Bat Acoustic Survey

Dakota Range III Wind Project

Grant and Roberts Counties, South Dakota

Final Report

May 10 – October 22, 2018

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EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. (WEST) completed a bat acoustic survey from May 10 – October 22, 2018, for the proposed Dakota Range III Wind Project (Project) located in Grant and Roberts Counties, South Dakota. WEST designed the survey to evaluate bat activity (bat passes per detector-night) at a meteorological (met) tower location and at bat features (locations with forest and water features where bats may be more likely to forage and roost) within the Project. The study was completed based on coordination with the U.S. Fish and Wildlife Service and South Dakota Game, Fish, and Parks.

Biologists paired two AnaBat™ detectors at the met tower, with one ground-based at 5.0 feet (ft; 1.5 meters [m]) and one elevated to 148.0 ft (45.1 m) above ground level, referred to as the met tower stations. The placement of the raised unit allowed the detector to sample bat activity near the potential rotor-swept zone in habitats similar to where turbines are likely to be placed. Additionally, biologists deployed two ground-based detectors at locations near habitat bats are likely to use for foraging and roosting, where turbines are not likely to be located.

During a total of 480 detector-nights the average bat activity rate (± the standard error) was lower at the met tower stations and higher at the bat feature stations, with 2.34 ± 0.19 bat passes per detector-night at the met tower station and 15.90 ± 1.39 bat passes per detector-night at the bat feature stations. The majority of the bat passes recorded at all units were classified as low-frequency (LF; calls less than 30 kilohertz; e.g., big brown bat, silver-haired bat, and hoary bat). The average bat activity rate at the ground-based station at the met tower (3.26 ± 0.29 bat passes per detector-night) was more than double the activity rate at the raised station (1.43 ± 0.19 bat passes per detector-night) throughout the study period.

Overall bat activity peaked in early August at the met tower stations, while activity at the bat feature stations peaked in late August and early September. At the bat feature stations, the LF bat activity peaked in late June and early July and high-frequency (HF) bat activity peaked in early September at the bat feature stations. Average bat activity increased throughout the study period, peaking in early July; however, no large increases in bat overall bat activity were observed during the fall migration period when mortality risk at operating wind projects has historically been greatest.

Due to the similarity of the Project's habitat with current operating projects in the region (e.g., Buffalo Ridge II located approximately 58.0 miles (93.3 kilometers) away in similar tilled agriculture and grassland habitat with a bat mortality rate of 2.81 fatalities per megawatt per year), it is probable that bat mortality at the Project would be low to moderate and follow similar patterns as those observed at other facilities within the region.

STUDY PARTICIPANTS

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INTRODUCTION

Western EcoSystems Technology, Inc. (WEST) completed a bat acoustic survey to assess bat activity at a meteorological (met) tower location and at two bat habitat features (locations with forest and water features where bats may be more likely to forage and roost) at the proposed Dakota Range III Wind Project (Project) in Grant and Roberts counties, South Dakota (Figure 1). The purpose of the study was to characterize bat activity in the area proposed for development. The study was completed based on recommendations from the U.S. Fish and Wildlife Service (USFWS) and South Dakota Game, Fish and Parks (SDGFP), and is consistent with approaches recommended in the USFWS *Land-Based Wind Energy Guidelines* (USFWS 2012).

PROJECT AREA

The approximately 18,744.7-acre (ac) Project is located in the Big Sioux Basin Level IV Ecoregion within the Northern Glaciated Plains Level III Ecoregion (US Environmental Protection Agency 2017). The predominant land cover types within the Project area consist of approximately 55.6% cultivated crops and 34.7% herbaceous (grassland), with the remaining land cover/use types individually accounting for less than 6.0% of the Project area, including developed areas (5.4%), emergent herbaceous wetlands (1.4%), hay/pasture (1.2%), open water (0.8%), deciduous forest (0.6%), barren land (0.3%), and shrub/scrub (less than 0.1%; Table 1, US Geological Survey National Land Cover Database 2011, Homer et al. 2015). The most common cultivated croplands in 2017 were corn (*Zea mays*) and soybeans (*Glycine max*; US Department of Agriculture National Agricultural Statistics Service 2018).

Table 1. Land cover types in the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota.

Land Cover Types	Acres	Percent Composition (%)
Cultivated Crops	10,422.6	55.6
Herbaceous (Grassland)	6,496.4	34.7
Developed	1,007.3	5.4
Emergent Herbaceous Wetlands	258.0	1.4
Hay/Pasture	233.1	1.2
Open Water	156.0	0.8
Deciduous Forest	107.9	0.6
Barren Land	51.8	0.3
Shrub/Scrub	11.6	<0.1
Total	**18,744.7**	**100**

Data from US Geological Survey National Land Cover Database 2011, Homer et al. 2015.

Note: Totals may not add up precisely due to rounding of values.

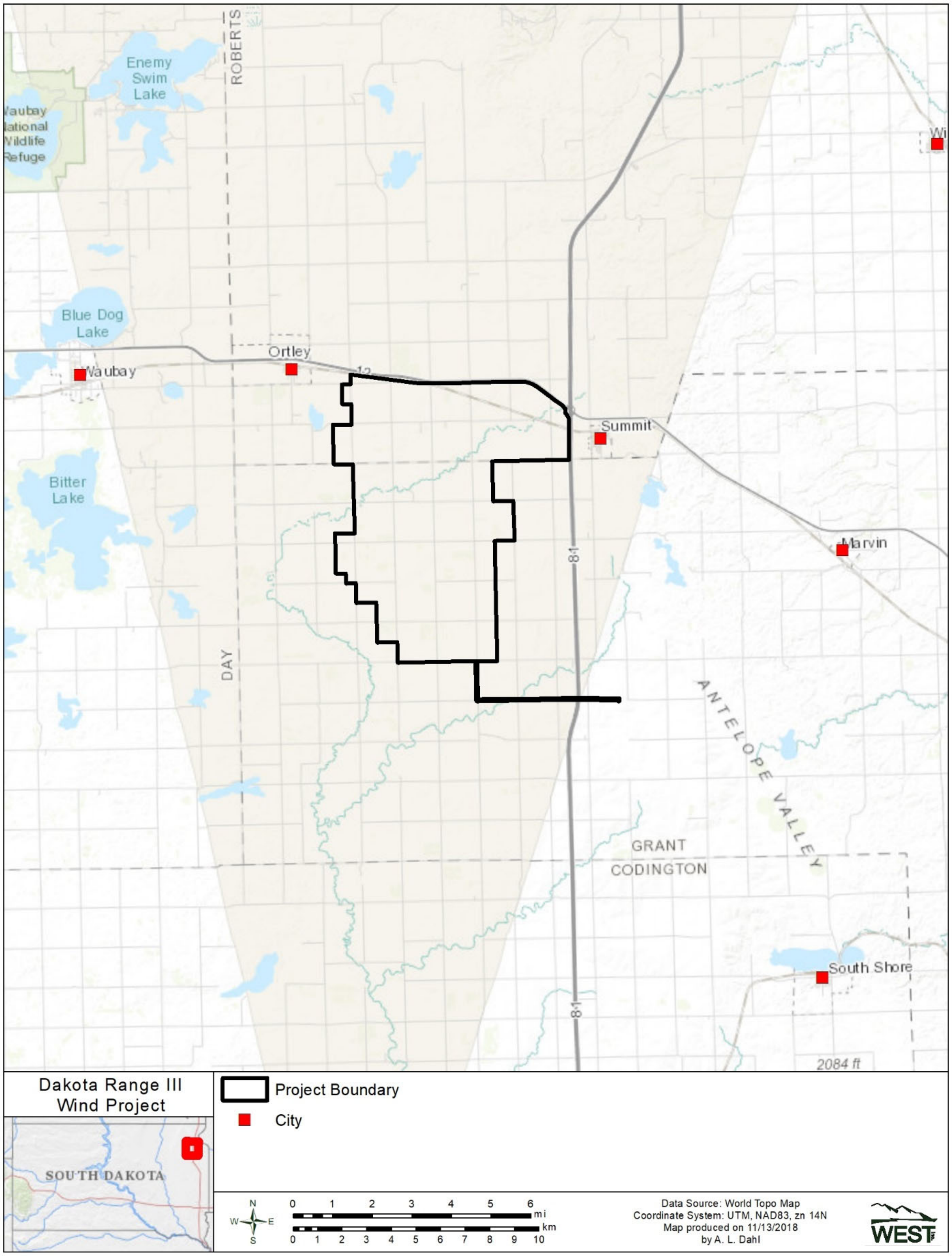


Figure 1. Location of the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota.

