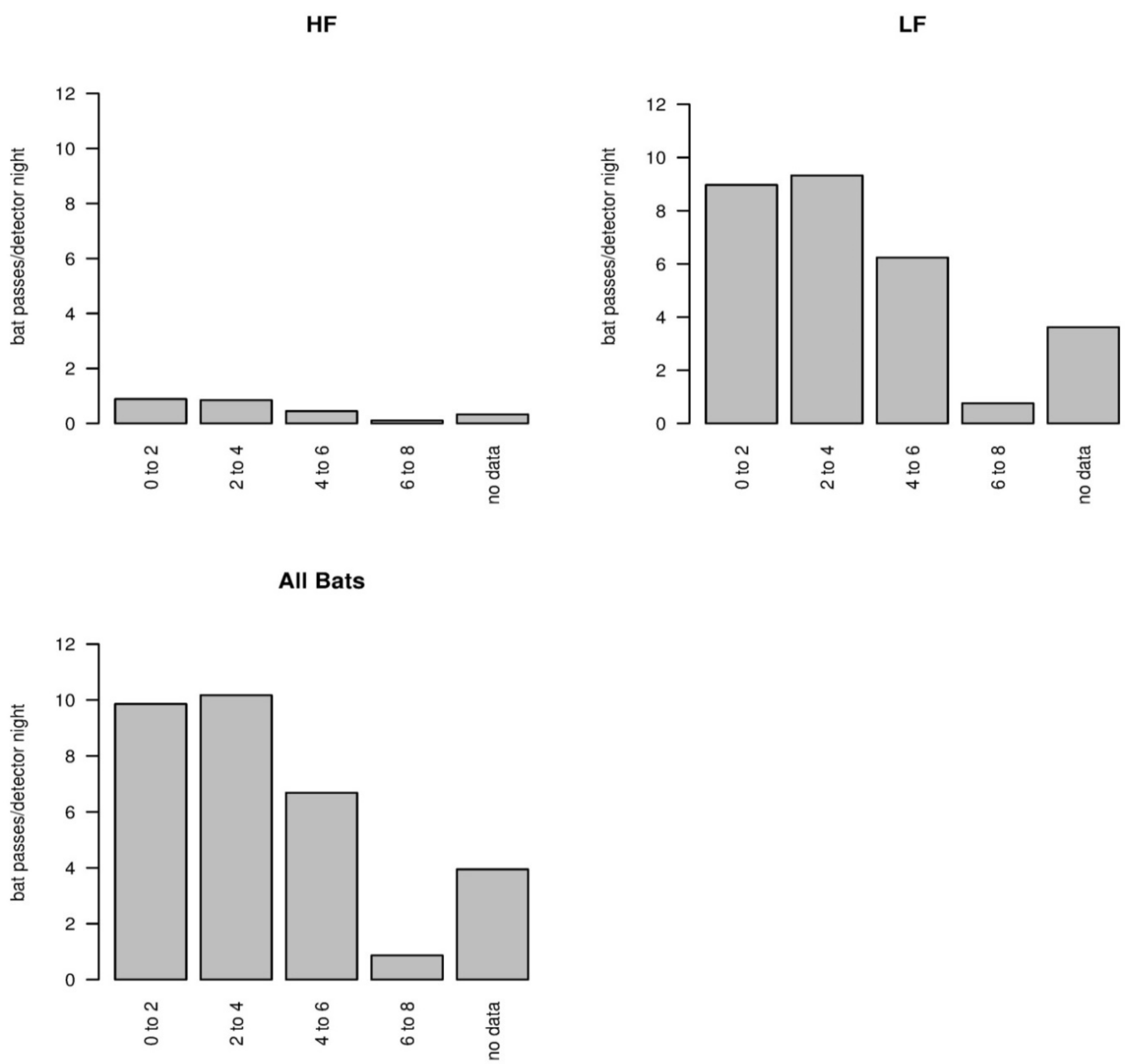

Figure 10. Histogram of bat passes per detector-night by wind speed (m/s) category for high-frequency (HF), low-frequency (LF), and all bats (AB) recorded in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

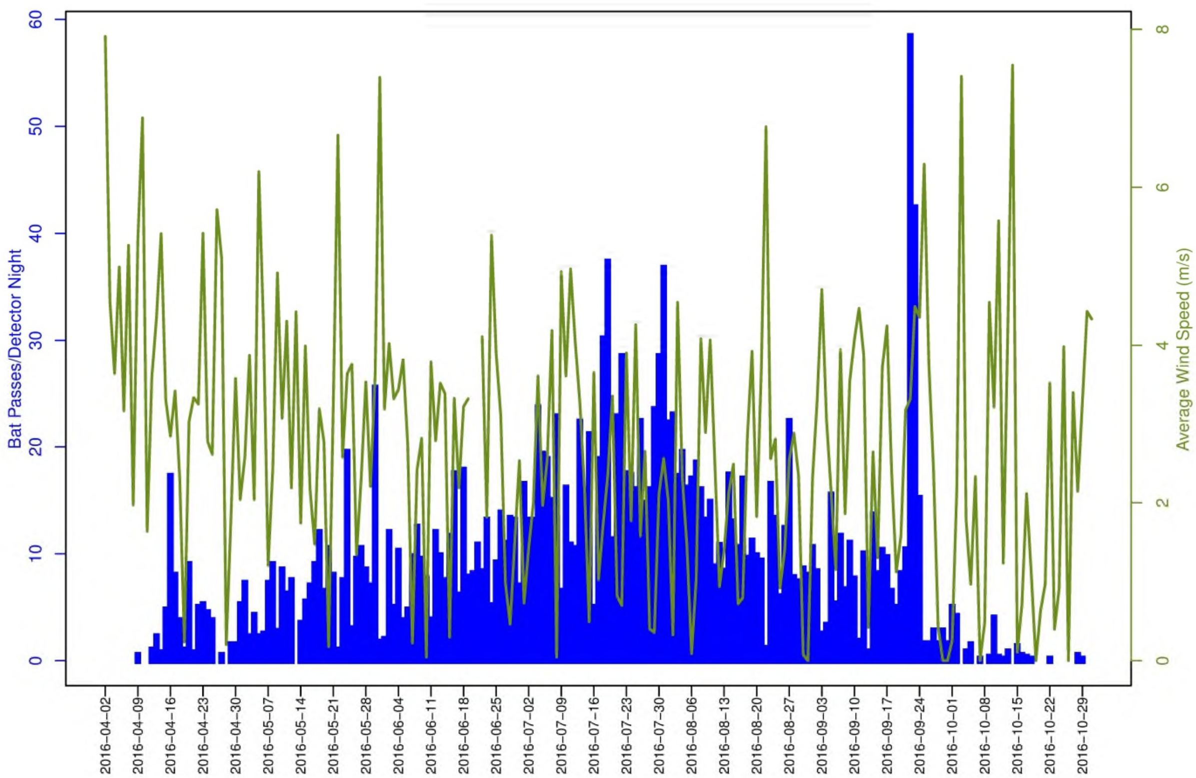

Figure 11. All bat passes per detector-night and average wind speed (m/s) by date recorded in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

4.2.2 Temperature Association

The majority of nights (78 nights) were within the 15-20 °Celsius (°C; 59-68 °Fahrenheit [°F]) temperature category. The highest bat activity, 14.6 passes per detector-night for all bats, occurred within the 20-25 °C (59-68 °F) temperature category (Table 7, Figure 12). The number of bat passes per detector-night decreased for all bats as temperatures decreased, dropping to 0.0 bat passes per detector-night recorded in the -5-0 °C (23-32 °F) category (Table 7, Figures 12 and 13). Correlation analysis confirmed this positive relationship between temperature and bat activity (Pearson product-moment correlation coefficient = 0.58, $p < 0.001$). At the highest temperature category (25-30 °C [77-86 °F]), bat activity decreased to 8.7 passes per detector-night for all bats from the 14.6 passes per detector-night recorded at 20-25 °C (68-77 °F; Table 7, Figures 12 and 13).

Table 7. Distribution of nights and bat passes per detector-night by temperature category for high-frequency (HF), low-frequency (LF), and all bats (AB) recorded at ground and raised stations in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

Temperature Category (°C)	Temperature Category (°F)	Number of Nights	Nights[1] (% composition)	Bat Passes per Detector-Night		
				HF	LF	AB
-5 to 0	23 to 32	1	0.5	0.0	0.0	0.0
0 to 5	32 to 41	16	7.5	<0.1	0.1	0.1
5 to 10	41 to 50	33	15.5	0.1	2.0	2.1
10 to 15	50 to 59	42	19.7	0.4	5.7	6.2
15 to 20	59 to 68	78	36.6	1.1	11.4	12.5
20 to 25	68 to 77	37	17.4	1.3	13.3	14.6
25 to 30	77 to 86	3	1.4	0.7	7.9	8.7
no data	no data	3	1.4	0.3	6.1	6.3

[1] Nights (% composition) refers to the percentage of nights classified within each wind speed category.

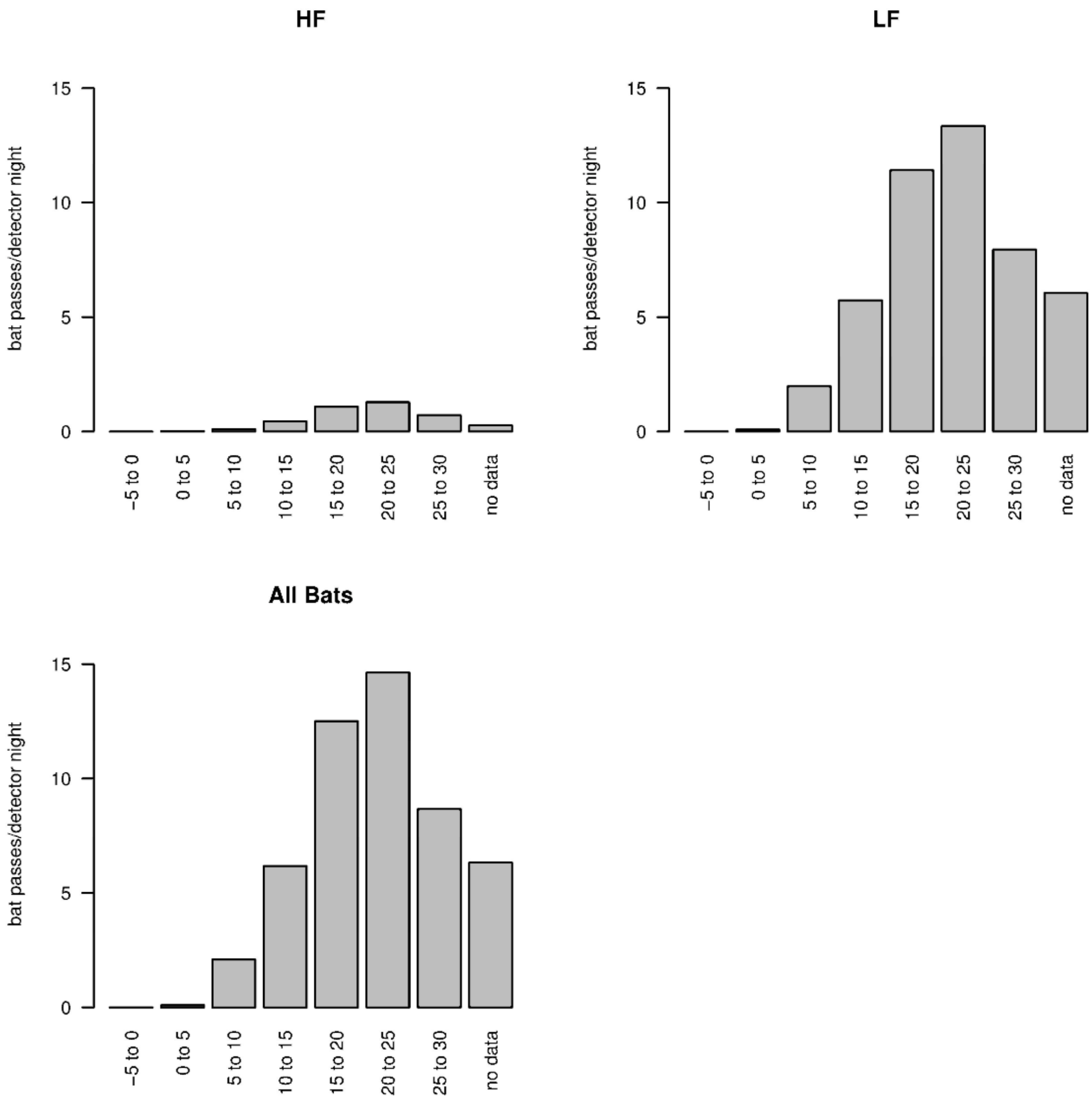

Figure 12. Histogram of bat passes per detector-night by temperature category (°C) for high-frequency (HF), low-frequency (LF), and all bats (AB) at ground and raised stations recorded in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

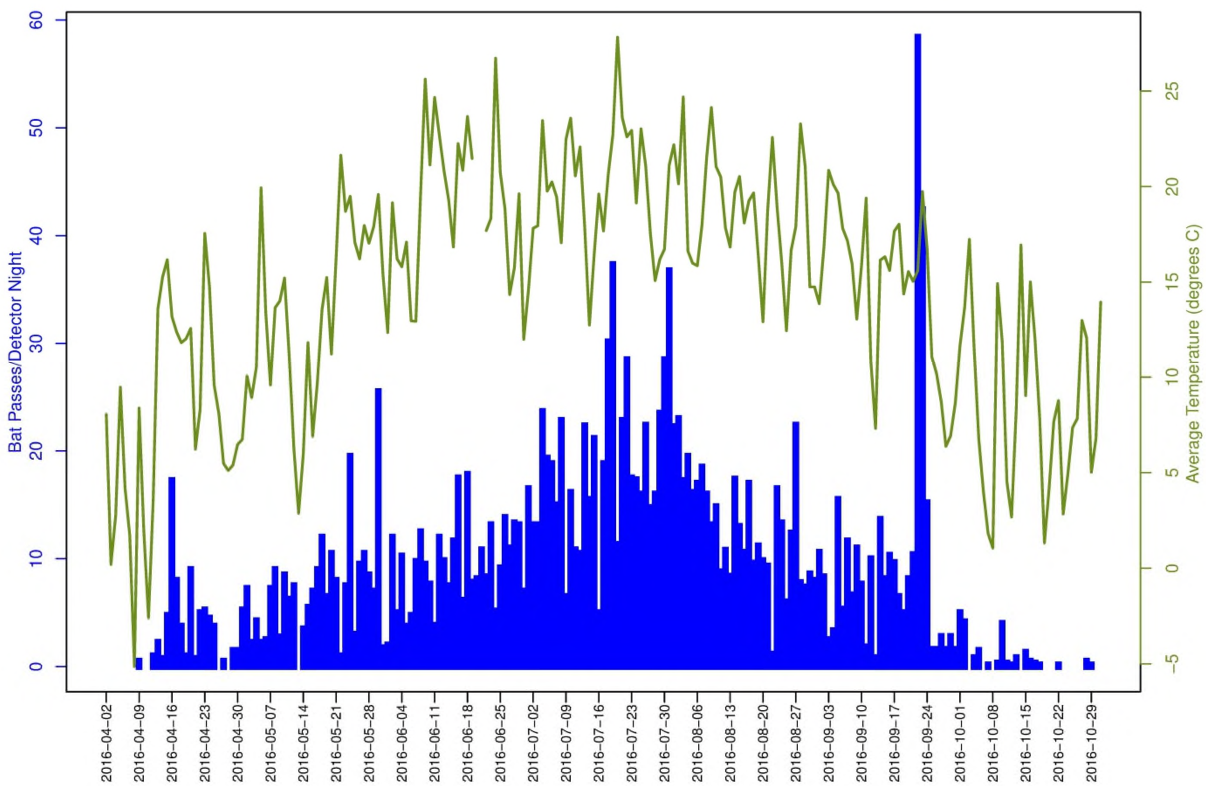

Figure 13. All bat passes per detector-night and average temperature (°C) by date in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

4.2.3 Relative Humidity Association

The majority of nights (83 nights) during the study were within the 80%-90% relative humidity category, when 10.4 bat passes per detector-night were recorded for all bats (Table 8, Figure 14). Bat activity decreased to 3.0 bat passes per detector-night for all bats when relative humidity was between 40% and 50%. The highest activity for all bats (11.8 bat passes per detector-night) was recorded within the 90%-100% relative humidity category (Table 8, Figure 14). Relative humidity and bat activity were significantly correlated (Pearson's correlation coefficient = 0.29, $p < 0.001$); however, not as strongly correlated as were bat activity and temperature (Figure 15).

Table 8. Distribution of nights and bat passes per detector-night by humidity category (percent relative humidity) for high-frequency (HF), low-frequency (LF), and all bats (AB) recorded in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

Humidity Category (% relative humidity)	Number of Nights	Nights[1] (% composition)	Bat Passes per Detector-Night		
			HF	LF	AB
40 to 50	5	2.3	0.1	3.0	3.0
50 to 60	13	6.1	0.1	5.1	5.1
60 to 70	21	9.9	0.3	4.7	5.0
70 to 80	42	19.7	0.5	6.0	6.5
80 to 90	83	39.0	1.0	9.4	10.4
90 to 100	47	22.1	1.0	10.7	11.8
no data	2	0.9	0.4	9.1	9.5

[1] Nights (% composition) refers to the percentage of nights classified within each wind speed category.

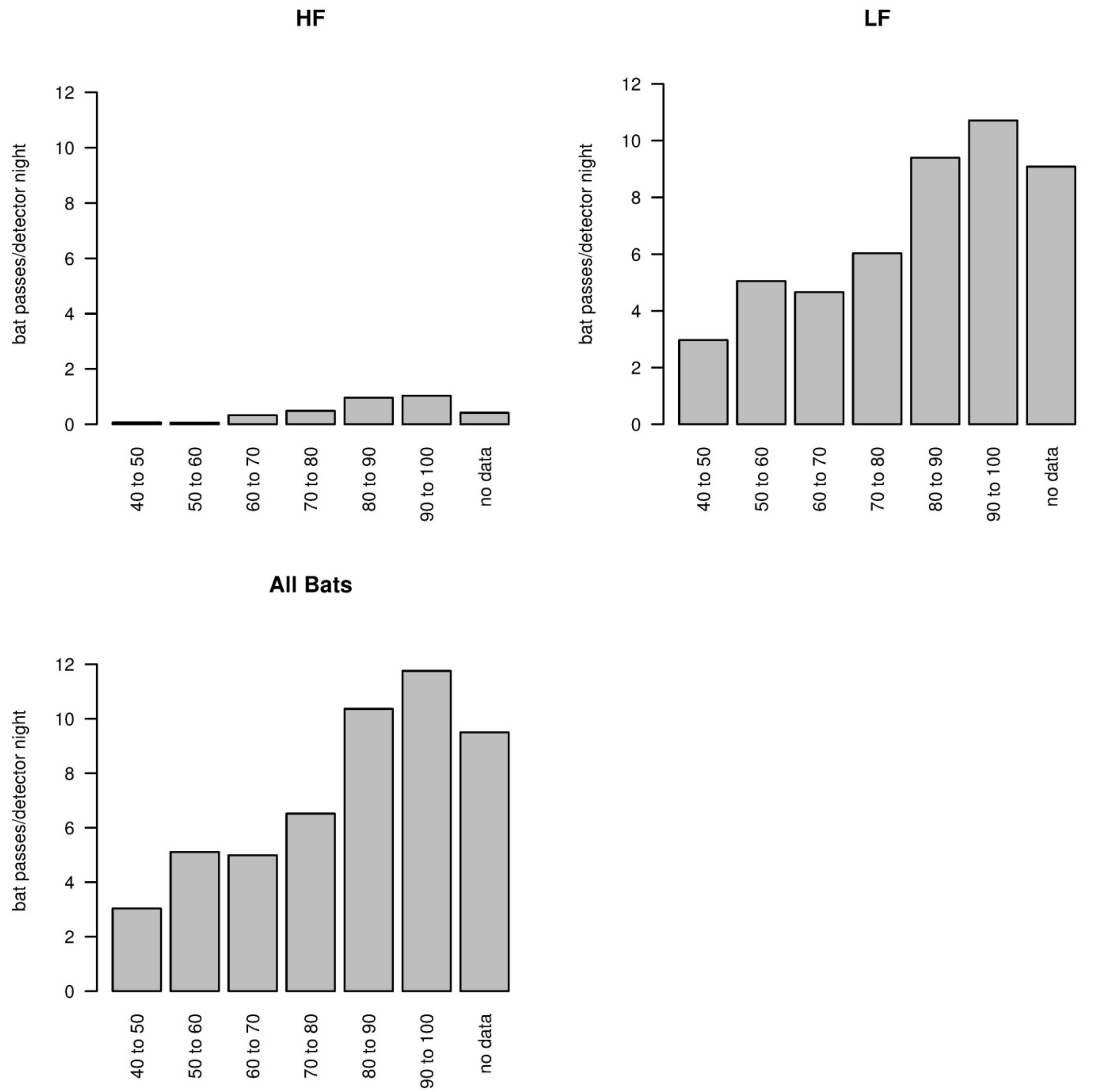

Figure 14. Histogram of bat passes per detector-night by humidity category (% relative humidity) for high-frequency (HF), low-frequency (LF), and all bats (AB) recorded in the Bitter Root Wind Energy Project area from April 2 to November 1, 2016.

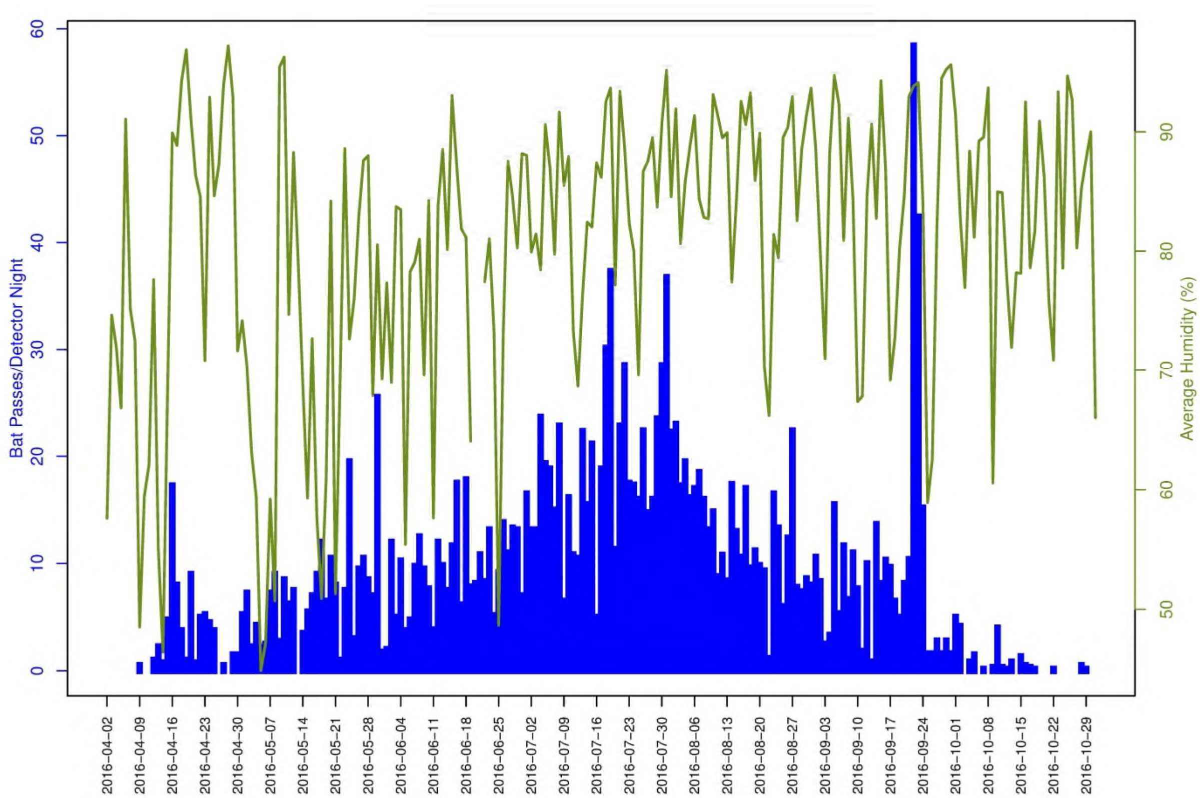

Figure 15. All bat passes per detector-night and average humidity (% relative humidity) by date recorded in the Bitter Root Wind Energy Project from April 2 to November 1, 2016.