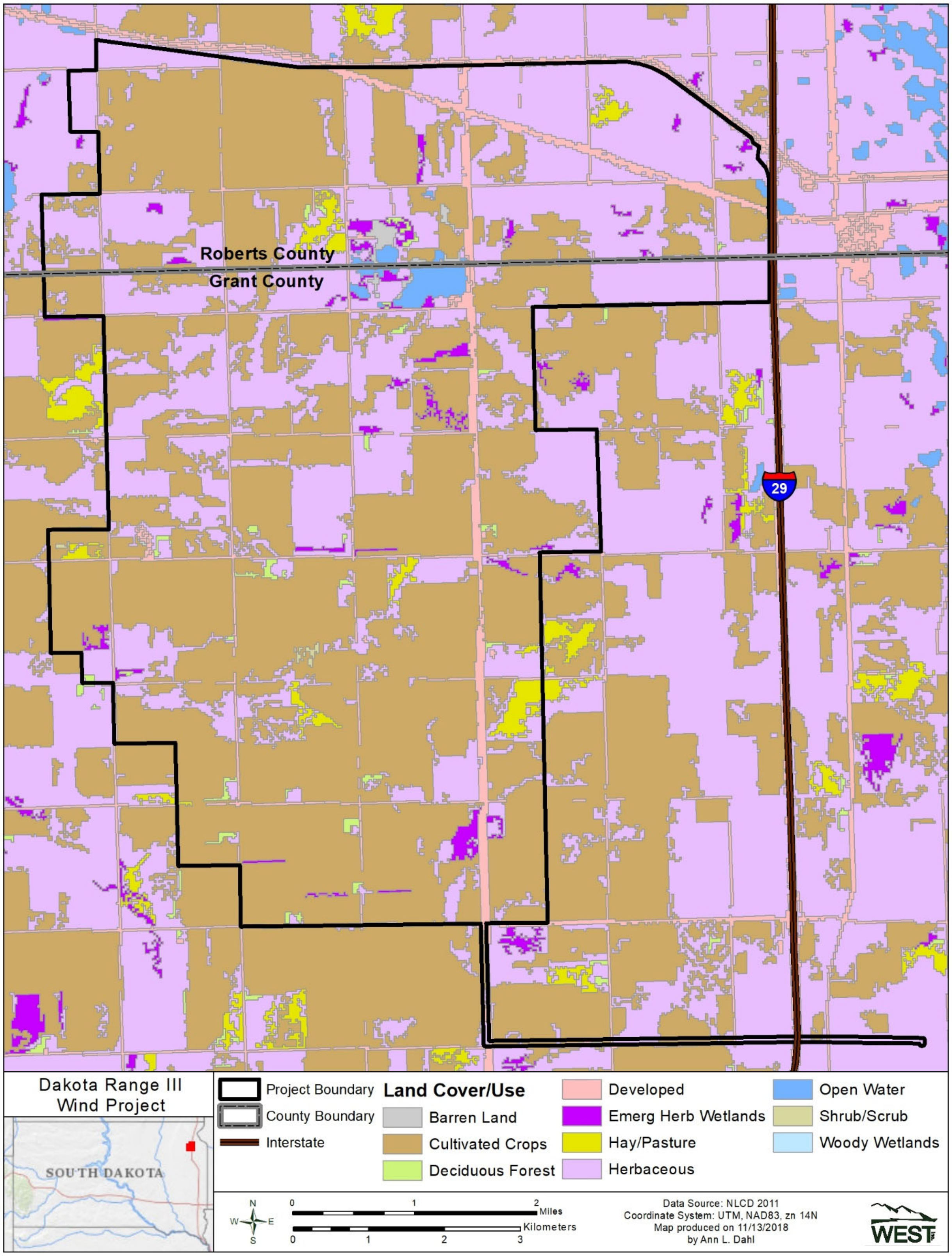


Figure 2. Land cover types at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota (Sources: US Geological Survey National Land Cover Database 2011, Homer et al. 2015).

Overview of Bat Diversity

Six of the 12 species of bats in South Dakota have the potential to occur within the Project area (Table 2; South Dakota Bat Working Group 2004, USFWS 2017, International Union for Conservation of Nature 2018).

Northern Long-eared Bat

Since 2015, the northern long-eared bat ([NLEB] *Myotis septentrionalis*) has been federally listed as threatened with 4(d) rule due to population declines caused by white-nose syndrome (WNS) across North America (USFWS 2015). This species has known occurrences in Roberts County (SDGFP 2016, 2018). WNS was confirmed in the Badlands National Park in South Dakota in May of 2018 (www.whitenosesyndrome.org) putting South Dakota in the WNS zone. Under the 4(d) rule areas inside the WNS zone there is no federal prohibition against incidental take of NLEB so long as the project does not: 1) result in the incidental take of the bat in hibernacula, 2) result in the incidental take of the bat by altering a known hibernaculum's entrance or interior environment if the alteration impairs an essential behavioral pattern, including sheltering bats, or 3) result in tree-removal activities that incidentally take bats when the activity either occurs within 0.25 mile of a known hibernaculum, or cuts or destroys known occupied maternity roost trees, or any other trees within a 150-foot radius from the maternity roost tree, during the pup season from June 1 through July 31.

Table 2. Bat species, with potential to occur within the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, categorized by echolocation call frequency.

Common Name	Scientific Name
High-Frequency (> 30 kHz)	
eastern red bat[1,2]	*Lasiurus borealis*
little brown bat[1]	*Myotis lucifugus*
northern long-eared bat[1,3]	*Myotis septentrionalis*
Low-Frequency (< 30 kHz)	
big brown bat[1]	*Eptesicus fuscus*
silver-haired bat[1,2]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

Species information from South Dakota Bat Working Group 2004; South Dakota Department of Game, Fish and Parks 2016, 2018; US Fish and Wildlife Service 2017; International Union for Conservation of Nature 2018.

[1.] Species known to have been killed at wind energy facilities (O'Connell and Piorkowski 2006, Kunz et al. 2007b, Hale and Karsten 2010).

[2.] Long-distance migrant.

[3.] Federally threatened species.

METHODS

Bat Acoustic Surveys

Acoustic surveys were completed during the spring (May 10 – May 31), summer (June 1 – August 15), and fall (August 16 – October 22) seasons in 2018. Four AnaBat™ SD2 and SD1

(Titley Scientific™) bat call (pulses) detectors were used during the study. Two detectors were paired at a meteorological (met) tower, with one detector at ground level (ground-based station) approximately 5.0 feet (ft; 1.5 meters m) above the ground, and another within the potential rotor-swept zone for potential collision with a turbine blade (raised station), approximately 148.0 ft (45.1 m) above the ground (Figure 3). These two stations (met tower stations) were located in a flat, open grassland, and were considered representative of potential wind turbines locations.

Two ground-based stations were also deployed at fixed locations near water and forest patch habitat features where bats are more likely to forage and roost (bat feature stations; Figure 3). Ground-based stations likely detected a more complete sample of the bat species present within the Project area, whereas raised units may give a more representative assessment of risk to bat species flying at typical rotor-swept heights (Kunz et al. 2007a, Amorim et al. 2012, Müeller et al. 2013).

Survey Stations

Each AnaBat detector was enclosed within a plastic weather-tight container that had a hole cut in the side through which the microphone extended. Each ground-based microphone was encased in a 45-degree angle poly-vinyl chloride (PVC) tube; holes were drilled in the PVC tube to allow rainwater to drain. The raised AnaBat microphone was elevated on the met tower using a pulley system. Standard Bat-Hat weatherproof housing for the raised microphones (EME Systems) was modified to use a 45-degree angle PVC elbow instead of a reflector plate.

At each of the monitoring heights, the microphone was positioned upwards at or more than a 45-degree angle to the ground and facing away from the predominant wind direction. The microphone had a variable detection distance (approximately 98.4 ft [30.0 m]), which was affected by atmospheric attenuation (changes with humidity, temperature, air pressure, etc.), surrounding vegetation, and wind, in addition to a bat's call frequency, amplitude, and direction.

Survey Schedule

Acoustic monitoring began May 10, 2018, at the ground-based met tower station (DR2g). The raised met tower station (DR2r) was deployed June 16, 2018, and the two ground-based bat feature stations (DR4g and DR5g) were deployed on June 30, 2018. All stations monitored acoustic activity through October 22, 2018. The detectors were programmed to record from approximately 30 minutes (min) before sunset until 30 min after sunrise each night throughout the survey period.

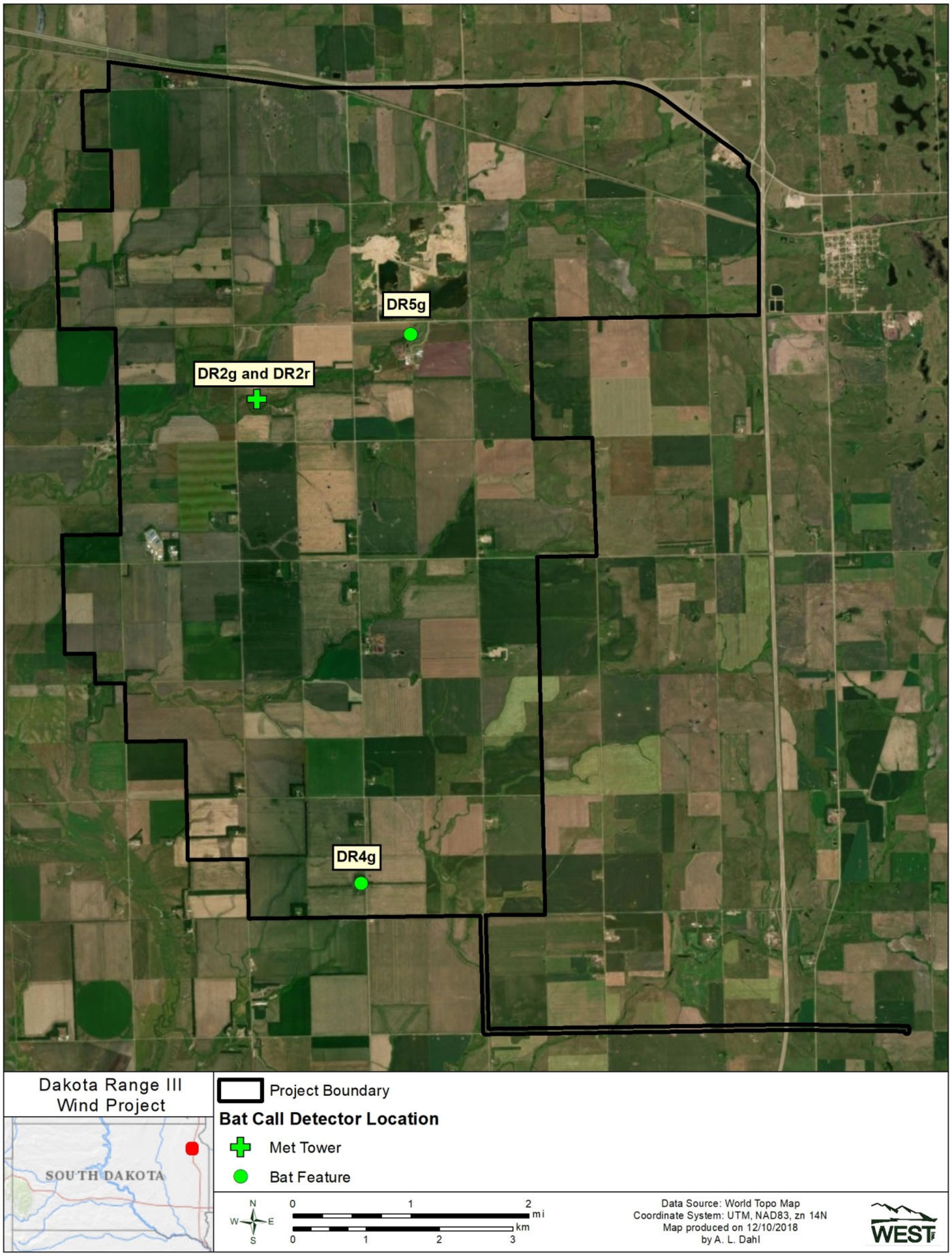


Figure 3. Locations of acoustic bat stations at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota.

Data Collection and Call Analysis

AnaBat detectors use a broadband high-frequency (HF) microphone to detect the echolocation calls of bats during flight for navigation and detection; calls are recorded as ultrasonic data and are referred to as bat calls. Incoming acoustic bat calls are digitally processed and stored on a high-capacity compact flash card.

Data files collected on the compact flash card during this study were uploaded and stored on a server immediately following data collection. The resulting files were viewed in appropriate software (AnalookW ©) as digital sonograms that showed 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, etc.) and to determine the call frequency category and, when possible, the species of bat that generated the calls. When a bat call file contained a sequence of at least two pulses produced by an individual bat with no pause between calls of more than one second, they were defined as a bat pass, the unit of measure for bat activity analysis (White and Gehrt 2001, Gannon et al. 2003).

To standardize acoustic sampling effort across the Project area, AnaBat units were calibrated and sensitivity levels were set to six on all units, 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).

To assess bat activity levels and provide data comparable with previous studies from other sites, bat passes from each station were sorted by an acoustic expert into two groups, based on their minimum frequency, which corresponded roughly to species groups of interest: HF echolocating bats and low-frequency (LF) echolocating bats. For example, most species of *Myotis* bats and eastern red bats (*Lasiurus borealis*) use calls at frequencies greater than 30 kilohertz (kHz; HF bats), whereas species such as the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*), typically use calls at frequencies between 15 and 30 kHz (LF bats; Table 2).

Data Analysis and Risk Assessment

The number of bat passes per detector-night was used as an index of bat activity. A detector-night was defined as one detector operating for one entire night (at least within one hour of sunrise). Bat passes per detector-night were calculated HF bats, LF bats, and overall. Mean bat activity (± standard error; SE) was calculated by detector, by season, and overall. Overall averages were calculated as an unweighted average of total activity at each individual detector. The use of detector-nights as a metric for calculating bat activity, controlled differences in sampling effort among individual detectors and provided unbiased estimates for the deployed nights.

Comparisons were made of mean bat activity during the spring, summer, and fall, to evaluate seasonal variation in bat activity during the study period. In addition, comparisons were made of mean bat activity at the between the met tower stations (i.e., ground-based and raised units at the met tower) and between the ground-based bat feature stations, to evaluate spatial differences in bat activity. Comparisons between the met tower stations and bat feature stations were not made due to bias caused by how the locations were selected.

RESULTS

Bat Acoustic Surveys

AnaBats were operational for a total of 480 detector nights (91.4% of the study period; Figure 4). The met tower stations recorded 648 bat passes over 264 nights for a mean (± SE) of 2.34 ± 0.19 bat passes per detector-night (Table 3). The bat feature stations recorded 3,357 bat passes over 216 nights for a mean (± SE) of 15.90 ± 1.39 bat passes per detector-night (Table 3).

Table 3. Results of acoustic bat surveys conducted at the Dakota Range III Wind Project in Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018.

Station	Location	Station Type	Bat Passes High Frequency	Bat Passes Low Frequency	Bat Passes Total	Detector-Nights	Mean Bat Passes/Night (± Standard Error)[1]
DR2g	ground	met tower	74	408	482	148	3.26 ± 0.29
DR2r	raised	met tower	10	156	166	116	1.43 ± 0.19
DR4g	ground	bat feature	226	964	1,190	115	10.35 ± 1.96
DR5g	ground	bat feature	1,178	989	2,167	101	21.46 ± 1.81
Total Met Tower (Percent [%])			**84 (13.0)**	**564 (87.0)**	**648**	**264**	**2.34±0.19**
Total Bat Feature (%)			**1,404 (41.8)**	**1,953 (58.2)**	**3,357**	**216**	**15.90±1.39**
Total (%)			**1,488 (37.2)**	**2,517 (62.8)**	**4,005**	**480**	**---**

1. ± Bootstrapped standard error.

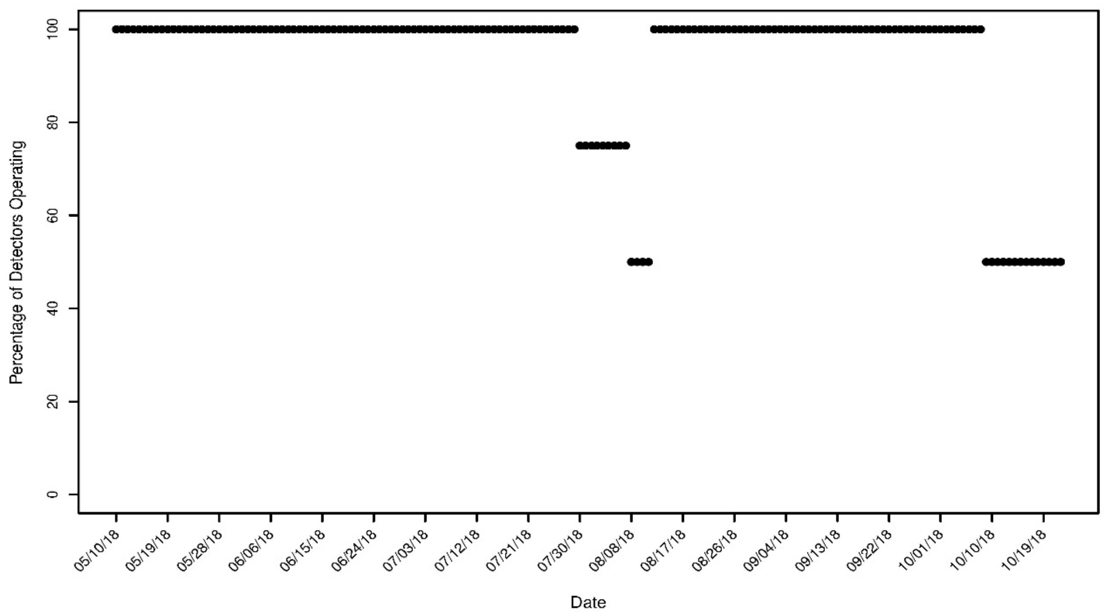


Figure 4. Operational status of the four AnaBat detectors at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018.

Species Composition

At the met tower stations, 13.0% of bat passes were classified as HF (e.g., little brown bat, eastern red bat), and 87.0% of bat passes were classified as LF (e.g., big brown bat, hoary bat, silver-haired bat; Table 3). At the bat feature stations 41.8 % of bat passes were classified as HF and 58.2 % were classified as LF (Table 3).