5 DISCUSSION

Bat activity recorded in the Project area was fairly consistent across stations with the exception of BR5g, which recorded more than twice the activity recorded at any other station. It is unknown why bat activity was so high at station BR5g, as all stations were placed in agricultural or pasture habitats. It is possible that a small wooded lot to the north of station BR5g provided suitable summer maternity habitat, which is limited within the Project. Forests and wetlands compose less than 2.0% of the land cover at the Project (Table 1).

Bat activity was consistently higher at ground stations than at raised stations throughout the 7-month study period. Low frequency bats passes made up 91.8% of the calls at ground units and 89.9% of the calls at raised stations.

Bat activity varied temporally throughout the study period. When all acoustic units were considered, bat activity peaked between late July and early August. This timing coincides with the period of peak bat mortality documented at most wind energy facilities (Arnett et al. 2008).

Wind speed, temperature, and relative humidity were all significantly correlated with bat activity. Temperature and relative humidity were both positively correlated with bat activity, although temperature showed a stronger correlation than relative humidity. Wind speed was negatively correlated with bat activity. In general, bat activity increased on calm, warm, and humid nights, although data suggest that bat activity decreased on the warmest (25 to 30 °C [77 to 86 °F]) nights. While these correlations were statistically significant, there was also unexplained variation in bat activity, which could have been due to insect availability, other weather conditions, or a combination of factors.

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Grassland Bird Survey Report

Grassland Bird Survey Report

for the Bitter Root Wind Farm

Yellow Medicine County, Minnesota, and Deuel County, South Dakota

June 18 – July 6, 2016

Prepared for:
Flying Cow Wind, LLC

At the request of
Global Winds Harvest, Inc.
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REPORT REFERENCE

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APPENDIX

INTRODUCTION

Flying Cow Wind, LLC is developing the Bitter Root Wind Farm (Project) in Yellow Medicine County, Minnesota, and Deuel County, South Dakota (Figure 1). Western EcoSystems Technology, Inc. (WEST) provided assistance to the Project by identifying areas of extensive grasslands during Geographic Information System-based assessments, with follow-up field assessments to document 1) avian species abundance and community composition within these grassland habitats, and 2) any federal and/or state listed species that may be affected by the proposed wind energy facility. This report provides results of the grassland bird surveys conducted at the Project in late June – early July 2016.

STUDY AREA

The proposed Project is located in Yellow Medicine County, in southwest Minnesota, west of the town of Canby, and in eastern Deuel County, South Dakota (Figure 1). The Project falls in the Northern Glaciated Plains Level III Ecoregion and the Prairie Couteau Level IV Ecoregion (US Environmental Protection Agency [USEPA] 2016). The Northern Glaciated Plains Ecoregion is a flat to gently rolling landscape of glacial drift. The region is transitional between tallgrass and shortgrass prairie and high concentrations of temporary and seasonal wetlands offer suitable habitat for waterfowl nesting and migration. The Prairie Coteau Ecoregion is generally a higher elevation plateau with poorly defined drainage. Many lakes and a mix of row crops and pasture are present in this region. This region, previously dominated by shortgrass and tallgrass prairies, seasonal and semi-permanent wetlands, mixed tall shrubs, and riparian and oak-aspen (*Quercus* spp.-*Populus* spp.) groves, has been extensively converted to farmland and cropland, livestock production, and pasture lands (USEPA 2016). Topography in the Prairie Coteau Ecoregion is flat to gently rolling, and within this area of the Prairie Couteau Ecoregion is the Yellow Medicine Couteau, the site of this Project.

Figure 1. Location of the proposed Bitter Root Wind Farm.

Based on the US Geological Survey (USGS) National Land Cover Database (NLCD), land cover within the Project area is predominately cultivated crops (45%), herbaceous (22%), and hay/pasture (21%) (USGS NLCD 2011, Homer et al. 2015). Prairies and grasslands are frequently identified with the USGS NLCD within the herbaceous and hay/pasture land cover classification in Minnesota. Prairies provide key breeding and foraging habitats for grassland birds. The Minnesota Department of Natural Resources (MNDNR) and the Minnesota Department of Commerce require grassland bird surveys for areas with contiguous grassland habitats of more than 16.2 hectares (40 acres). Given the mix of crop lands and grassland habitats, we conducted this grassland bird assessment to characterize the avian community in these areas.

METHODS

Grassland bird surveys are used to gather information on species presence and relative abundance within or immediately adjacent to the Project area during the breeding and nesting season. WEST completed grassland bird surveys using pairs of fixed-width transects surveys in large blocks of un-fragmented grassland habitat during the nesting season. During the initial screenings, five parcels identified for potential development in Layout 12 (turbines, transmission and collector lines) were within areas of contiguous grassland habitats of >40 acres, therefore specific grassland bird surveys were recommended. Grasslands considered for surveys included following features:

- size and extent of patch size (16.2 hectares [40 acres]),
- proximity of grassland parcel to adjoining grassland parcels, and
- relation of the grassland parcel to the project boundary (i.e. Is the parcel interior to the project and central to the development plan?).

Furthermore, each of these areas identified met minimum survey placement requirements established in the *Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota* (Avian and Bat Survey Protocols; Mixon et al. 2014), including the following features:

- Greater than 150 m from roads and habitat edges;
- adequate area to contain the >100m x 150m of transect; and
- proximity of grassland parcel to development within or adjacent to the parcel.

Site visits by J. Stucker on June 16-17, 2016 confirmed the need for grassland bird surveys on these units.

Transect bird use surveys

Study Design

For each of the five grassland areas surveyed, two 200-meter (m; 656-feet [ft]) transects were placed in the habitats to maximize surveys of grassland habitats, avoiding areas of emergent wetlands (Figure 2). Surveys followed methods specified by the MNDNR in the *Avian and Bat Survey Protocols* (Mixon et al. 2014). Each surveyed transect extended 200 m in length with a width of 150 m (492 ft), or 75 m (246 ft) on either side of the transect line. Transects were spaced at least 250 m (820 ft) apart and 150 m from the edge of the grassland habitat. Biologists recorded observations for 100-m (328-ft) segments along each transect, pausing for five minutes (min) at the beginning and end of each segment to listen for and observe birds. Transects were followed using Global Positioning System (GPS) units and the observer recorded all birds detected by sight or sound. Effort was made to maintain a consistent walking pace to ensure similar observation effort for each transect.

In addition to the species observed and location, the following data were recorded for each transect survey: date, start and end time of observation period, transect number, species or best possible identification, number of individuals, behavior, and auditory-only observations. Weather information, such as temperature, wind speed, wind direction, precipitation, and cloud cover, were also recorded for each transect survey. Transects were located and followed using GPS units with pre-recorded waypoints.

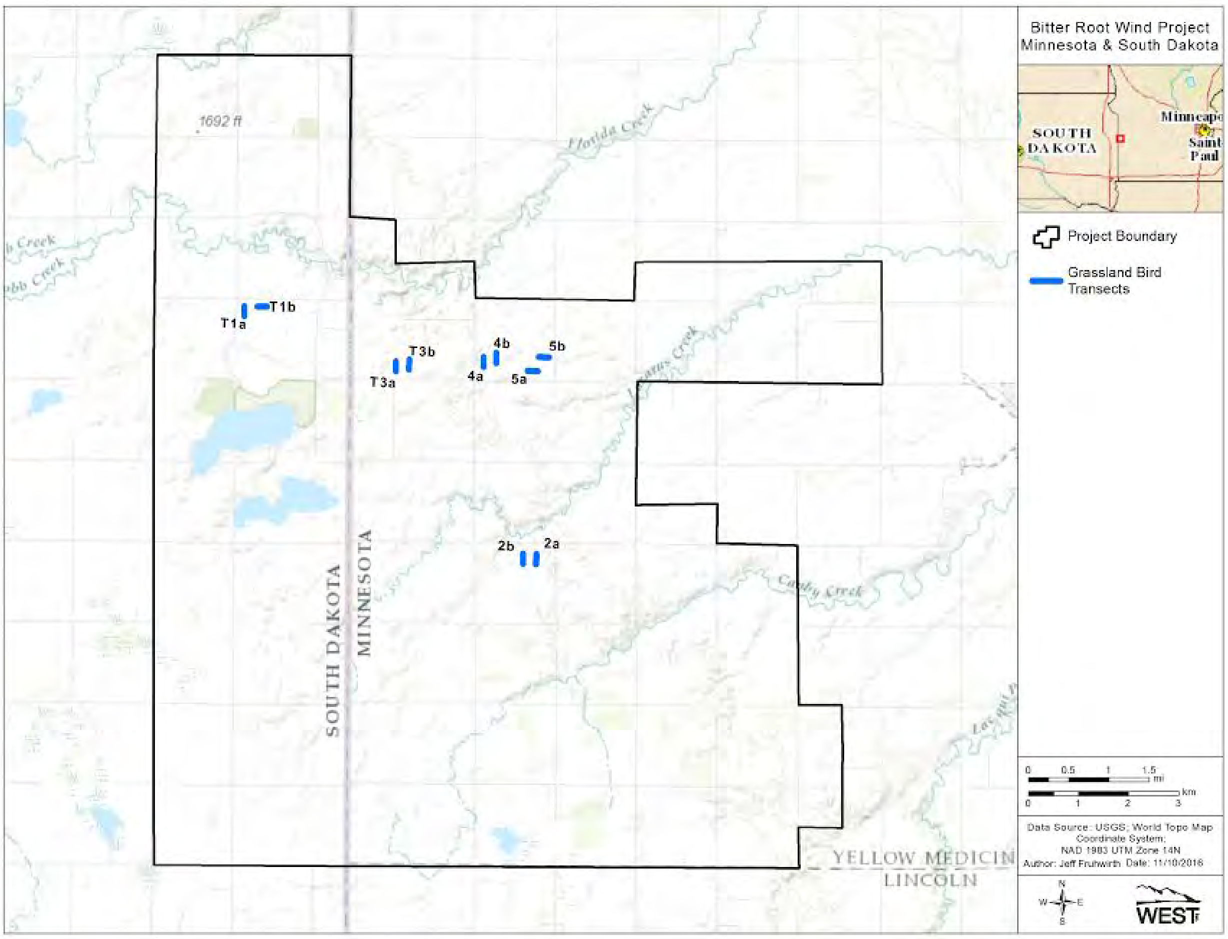

Figure 2. Grassland bird survey transects in the Bitter Root Wind Farm.

Observation Schedule

WEST biologists conducted surveys at each of the transects three times between June 18 – July 6, 2016, with the three survey periods occurring June 18-20, June 27-29, and July 4-6. All surveys were completed between the hours of sunrise and 1000 H (10:00 AM local time) to maximize auditory detection of singing/calling birds.

Statistical Analysis

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. A sample of records from an electronic database was compared to the raw data forms and any errors detected were corrected. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

A Microsoft® SQL relational database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. All data forms, field notebooks, and electronic data files were retained for reference.

Transect Bird Surveys

<u>Bird Diversity and Species Richness</u>

Bird diversity summarizes the total number (count) of unique species observed. Species lists, with the number of observations and the number of groups, including all observations of birds detected within 75 m of the transect. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/transect/survey period).

<u>Bird Use, Percent of Use, and Frequency of Occurrence</u>

For the standardized bird use estimates, only observations of birds detected within 75 m on either side of the transect were used. Estimates of bird use (i.e., number of birds/transect) were used to compare differences between bird group types.

The frequency of occurrence was calculated as the percent of surveys in which a particular species/bird type was observed. Percent composition was calculated as the proportion of the overall mean use for a particular species/bird type. Frequency of occurrence and percent composition provide relative estimates of species exposure to the Project.

RESULTS

Transect Use Surveys

Bird use transect surveys were conducted within the Project survey areas three times during the summer. A total of 30 200-m transect surveys were conducted (Table 1).

Table 1. Summary of overall bird use (number of birds/200-meter transect survey), species richness (species/200-meter transect), and sample size during the transect bird use surveys in the Bitter Root Wind Farm June 18 – July 6, 2016.

	# of Visits	Mean Use	Species Richness	# Species	# Surveys Conducted
Overall	**3**	**42.97**	**12.8**	**52**	**30**

Bird Diversity and Species Richness

Fifty-two unique species were identified during the transect use surveys and the mean number of species observed per transect per survey period was approximately 43 individuals representing 12.8 species (Table 1). A total of 1,290 individual bird observations within 892 separate groups were recorded (Table 2). Cumulatively, five species (less than 10% of all species identified) accounted for 50% of the individual observations: red-winged blackbird (*Agelaius phoeniceus),* bobolink (*Dolichonyx oryzivorus*), cliff swallow (*Petrochelidon pyrrhonota*), grasshopper sparrow (*Ammodramus savannarum*), and western meadowlark (*Sturnella neglecta*). All other species accounted for 5% or less of the total observations.

Bird Use, Composition, and Frequency of Occurrence by Species and Type

Mean bird use estimates, percent of total composition, and frequency of occurrence for all species and bird types are shown in Table 3.

Table 2. Total number of group (grps) and individual (obs) observations for each bird type and species by season during the transect bird use surveys in the Bitter Root Wind Resource Area, June 18 – July 6, 2016.

Bird Type / Species	Scientific Name	# grps	# obs
Waterbirds		**6**	**22**
American white pelican	*Pelecanus erythrorhynchos*	4	20
great blue heron	*Ardea Herodias*	1	1
unidentified waterbird		1	1
Waterfowl		**17**	**30**
blue-winged teal	*Anas discors*	6	8
Canada goose	*Branta Canadensis*	1	1
mallard	*Anas platyrhynchos*	9	20
wood duck	*Aix sponsa*	1	1
Shorebirds		**39**	**42**
Killdeer	*Charadrius vociferous*	11	14
unidentified shorebird		2	2
upland sandpiper	*Bartramia longicauda*	20	20
Wilson's snipe	*Gallinago delicate*	6	6
Gulls/Terns		**4**	**4**
Herring gull	*Larus argentatus*	2	2
ring-billed gull	*Larus delawarensis*	1	1
unidentified gull		1	1
Rails/Coots		**1**	**1**
sora	*Porzana carolina*	1	1
Diurnal Raptors		**5**	**6**
red-tailed hawk	*Buteo jamaicensis*	5	6

Table 2. Total number of group (grps) and individual (obs) observations for each bird type and species by season during the transect bird use surveys in the Bitter Root Wind Resource Area, June 18 – July 6, 2016.

Bird Type / Species	Scientific Name	# grps	# obs
Upland Game Birds		**2**	**2**
ring-necked pheasant	*Phasianus colchicus*	2	2
Doves/Pigeons		**8**	**14**
mourning dove	*Zenaida macroura*	7	11
rock pigeon	*Columba livia*	1	3
Passerines		**805**	**1,161**
Passerines		*18*	*20*
unidentified passerine		18	20
Blackbirds/Orioles		*406*	*662*
Baltimore oriole	*Icterus galbula*	1	1
bobolink	*Dolichonyx oryzivorus*	104	146
brown-headed cowbird	*Molothrus ater*	34	70
common grackle	*Quiscalus quiscula*	30	41
European starling	*Sturnus vulgaris*	1	7
orchard oriole	*Icterus spurius*	2	2
red-winged blackbird	*Agelaius phoeniceus*	124	239
unidentified icterids		3	31
western meadowlark	*Sturnella neglecta*	82	83
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	25	42
Finches/Crossbills		*32*	*58*
American goldfinch	*Spinus tristis*	32	58
Flycatchers		*16*	*17*
eastern kingbird	*Tyrannus tyrannus*	13	14
western kingbird	*Tyrannus verticalis*	3	3
Grassland/Sparrows		*144*	*157*
chipping sparrow	*Spizella passerine*	2	2
clay-colored sparrow	*Spizella pallida*	24	33
dickcissel	*Spiza Americana*	11	13
grasshopper sparrow	*Ammodramus savannarum*	80	80
horned lark	*Eremophila alpestris*	3	3
Savannah sparrow	*Passerculus sandwichensis*	1	1
song sparrow	*Melospiza melodia*	7	8
swamp sparrow	*Melospiza georgiana*	7	7
unidentified sparrow		9	10
Mimids		*2*	*2*
brown thrasher	*Toxostoma rufum*	1	1
gray catbird	*Dumetella carolinensis*	1	1
Swallows		*70*	*120*
bank swallow	*Riparia riparia*	5	5
barn swallow	*Hirundo rustica*	4	6
cliff swallow	*Petrochelidon pyrrhonota*	58	104
tree swallow	*Tachycineta bicolor*	2	4
unidentified swallow		1	1
Shrikes		*4*	*4*
loggerhead shrike	*Lanius ludovicianus*	4	4
Thrushes		*7*	*7*
American robin	*Turdus migratorius*	7	7
Vireos		*1*	*1*
warbling vireo	*Vireo gilvus*	1	1
Warblers		*50*	*50*
common yellowthroat	*Geothlypis trichas*	49	49
yellow warbler	*Setophaga petechial*	1	1

Table 2. Total number of group (grps) and individual (obs) observations for each bird type and species by season during the transect bird use surveys in the Bitter Root Wind Resource Area, June 18 – July 6, 2016.

Bird Type / Species	Scientific Name	# grps	# obs
Wrens		*55*	*63*
marsh wren	*Cistothorus palustris*	29	37
sedge wren	*Cistothorus platensis*	25	25
unidentified wren		1	1
Goatsuckers		**3**	**5**
common nighthawk	*Chordeiles minor*	3	5
Woodpeckers		**2**	**3**
northern flicker	*Colaptes auratus*	1	1
red-bellied woodpecker	*Melanerpes carolinus*	1	2
Overall		**892**	**1,290**

Table 3. Mean bird use (number of birds/200-m transect), percent of use (%), and frequency of occurrence (%) for each bird type and species during the transect bird use surveys in the Bitter Root Wind Farm, June 18 – July 6, 2016.

Bird Type / Species	Mean Use	% of Use	% Frequency
Waterbirds	0.73	1.7	20.0
Waterfowl	1.00	2.3	46.7
Shorebirds	1.40	3.3	46.7
Gulls/Terns	0.13	0.3	10.0
Rails/Coots	0.03	<0.1	3.3
Diurnal Raptors	0.17	0.4	13.3
Upland Game Birds	0.07	0.2	6.7
Doves/Pigeons	0.47	1.1	26.7
Passerines	38.70	90.1	100
Passerines	*0.67*	*1.6*	*40.0*
Blackbirds/Orioles	*22.07*	*51.4*	*100*
Finches/Crossbills	*1.93*	*4.5*	*53.3*
Flycatchers	*0.57*	*1.3*	*26.7*
Grassland/Sparrows	*5.23*	*12.2*	*90.0*
Mimids	*0.07*	*0.2*	*6.7*
Swallows	*4.00*	*9.3*	*76.7*
Shrikes	*0.13*	*0.3*	*10.0*
Thrushes	*0.23*	*0.5*	*16.7*
Vireos	*0.03*	*<0.1*	*3.3*
Warblers	*1.67*	*3.9*	*73.3*
Wrens	*2.10*	*4.9*	*53.3*
Goatsuckers	0.17	0.4	10.0
Woodpeckers	0.10	0.2	6.7
Overall	**42.97**	**100**	

Waterbirds

Waterbird species had a mean bird use of 0.73 birds/transect/survey. Waterbirds were observed during 20% of the surveys and accounted for 1.7% of the overall use (Table 3).

Waterfowl

Waterfowl had a mean use of 1.0 birds/transect/survey (Table 3); mallard (*Anas platyrhynchos*) had a mean use of 0.67 birds per transect, the highest use of all waterfowl species observed.

Waterfowl were observed during 49.7% of the surveys, but only accounted for 2.3% of the overall use (Table 3).

Shorebirds

Upland sandpiper (*Bartramia longicauda*), and killdeer (*Charadrius vociferus*) were the primary shorebirds observed (Table 2) and had a mean use of 0.67 and 0.47 birds/transect/survey, respectively (Table 3). Shorebirds were observed during 46.7% of the surveys (Table 3) and accounted for 3.3% of the overall use.

Gulls/Terns

Gulls and terns had a mean bird use of 0.13 birds/transect/survey. Gulls and terns were observed during 10.0% of the surveys and accounted for 0.3% of the overall use (Table 3).

Rails/Coots

Coots and rails had a mean bird use of 0.03 birds/transect/survey. Coots and rails were observed during 3.3% of the surveys and accounted for less than 0.1% of the overall use (Table 3).

Raptors

The only raptor observed during transects was the red-tailed hawk (*Buteo jamaicensis*; Table 2). Mean use by raptors was 0.17 birds/transect/survey. Raptors were observed during 13.3% of the surveys and accounted for 0.4% of the overall use (Table 3).

Upland Game Birds

The ring-necked pheasant (*Phasianus colchicus*) was the only upland gamebird observed during transect surveys (Table 2). Mean bird use by upland game birds was 0.07 birds/transect/survey. Upland game birds were observed during 6.7% of the surveys, accounting 0.2% of the overall use.

Doves/Pigeons

Doves and pigeons had a mean bird use of 0.47 birds/transect/survey. Doves and pigeons were observed during 26.7% of the surveys, but accounted for only 1.1% of the overall use (Table 3).

Passerines

Mean use was highest for passerines (38.7 birds/transect/survey) among all bird types. Most of passerine use was accounted for by the subtype blackbirds/orioles (22.1 birds/transect/survey). Within passerines, bobolink and red-winged blackbird (4.87 and 7.97 birds/transect/survey, respectively) were the two species with the highest mean use. Passerines were observed during all transect surveys and accounted for 90.0% of overall use (Table 3).

Sensitive Species Observations

None of the species observed were protected by the federal Endangered Species Act. Two species were protected by the State of Minnesota and nine species were identified as Species in Greatest Conservation Need (MNDNR 2016; Table 4). During the surveys, a loggerhead shrike (state endangered; *Lanius ludovicianus*) nest and several food caches were documented near Transect 4b.

Table 4. Summary of sensitive species observed at the Bitter Root Wind Resource Area during transect bird use surveys from June 18, to July 6, 2016.

Species	Scientific Name	Status	# grps	# obs
American white pelican	*Pelecanus erythrorhynchos*	SC	4	20
brown thrasher	*Toxostoma rufum*	SGCN	1	1
common nighthawk	*Chordeiles minor*	SGCN	3	5
dickcissel	*Spiza americana*	SGCN	11	13
grasshopper sparrow	*Ammodramus savannarum*	SGCN	80	80
loggerhead shrike	*Lanius ludovicianus*	SE	4	4
sedge wren	*Cistothorus platensis*	SGCN	25	25
upland sandpiper	*Bartramia longicauda*	SGCN	20	20
western kingbird	*Tyrannus verticalis*	SGCN	3	3
western meadowlark	*Sturnella neglecta*	SGCN	82	83
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	SGCN	25	42
Total	**Species**		**258**	**296**

SE = state endangered species; SC= state species of special concern; SGCN= state species of greatest conservation need (MNDNR 2016).

Spatial Use

Mean use (birds/transect survey) was plotted by transect for all birds combined, waterbirds, waterfowl, shorebirds, gulls and terns, rails and coots, diurnal raptors, upland game birds, doves and pigeons, passerines and passerine subtypes, goatsuckers, and woodpeckers (*see* Appendix A). For all bird species combined, use was greatest for transects 3a, 3b, and 4a (55.7 to 57.0 birds/survey). Bird use for the other transects ranged from 27.0 to 42.3 birds/survey. Waterbirds had the greatest mean use for Transect 4b (5.00 birds/survey), waterfowl had the highest mean use at Transect 3b (4.33 birds/survey), and shorebird use was highest at Transect 5b (5.67 birds/survey). Raptors were observed at only three transects, with the greatest use recorded at Transect 4a (1.00 birds/survey). Passerine use was highest at Transect 3a (56.0 birds/survey), with Transect 3b and Transect 4b similarly high (50.3 and 51.3 birds/survey, respectively). Blackbird and oriole species had a mean use of over 20.0 birds/survey at transects 1a (23.0), 1b (13.3), 3a (39.7), 3b (34.3), and 4a (26.3 birds/survey). Use by finches and crossbills was highest at Transect 4a (9.00 birds/survey). Grassland birds and sparrows had a mean bird use of 10.0 birds/survey (Transect 5b), and 9.0 birds/survey (Transect 3b); use ranged between 1.33 and 7.33 birds/survey at the other transects. Use by swallows was highest at transects 1b and 3a (7.33 birds/survey, each). Wrens had the highest use at transects 1a (5.67) and 1b (6.00 birds/survey). Use by shrikes was reported only at Transect 4b (1.33 birds/transect), and use by goatsuckers was only recorded at transects 4a and 5a (0.67 and 1.00 birds/transect, respectively).