Spatial Variation

Met Tower Units
Overall activity was higher at the ground-based met tower station compared to the raised met tower station (Table 3, Figure 5). On average during the study period, activity at the ground-based met tower station (3.26 ± 0.29 bat passes per detector-night) was more than double the activity at the raised met tower station (1.43 ± 0.19; Table 3). The paired met tower stations were both operational at the same time for 102 detector-nights; however, the ground station had nearly double the bat activity compared to the raised station (Figure 6). The majority of bat passes recorded at ground-based (84.6%) and at raised (94.0%) detectors were identified as calls by LF bats (Table 3).

Bat Feature Units
At the two bat feature stations the bat activity was higher at station DR5g compared to DR4g (Figure 5). On average during the study period, activity at station DR5g (21.46 ± 1.81) was more than double the activity at station DR4g (10.35 ± 1.96; Table 3). This different in activity was mainly due to the higher number of HF bat passes recorded at DR5g (1,178 bat passes) compared to DR4g (226 bat passes; Table 3).

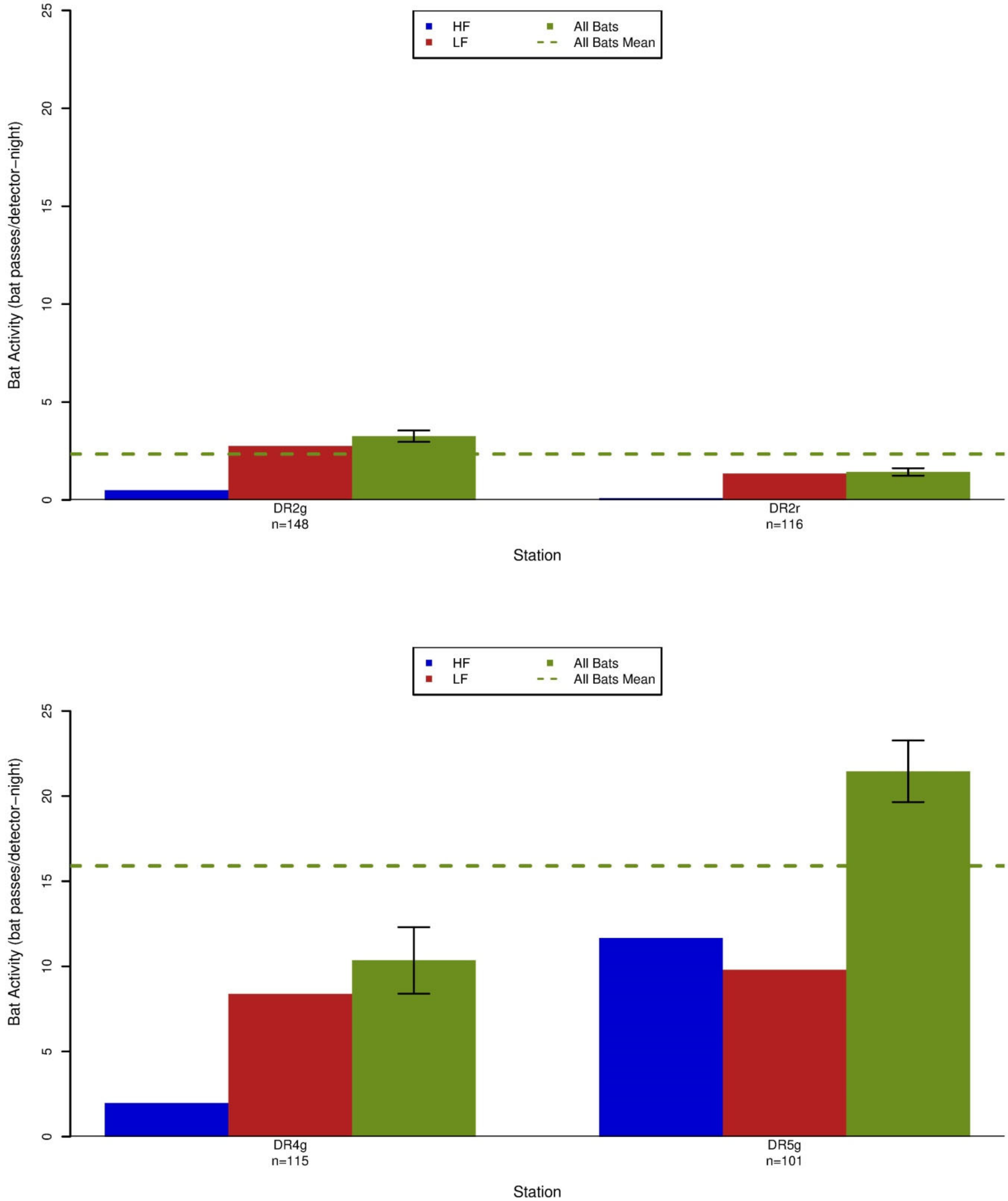


Figure 5. Mean bat activity by high-frequency (HF), low-frequency (LF), and all bats recorded at met tower stations (top) and bat feature stations (bottom) within the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018. The bootstrapped standard errors are represented by the black error bars on the 'All Bats' columns.

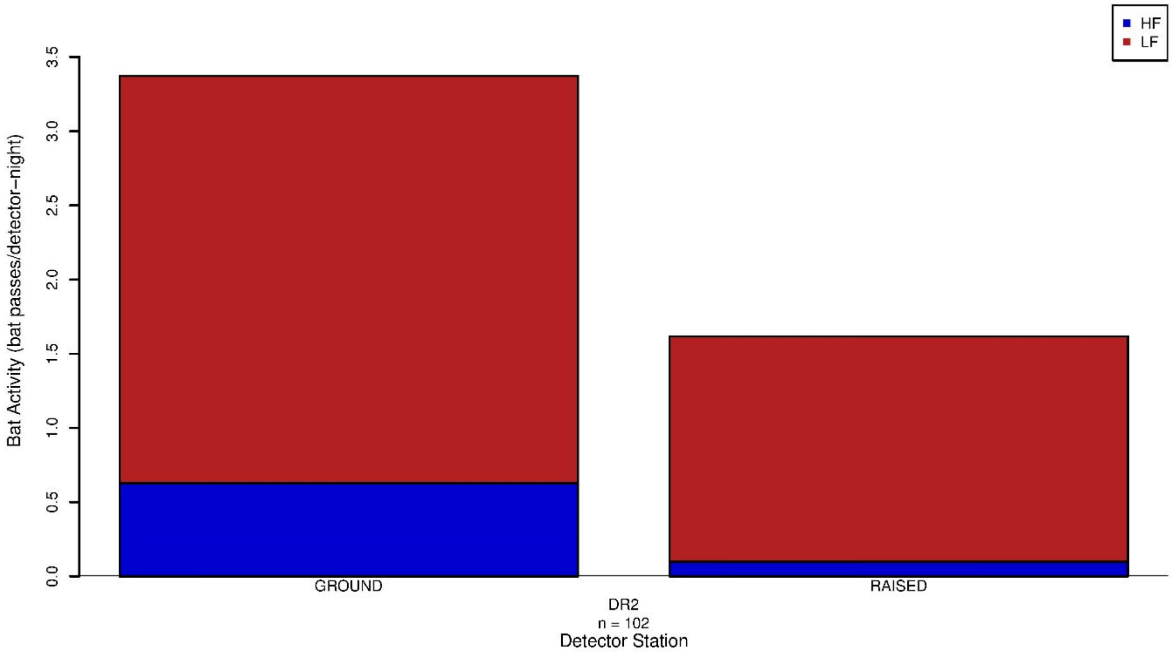


Figure 6. Mean bat activity by high-frequency (HF), low-frequency (LF), and all bats, recorded at the met tower stations when both paired detectors were concurrently operational at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018.