DISCUSSION

Some grassland specialist bird species are known or suspected to be susceptible to indirect impacts of wind farm development, perhaps because of their behavioral aversion to trees and other tall structures (Strickland et al. 2011, Shaffer and Buhl 2016). A number of the high priority species of greatest conservation need listed in Table 4 are also species identified by Shaffer and Buhl (2016) as susceptible to indirect impacts. Wind energy facility operation appears to cause small scale local displacement of grassland passerines and is likely due to the birds avoiding turbine noise and maintenance activities. Construction within prairie habitats may also reduce habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Johnson et al. 2000, Leddy 1996). Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program grasslands at the Buffalo Ridge wind energy facility in Minnesota, and found mean densities of 10 grassland bird species were four times higher at areas located 591 ft (180 m) from turbines than they were at grasslands nearer turbines.

These indirect impacts of wind energy facilities have also been raised as a general concern by the USFWS for wind energy facilities across the US. In particular, the USFWS (2012) has expressed concern over the potential impacts of wind development on species of habitat fragmentation concern, including species that need large intact tracts of a particular habitat, such as grassland areas. Region-wide declines in many grassland associated birds species have been well documented using US Geological Survey Breeding Bird Survey data (Peterjohn and Sauer 1999, Sauer and Link 2011), although the causal mechanism for declines have been challenging to assess.

In contrast to indirect effects, the most probable direct impact to birds from wind energy facilities is direct mortality or injury due to collisions with turbines or guy wires of meteorological towers. Collisions may occur with resident birds foraging and flying within the Project area or with migrant birds seasonally moving through the Project area. Project construction could affect birds through loss of habitat, potential fatalities from construction equipment, and disturbance or displacement effects from construction activities. Impacts from the decommissioning of the facility are anticipated to be similar to construction in terms of noise, disturbance, and equipment. Potential mortality from construction equipment is expected to be very low. Equipment used in wind energy facility construction generally moves at slow rates or is stationary for long periods (e.g., cranes). The risk of direct mortality to birds from construction is most likely potential destruction of a nest for ground- and shrub-nesting species during initial site clearing.

Data from publicly available fatality studies can potentially be used to make comparisons of possible fatality rates that may be found at the Project (Loss et al. 2013). The overall bird fatality rate at wind energy facilities in the U.S. with publicly available data ranges between three to five birds per megawatt/year (National Wind Wildlife Coordinating Collaborative [NWCC] 2010). Annual wind energy facility-related bird fatalities likely compose 0.01% to 0.02% (e.g., one out of every 5,000 to 10,000 bird fatalities) of known anthropogenic sources of bird fatalities (Erickson et al. 2001) and wind energy facility related bird fatalities are unlikely to affect current population trends of most North American songbirds (NWCC 2010, Erickson et al. 2014). Although songbirds may collide with wind turbines at the site, these collisions are not expected to result in any measurable change to local or regional songbird populations.

The general location of the proposed Bitter Root Wind Farm on the Yellow Medicine Couteau included a relative abundance of high quality prairie habitat compared to nearby areas of similar size. Based on the surveyed area, some intact grasslands host robust densities of grassland bird communities. Since grassland birds are closely tied to extensive tracks of prairie, and grassland-wetland complexes, minimizing development on grassland habitat and continued efforts to site Project turbines in locations to avoid native prairie remnants, larger tracts of grasslands, and minimizing impacts to grazed grasslands would further reduce the potential for indirect impacts. Since the grassland bird sampling for this Project was planned and implemented, subsequent proposed development layouts have minimized the proximity of turbine and road development to grassland habitats, thereby reducing the risk to developed and adjoining habitats. Results of this grassland bird assessment are similar to prior efforts in the area (Derby and Dahl 2009).

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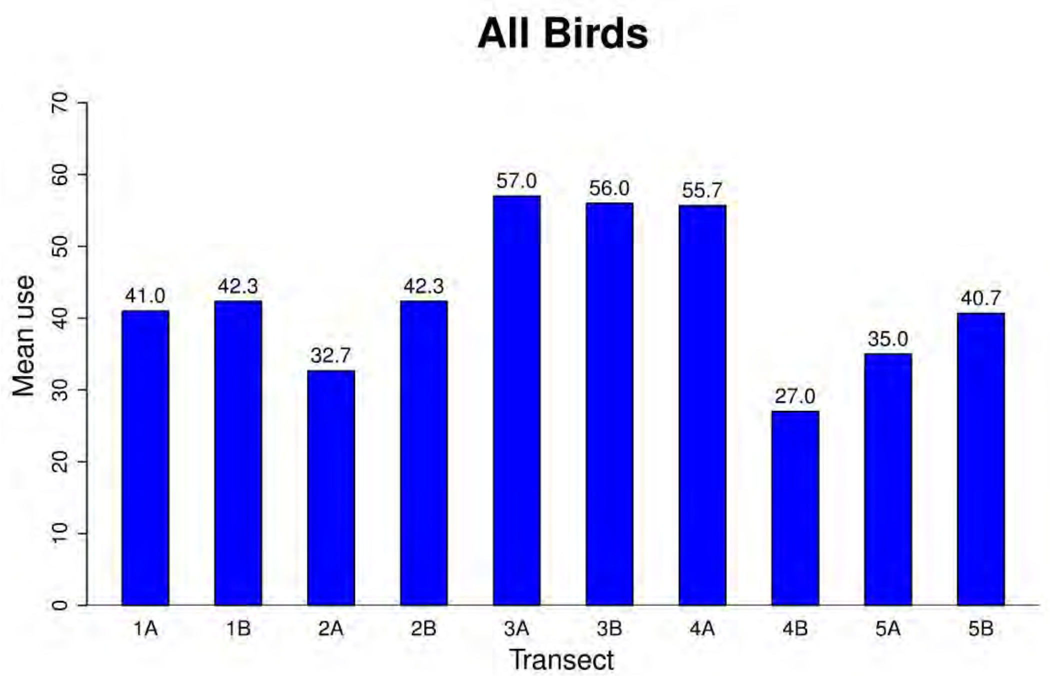
APPENDIX A. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm



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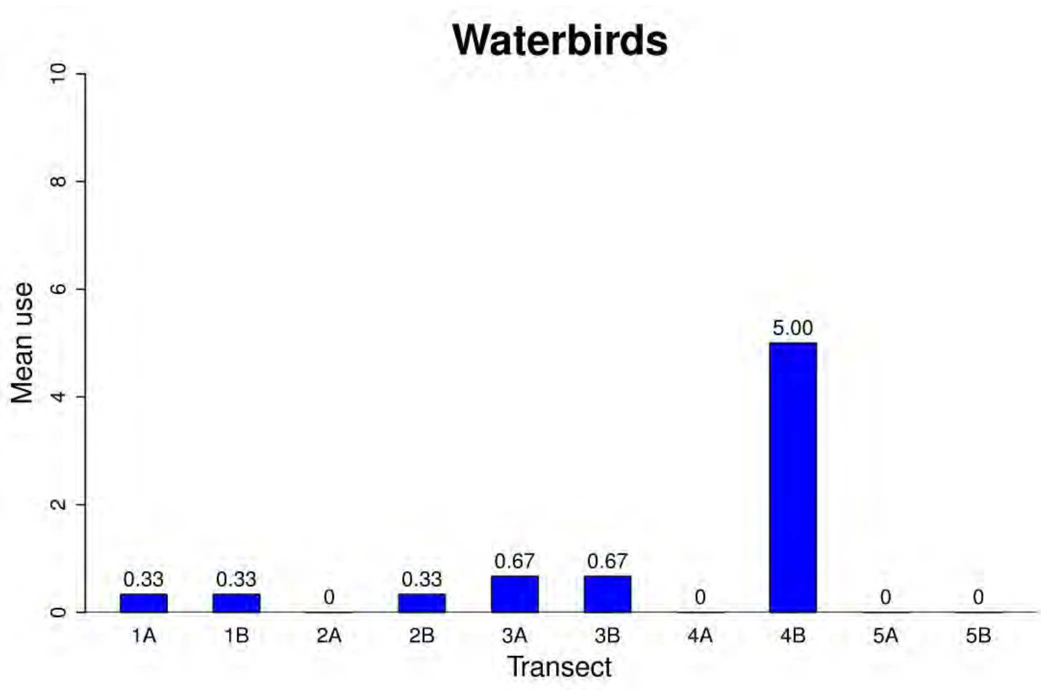