Seasonal Variation

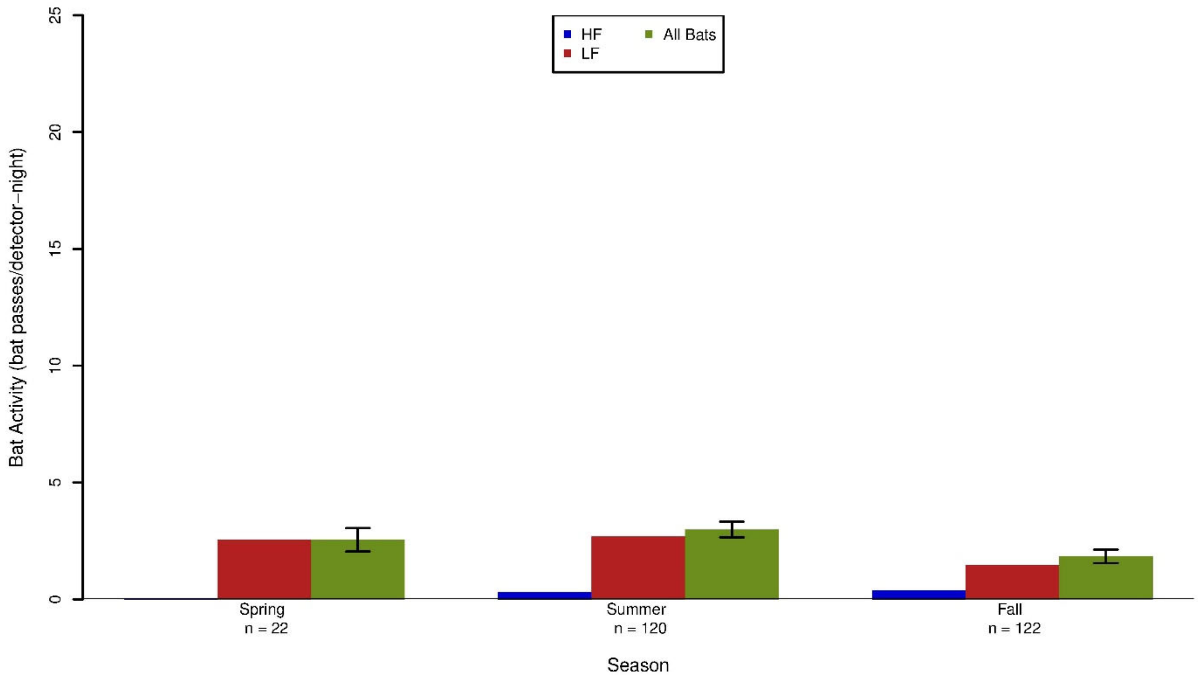
Overall bat activity was higher in the summer at both met tower stations (2.99 ± 0.33 bat passes per detector-night) and bat feature stations (20.16 ± 1.92) compared to the fall (Table 4, Figure 7). Spring bat activity (2.55 ± 0.50) at the met tower stations was similar to the summer (2.99 ± 0.33) but only DR2g was deployed, limiting the number of nights of data collection in the spring (n=22; Figure 7).

Overall bat activity at the met tower stations peaked in early August (8.50 bat passes per detector-night; Table 5, Figure 8). At the bat feature stations, overall bat activity peaked in late August and early September (29.93); however, the LF bat activity peaked in late June and early July (25.79) and HF bat activity peaked in early September (21.57; Table 5, Figure 8).

Table 4. Seasonal bat activity (mean number of bat passes per detector-night) at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018, grouped by call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).

Station	Call Frequency	Season: Spring (May 10 – May 31)	Season: Summer (June 1 – Aug 15)	Season: Fall (Aug 16 – Oct 22)	Season: Fall Migration (July 30 – Oct 14)
DR2g	LF	2.55	3.38	2.02	2.82
	HF	0	0.51	0.69	0.81
	AB	2.55	3.89	2.70	3.63
DR2r	LF	---	2.00	0.88	1.12
	HF	---	0.08	0.09	0.11
	AB	---	2.08	0.97	1.23
DR4g	LF	---	13.21	5.04	4.78
	HF	---	2.70	1.46	1.62
	AB	---	15.91	6.50	6.40
DR5g	LF	---	13.30	6.74	8.55
	HF	---	11.11	12.15	14.01
	AB	---	24.40	18.89	22.56
Met Tower Totals	**LF**	**2.55 ± 0.50**	**2.69 ± 0.28**	**1.45 ± 0.27**	**1.97 ± 0.29**
	HF	**0.00 ± 0.00**	**0.30 ± 0.07**	**0.39 ± 0.07**	**0.46 ± 0.07**
	AB	**2.55 ± 0.50**	**2.99 ± 0.33**	**1.84 ± 0.29**	**2.43 ± 0.33**
Bat Feature Totals	**LF**	---	**13.26 ± 1.86**	**5.89 ± 1.25**	**6.66 ± 1.08**
	HF	---	**6.90 ± 0.91**	**6.80 ± 1.21**	**7.82 ± 1.00**
	AB	---	**20.16 ± 1.92**	**12.69 ± 1.88**	**14.48 ± 1.59**

--- Station not deployed



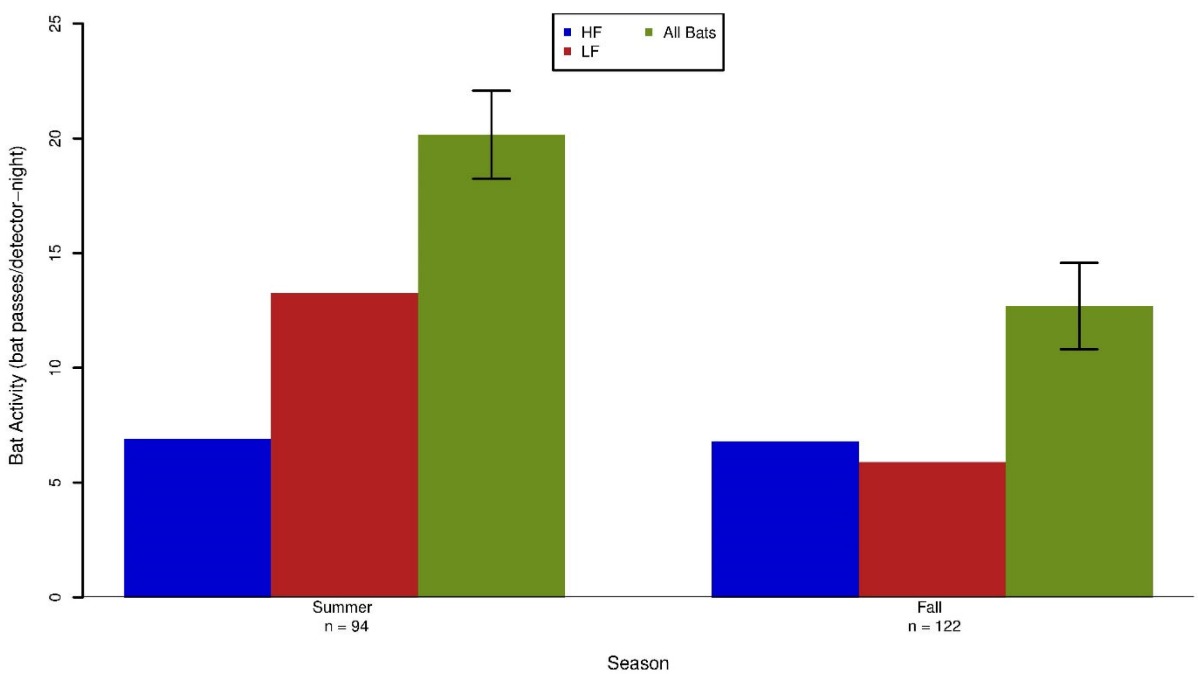


Figure 7. Mean seasonal bat activity, by high-frequency (HF), low-frequency (LF), and all bats,, for the met tower stations (top) and bat feature stations (bottom) at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018. The bootstrapped standard errors are represented on the 'All Bats' columns.

Table 5. Periods of peak activity for high-frequency (HF), low-frequency (LF), and all bats, at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018.

Station Type	Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
Met Tower	LF	Aug 4	Aug 10	7.25
	HF	July 30	Aug 5	1.29
	All Bats	Aug 4	Aug 10	8.50
Bat Feature	LF	June 30	July 6	25.79
	HF	Sept 9	Sept 15	21.57
	All Bats	Aug 26	Sept 1	29.93