Figure A2. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

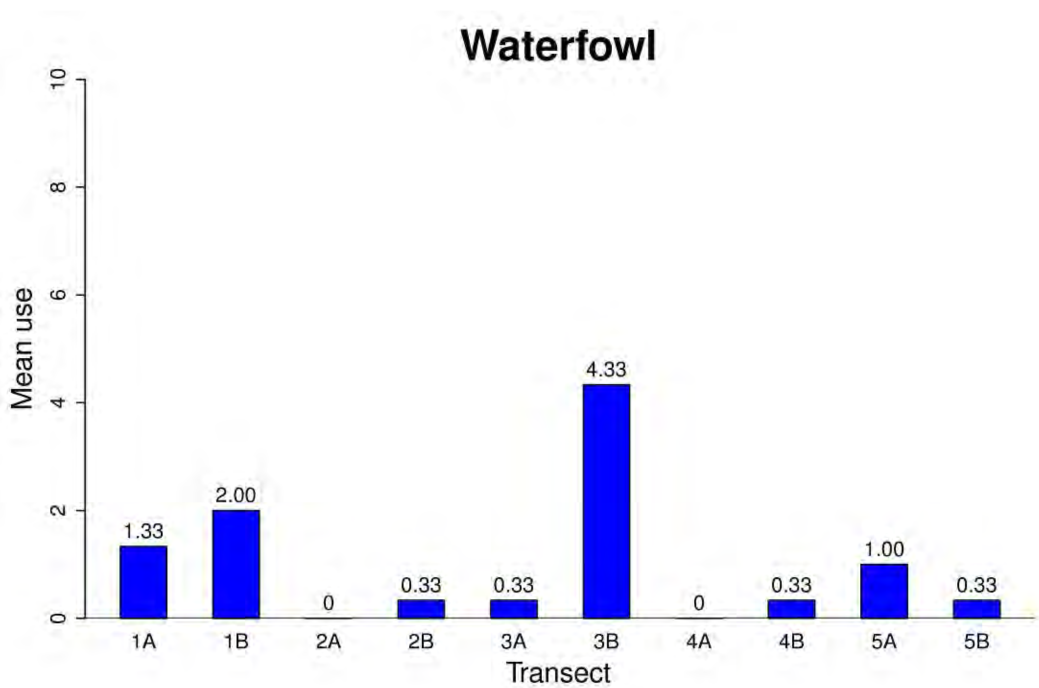


Figure A3. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

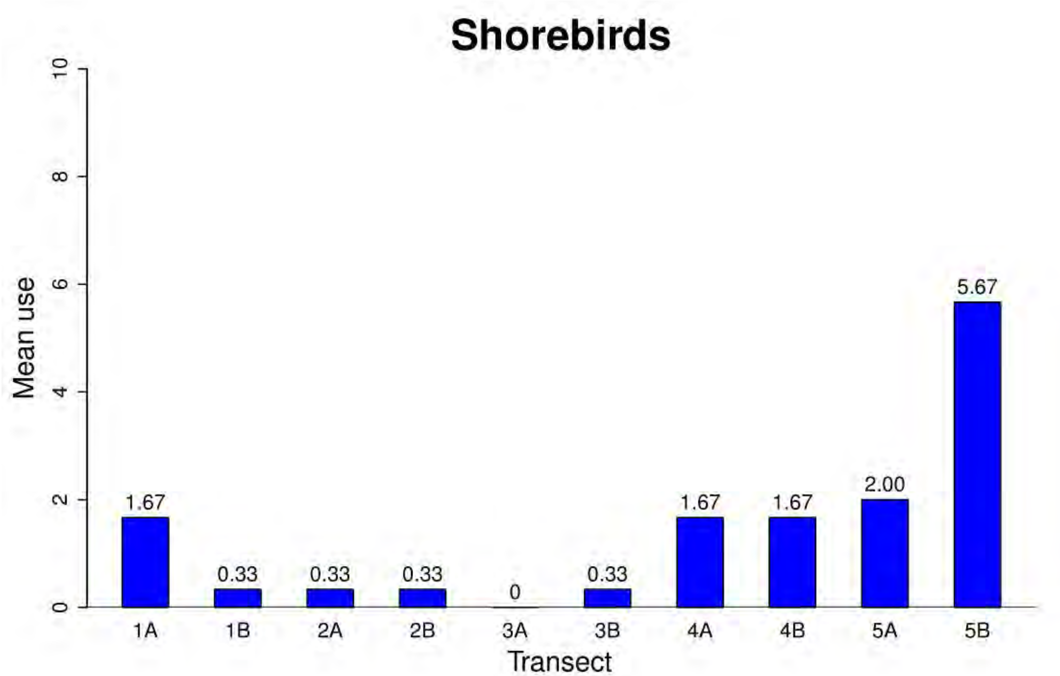


Figure A4. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

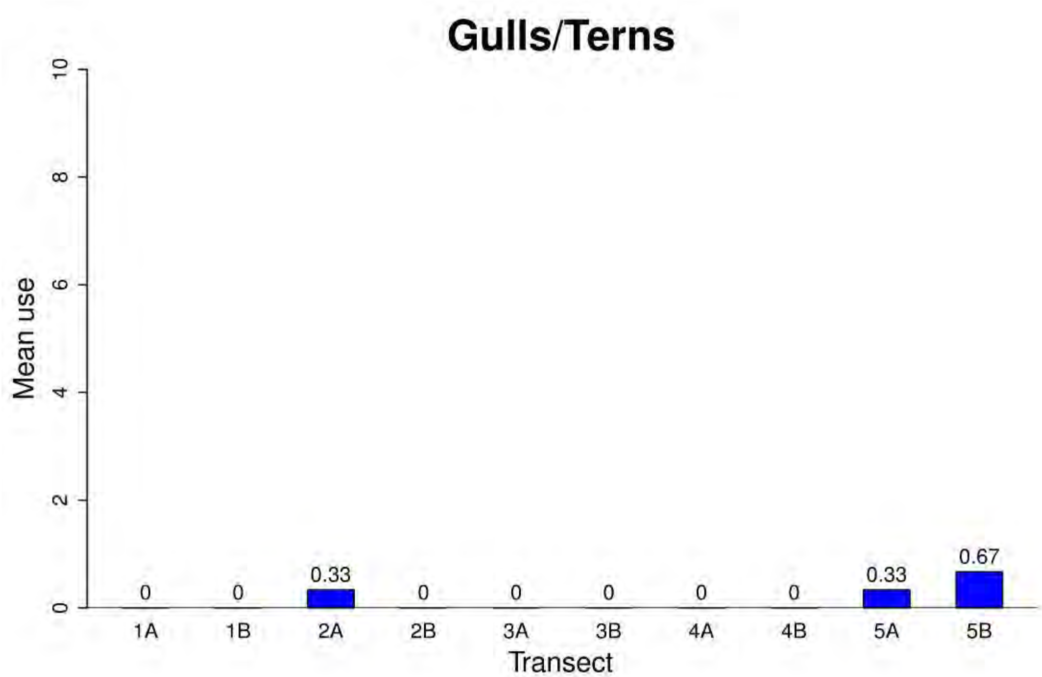


Figure A5. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

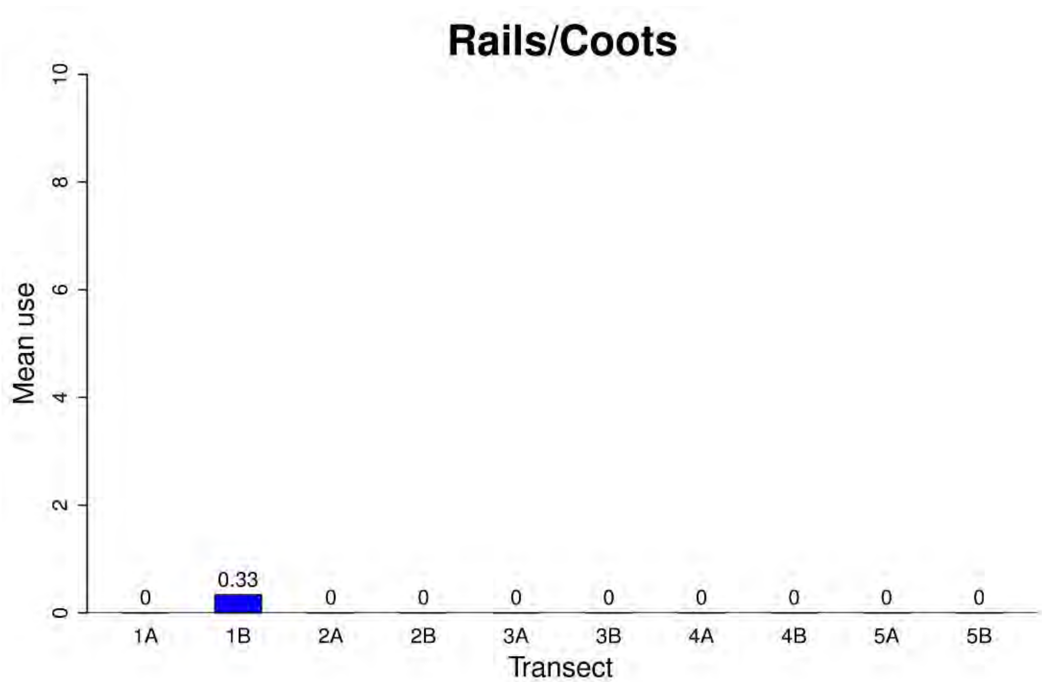


Figure A6. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

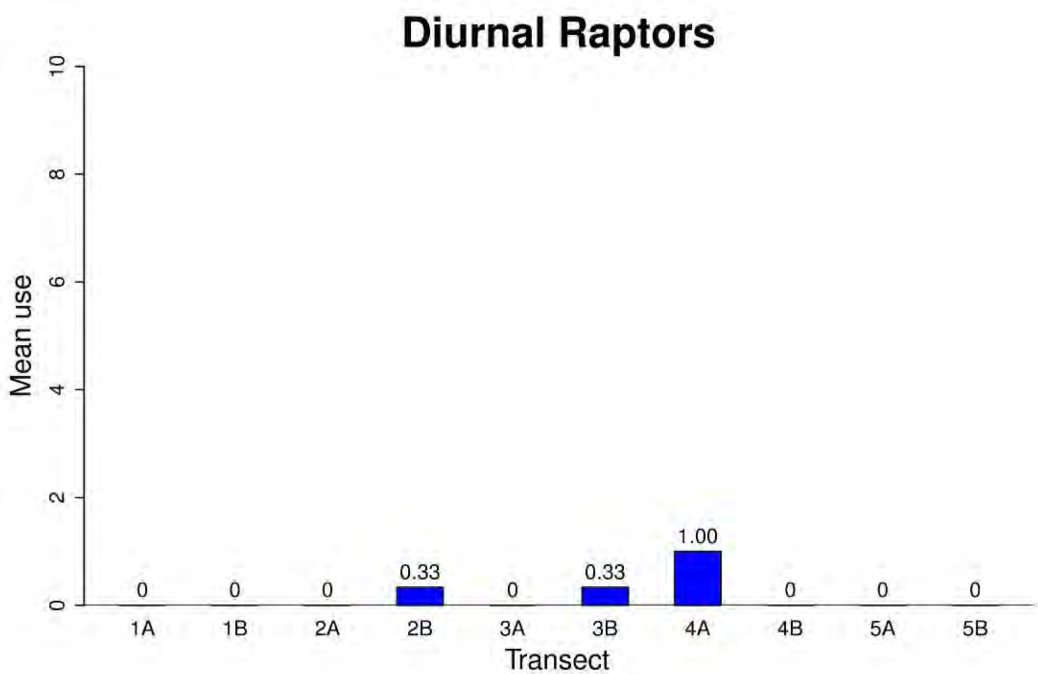


Figure A7. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

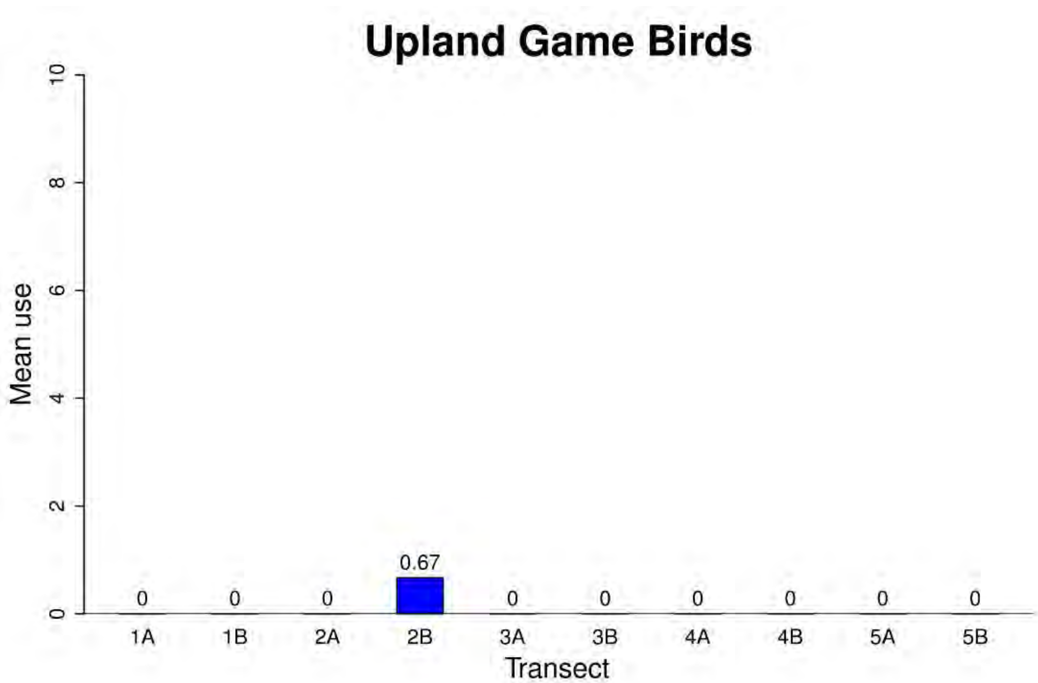


Figure A8. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

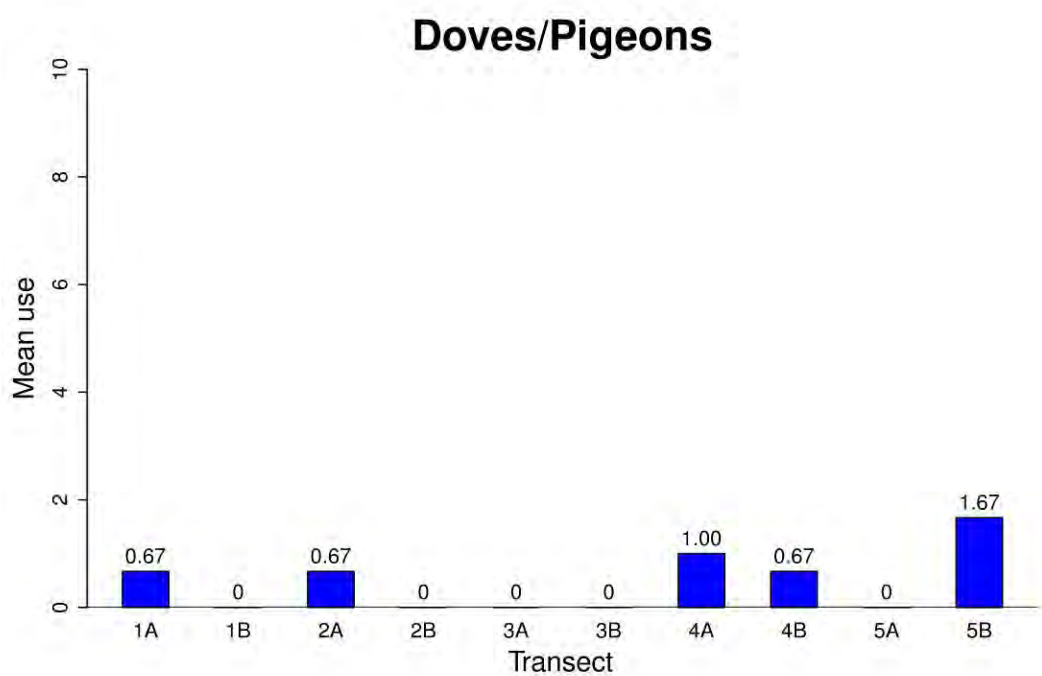


Figure A9. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

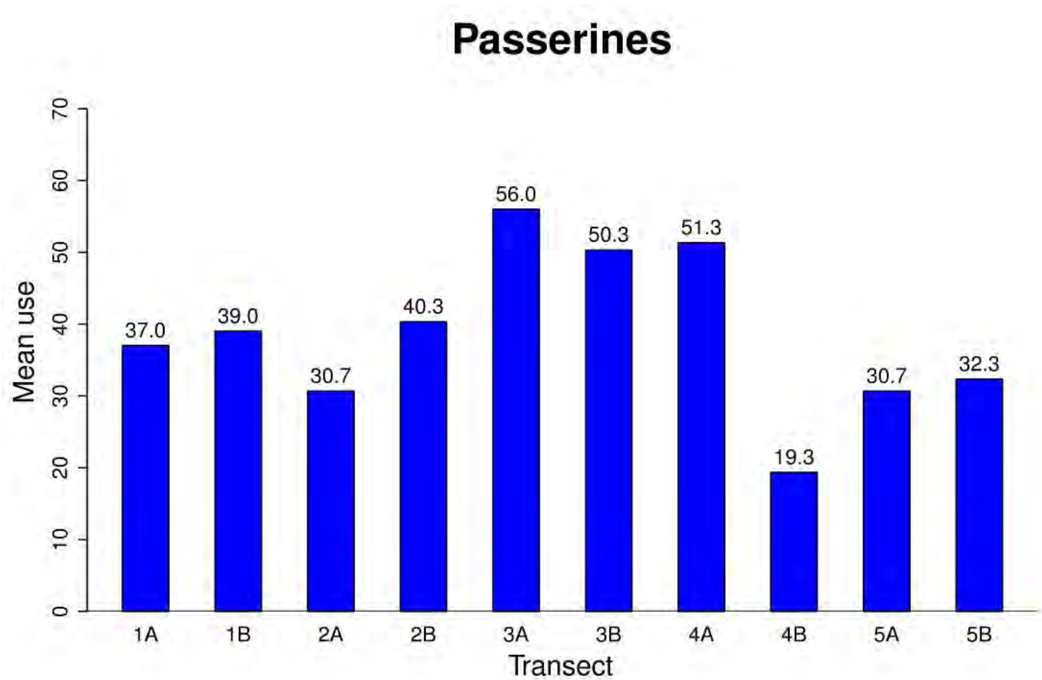


Figure A10. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

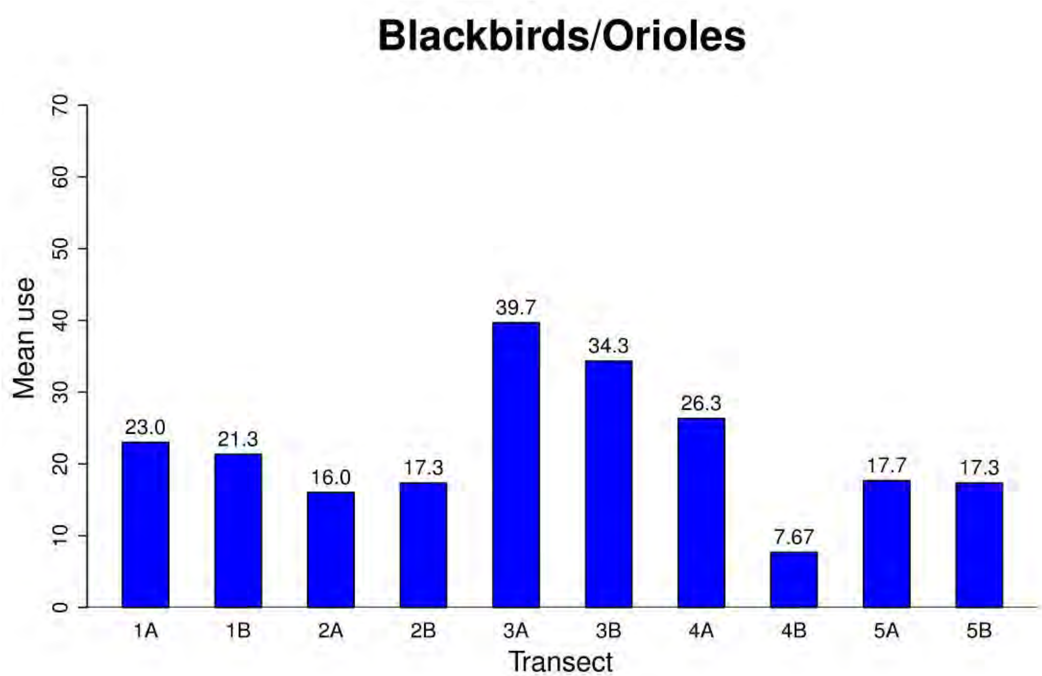


Figure A11. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

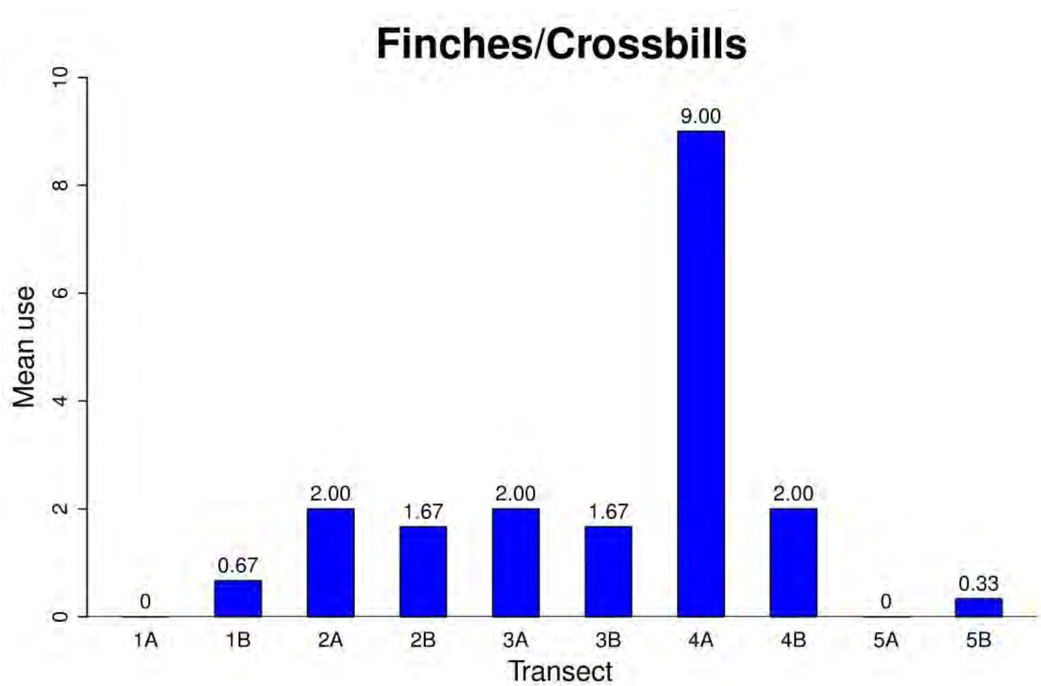


Figure A12. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

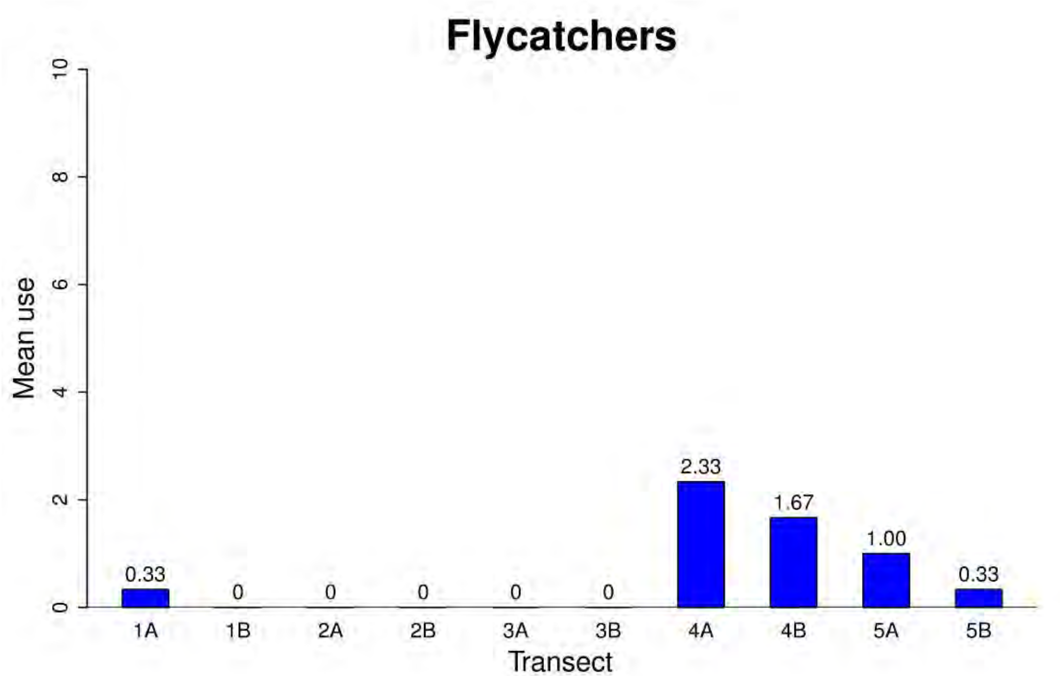


Figure A13. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

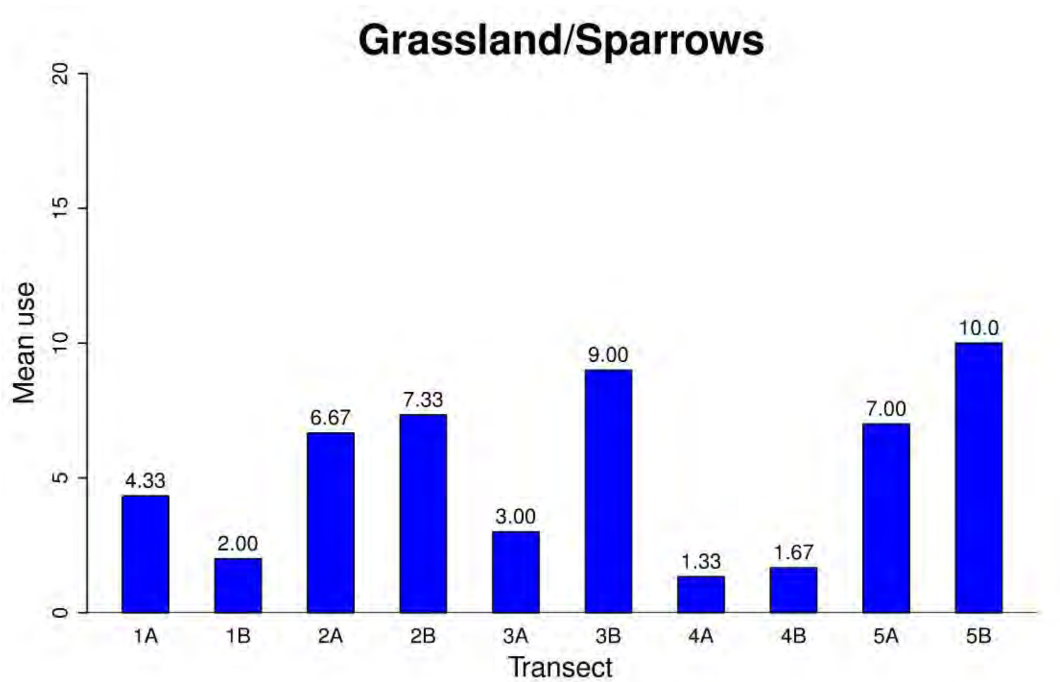


Figure A14. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

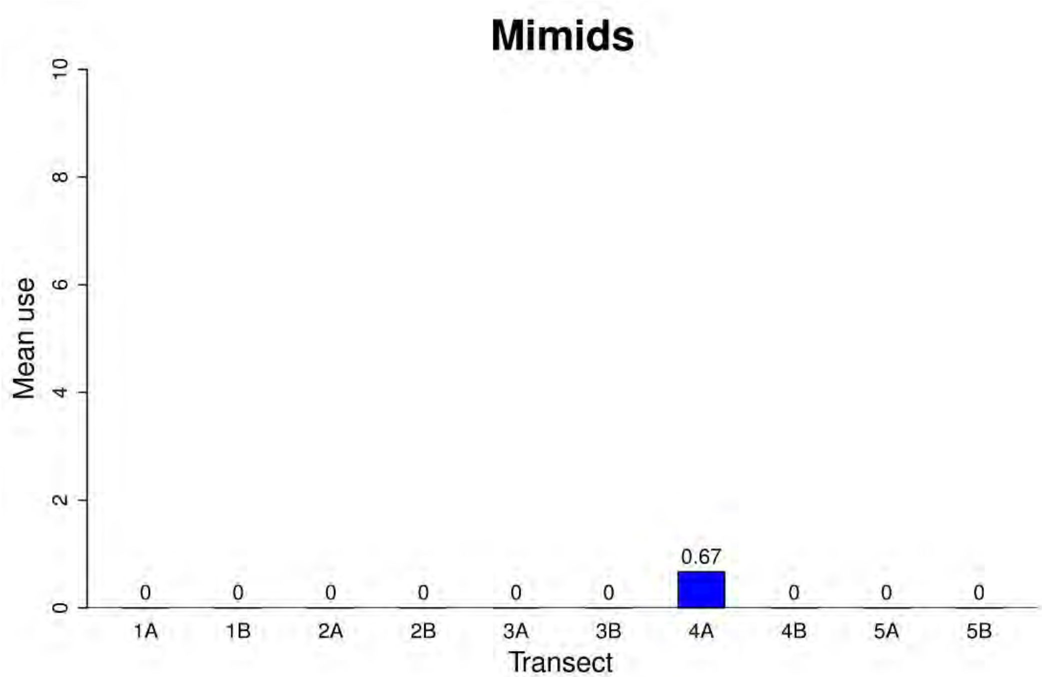


Figure A15. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

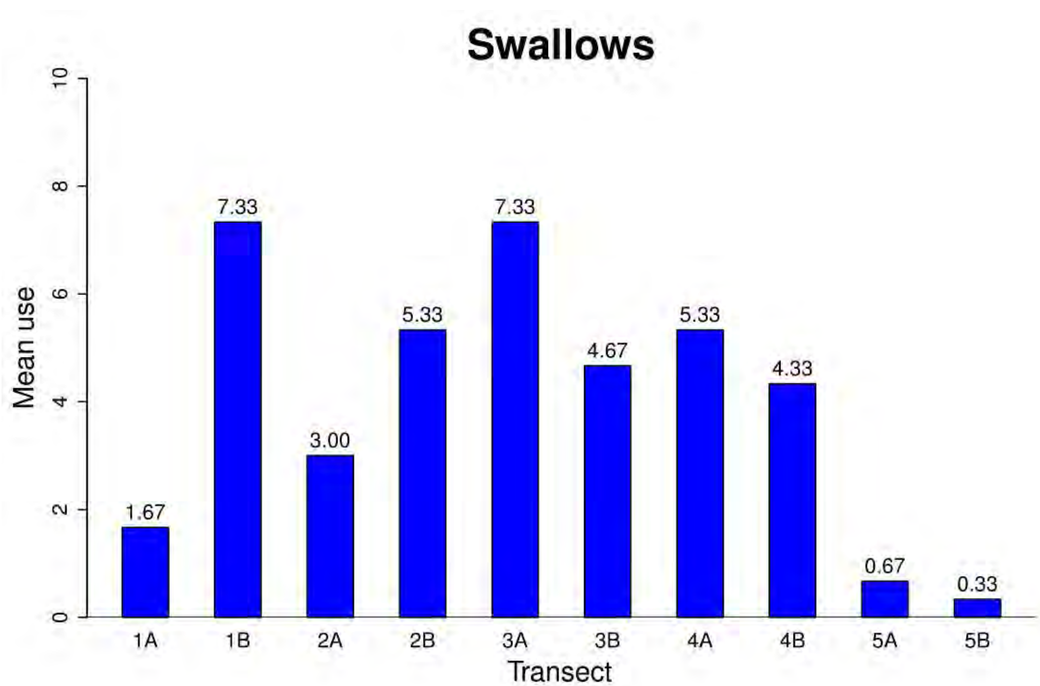
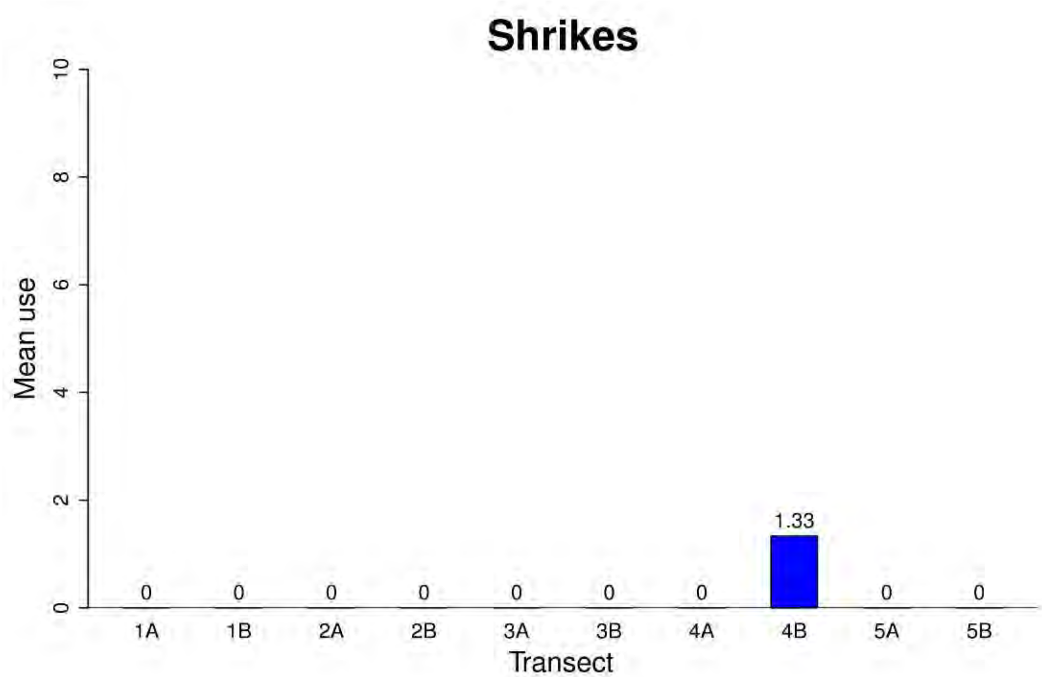


Figure A16. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.



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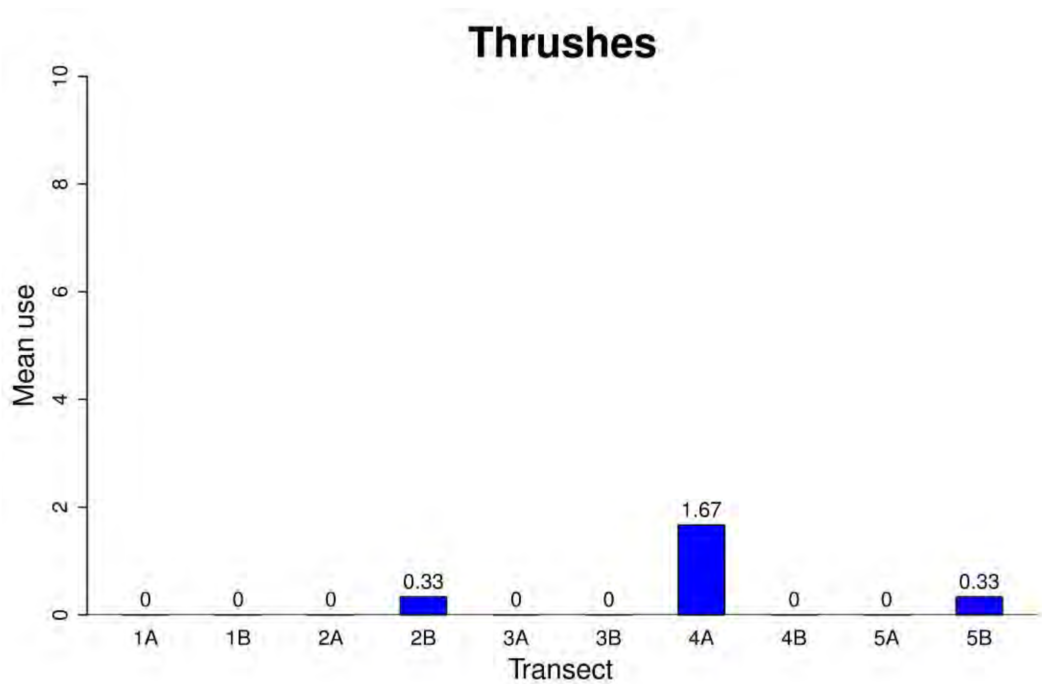

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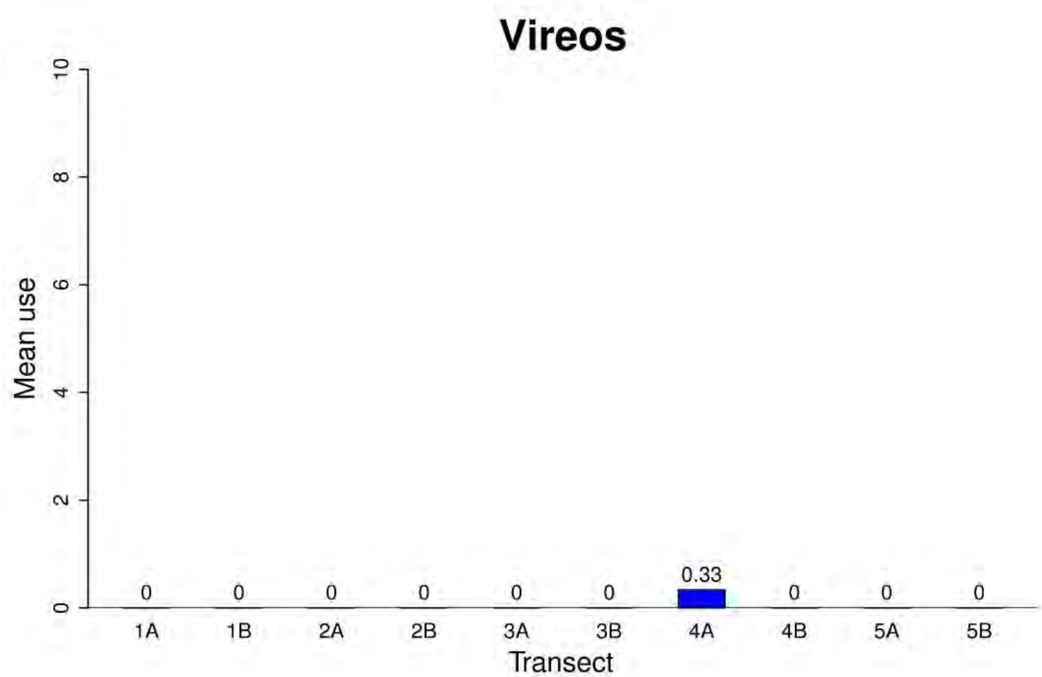
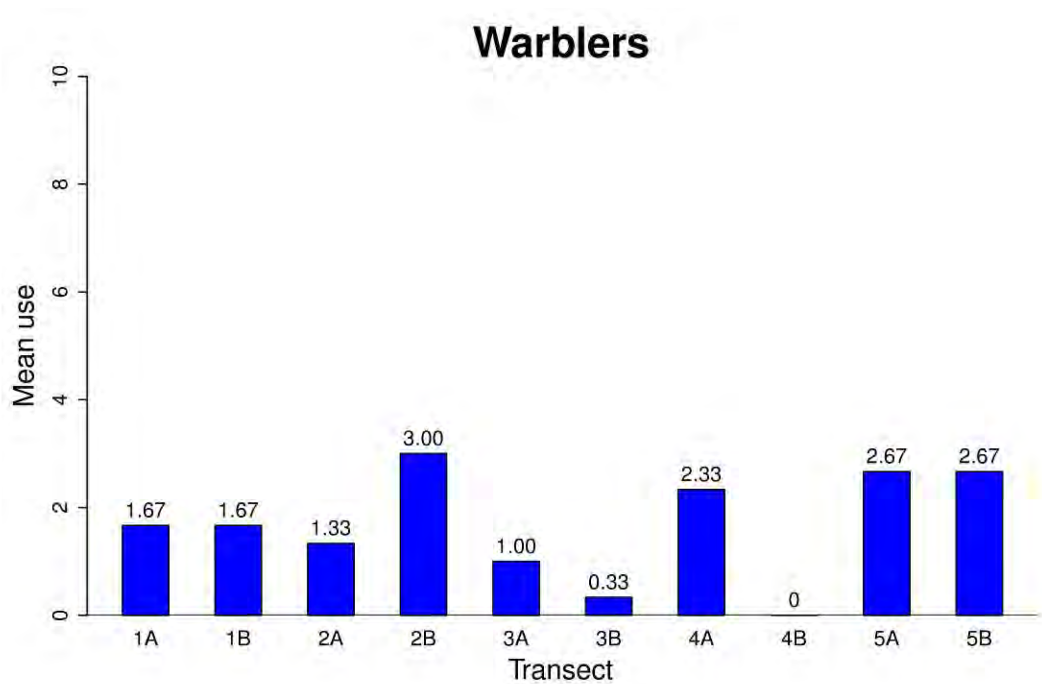


Figure A19. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.



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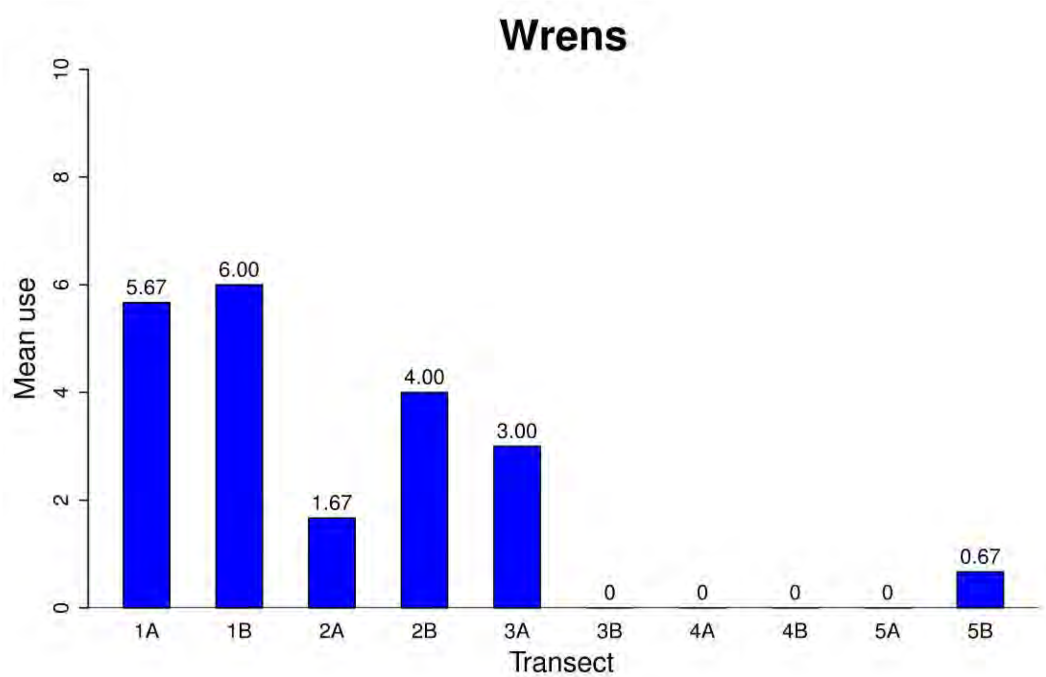

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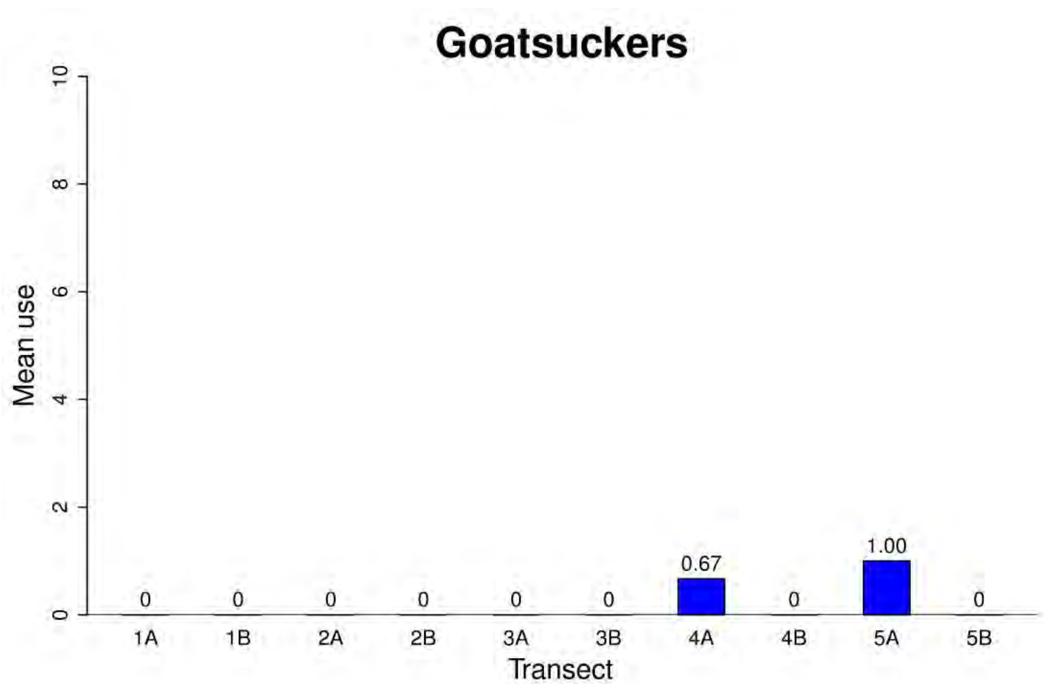

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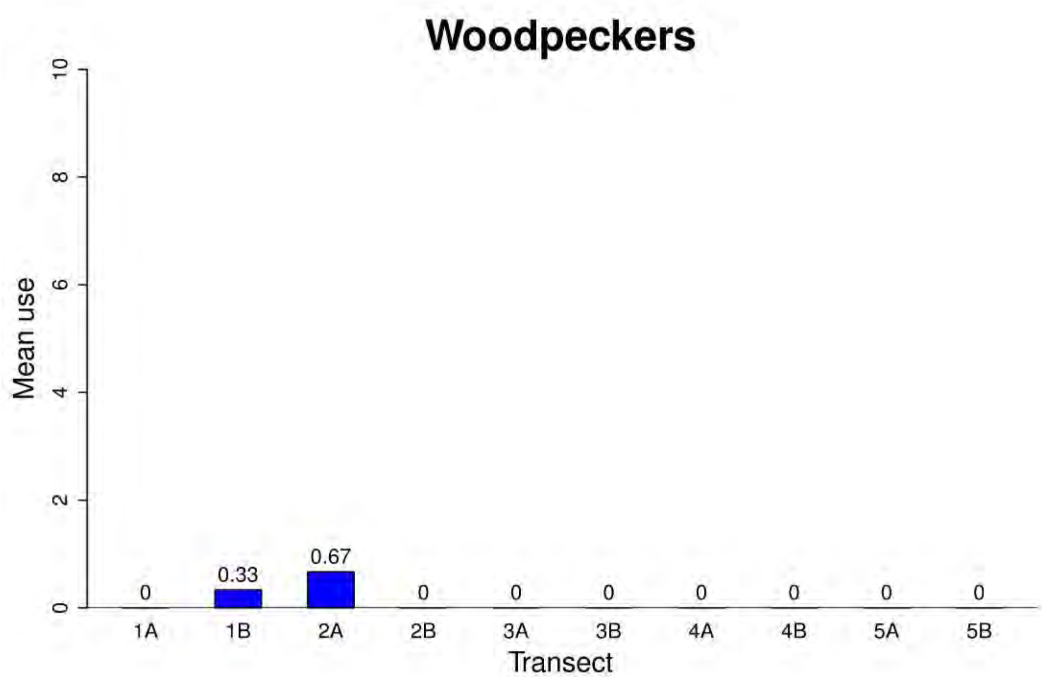

Figure A23. Mean use (number of birds/200-meter transect survey) at each grassland transect for all birds, major bird types, and passerine subtypes at the Bitter Root Wind Farm.

Appendix B. Photos of Grassland Bird Transect Areas

Transect 1a

Transect 1b

Transect 2a

Transect 2b

Transect 3a

Transect 3b

Transect 4a

Transect 4b

Transect 5a

Transect 5b

Pair of loggerhead shrikes at transect 4b; loggerhead shrikes are endangered in Minnesota

Suspected loggerhead shrike nest, attended by shrikes within transect 4b.

Loggerhead shrike food cache within transect 4b.

Northern Long-Eared Bat
Presence/Absence Acoustic Surveys

Northern Long-Eared Bat Presence/Absence Acoustic Surveys Bitter Root Wind Farm Yellow Medicine County, MN and Deuel County, SD

July 26 – 28, 2016

Prepared for:

Flying Cow Wind, LLC

at the request of

Global Winds Harvest, Inc.

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Confidential Business Information

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LIST OF APPENDICES

BACKGROUND AND PROJECT OVERVIEW

Flying Cow Wind, LLC is considering the development of the Bitter Root Wind Farm (Project) located in Yellow Medicine County, MN and Deuel County, SD (Figure 1). At Flying Cow Wind's request, Western EcoSystems Technology, Inc. (WEST) conducted acoustic presence/probable absence surveys for the federally threatened northern long-eared bat (NLEB, *Myotis septentrionalis*) during the summer of 2016. The primary objective of the summer bat surveys was to evaluate the potential presence of NLEB during the summer months in habiats located near potential turbine locations. This report summarizes the results of the NLEB acoustic presence/absence surveys completed for the Project during summer 2016.

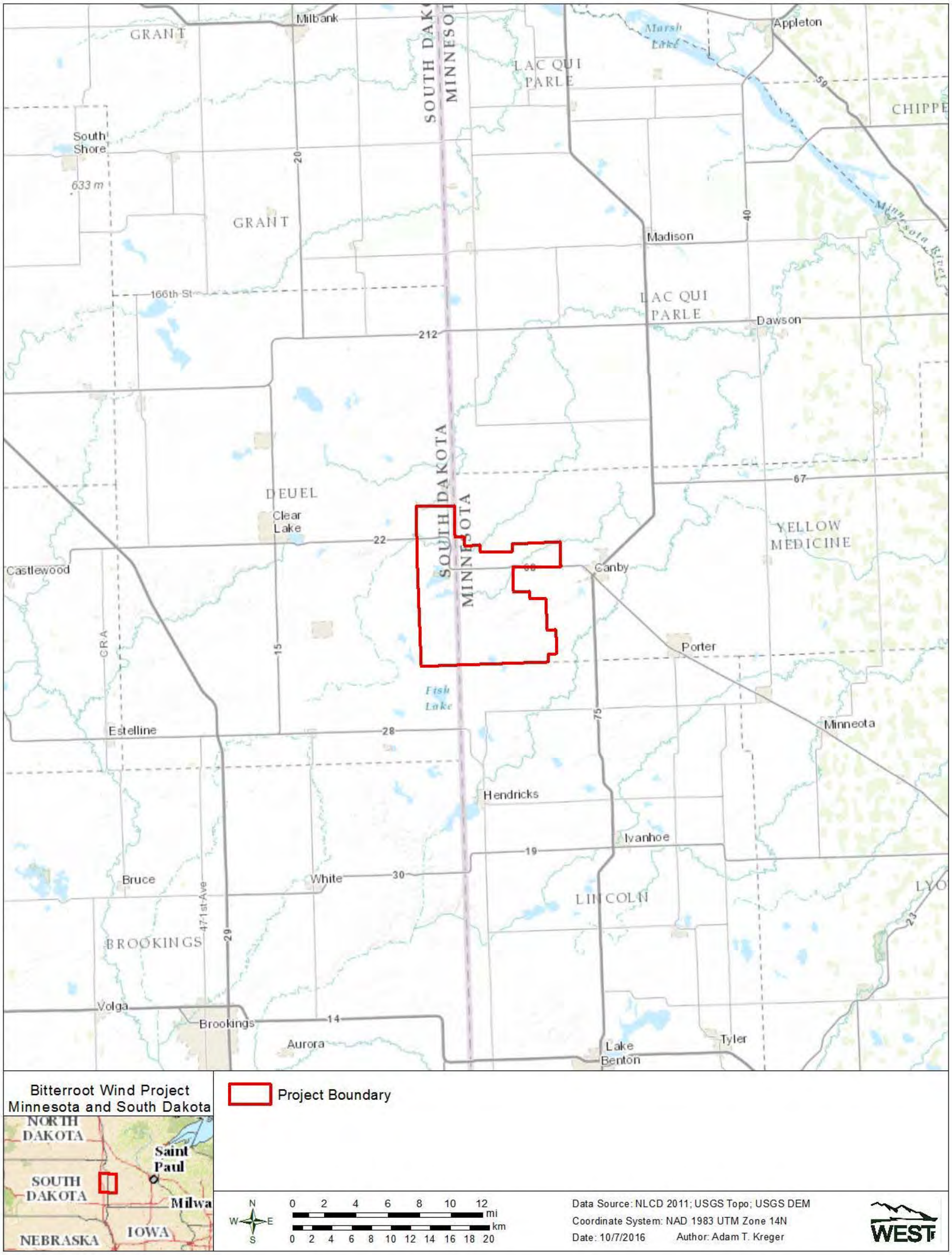


Figure 1. Location of the Bitter Root Wind Farm in Yellow Medicine County, MN and Deuel County, SD.

METHODS

The bat acoustic surveys conducted by WEST followed the U.S. Fish and Wildlife Service (USFWS) *2016 Range-Wide Indiana Bat Summer Survey Guidelines* (USFWS Guidelines, USFWS 2016), which are also applicable to NLEB, per the *Northern Long-Eared Bat Interim Conference and Planning Guidance* (USFWS 2014). The USFWS Guidelines recommend the following to assess the presence or probable absence of NLEB: 1) desktop habitat assessment, and 2) presence/probable absence surveys using acoustic detectors or mist-netting.

Desktop Habitat Assessment

The USFWS Guidelines (USFWS 2016) define suitable habitat for NLEB as any forest (e.g., deciduous, coniferous, mixed) or forested landscape feature (e.g., woody wetlands, forested riparian areas, shelterbelts) and recommend sampling at least two detector locations for every 123 acres (ac; 0.50 square kilometers [km^2]) of suitable habitat within a non-linear project area for at least four detector nights. WEST conducted a desktop assessment of potential NLEB habitat within the Project. Potential foraging or roosting habitat within the Project was limited, with relatively few areas where shelterbelts and larger forested patches were separated by less than 1,000 feet (ft; 305 meters [m]). The total forested area within the Project was approximately 620 ac (2.5 km^2), with a total for connected habitat of approximately 409 ac (1.66 km^2). Two acoustic survey sites with potential NLEB habitat were selected within the Project in the vicinity of proposed turbine locations and on lands where landowner access was available (Figure 2).

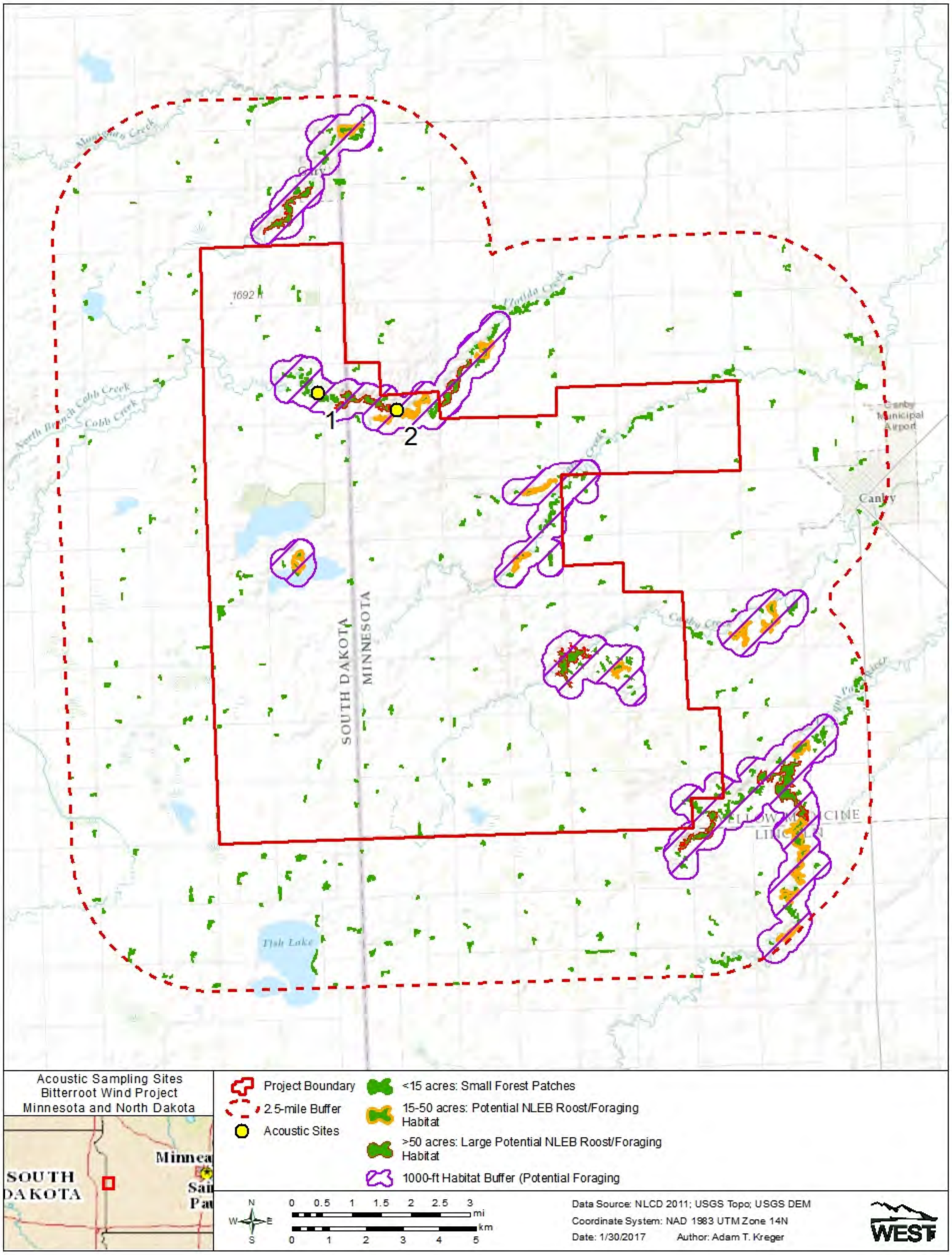


Figure 2. Bitter Root Wind Farm Acoustic Sampling Sites in Yellow Medicine County, MN and Deuel County, SD.

Acoustic Surveys

Acoustic surveys were conducted from July 26 to 28, 2016, following USFWS Guidelines (USFWS 2016). Surveys were conducted at two sites with two detector locations (stations) at each site for a total of four acoustic survey stations (Figure 3). Each station was surveyed for at least two nights for a total of eight complete detector nights. Bats were surveyed using full spectrum Song Meter SM3 acoustic recorders (Wildlife Acoustics, Inc.). WEST placed detectors in suitable habitat for NLEB, including forest edges, small clearings and forest-canopy openings, near water sources, and forested riparian edges. Detector stations were placed in areas with open tree canopies or canopy heights greater than 33 ft (10 m) and were spaced at least 656 ft (200 m) apart. Detectors were elevated at least 9.8 ft. (3.0 m) above ground level (AGL) to minimize acoustic interference from vegetation. Detectors were programmed to record from before sunset to sunrise each survey night.

Acoustic monitoring began before sunset and continued for the entire night. If weather conditions such as persistent rain (more than 30 minutes), strong sustained winds (greater than 9 miles per hour [mph] average for more than 30 minutes), or cold temperatures (below 10°C [50°F] for more than 30 minutes) occurred during the first five hours of a survey night, then that location was surveyed for an additional night unless target species were detected or bat activity was unaffected by weather conditions (USFWS 2016). For each acoustic survey location, the date, start and end time, site description, site coordinates, and weather data were recorded. Representative photographs of each acoustic survey station were taken (see Appendix A).

Bat calls were quantitatively identified using an automated acoustic bat identification software program approved by the USFWS (Kaleidoscope Pro, version 3.1.7, Wildlife Acoustics, Inc.). If the automated bat identification program identified calls as NLEB with a high degree of probability (p less than 0.05), then qualitative analysis was conducted by a bat acoustical expert to confirm NLEB calls. Qualitative echolocation call analysis was conducted by a biologist experienced with acoustic identification and who met required USFWS qualifications (Dr. Kevin Murray of WEST; USFWS 2016). If probable NLEB echolocation call sequences identified by Kaleidoscope were not characteristic of NLEB, contained distinct calls produced by species other than NLEB, or were of insufficient quality, they were reclassified. Per USFWS Guidelines (USFWS 2016), NLEB were considered present at sites with probable calls verified by qualitative analysis. NLEB were considered absent from sites with no probable NLEB calls or from sites with probable NLEB calls (as identified by the Kaleidoscope software) that were not verified by qualitative analysis.