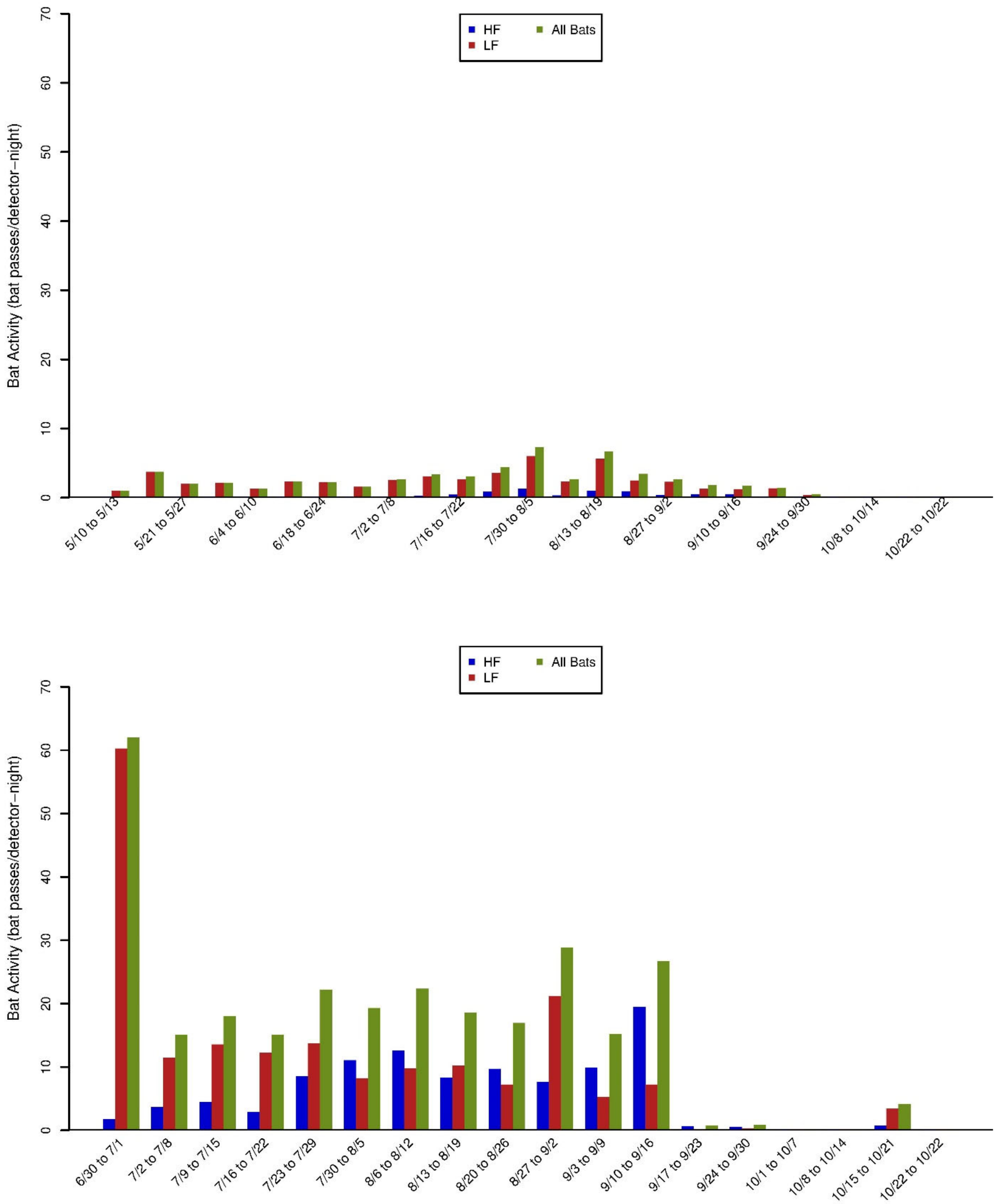


Figure 8. Weekly patterns of bat activity (bat passes/detector-night) by high-frequency (HF), low-frequency (LF), and all bats, at met tower stations (top) and bat feature stations (bottom) at the Dakota Range III Wind Project, Grant and Roberts counties, South Dakota, from May 10 – October 22, 2018.

DISCUSSION AND CONCLUSIONS

The met tower where the two paired detectors were deployed for the Project was located in open grassland habitat representative of areas where turbines are likely to be sited. Open habitat typically results in decreased bat activity relative to habitat near open water, forested, or riparian habitats (bat features) that have the tendency to attract bats for foraging and roosting opportunities (Brooks and Ford 2005).

Overall bat activity was relatively low (2.34 bat passes per detector-night) at the met tower compared to the bat feature stations (15.9), suggesting that risk of operational mortality during normal operations (i.e., without implementation of impact avoidance or reduction measures) may be low at the Project. Bat activity was highest in the summer compared to other seasons, but was not so large a difference as to assume that bat mortality at the Project will not follow similar patterns observed at other regional facilities with similar habitats and bat activity levels (i.e., increased mortality during the Fall Migration Period [July 30 – October 14]). Overall, it is expected that bat risk at the Project will be similar to other local and regional projects. For example, the Buffalo Ridge II Wind Project (Buffalo Ridge II), located approximately 58.0 miles (93.3 kilometers) southeast from the Project, has similar land cover, with rolling topography dominated by grassland and herbaceous vegetation with some open water available (Derby et al. 2012a). Estimated bat fatality rates at wind energy facilities in North America can be found in Appendix A.

The majority of bat passes at the met tower stations were made by LF bats. At the bat feature stations, more HF bats were recorded compared to the met tower stations, but the LF bats still made up a majority of the recorded bat passes at the Project. Given that hoary bats, eastern red bats, and silver-haired bats are among the most common bat fatalities at many facilities (Arnett et al. 2008, Arnett and Baerwald 2013, American Wind Wildlife Institute 2018), it is expected that these three species would be the most common fatalities at the Project.

Most bat fatality studies at wind energy facilities in the US have shown peaks in recorded fatalities in August and September, generally lower mortality earlier in the summer, and very low mortality during the spring (Johnson 2005, Arnett et al. 2008). Based on these data and the data recorded and analyzed during this study, similar patterns may occur during Project operations.

Northern Long-eared Bat

The NLEB is a forest-dependent species that tends to avoid open habitats, generally relying on forest interior habitat features with adequate canopy for both foraging and roosting during the summer months. Abundance of NLEB prey items, particularly beetles and moths, are typically higher in more closed forest stands than in forest openings. Since the project area is primarily agricultural lands and lacks key NLEB forested habitat requirements, it is anticipated that the operation of the project will not pose a significant risk to the NLEB. Presence/probable absence surveys for NLEBs were not conducted at the Project to confirm probable absence, however, there are only 108 acres (Table 1) of forested habitat within the Project indicating minimal potential habitat.

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Appendix A. North American Fatality Summary Tables.

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Dakota Range III, SD (this study)	3.26				
Midwest					
Cedar Ridge, WI (2009)	9.97[C,D,E,F]	7/16/07-9/30/07	30.61	41	67.6
Blue Sky Green Field, WI (2008; 2009)	7.7[F]	7/24/07-10/29/07	24.57	88	145.0
Cedar Ridge, WI (2010)	9.97[C,D,E,F]	7/16/07-9/30/07	24.12	41	68.0
Fowler I, II, III, IN (2011)			20.19	355	600.0
Lakefield Wind, MN (2012)			19.87	137	205.5
Fowler I, II, III, IN (2010)			18.96	355	600.0
Forward Energy Center, WI (2008-2010)	6.97	8/5/08-11/08/08	18.17	86	129.0
Top Crop I & II (2012-2013)			12.55	68 (phase I) 132 (phase (II)	300.0 (102 (phase I) 198 (phase II))
Rail Splitter, IL (2012-2013)			11.21	67	100.5
Harrow, Ont (2010)			11.13	24 (four 6-turb facilities)	39.6
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80.0
Waverly Wind, KS (2016-2017)			8.20	95	199.0
Fowler I, IN (2009)			8.09	162	301.0
Crystal Lake II, IA (2009)			7.42	80	200.0
Top of Iowa, IA (2003)			7.16	89	80.0
Odell, MN (2016-2017)			6.74	100	200.0
Kewaunee County, WI (1999-2001)			6.45	31	20.5
Fowler, IN (2014)			4.86	355	600.0
Ripley, Ont (2008)			4.67	38	76.0
Winnebago, IA (2009-2010)			4.54	10	20.0
Fowler, IN (2016)			4.54	420	750.0
Fowler, IN (2015)			4.54	420	NA
Pioneer Prairie I, IA (Phase II; 2011-2012)			4.43	62	102.3
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2[D]	6/15/01-9/15/01	4.35	143	107.3
Pioneer Prairie II, IA (2013)			3.83	62	102.3
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2[D]	6/15/01-9/15/01	3.71	138	103.5
Crescent Ridge, IL (2005-2006)			3.27	33	49.5
Fowler I, II, III, IN (2012)			2.96	355	600.0
Elm Creek II, MN (2011-2012)			2.81	62	148.8
Buffalo Ridge II, SD (2011-2012)			2.81	105	210.0
Buffalo Ridge, MN (Phase III; 1999)			2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)			2.59	143	107.3
Moraine II, MN (2009)			2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)			2.16	143	107.3
PrairieWinds ND1 (Minot), ND (2010)			2.13	80	115.5
Grand Ridge I, IL (2009-2010)			2.10	66	99.0
Big Blue, MN (2013)			2.04	18	36.0