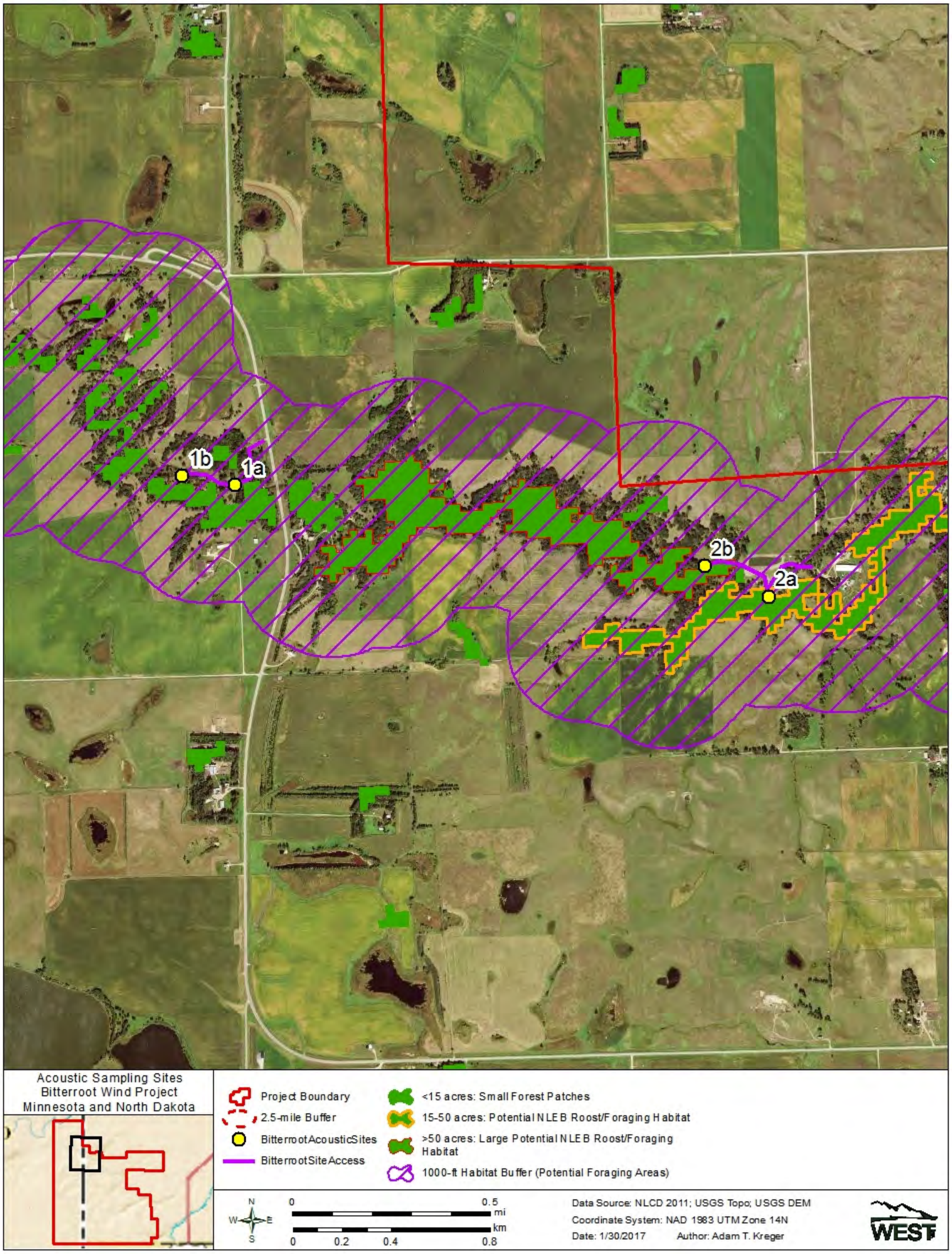


Figure 3. Location of the Bitter Root Wind Farm Acoustic Detector Stations in Yellow Medicine County, MN and Deuel County, SD.

RESULTS

Acoustical Analysis

Acoustic surveys were completed at two survey sites (four survey stations) from July 26 to 28, 2016, for a total of eight detector nights, all of which met appropriate weather criteria. UTM coordinates and site descriptions for each survey station are listed in Table 1. Photographs and datasheets with site descriptions are found in Appendix A.

Table 1. Location and site description of acoustic survey stations at the Bitter Root Wind Farm.

Site ID	Station ID	Easting†	Northing†	Site Description
1	A	701108	4957140	Sparsely treed slope with creek to the south and west and forest to the north and east.
1	B	700893	4957180	Grassy slope with creek to the west and forest to the north and east.
2	A	703275	4956690	Grassy field with creek to the west and south and grassy hill to the north.
2	B	703016	4956820	Grassy field with sparse trees north of creek with forested areas to the north and south.

† = NAD 1983, Zone 14

To assess study conditions for compliance with USFWS Guidelines (USFWS 2016), weather was monitored using the Clear Lake weather station (MAU008) on Weather Underground's Wundermap (http://www.wunderground.com/wundermap/). Stations BR-1a, BR-2a, and BR-2b were deployed on July 26 and retrieved on July 28. Weather conditions met USFWS criteria for these stations on the nights of July 26 and July 27. Together, these four stations collected eight nights of valid data, meeting the requirement of at least four detector nights per site.

Kaleidoscope identified a total of 1,972 bat call files and identified 1,926 files (97.7%) to species. Average number of bat calls per detector night was 240.75. Table 2 summarizes the number of detector nights, number of bat call files, and number of bat calls identified to species at each survey station. Table 3 provides information on species identifications for each survey station.

Table 2. Number of bat calls recorded at each acoustic survey station determined by Kaleidoscope for the Bitter Root Wind Farm.

Acoustic Survey Site	Acoustic Survey Station	ID program	Total Bat Calls	Calls Identified	Detector Nights	Bat Calls/ Detector Night
1	A	Kaleidoscope	403	389	2	187.5
	B	Kaleidoscope	231	224	2	108.5
2	A	Kaleidoscope	587	575	2	281.5
	B	Kaleidoscope	751	738	2	362.5
Total			**1972**	**1926**	**8**	

Table 3. Summary of Kaleidoscope echolocation call identifications for the Bitter Root Wind Farm.

Site ID	Station ID	EPFU[1]	LABO	LACI	LANO	MYLU	NLEB	UNK	Total
1	A	199	80	51	54	5	0	14	403
1	B	146	28	15	32	3	0	7	231
2	A	197	239	46	81	12	0	12	587
2	B	510	77	48	103	0	0	13	751
Total		**1052**	**424**	**160**	**270**	**20**	**0**	**46**	**1972**

[1] EPFU = Big Brown Bat; LABO = Eastern Red Bat; LACI = Hoary Bat; LANO = Silver-haired Bat; MYLU = Little Brown Bat; NLEB = Northern Long-eared Bat; PESU = Tri-colored bat; UNK = Unknown.

Based on the screening done by the automated call identification software, none of the stations recorded potential NLEB calls with a p-value less than 0.05 for the maximum-likelihood estimation (Table 4); Kaleidoscope did not identify any potential NLEB calls at any of the survey stations, and therefore no qualitative analysis was necessary for these calls (Tables 4 and 5).

Table 4. Summary of actions at each acoustic survey station for the Bitter Root Wind Farm.

Site	Station ID	NLEB Calls	Probable NLEB Calls (P < 0.05)	NLEB Qualitatively Verified	Recommended Action
1	A	No	No	No	no further action
1	B	No	No	No	no further action
2	A	No	No	No	no further action
2	B	No	No	No	no further action

DISCUSSION

Limited information is available on NLEB migratory pathways and behaviors. While there is some information suggesting this species tends to follow forested areas and avoid open areas if possible, these bats may occasionally move through non-forested areas.

If these bats occur in the Project area during the summer months, they will likely occur within or near (within 1,000 ft [305 m]) suitable wooded habitat patches. WEST conducted acoustical surveys for NLEB at four detector locations within two sites in areas of suitable habitat within the Bitter Root Wind Farm.

NLEB was not identified at any of the four acoustic stations at any of the surveyed sites. Therefore this species is considered likely absent from the proposed Project. Surveys are considered complete for all four survey stations at the two sites, and no further action is recommended to confirm NLEB bat absence pursuant to USFWS *Northern Long-eared Bat Interim Conference and Planning Guidance* (USFWS 2014) and *2016 Range-Wide Indiana Bat Summer Survey Guidelines* (USFWS 2016). Furthermore, the Project is not located in the vicinity of known maternity roost trees and/or hibernacula sites known to the Minnesota Department of Natural Resources or the USFWS (MNDNR and USFWS 2016).

LITERATURE CITED

Minnesota Department of Natural Resources (MNDNR) and U.S. Fish and Wildlife Service (USFWS). 2016. Townships Containing Documented Northern Long-eared Bat (NLEB) Maternity Roost Trees and/or Hibernacula Entrances in Minnesota. April 1, 2016. http://files.dnr.state.mn.us/eco/ereview/minnesota_nleb_township_list_and_map.pdf

U.S. Fish and Wildlife Service (USFWS). 2014. Northern Long-eared Bat Interim Conference and Planning Guidance. January 6, 2014. USFWS Regions 2, 3, 4, 5, & 6. http://www.fws.gov/northeast/virginiafield/pdf/NLEBinterimGuidance6Jan2014.pdf

U.S. Fish and Wildlife Service (USFWS). 2016. 2016 Range-Wide Indiana Bat Summer Survey Guidelines (April 2016). USFWS Endangered Species Program: Midwest Region. https://www.fws.gov/midwest/endangered/mammals/inba/surveys/pdf/2016IndianaBatSummerSurveyGuidelines11April2016.pdf

Appendix A. Bitter Root Wind Farm Acoustic Survey Station Photographs and Datasheets

Acoustic Detector Station BR-1a

Station BR-1a Location

Station BR-1a Orientation

Station BR-1a Detection Cone

SP

A→020

B→EW7D

Acoustic Presence/Probable Absence 2016 Form

WEST

Project: Bitterroot **Station ID:** 1a

Start Date/Time (military): 20160726 1253 End Date/Time: 20160728 1016

Observer(s): ETG RLK

Station Information:

County: Yellow Medicine State: MN

Datum: NAD27 (NAD83) Zone: 14T Easting: (6 digits) 702822 Northing: (7 digits) 4956483

Detector Type: SM2+ Detector Serial #: 15553 Tablet Location*: /

Detector Housing: Ammo Box Toolbox Plastic Tote Other: N/A

Battery source: (Internal) External If External: ____ volts ____ amp/hrs

Microphone

Mic Serial#* 2705 Mic Ht (m): (from ground) 3.648 Mic Channel* R Audio Div* / Data Div* /

Mic Horizontal Orientation: 164 Mic Vertical Orientation: 23 Sound Reception: (None) Horn Bat Hat PVC Elbow

All Detector Checklist						**Anabat Only**				
Date/Time	Battery Voltage	Mic Check Good? Y/N	Cables; detector housing; mic holder good?	Data Card(s) Replaced?	Battery Changed?	Sensitivity Setting (normally 8)	Test Indicators (checkmark)	Volume (sound setting) Yes/No	LED Lights (circle) (should be Standby unless between 1800 and 0800 hrs)	Comments i.e., detector off, detector picked up, moved, vandalized, etc.
20160726 1305	6.44	✓	✓	✓	✓		"Data" lit Static Heard		Record Standby Status Error Data	
20160728 1016	5.56						"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	

Habitat Description *(within 100m)*

% Forested: 50 %Open/Ag: 35 %Water: 15 **Dominant Tree Spp:** Bur Oak + American Elm

Stand Age: Young (Mature) Old

Detector Sampling *(circle 1 or more):*

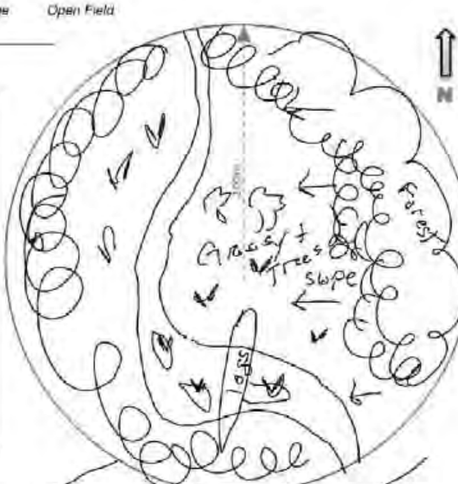
(Creek Riparian) Pond (Bottomland Forest) Upland Forest Field Edge Open Field

Cave Entrance Mine Portal Bridge Structure Other: ____

Topography: (Flat) Slope High Point (Low Point) Other: ____

Habitat Description: *Map out habitat features within 100 m radius of Song Meter (x). Indicate direction of microphone using an arrow. Include any features of interest (water, buildings, rocky outcrops, etc.). Provide a written description in the space below, including details on width of the road/trail/cutline, size of pond/lake, distance to nearest water, etc.)*

Detector is ~15m to the N+E of the creek. Creek flows from N to S, but widens just SE of the location. The wide area has 3 small grassy isles + a damn build of fallen logs. To the west there is an upward slope w/ trees. To the east there is more forest.



Photos (check)

Detector Location ✓ *(detector + main habitat surveyed)*

Detector Orientation ✓ *(detector + surrounding habitat)*

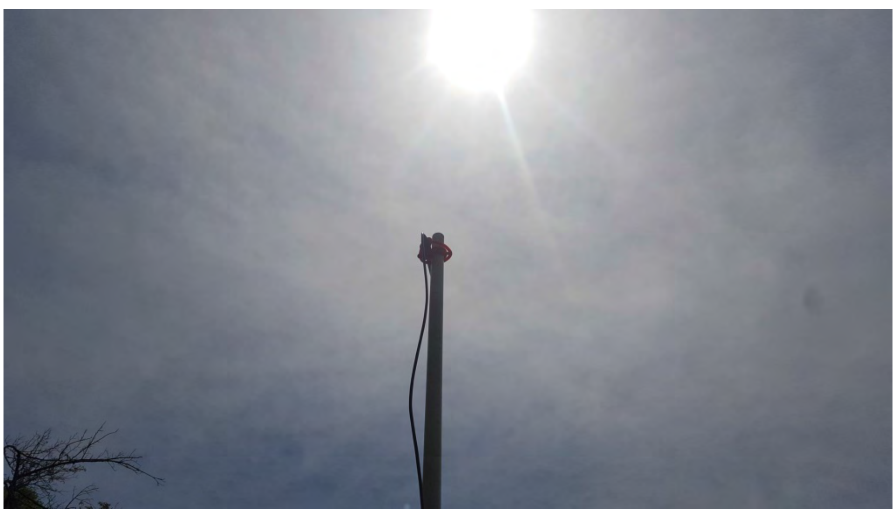
Detection Cone ✓ *(air space sampled)*

Station BR-1a Datasheet

Acoustic Detector Station BR-1b

Station BR-1b Location

Station BR-1b Orientation



Station BR-1b Detection Cone

Acoustic Presence/Probable Absence 2016 Form

WEST

Project: Bitterroot **Station ID:** 1b

Start Date/Time (military): 20160726 1317 End Date/Time: 20160728 1007

Observer(s): ETG RLK

Station Information:

County: Yellow Medicine State: MN

Datum: NAD27 (NAD83) Zone: 14 Easting: (6 digits) 702789 Northing: (7 digits) 4957106

Detector Type: SM2+ Detector Serial #: 13788 Tablet Location*: /

Detector Housing: *Ammo Box* *Toolbox* *Plastic Tote* *Other:* N/A

Battery source: (*Internal*) *External* *If External:* ____ volts ____ amp/hrs

Microphone

Mic Serial#* 2717 Mic Ht (m): (from ground) 3.648 Mic Channel* R Audio Div* / Data Div* /

Mic Horizontal Orientation: 132 Mic Vertical Orientation: 22 Sound Reception: (*None*) *Horn* *Bat Hat* *PVC Elbow*

SD

6-24

13-EWEL

All Detector Checklist						**Anabat Only**				
Date/Time	Battery Voltage	Mic Check Good? y/n	Cables, detector housing, mic holder Good?	Data Card(s) Replaced?	Battery Changed?	Sensitivity Setting (normally 6)	Test Indicators (checkmark)	Volume (insert setting) Yes/No	LED Lights (circle) (should be Standby unless between 1400 and 0800hrs)	Comments i.e., detector on, detector picked up, moved, vandalized, etc.
20160726 1323	6.43	✓	✓	✓	✓	✓	"Data" lit Static Heard		Record Standby Status Error Data	
20160728 1032	5.52						"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	

Habitat Description *(within 100m)*

% Forested 63 *%Open/Ag* 30 *%Water:* 7 **Dominant Tree Spp:** American Elm

Stand Age: *Young* *Mature* *Old*

Detector Sampling (circle 1 or more):

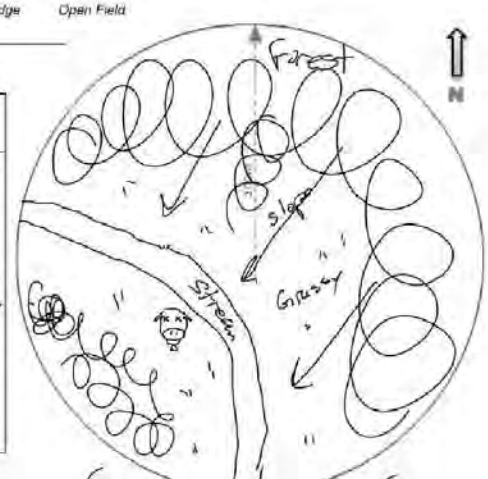
(*Creek Riparian*) *Pond* *Bottomland Forest* *Upland Forest* *Field Edge* *Open Field*

Cave Entrance *Mine Portal* *Bridge* *Structure* *Other:* ____

Topography: *Flat* (*Slope*) *High Point* *Low Point* *Other:* ____

Habitat Description: *Map out habitat features within 100 m radius of Song Meter (x). Indicate direction of microphone using an arrow. Include any features of interest (water, buildings, rocky outcrops, etc.). Provide a written description in the space below, including details on width of the road/trail/cutline, size of pond/lake, distance to nearest water, etc.)*

Detetor is on a sharp descending slope down to the creek. Creek runs West to South. SW bank of the creek is flat w/ grass, trees, and a rutting. Dead cow (~3-4 weeks). Downward slope has brush + dead trees. N, NE, E, + SE has forest.



Photos (check)

Detector Location ✓ *(detector + main habitat surveyed)*

Detector Orientation ✓ *(detector + surrounding habitat)*

Detection Cone ✓ *(air space sampled)*

Station BR-1b Datasheet

Acoustic Detector Station BR-2a

Station BR-2a Location

Station BR-2a Orientation

Station BR-2a Detection Cone

WEST

Acoustic Presence/Probable Absence 2016 Form

Project: Bitterroot **Station ID:** 2a

Start Date/Time (military): 20160726 1158 End Date/Time: 20160728 1044

Observer(s): ETG RLK

Station Information:

County: Yellow Medicine State: MN

Datum: NAD27 (NAD83) Zone: 14T Easting: (6 digits) 703276 Northing: (7 digits) 4956688

Detector Type: SM2+ Detector Serial #: 13629 Tablet Location*: \

Detector Housing: Ammo Box Toolbox Plastic Tote Other: N/A

Battery source: (Internal) External If External: ____ volts ____ amp/hrs

SD

A → 28

B → B003

Microphone

Mic Serial#* 2386 Mic Ht (m): (from ground) 3or8 Mic Channel* R Audio Div* \ Data Div* \

Mic Horizontal Orientation: 119 Mic Vertical Orientation: 24 Sound Reception: (None) Horn Bat Hat PVC Elbow

All Detector Checklist / **Anabat Only**

Date/Time	Battery Voltage	Mic Check Good? Y/N	Cables; detector housing; mic holder Good?	Data Card(s) Replaced?	Battery Changed?	Sensitivity Setting (normally 6)	Test Indicators (checkmark)	Volume (install setting) Yes/No	LED Lights (circle) (should be Standby unless between 1800 and 0800 hrs)	Comments i.e., detector on, detector picked up, moved, vandalized, etc.
20160726 1200	6.48	✓	✓	✓	✓		"Data" lit Static Heard		Record Standby Status Error Data	
20160728 1056	5.6						"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	

Habitat Description *(within 100m)*

% Forested: 40 % Open/Ag: 50 % Water: 10 **Dominant Tree Spp:** Bur Oak + E. Cottonwood

Stand Age: Young (Mature) Old

~~Detector Sampling~~ (circle 1 or more):

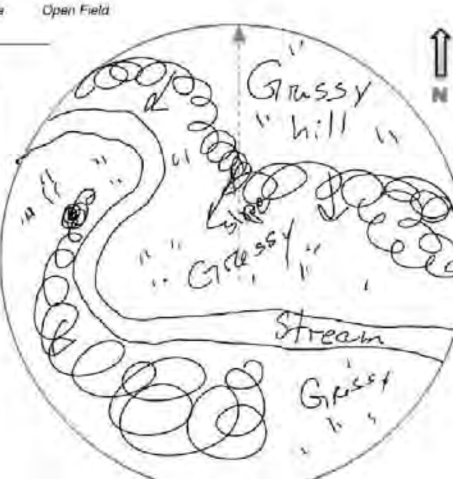
(Creek Riparian) Pond (Bottomland Forest) Upland Forest Field Edge Open Field

Cave Entrance Mine Portal Bridge Structure Other: ____

Topography: (Flat) Slope High Point (Low Point) Other: ____

Habitat Description: *Map out habitat features within 100 m radius of Song Meter (x). Indicate direction of microphone using an arrow. Include any features of interest (water, buildings, rocky outcrops, etc.). Provide a written description in the space below, including details on width of the road/trail/cutline, size of pond/lake, distance to nearest water, etc.)*

Detector is on the northern bank of a stream. Stream S-curves through a flat plateau. To the north is a grassy hill for grazing. To the south is forest, but w/ a grassy clearing to the S.E. Seperating the grassy hill + the stream is a line of Trees to the North.



Photos (check)

Detector Location ✓ *(detector + main habitat surveyed)*

Detector Orientation ✓ *(detector + surrounding habitat)*

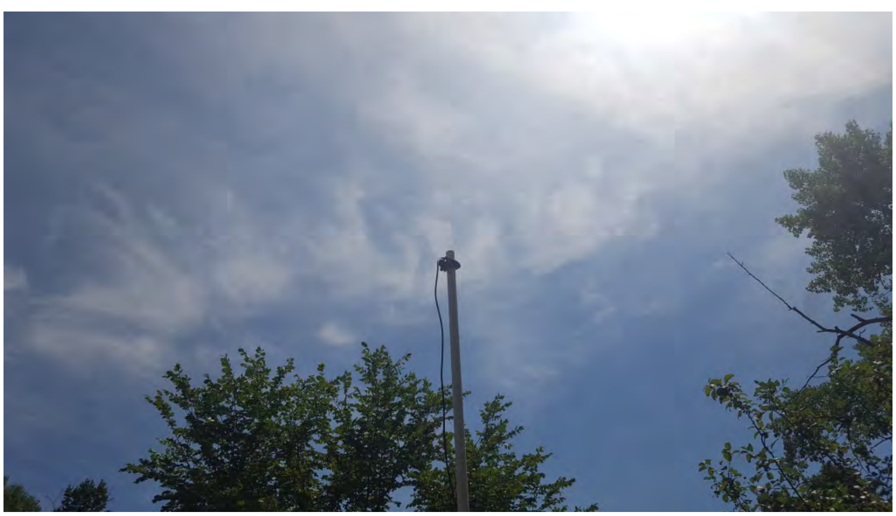
Detection Cone ✓ *(air space sampled)*

Station BR-2a Datasheet

Acoustic Detector Station BR-2b

Station BR-2b Location

Station BR-2b Orientation



Station BR-2b Detection Cone

WEST

Acoustic Presence/Probable Absence 2016 Form

Project: Bitterroot **Station ID:** 2b

Start Date/Time (military): 20160726 1231 End Date/Time: 20160728 1034

Observer(s): ETG RLK

Station Information:

County: Yellow Medicine State: MN

Datum: NAD27 NAD83 Zone: 14 Easting: (6 digits) 703616 Northing: (7 digits) 4956815

Detector Type: SM2+ Detector Serial #: 11584 Tablet Location*: /

Detector Housing: Ammo Box Toolbox Plastic Tote Other: N/A

Battery source: Internal External If External: ______ volts ______ amp/hrs

SD
A → 014
B → B08

Microphone

Mic Serial#* 2736 Mic Ht (m): (from ground) 3.648 Mic Channel* R Audio Div* / Data Div* /

Mic Horizontal Orientation: 241 Mic Vertical Orientation: 23 Sound Reception: None Horn Bat Hat PVC Elbow

All Detector Checklist						Anabat Only				
Date/Time	Battery Voltage	Mic Check Good? y/n	Cables, detector housing, mic holder good?	Data Card(s) Replaced?	Battery Changed?	Sensitivity Setting (normally 6)	Test Indicators (checkmark)	Volume (Sound setting) Yes/No	LED Lights (circle) (should be Standby unless between 1800 and 0800 hrs)	Comments i.e., detector off, detector picked up, moved, knocked over, vandalized, etc.
20160726 1241	6.98	✓	✓	✓	✓		"Data" lit Static Heard		Record Standby Status Error Data	
20160728 1032	5.6						"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	
							"Data" lit Static Heard		Record Standby Status Error Data	

Habitat Description *(within 100m)*

% Forested 60 %Open/Ag 25 %Water 15 **Dominant Tree Spp:** Bur Oak

Stand Age: Young Mature Old

Detector Sampling (circle 1 or more):

Creek Riparian Pond Bottomland Forest Upland Forest Field Edge Open Field

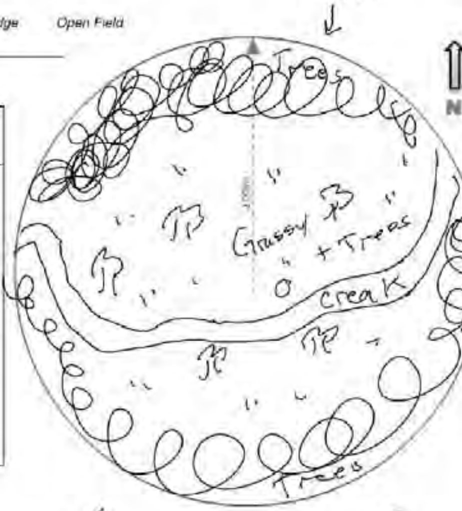
Cave Entrance Mine Portal Bridge Structure Other: ______

Topography: Flat Slope High Point Low Point Other: ______

Habitat Description: Map out habitat features within 100 m radius of Song Meter (x). Indicate direction of microphone using an arrow. Include any features of interest (water, buildings, rocky outcrops, etc.). Provide a written description in the space below, including details on width of the road/trail/outline, size of pond/lake, distance to nearest water, etc.)

Detector is on the north bank of the creek. Cattle grazing area. Grassy areas to the N+S of creek are sparsely populated by trees. Trees line the creek banks. Creek snakes from NW, S, to NE. Mic is just next to a dead tree (east).

O = Dead Tree



Photos (check)

Detector Location ✓ *(detector + main habitat surveyed)*

Detector Orientation ✓ *(detector + surrounding habitat)*

Detection Cone ✓ *(air space sampled)*

Station BR-2b Datasheet

2016 Raptor Nest Survey

Raptor Nest Survey

Bitter Root Wind Energy Project

Yellow Medicine County, Minnesota, and Deuel County, South Dakota

Final Report

March 28 – 31, 2016

Prepared for:

Flying Cow Wind, LLC

at the request of

Global Winds Harvest, Inc.

103 Front Street
Schenectady, New York 12305

Prepared by:

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January 30, 2017

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Sofia Agudelo	Report Compiler
Andrea Palochak	Technical Editor

REPORT REFERENCE

Simon, S., S. Agudelo, and T. Mattson. 2016. Raptor Nest Survey Bitter Root Wind Energy Project, Yellow Medicine County, Minnesota, and Deuel County, South Dakota. Final Report: March 28 – 31, 2016. Prepared for Flying Cow Wind, LLC, at the request of Global Winds Harvest, Inc., Schenectady, New York 12305. Prepared by Western EcoSystems Technology, Inc. (WEST). Golden Valley, Minnesota.

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INTRODUCTION

Flying Cow Wind, LLC is considering development of the Bitter Root Wind Energy Project (Project) in Yellow Medicine County, Minnesota, and Deuel County, South Dakota (Figure 1). At Flying Cow Wind's request, Western EcoSystems Technology, Inc. (WEST) conducted an aerial raptor nest survey to record bald eagle (*Haliaeetus leucocephalus*) and other raptor nests in and within the vicinity of the Project area. The aerial survey was conducted in accordance with the guidance provided in the U.S. Fish and Wildlife Service (USFWS) *Eagle Conservation Plan Guidance: Module 1 – Land-based Wind Energy, Version 2* (ECPG; USFWS 2013) and the USFWS *Interim Golden Eagle Inventory and Monitoring Protocols; and Other Recommendations* (Pagel et al. 2010). The survey was conducted on March 28 – 31, 2016. Following the aerial raptor nest survey, one occupied bald eagle nest was monitored from May 15 to June 20, 2016. The results of the aerial nest survey and bald eagle nest monitoring are documented below.

SURVEY AREA

The survey area included the Project boundary and a 10.0-mile (mi; 16.0-kilometer [km]) buffer, including portions of Yellow Medicine and Lincoln counties in Minnesota, and Deuel and Brookings counties in South Dakota (Figure 1). The Project is in the Northern Glaciated Plains Level III Ecoregion and the Prairie Coteau Level IV Ecoregion (USEPA 2016). The Northern Glaciated Plains Ecoregion is flat to gently rolling landscape of glacial drift. The region is transitional between tallgrass and shortgrass prairie and high concentrations of temporary and seasonal wetlands offer suitable habitat for waterfowl nesting and migration. The Prairie Coteau Ecoregion is generally a higher elevation plateau with poorly defined drainage. Many lakes and a mix of row crops and pasture are present in this region and within the Project itself.

METHODS

Aerial Raptor Nest Survey

An aerial survey was conducted from a Robinson R44 helicopter by a qualified biologist on March 28 - 31, 2016. The goal of the survey was to document all raptor nests within the Project boundary and a 2.0-mi (3.2-km) buffer, and a 10.0-mi (16.0-km) buffer solely for bald eagle nests. The survey was timed to coincide with the period when bald eagles are likely incubating eggs or tending young, based on chronology for nesting bald eagles in the region (see the USFWS *National Bald Eagle Management Guidelines* [USFWS 2007]). This was also when other local raptor species were likely to be nesting and prior to leaf out conditions when stick nests would be most visible. Pre-flight planning included the creation of field maps and mobile Geographic Information System (GIS) files and review of relevant background information, such as previously recorded nest locations, topographic maps, and aerial photographs.

A survey route was planned using aerial imagery and the U.S Geological Survey (USGS) National Land Cover Database (NLCD; see UGSG NLCD 2011, Homer et al. 2015) to cover all suitable bald eagle and raptor nesting habitat within 10.0 mi (16.0 km) of the Project boundary; suitable nesting habitat included wooded areas, riparian corridors, and forested margins of waterbodies. All raptor nests found within the Project boundary and 2.0-mi (3.2-km) buffer, and eagle nests found within the Project boundary and 10.0-mi (16.0-km) buffer, were recorded. Within the Project boundary, transects were flown approximately 0.5 mile (0.8 km) apart to provide complete coverage of all areas where construction impacts may occur. The survey track was recorded using a handheld global positioning system (GPS) unit to ensure that all areas were adequately covered. The helicopter was positioned to allow thorough visual inspection of the habitat, and in particular, to provide a view of the tops of the tallest dominant trees where bald eagles generally prefer to nest (Buehler 2000). During the survey, the helicopter was flown approximately 150 to 200 feet (ft; 46 to 61 meters [m]) above ground level at an airspeed of approximately 75 miles (121 km) per hour.

Data recorded for each observed nest site included:

- Nest status (i.e., occupied [active/inactive] or unoccupied)
- Species occupying the nest
- Number of adults and young present
- Behavior of adults at the nest
- Nest condition (i.e., poor, fair, good, excellent)
- Nest location marked with a hand-held GPS
- Nest substrate (e.g., coniferous or deciduous tree, power line pole)

Included below are descriptions of terms used during the documentation of nests (see Results section).

Nest Identification (ID) - WEST assigned a unique nest identification number for each nest documented.

Species - A species was assigned to each nest when possible, otherwise, it was classified as an unknown raptor nest. Nests documented as unknown raptor species are defined as any stick nest that did not have an occupant associated with it at the time of the survey. Unknown raptor nests, including old nests or nests that could become suitable for raptors, are documented in order to populate a nest database to ensure that future surveys include all potentially suitable nest sites.

Nest Condition - Nest condition was categorized using descriptions ranging from poor to excellent. Although the determination of nest condition can be subjective and may vary between observers, it gives a general sense of when a nest or nest site may have last been used. Nests in fair to poor condition are characterized by varying degrees of disrepair, sloughing, or sagging heavily, and would require some level of effort to rebuild in order to be suitable for successful nesting. Nests in good to excellent condition are those that appear to have been well maintained, have a well-defined bowl shape, are not sagging or sloughing, and appear to be suitable for nesting.

Substrate - The substrate in which a nest was observed was recorded to provide observers a visual reference. Substrates range from manmade structures (such as power lines, nest platforms, and dock hoists) to biological and physical structures (conifer and deciduous tree species, cliff faces).

Nest Status - WEST categorizes basic nest use consistent with definitions from the USFWS *Eagle Conservation Plan Guidance* (ECPG; USFWS 2013). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) occurrence of a pair of adults (or, sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed early in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, or droppings or molted feathers on its rim or underneath. Occupied nests were further classified as active if an egg or eggs had been laid or nestlings were observed, or inactive if no eggs or chicks were present. A nest that does not meet the above criteria for "occupied" was classified as "unoccupied".

Ground-Based Bald Eagle Nest Monitoring Surveys

WEST conducted monitoring at one occupied/active bald eagle nest documented during the aerial survey (Nest 16, discussed below) to better document flight directions from the nest, feeding behaviors and patterns, and general utilization of habitats near the Project area. Prior to conducting the monitoring, WEST established three observation points from which eagle movements and behaviors were observed and documented. All observations within a 2,625-ft (800-m) buffer of each point were recorded, following methods similar to Reynolds et al. (1980), and consistent with recommendations outlined in the ECPG (USFWS 2013). Each observation point was located within 0.5 mile (0.8 km) of the bald eagle nest, and triangulated to provide maximum visibility of the nest and the nearby habitats (Figure 2). During each site visit, WEST biologists monitored eagle behaviors for two hours at each of the three points surrounding the nest that was determined to be occupied/active. WEST biologists monitored the nest over four visits from May 15 to June 20, 2016 including two visits in May and two visits in June. During the four site visits, WEST monitored the nest for a total of 24 hours.

During the monitoring visits, a WEST biologist recorded all eagles, regardless of distance from the observer. Data recorded by the biologist included: distance to each bird, estimated to the nearest 16 ft (5 m); date; start and end time of the observation period; plot number; number of individuals; sex and age class (if possible); distance from plot center when first observed; closest distance; height above ground; behavior; and habitat. These data were recorded during each one-minute interval the eagle was within view for each observation, per the ECPG (USFWS 2013). Behavior categories recorded included soaring flight, flapping-gliding, hunting, kiting-hovering, stooping/diving at prey, stooping/diving in an antagonistic manner with other perched bird species, being mobbed, undulating/territorial flight, auditory, and other (noted in comments section of data sheets). Initial flight patterns and habitat types (at first observation) were uniquely identified on data sheets and subsequent patterns and habitats were also recorded, including specific perch trees, common perches, used repeatedly. The flight directions of observed bald eagles were recorded on data sheet maps, with descending soaring and flapping flight drawn as straight or curving lines, while ascending soaring flights on thermals are typically documented as looping paths. Estimated flight height at first observation was recorded to the nearest 16 ft (5 m); the estimated lowest and highest flight heights observed were also recorded. Any comments or unusual observations were also noted in the comments section of data sheets.

RESULTS

Aerial Raptor Nest Survey

The aerial survey identified 33 raptor stick nests within the survey area (Figure 1, Table 1). Seven occupied/active bald eagle nests were located in the survey area: one bald eagle nest within the Project boundary (Nest 16), two bald eagle nests within the 2.0-mi (3.2-km) buffer of the Project boundary (Nests 6 and 14), and four bald eagle nests within the 10.0-mi (16.0-km) buffer of the Project (Nests 30, 31, 32, and 33; Figure 1, Table 1). In addition, four occupied/active great horned owl (*Bubo virginianus*) nests, seven occupied/active red-tailed hawk (*Buteo jamaicensis*) nests, one occupied/active unknown owl nest, three occupied/inactive unknown raptor nests, and 11 unoccupied/inactive unknown raptor nests were documented during the survey (Figure 1, Table 1). Two of the unoccupied/inactive unknown raptor species nests (Nests 1 and 29) were consistent with the size and structure of bald eagle nests; both were located within the 2.0-mi (3.2-km) buffer of the Project boundary (Figure 1, Table 1). No federally or state-listed threatened or endangered raptor species were observed nesting within the Project boundary or its associated buffers.

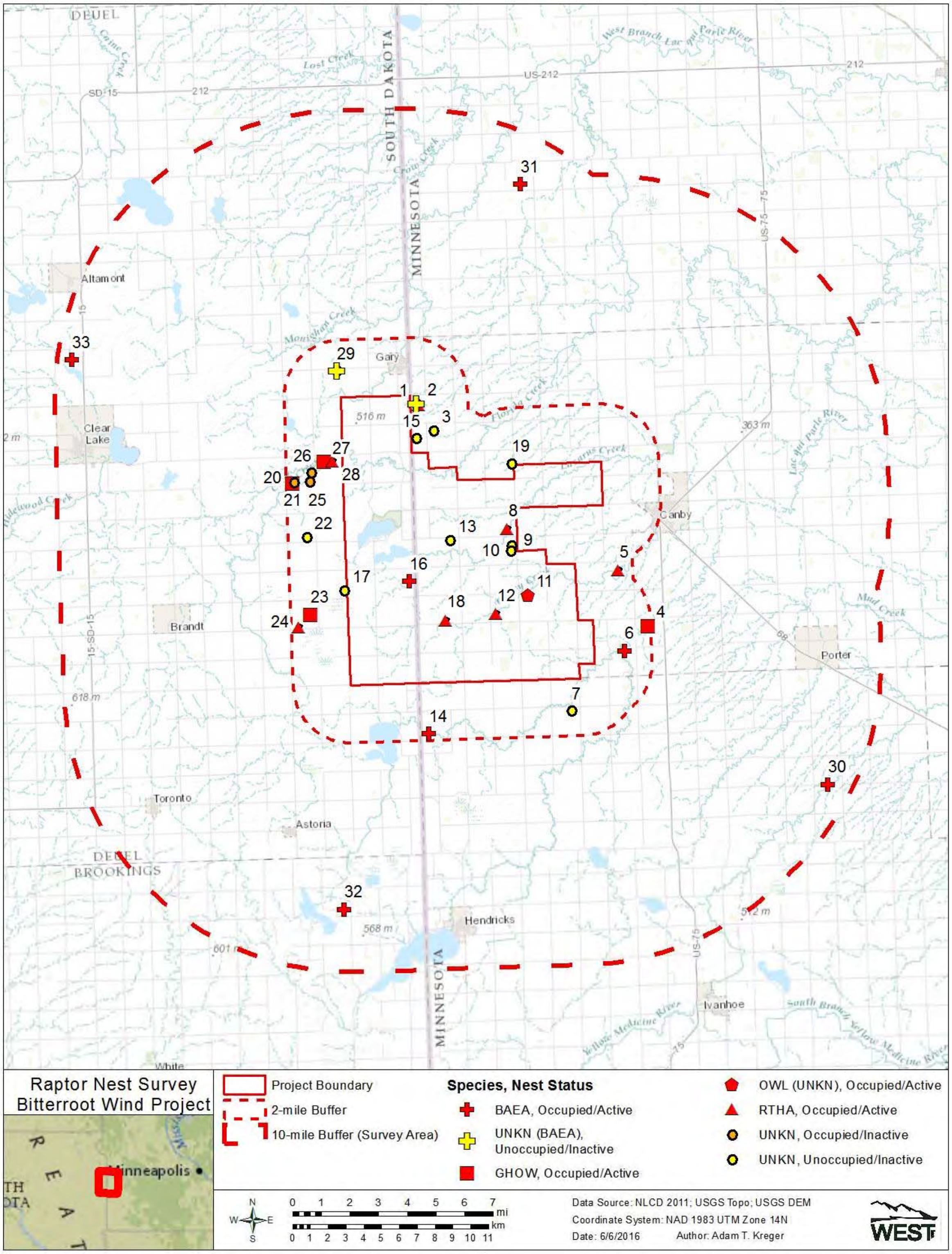

Figure 1. Location of raptor nests within the proposed Bitter Root Wind Energy Project boundary and associated buffers during the aerial raptor nest survey conducted on March 28 - 31, 2016. (BAEA = bald eagle, GHOW = great horned owl, OWL (UNKN) = unknown owl species, RTHA = red-tailed hawk, UNKN = unknown raptor species, UNKN (BAEA) indicates the nest was of size and structure consistent with a bald eagle nest.)

Table 1. Summary of raptor nests identified during the aerial nest survey conducted for the Bitter Root Wind Energy Project on March 28 - 31, 2016.

Nest ID	Species[1]	Nest Status	Nest Type	Nest Condition	Substrate	Within Project Boundary?	Comments
1	UNKN (BAEA)	Unoccupied/Inactive	Stick	Good	Deciduous tree	No	Nest of the size and structure consistent with bald eagle nest
2	RTHA	Occupied/Active	Stick	Good	Deciduous tree	No	Adult on nest
3	UNKN	Unoccupied/Inactive	Stick	Good	Deciduous tree	No	
4	GHOW	Occupied/Active	Stick	Good	Deciduous tree	No	Adult on nest
5	RTHA	Occupied/Active	Stick	Good	Deciduous tree	No	Adult on nest
6	BAEA	Occupied/Active	Stick	Good	Deciduous tree	No	Adult on nest
7	UNKN	Unoccupied/Inactive	Stick	Fair	Deciduous tree	No	
8	RTHA	Occupied/Active	Stick	Good	Deciduous tree	Yes	Adult on nest
9	UNKN	Unoccupied/Inactive	Stick	Good	Deciduous tree	Yes	
10	UNKN	Unoccupied/Inactive	Stick	Good	Deciduous tree	Yes	
11	OWL (UNKN)	Occupied/Active	Stick	Good	Deciduous tree	Yes	Adult flew off nest, 2 young visible
12	RTHA	Occupied/Active	Stick	Good	Deciduous tree	Yes	Adult on nest
13	UNKN	Unoccupied/Inactive	Stick	Fair	Deciduous tree	Yes	
14	BAEA	Occupied/Active	Stick	Good	Deciduous tree	No	Adult on nest
15	UNKN	Unoccupied/Inactive	Stick	Good	Deciduous tree	No	
16	BAEA	Occupied/Active	Stick	Good	Deciduous tree	Yes	Adult flew off nest, 2 eggs visible
17	UNKN	Unoccupied/Inactive	Stick	Good	Deciduous tree	No	
18	RTHA	Occupied/Active	Small Stick	Good	Deciduous tree	Yes	1 RTHA in incubating position
19	UNKN	Unoccupied/Inactive	Small Stick	Good	Deciduous tree	No	
20	GHOW	Occupied/Active	Medium Stick	Excellent	Deciduous tree	No	Adult flushed, chicks present
21	UNKN	Occupied/Inactive	Medium Stick	Excellent	Deciduous tree	No	
22	UNKN	Unoccupied/Inactive	Medium Stick	Good	Deciduous tree	No	
23	GHOW	Occupied/Active	Medium Stick	Excellent	Deciduous tree	No	Adult in incubating position
24	RTHA	Occupied/Active	Medium Stick	Excellent	Deciduous tree	No	Adult present

Table 1. Summary of raptor nests identified during the aerial nest survey conducted for the Bitter Root Wind Energy Project on March 28 - 31, 2016.

Nest ID	Species[1]	Nest Status	Nest Type	Nest Condition	Substrate	Within Project Boundary?	Comments
25	UNKN	Occupied/Inactive	Medium Stick	Excellent	Deciduous tree	No	
26	UNKN	Occupied/Inactive	Medium Stick	Excellent	Deciduous tree	No	
27	GHOW	Occupied/Active	Medium Stick	Excellent	Deciduous tree	No	Adult in incubating position
28	RTHA	Occupied/Active	Medium Stick	Excellent	Deciduous tree	No	Adult present
29	UNKN (BAEA)	Unoccupied/Inactive	Large Stick	Good	Deciduous tree	No	Nest of the size and structure consistent with bald eagle nest
30	BAEA	Occupied/Active	Stick	Good	Deciduous tree	No	Adult flew off nest, 2 eggs visible
31	BAEA	Occupied/Active	Stick	Good	Deciduous tree	No	Two adults on nest
32	BAEA	Occupied/Active	Large Stick	Excellent	Deciduous tree	No	BAEA flushed off nest; two eggs in nest
33	BAEA	Occupied/Active	Large Stick	Excellent	Deciduous tree	No	Adult and 2 eggs present

[1] BAEA = bald eagle; GHOW = great horned owl; OWL (UNKN) = unknown owl species; RTHA = red-tailed hawk; UNKN = unknown raptor species; UNKN (BAEA) indicates the nest was of size and structure consistent with a bald eagle nest.

Ground-Based Bald Eagle Nest Monitoring Surveys

At the occupied/active bald eagle nest (Nest 16), WEST completed a total of 24 hours of nest monitoring from May 15 through June 20, 2016 (Table 2). Visibility of the nest was limited due to leaf-out, but two adult bald eagles and one chick were documented at the nest in May. Adult bald eagles were observed in flight to and from the nest, flying in a predominantly north/northwest direction from the nest, suggesting flights to and from the Lake Cochrane and South Slough complex. Perch locations and flight paths were documented for adult bald eagles (Figure 2).

During the first visit in June, less adult bald eagle activity was observed near the nest, although documented flights revealed the same general north/northwest to south/southeast flight pattern to and from the Lake Cochrane and South Slough complex and the nest. One juvenile remained in the nest and adults were observed carrying food back to the nest. By the second visit on June 20, only one adult bald eagle was observed occasionally in the area of the nest and the juvenile and other adult bald eagle were not observed during the six hours of monitoring.

The nest was observed incidentally while conducting avian use surveys in beginning of July, but no adult or juvenile activity was observed at or near the nest, during the hour-long period. The nest was checked incidentally during subsequent avian use surveys in mid-July and the end of July and no adults or juveniles were observed at any time. Given that the juvenile should have fledged and remained near the nest during late June or early July, and that adults would still have routine flights to and from the nest area to feed, it is possible the chick/juvenile eagle did not survive.

Table 2. Total bald eagle nest observation hours per month at the Bitter Root Wind Energy Project from May 15 to June 20, 2016.

	May	June	Total Hours Per Nest
Bald Eagle Nest	12	12	24

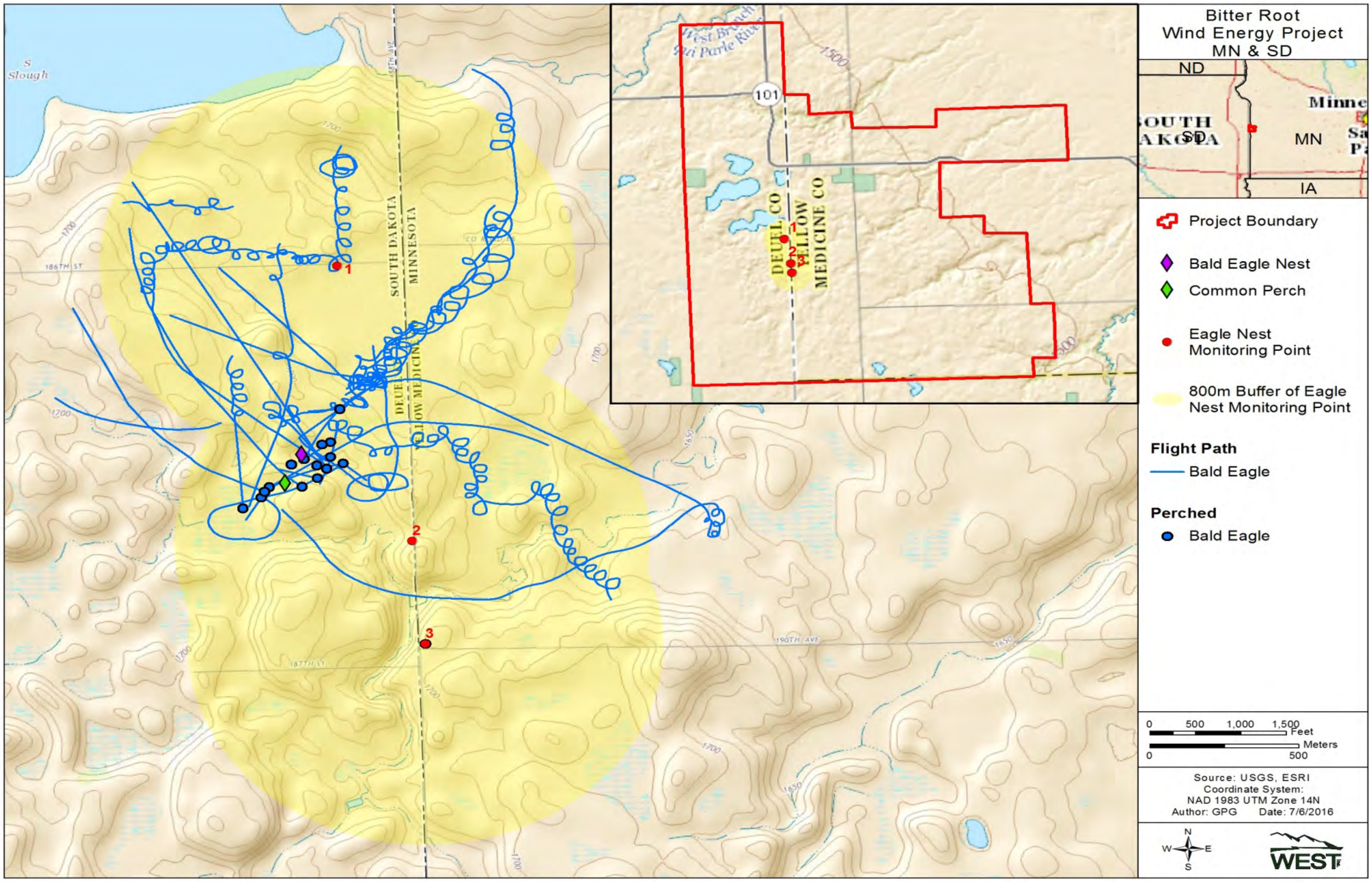

Figure 2. Bald eagle nest survey point locations, buffers, and flight paths documented within the Bitter Root Wind Energy Project from May 15 to June 20, 2016.

DISCUSSION

The aerial raptor nest surveys provided information on raptor and eagle nesting activity at the Project area. The single occupied bald eagle nest observed within the Project area (Nest 16) was located less than 1.0 mile (1.6 km) south of the Lake Cochrane and South Slough complex in the western portion of the Project area.

The Project area is situated in an area dominated by cultivated agricultural lands and hayfields/pastures with relatively little forest cover. Several lakes are located within the Project area, providing suitable foraging habitat for bald eagles. Additionally, some of the lakes have a periphery of forested patches and wetland complexed associated with them, providing nesting and foraging habitat. The majority of bald eagle flight paths documented at Nest 16 were associated with the Lake Cochrane and South Slough complex (i.e., movement patterns to and from this complex), suggesting that the eagles use this complex and possibly other lakes located to the north/northwest of the nest (e.g., Lake Oliver, Culver Lake).

Though the monitored bald eagle nest may not have been successful (i.e., chick/juvenile may not have survived), there is potential for bald eagles to reuse this same nest in the future. Bald eagles have a tendency to reuse nesting sites from year to year, and given the availability of foraging resources (Lake Cochrane/South Slough) on the landscape within the Project area, this nest location would provide favorable nesting habitat (Buehler 2000). Based on observations in 2016 and general bald eagle behavior patterns (Buehler 2000), we expect the area to the north of this nest to be the most highly utilized portion of this nesting territory.

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2017 Raptor Nest Survey Report

2017 Raptor Nest Survey Report

Bitter Root Wind Energy Project

Yellow Medicine County, Minnesota

Deuel County, South Dakota

Prepared for:

Flying Cow Wind, LLC

Prepared by:

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September 30, 2017

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REPORT REFERENCE

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INTRODUCTION

Flying Cow Wind, LLC (Flying Cow) is proposing to develop a utility-scale wind energy project, the Bitter Root Wind Energy Project (Project), in Yellow Medicine County, Minnesota and Deuel County, South Dakota. At Flying Cow's request, Western EcoSystems Technology, Inc. (WEST) conducted a raptor nest survey to record bald eagle (*Haliaeetus leucocephalus*) and other raptor nests in and near the Project. This survey will aid in assessing potential effects of the Project on eagles and other raptors. The survey was conducted in accordance with the guidance provided in the US Fish and Wildlife Service's (USFWS) *Eagle Conservation Plan Guidance* (ECPG; USFWS 2013) and the USFWS *Interim Golden Eagle Technical Guidance* (Pagel et al. 2010). This 2017 survey was a follow-up survey to a similar study completed in 2016 (Simon et al. 2017).

SURVEY AREA

The survey area for all raptor stick-nests consisted of a 1-mile (mi; 1.6-kilometer [km]) buffer of potential turbine siting areas, and the survey area for bald eagle nests consisted of a 5-mi (8.0-km) buffer of potential turbine siting areas (Figure 1). This Project area encompasses approximately 22,751 acres in Yellow Medicine County, Minnesota and falls within the Northern Glaciated Plains Level III Ecoregion and the Prairie Coteau Level IV Ecoregion. The Northern Glaciated Plains Ecoregion is flat to gently rolling landscape of glacial drift. The region is transitional between tallgrass and shortgrass prairie and high concentrations of temporary and seasonal wetlands offer suitable habitat for waterfowl nesting and migration. The Prairie Coteau Ecoregion is generally a higher elevation plateau with poorly defined drainage (US Environmental Protection Agency (USEPA) 2013, USEPA 2015).

METHODS

Aerial Raptor Nest Survey

Aerial raptor surveys were conducted from a helicopter on April 6, April 8, and April 11, 2017, a period before leaf out when raptors would be actively tending to a nest or incubating eggs. Aerial surveys were conducted in accordance with the guidance provided in the ECPG (USFWS 2013) and the USFWS *Interim Golden Eagle Technical Guidance* (Pagel et al. 2010). An experienced raptor ecologist and a skilled helicopter pilot conducted the survey. Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls (Buehler 2000). However, the main focus of the survey was to identify bald eagle nests. Bald eagle nest surveys focused on locating eyries (large, stick nest structures) in suitable eagle nesting substrate (trees, transmission line poles, etc.) within and around the proposed Project (Figure 1). An eagle nest, as described in the Code of Federal Regulations (50 CFR 22.3), is any readily identifiable structure built, maintained, or used by bald or golden eagles for the purpose of reproduction. Bald eagles generally select one of the largest trees available with accessible limbs capable of supporting a nest (Buehler 2000). Nests are usually placed in the top quarter of the tree, just below the crown, and against the trunk or in a fork of large branches near the trunk. On average, bald eagle nests are 5 – 6 feet (ft; 1.5 – 1.8 meters [m]) in diameter and 2 – 4 ft tall (0.6 – 1.2 m; Buehler 2000). Pre-flight planning included the creation of field maps and mobile Geographic Information System files and review of relevant background information, such as previously recorded nest locations, topographic maps, and aerial photographs.

Surveys within the Project boundary and 1-mi (1.6-km) buffer documented all potential raptor nests, including bald eagles, while the surveys out to the 5-mi (8-km) buffer focused only on identifying potential bald eagle nests. Efforts were made to minimize disturbance to breeding raptors; the greatest possible distance at which the species could be identified was maintained, with distances varying, depending upon nest location and wind conditions.

Note that the original Project boundary that was available at the time of the aerial survey has been subsequently modified. Figure 1 illustrates both the original boundary used for the survey and the currently proposed Project boundary.

In general, all potential raptor nest habitat was surveyed by flying transects between 0.25 – 1.0 mi (0.8 – 1.6 km) apart, flying at speeds of approximately 46 mi per hour (74 km per hour) when actively scanning for nests. Surveys were typically conducted between 07:00 hours and 18:00 hours.

The survey track was recorded using a handheld Global Positioning System (GPS) unit to ensure that all areas were adequately covered. The helicopter was positioned to allow thorough visual inspection of the habitat, and in particular, to provide a view of the tops of the tallest dominant trees where bald eagles generally prefer to nest (Buehler 2000). The locations of all potential raptor nests were recorded using a handheld GPS. This included all confirmed and potential nests regardless of their activity status.

To determine the status of a nest, the biologist evaluated behavior of adults on or near the nest, and presence of eggs, young, whitewash, or fresh building materials. Attempts were made to identify the species of raptor associated with each active nest. Raptor species, nest type, nest status, nest condition, and nest substrate were recorded at each nest location to the extent possible.

Nest Activity Monitoring

WEST conducted follow-up surveys of eagle and potential eagle nests in the vicinity of the Project area following the initial aerial surveys. The follow-up survey objectives were to document nest status and assess predominant use patterns of eagles around these nests (e.g., directions of flight to and from the nest).

Terminology

Included below are descriptions of terms used during the documentation of nests (see Results section).

Nest ID – A unique nest identification number was assigned for each nest documented.

Species – A species was assigned to each nest when possible, otherwise, it was classified as an unknown raptor nest. Nests documented as unknown raptor species were defined as any stick nest not having an occupant associated with it at the time of the survey. Many times nests become abandoned or are no longer used, and over time, may become a historic nest site. Unknown raptor nests, including old nests or nests that could become suitable for raptors, were documented in order to populate a nest database to ensure future surveys include all potentially suitable nest sites.

Nest Condition – Nest condition was categorized as either good or in disrepair. Although the determination of nest condition can be subjective and may vary between observers, it gives a general sense of when a nest or nest site was last used. Nests in good condition appeared well maintained, had a well-defined bowl shape, were not sagging or sloughing, and appeared suitable for nesting. Nests in disrepair were sloughing or sagging heavily, and would require effort to restore for successful nesting.

Substrate – Nest substrate was observed and recorded providing observers a visual reference. Substrates included manmade structures such as power lines, nest platforms, and dock hoists, and biological and physical structures included conifer and deciduous tree species or cliff faces.

Nest Status – Nest status was categorized using definitions consistent with the USFWS ECPG. Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) a pair of adults (sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed earlier in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if (1) an adult was present on the nest in incubating position, (2) an egg or eggs were present, or (3) nestlings observed. Nests were classified as inactive if no eggs or chicks were present. Nests not meeting the above criteria for “Occupied” were classified as “Unoccupied”.

RESULTS

Aerial Raptor Surveys

A total of 11 raptor nests representing three raptor species were detected during the aerial surveys on April 6, April 8, and April 11, 2017 (Table 1). Five occupied and active bald eagle nests were documented. Additional raptor nests documented during the survey included one occupied and active great horned owl (*Bubo virginianus*) nest, two occupied and active red-tailed hawk (*Buteo jamaicensis*) nests, one occupied and active nest of unknown species, and two unoccupied and inactive nests of unknown species (likely red-tailed hawks).

WEST conducted aerial raptor nest surveys at the Project in 2016 and detected seven occupied and active bald eagle nests within a 10-mi (16.0-km) buffer of the Project; one bald eagle nest within the 2016 Project boundary (this nest now falls outside of the current Project boundary), two bald eagle nests within the 2.0-mi (3.2-km) buffer of the Project boundary, and four bald eagle nests within the 10.0-mi (16.0-km) buffer of the Project. In addition, two unoccupied/inactive unknown raptor species nests were consistent with the size and structure of bald eagle nests; both were located within the 2.0-mi (3.2-km) buffer of the Project boundary. In 2017, these two nests were identified as occupied and active red-tailed hawk nests (Simon et al. 2017).

The following section provides more details on each eagle nest documented during the aerial survey:

Nest 1620 – this nest was located within the original Project boundary but outside of the currently proposed Project boundary. The nest was good condition. An adult bald eagle was present on the nest and in incubating position. The nest is therefore considered occupied and active in 2017 (Figure 1, Appendix A1). This nest was new in 2017, although a nest was found 1 mile (1.6 km) to the northeast in 2016; this 2016 eagle nest was occupied by a great horned owl in 2017.

Nest 1616 – this nest was located approximately 1.10 mi (1.77 km) east of the original Project boundary. The nest was in good condition. An adult bald eagle was present on the nest and in incubating position. The nest is therefore considered occupied and active in 2017 (Figure 1, Appendix A2). This nest was also found occupied and active in surveys conducted by WEST in 2016.

Nest 1618 – this nest was located approximately 1.75 mi (2.82 km) south of the original Project boundary. The nest was in good condition. An adult bald eagle was present on the nest and in incubating position. The nest is therefore considered occupied and active in 2017 (Figure 1, Appendix A3). This nest was also found occupied and active in surveys conducted by WEST in 2016.

Nest 1624 – this nest was located approximately 5.30 mi (8.53 km) northeast of the original Project boundary. The nest was in good condition. An adult bald eagle was present on the nest and in incubating position. The nest is therefore considered occupied and active in 2017 (Figure 1, Appendix A4).

Nest 1744 – this nest was located approximately 5.45 mi (8.77 km) southeast of the original Project boundary. The nest was in good condition. An adult bald eagle was present on the nest and in incubating position. The nest is therefore considered occupied and active in 2017 (Figure 1, Appendix A5).

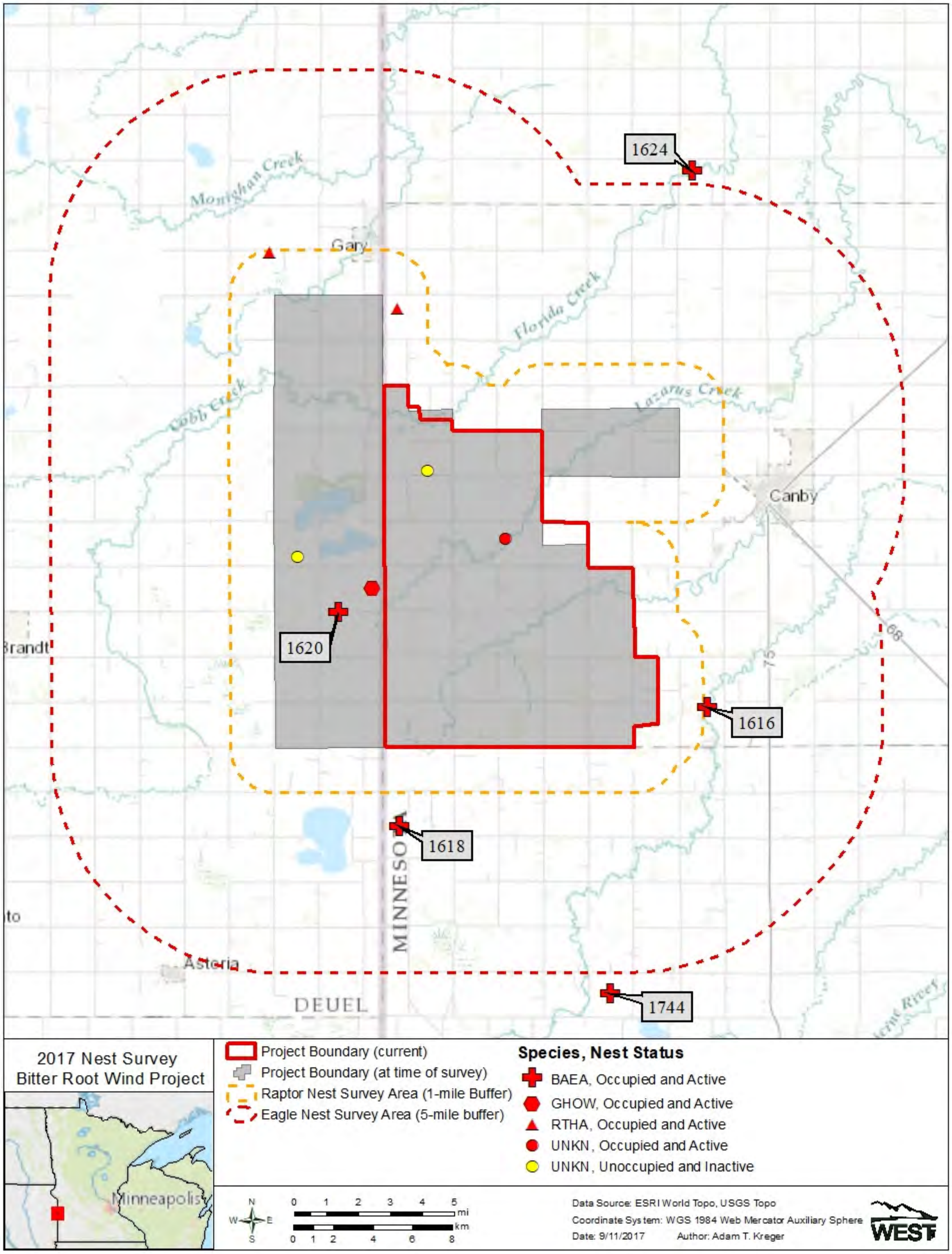

Figure 1. Locations of raptor nests observed near the Bitter Root Wind Energy Project, Yellow Medicine County, Minnesota, and Deuel County, South Dakota. (BAEA = bald eagle, GHOW = great-horned owl, RTHA = red-tailed hawk, UNKN = unknown species).

Table 1. Raptor nest ID, location, species, status, substrate, and condition of nests during the April 6, April 8, and April 11, 2017 survey for the Bitter Root Wind Energy Project, Yellow Medicine County, Minnesota and Deuel County, South Dakota.

Nest ID	Latitude	Longitude	Species[1]	Status at time of survey	Nest Substrate	Condition
1616	44.643700	-96.304497	BAEA	Occupied, Active	Tree	Good
1618	44.605301	-96.443901	BAEA	Occupied, Active	Tree	Good
1620	44.674301	-96.471603	BAEA	Occupied, Active	Tree	Good
1624	44.816299	-96.311600	BAEA	Occupied, Active	Tree	Good
1744	44.551601	-96.348602	BAEA	Occupied, Active	Tree	Good
1621	44.681900	-96.456100	GHOW	Occupied, Active	Tree	Good
1627	44.771702	-96.445099	RTHA	Occupied, Active	Tree	Good
1622	44.789902	-96.502998	RTHA	Occupied, Active	Tree	Good
1625	44.697899	-96.396004	UNKN	Occupied, Active	Tree	Good
1623	44.691898	-96.490196	UNKN	Unoccupied, Inactive	Tree	Good
1626	44.719700	-96.431198	UNKN	Unoccupied, Inactive	Tree	Disrepair

1. BAEA = bald eagle, GHOW = great-horned owl, RTHA = red-tailed hawk, UNKN = unknown species

Nest Activity Monitoring

Ground-based follow-up surveys began in 11 May, but visibility of several nests was reduced due to leaf-out. Therefore a second round of aerial surveys of the occupied and active eagle nests within the 5-mi buffer of the Project was conducted on May 24, 2017 to confirm activity status. Nest activity monitoring continued for the occupied and active nests nearest to the proposed Project development area (Nest 1620 and Nest 1616). Eagles using the nests further from the Project boundary are unlikely to be impacted by Project construction and operation.

Nest 1620 – during the follow-up aerial survey on May 24, 2017, the status of Nest 1620 was confirmed as occupied and active. A 30-minute nest activity monitoring survey was conducted from the ground on June 20, 2017 and no eagles were observed, with no activity in the nest. No additional monitoring was conducted.

Nest 1616 – during the follow-up aerial survey on May 24, 2017, the status of Nest 1616 was confirmed as occupied and active; one fledgling was observed. Despite the obstructed and distant view (0.6 mile, ~ 1km) to the nest, 16 hours of activity monitoring were conducted at Nest 1616 in 2017: 3.5 hours on May 11, 4 hours on June 14, 0.5 hours on June 21, 4 hours on July 7, and 4 hours on July 13. No flying eagles were observed on May 11 or June 21, 2017. Flightpaths recorded during the surveys show that the majority of the eagle flight activity at this nest is concentrated along the Lac Qui Parle River corridor to the northeast and south of the nest (Figure 2). Overall, the activity patterns documented with this nest indicate that the eagles are primarily using the Lac Qui Parle River corridor for foraging. Eagles associated with this nest may periodically use areas outside of this riparian corridor, but it appears that the higher use areas related to eagle nest activity are associated with the riparian zone.

Nest 1618 – a follow-up aerial-based survey was conducted on May 24, 2017 but the status of Nest 1618 could not be confirmed due to leaf-out. No additional nest activity monitoring was conducted.

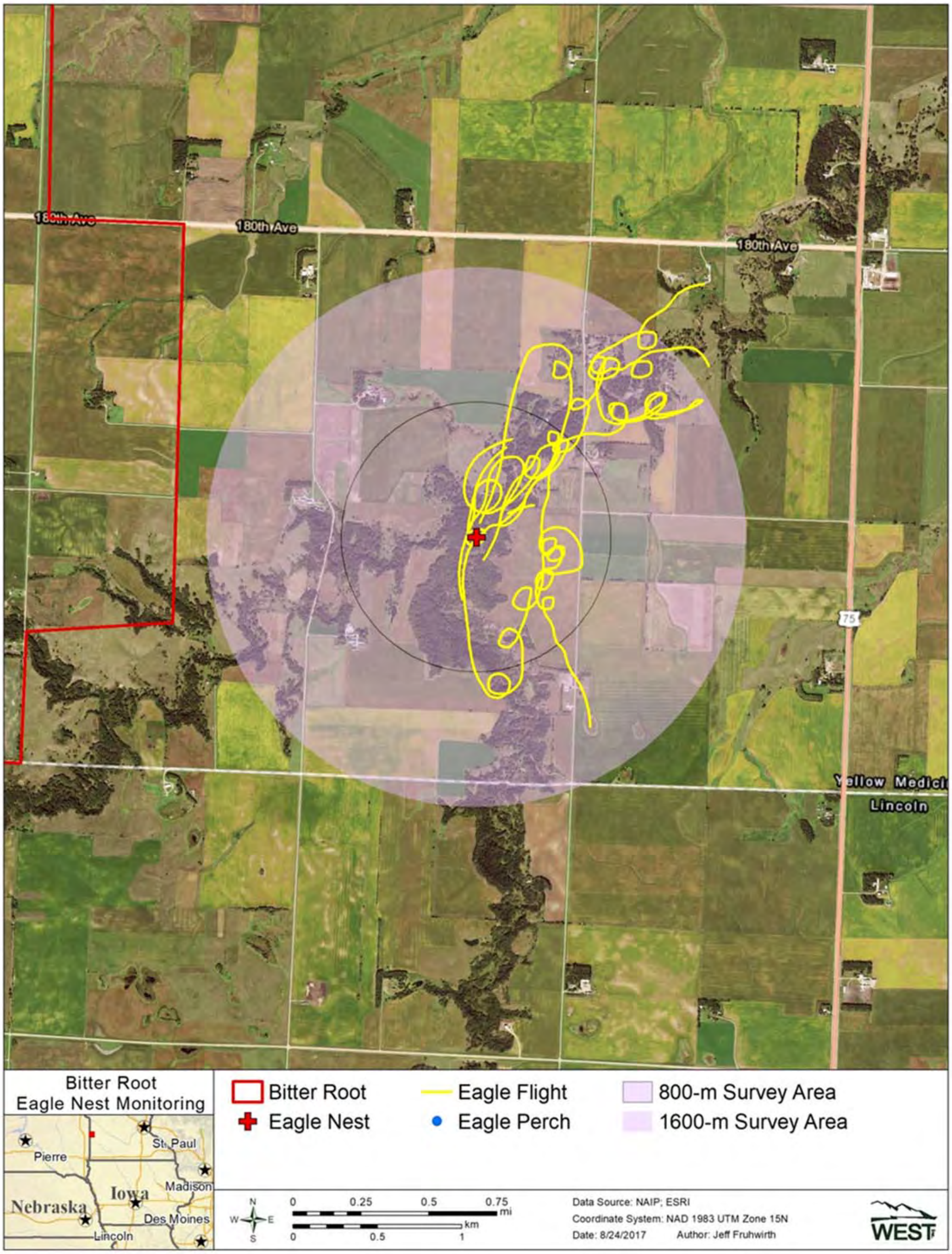

Figure 2. Flight paths associated with nest activity monitoring surveys at Nest 1616.

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Appendix A. Images of Active and Occupied Eagle Nests Found April 6, April 8, and April 11, 2017 within the 5-mile Buffer of the Bitter Root Wind Energy Project, Yellow Medicine County, Minnesota and Deuel County, South Dakota

Appendix A1 Nest 1620 was located within the Bitter Root Wind Energy Project boundary. The nest was in good condition; one adult was present and in incubating position on April 8, 2017.

Appendix A2. Nest 1616 was located approximately 1.10 miles (1.77 kilometers) east of the Bitter Root Wind Energy Project boundary. The nest was in good condition; one adult was present and in incubating position on April 8, 2017.

Appendix A3. Nest 1618 was located approximately 1.75 miles (2.82 kilometers) south of the Bitter Root Wind Energy Project boundary. The nest was in good condition; one adult was present and in incubating position on April 8, 2017.

Appendix A4 Nest 1624 was located approximately 5.30 miles (8.53 kilometers) northeast of the Bitter Root Wind Energy Project boundary. The nest was in good condition; one adult was present on the nest and in incubating position on April 11, 2017.

Appendix A5 Nest 1744 was located approximately 5.45 miles (8.77 kilometers) southeast of the Bitter Root Wind Energy Project boundary. The nest was in good condition; one adult was present and in incubating position on April 6, 2017.