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Barton I & II, IA (2010-2011)			1.85	80	160.0
Fowler III, IN (2009)			1.84	60	99.0
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9[D]	6/15/02-9/15/02	1.81	138	103.5
Pleasant Valley, MN (2016-2017)			1.80	100	200.0
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9[D]	6/15/02-9/15/02	1.64	143	107.3
Rugby, ND (2010-2011)			1.60	71	149.0
Elm Creek, MN (2009-2010)			1.49	67	100.0
Wessington Springs, SD (2009)			1.48	34	51.0
Big Blue, MN (2014)			1.43	18	36.0
PrairieWinds ND1 (Minot), ND (2011)			1.39	80	115.5
PrairieWinds SD1, SD (2011-2012)			1.23	108	162.0
NPPD Ainsworth, NE (2006)			1.16	36	20.5
PrairieWinds SD1, SD (2012-2013)			1.05	108	162.0
Buffalo Ridge, MN (Phase I; 1999)			0.74	73	25.0
PrairieWinds SD1, SD (2013-2014)			0.52	108	162.0
Prairie Rose, MN (2014)			0.41	119	200.0
Wessington Springs, SD (2010)			0.41	34	51.0
Buffalo Ridge I, SD (2009-2010)			0.16	24	50.4
Southern Plains					
Barton Chapel, TX (2009-2010)			3.06	60	120.0
Big Smile, OK (2012-2013)			2.9	66	132.0
Buffalo Gap II, TX (2007-2008)			0.14	155	233.0
Red Hills, OK (2012-2013)			0.11	82	123.0
Buffalo Gap I, TX (2006)			0.10	67	134.0
Southwest					
Dry Lake I, AZ (2009-2010)	8.8	4/29/10-11/10/10	3.43	30	63.0
Dry Lake II, AZ (2011-2012)	11.5	5/11/11-10/26/11	1.66	31	65.0
California					
Hatchet Ridge, CA (2012)			5.22	44	101.0
Hatchet Ridge, CA (2012-2013)			4.20	44	NA
Shiloh I, CA (2006-2009)			3.92	100	150.0
Shiloh II, CA (2010-2011)			3.80	75	150.0
Shiloh II, CA (2011-2012)			3.40	75	150.0
Shiloh II, CA (2009-2010)			2.60	75	150.0
High Winds, CA (2003-2004)			2.51	90	162.0
Hatchet Ridge, CA (2011)			2.23	44	101.0
Lower West, CA (2012-2013)			2.17	7	14.0
Dillon, CA (2008-2009)			2.17	45	45.0
Montezuma I, CA (2011)			1.90	16	36.8
High Winds, CA (2004-2005)			1.52	90	162.0
Alta Wind I, CA (2011-2012)	4.42[G]	6/26/2009 - 10/31/2009	1.28	100	150.0
Lower West, CA (2014-2015)			1.13	7	14.0
Montezuma II, CA (2012-2013)			0.91	34	78.2
Montezuma I, CA (2012)			0.84	16	36.8
Diablo Winds, CA (2005-2007)			0.82	31	20.5
Alta X, CA (2015-2016)			0.80	48	137.0

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Alta I, CA (2015-2016)			0.70	290	720.0
Alta X, CA (2014-2015)			0.42	48	137.0
Shiloh III, CA (2012-2013)			0.40	50	102.5
Alta I, CA (2013-2014)			0.36	290	720.0
Mustang Hills, CA (2016-2017)			0.33	100	300.0
Solano III, CA (2012-2013)			0.31	55	128.0
Alite, CA (2009-2010)			0.24	8	24.0
Pacific Wind, CA (2014-2015)			0.21	70	144.0
Cameron Ridge/Section 15, CA (2015-2016)			0.19	34	102.0
Pinyon Pines I & II, CA (2015-2016)			0.18	100	300.0
Alta VIII, CA (2014-2015)			0.17	100	300.0
Cameron Ridge/Section 15, CA (2014-2015)			0.15	34	102.0
Mustang Hills, CA (2012-2013)			0.10	50	150.0
Alta Wind II-V, CA (2011-2012)	0.78	6/26/2009 - 10/31/2009	0.08	190	570.0
Pinyon Pines I & II, CA (2013-2014)			0.04	100	NA
Windstar, CA (2012-2013)			0	53	106.0
Lower West, CA (2016-2017)			0	7	14.0
Pacific Wind, CA (2015-2016)			0	70	144.0
Alta VIII, CA (2012-2013)			0	50	150.0
Rising Tree, CA (2017-2018)			0	60	198.0
Mustang Hills, CA (2014-2015)			0	100	300.0
Alta II-V, CA (2013-2014)			0	290	720.0
Alta II-V, CA (2015-2016)			0	290	720.0
Pacific Northwest					
Palouse Wind, WA (2012-2013)			4.23	58	104.4
Biglow Canyon, OR (Phase II; 2009-2010)			2.71	65	150.0
Nine Canyon, WA (2002-2003)			2.47	37	48.1
Stateline, OR/WA (2003)			2.29	454	299.0
Tucannon River, WA (2015)			2.22	116	267.0
Elkhorn, OR (2010)			2.14	61	101.0
White Creek, WA (2007-2011)			2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)			1.99	76	125.4
Leaning Juniper, OR (2006-2008)			1.98	67	100.5
Chopin, OR (2016-2017)			1.90	6	10.0
Big Horn, WA (2006-2007)			1.90	133	199.5
Combine Hills, OR (Phase I; 2004-2005)			1.88	41	41.0
Linden Ranch, WA (2010-2011)			1.68	25	50.0
Pebble Springs, OR (2009-2010)			1.55	47	98.7
Hopkins Ridge, WA (2008)			1.39	87	156.6
Harvest Wind, WA (2010-2012)			1.27	43	98.9
Elkhorn, OR (2008)			1.26	61	101.0
Vansycle, OR (1999)			1.12	38	24.9
Klondike III (Phase I), OR (2007-2009)			1.11	125	223.6
Stateline, OR/WA (2001-2002)			1.09	454	299.0
Stateline, OR/WA (2006)			0.95	454	299.0

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Tuolumne (Windy Point I), WA (2009-2010)			0.94	62	136.6
Klondike, OR (2002-2003)			0.77	16	24.0
Combine Hills, OR (2011)			0.73	104	104.0
Hopkins Ridge, WA (2006)			0.63	83	150.0
Biglow Canyon, OR (Phase I; 2009)			0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)			0.57	65	150.0
Hay Canyon, OR (2009-2010)			0.53	48	100.8
Windy Flats, WA (2010-2011)			0.41	114	262.2
Klondike II, OR (2005-2006)			0.41	50	75.0
Vantage, WA (2010-2011)			0.40	60	90.0
Wild Horse, WA (2007)			0.39	127	229.0
Goodnoe, WA (2009-2010)			0.34	47	94.0
Marengo II, WA (2009-2010)			0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010-2011)			0.22	76	174.8
Marengo I, WA (2009-2010)			0.17	78	140.4
Klondike IIIa (Phase II), OR (2008-2010)			0.14	51	76.5
Kittitas Valley, WA (2011-2012)			0.12	48	100.8
Rocky Mountains					
Summerview, Alb (2006; 2007)	7.65[D]	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)			10.27	39	70.2
Judith Gap, MT (2006-2007)			8.93	90	135.0
Foote Creek Rim I, WY (1999)			3.97	69	41.0
Judith Gap, MT (2009)			3.20	90	135.0
Top of the World, WY (2010-2011)			2.74	110	200.0
Top of the World, WY (2011-2012)			2.43	110	200.0
Top of the World, WY (2012-2013)			2.34	110	200.0
Milford I, UT (2010-2011)			2.05	58	145.0
Milford I & II, UT (2011-2012)			1.67	107	160.5 (58.5 I, 102 II)
Foote Creek Rim I, WY (2001-2002)			1.57	69	41.0
Foote Creek Rim I, WY (2000)			1.05	69	41.0
Southeast					
Buffalo Mountain, TN (2005)			39.70	18	28.9
Buffalo Mountain, TN (2000-2003)	23.7[E]		31.54	3	1.9
Northeast					
Pinnacle, WV (2012)			40.20	23	55.2
Mountaineer, WV (2003)			31.69	44	66.0
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	17.53	132	264.0
Noble Wethersfield, NY (2010)			16.30	84	126.0
Criterion, MD (2011)			15.61	28	70.0
Mount Storm, WV (2010)	36.67[H]	4/18/10-10/15/10	15.18	132	264.0
Locust Ridge, PA (Phase II; 2010)			14.38	51	102.0
Locust Ridge, PA (Phase II; 2009)			14.11	51	102.0
Casselman, PA (2008)			12.61	23	34.5

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Maple Ridge, NY (2006)			11.21	120	198.0
Cohocton/Dutch Hills, NY (2010)			10.32	50	125.0
Howard, NY (2012)			10.00	27	54.0
Wolfe Island, Ont (July-December 2010)			9.50	86	197.8
Cohocton/Dutch Hill, NY (2009)			8.62	50	125.0
Casselman, PA (2009)			8.60	23	34.5
Noble Bliss, NY (2008)			7.80	67	100.0
Criterion, MD (2012)			7.62	28	70.0
Mount Storm, WV (2011)			7.43	132	264.0
Maple Ridge, NY (2012)			7.30	195	321.8
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164.0
Maple Ridge, NY (2007)			6.49	195	321.8
Wolfe Island, Ont (July-December 2009)			6.42	86	197.8
Roth Rock, MD (2011)			6.24	20	50.0
Steel Winds I & II, NY (2013)			6.14	14	35.0
Criterion, MD (2013)			5.32	28	70.0
Maple Ridge, NY (2007-2008)			4.96	195	321.75
Noble Clinton, NY (2009)	1.9[C]	8/1/09-09/31/09	4.50	67	100.0
Casselman Curtailment, PA (2008)			4.40	23	35.4
Noble Altona, NY (2010)			4.34	65	97.5
Noble Ellenburg, NY (2009)	16.1[C]	8/16/09-09/15/09	3.91	54	80.0
Noble Bliss, NY (2009)			3.85	67	100.0
Lempster, NH (2010)			3.57	12	24.0
Noble Ellenburg, NY (2008)			3.46	54	80.0
Noble Clinton, NY (2008)	2.1[C]	8/8/08-09/31/08	3.14	67	100.0
Lempster, NH (2009)			3.11	12	24.0
Record Hill, ME (2012)	24.6	4/16/12-10/23/12	2.96	22	50.6
Mars Hill, ME (2007)			2.91	28	42.0
Wolfe Island, Ont (July-December 2011)			2.49	86	197.8
Noble Chateaugay, NY (2010)			2.44	71	106.5
High Sheldon, NY (2010)			2.33	75	112.5
Stetson Mountain II, ME (2012)			2.27	17	25.5
Howard, NY (2013)			2.13	27	54.0
Beech Ridge, WV (2012)			2.03	67	100.5
Munnsville, NY (2008)			1.93	23	34.5
High Sheldon, NY (2011)			1.78	75	112.5
Groton, NH (2015)			1.74	24	48.0
Stetson Mountain II, ME (2010)			1.65	17	25.5
Groton, NH (2014)			1.63	NA	48.0
Bull Hill, ME (2013)			1.62	19	34.0
Stetson Mountain I, ME (2009)	28.5; 0.3[I]	7/10/09-10/15/09	1.40	38	57.0
Cohocton/Dutch Hill, NY (2013)			1.37	50	125.0
Groton, NH (2013)			1.31	24	48.0
Record Hill, ME (2016)			1.25	22	51.0
Stetson II, ME (2014)			0.83	17	26.0
Beech Ridge, WV (2013)			0.58	67	100.5
Record Hill, ME (2014)			0.55	22	50.6
Oakfield, ME (2017)			0.51	48	148.0

Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Mars Hill, ME (2008)			0.45	28	42.0
Rollins, ME (2014)			0.33	40	60.0
Spruce Mountain Wind Project, ME (2014)			0.31	10	20.0
Hancock, ME (2017)			0.30	17	51.0
Stetson Mountain I, ME (2011)			0.28	38	57.0
Bingham Wind Project, ME (2017)			0.23	56	185.0
Stetson Mountain I, ME (2013)			0.18	38	57.0
Rollins, ME (2012)			0.18	40	60.0
Kibby, ME (2011)			0.12	44	132.0

A = Bat passes per detector-night

B = Number of fatalities per megawatt per year

C = Activity rate based on data collected at various heights all other activity rates are from ground-based units only

D = Activity rate was averaged across phases and/or years

E = Activity rate calculated by WEST from data presented in referenced report

F = Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently

G = Average of ground-based detectors at CPC Proper (Phase I) for late summer/fall period only

H = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer and fall seasons

I = The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility Study	Activity Estimate Citation	Fatality Estimate Citation	Facility Study	Activity Estimate Citation	Fatality Estimate Citation
Dakota Range III, SD		This study.			
Alite, CA (2009-2010)		Chatfield et al. 2010	Linden Ranch, WA (2010-2011)		Enz and Bay 2011
Alta Wind I, CA (2011-2012)	Solick et al. 2010	Chatfield et al. 2012	Locust Ridge, PA (Phase II; 2009)		Arnett et al. 2011
Alta Wind I, CA (2013-2014)		Chatfield et al. 2014	Locust Ridge, PA (Phase II; 2010)		Arnett et al. 2011
Alta I, CA (2015-2016)		Thompson et al. 2016a	Lower West, CA (2012-2013)		Levenstein and Bay 2013a
Alta Wind II-V, CA (2011-2012)	Solick et al. 2010	Chatfield et al. 2012	Lower West, CA (2014-2015)		Levenstein and DiDonato 2015
Alta II-V, CA (2013-2014)		Chatfield et al. 2014	Lower West, CA (2016-2017)		WEST 2017b
Alta II-V, CA (2015-2016)		Thompson et al. 2016a	Maple Ridge, NY (2006)		Jain et al. 2007
Alta VIII, CA (2012-2013)		Chatfield and Bay 2014	Maple Ridge, NY (2007)		Jain et al. 2009a
Alta VIII, CA (2014-2015)		Western EcoSystems Technology, Inc. (WEST) 2016c	Maple Ridge, NY (2007-2008)		Jain et al. 2009b
Alta X, CA (2014-2015)		Chatfield et al. 2015	Maple Ridge, NY (2012)		Tidhar et al. 2013b
Alta X, CA (2015-2016)		Thompson et al. 2016b	Marengo I, WA (2009-2010)		URS 2010b
Barton I & II, IA (2010-2011)		Derby et al. 2011b	Marengo II, WA (2009-2010)		URS 2010c
Barton Chapel, TX (2009-2010)		WEST 2011	Mars Hill, ME (2007)		Stantec 2008a
Beech Ridge, WV (2012)		Tidhar et al. 2013a	Mars Hill, ME (2008)		Stantec 2009a
Beech Ridge, WV (2013)		Young et al. 2014a	Milford I, UT (2010-2011)		Stantec 2011b
Big Blue, MN (2013)		Fagen Engineering 2014	Milford I & II, UT (2011-2012)		Stantec 2012b
Big Blue, MN (2014)		Fagen Engineering 2015	Montezuma I, CA (2011)		ICF International 2012
Big Horn, WA (2006-2007)		Kronner et al. 2008	Montezuma I, CA (2012)		ICF International 2013
Big Smile, OK (2012-2013)		Derby et al. 2013b	Montezuma II, CA (2012-2013)		Harvey & Associates 2013
Biglow Canyon, OR (Phase I; 2008)		Jeffrey et al. 2009b	Moraine II, MN (2009)		Derby et al. 2010f
Biglow Canyon, OR (Phase I; 2009)		Enk et al. 2010	Mount Storm, WV (Fall 2008)	Young et al. 2009c	Young et al. 2009c
Biglow Canyon, OR (Phase II; 2009-2010)		Enk et al. 2011b	Mount Storm, WV (2009)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Biglow Canyon, OR (Phase II; 2010-2011)		Enk et al. 2012b	Mount Storm, WV (2010)	Young et al. 2010a, 2011b	Young et al. 2010a, 2011b
Biglow Canyon, OR (Phase III; 2010-2011)		Enk et al. 2012a	Mount Storm, WV (2011)		Young et al. 2011a, 2012a
Bingham Wind Project, ME (2017)		TRC 2017a	Mountaineer, WV (2003)		Kerns and Kerlinger 2004

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility Study	Activity Estimate Citation	Fatality Estimate Citation	Facility Study	Activity Estimate Citation	Fatality Estimate Citation
Blue Sky Green Field, WI (2008; 2009)	Gruver 2008	Gruver et al. 2009	Munnsville, NY (2008)		Stantec 2009b
Buffalo Gap I, TX (2006)		Tierney 2007			
Buffalo Gap II, TX (2007-2008)		Tierney 2009	Mustang Hills, CA (2012-2013)		Chatfield and Bay 2014
Buffalo Mountain, TN (2000-2003)	Fiedler 2004	Nicholson et al. 2005	Mustang Hills, CA (2014-2015)		WEST 2016c
Buffalo Mountain, TN (2005)		Fiedler et al. 2007	Mustang Hills, CA (2016-2017)		WEST 2018
Buffalo Ridge, MN (Phase I; 1999)		Johnson et al. 2000	Nine Canyon, WA (2002-2003)		Erickson et al. 2003
Buffalo Ridge, MN (Phase II; 1998)		Johnson et al. 2000	Noble Altona, NY (2010)		Jain et al. 2011a
Buffalo Ridge, MN (Phase II; 1999)		Johnson et al. 2000	Noble Bliss, NY (2008)		Jain et al.2009c
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Noble Bliss, NY (2009)		Jain et al. 2010c
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Noble Chateaugay, NY (2010)		Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 1999)		Johnson et al. 2000	Noble Clinton, NY (2008)	Reynolds 2010a	Jain et al. 2009d
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Noble Clinton, NY (2009)	Reynolds 2010a	Jain et al. 2010a
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Noble Ellenburg, NY (2008)		Jain et al. 2009e
Buffalo Ridge I, SD (2009-2010)		Derby et al. 2010d	Noble Ellenburg, NY (2009)	Reynolds 2010b	Jain et al. 2010b
Buffalo Ridge II, SD (2011-2012)		Derby et al. 2012a	Noble Wethersfield, NY (2010)		Jain et al. 2011c
Bull Hill, ME (2013)		Stantec Consulting (Stantec) 2014a	NPPD Ainsworth, NE (2006)		Derby et al. 2007
Cameron Ridge/Section 15, CA (2014-2015)		WEST 2016b	Oakfield, ME (2017)		TRC 2018
Cameron Ridge/Section 15, CA (2015-2016)		Rintz and Thompson 2017	Odell, MN (2016-2017)		Chodachek and Gustafson 2018
Casselman, PA (2008)		Arnett et al. 2009b	Pacific Wind, CA (2014-2015)		WEST 2016a
Casselman, PA (2009)		Arnett et al. 2010	Pacific Wind, CA (2015-2016)		WEST 2017a
Casselman Curtailment, PA (2008)		Arnett et al. 2009a	Palouse Wind, WA (2012-2013)		Stantec 2013a
Cedar Ridge, WI (2009)	BHE Environmental 2008	BHE Environmental 2010	Pebble Springs, OR (2009-2010)		Gritski and Kronner 2010b
Cedar Ridge, WI (2010)	BHE Environmental 2008	BHE Environmental 2011	Pinnacle, WV (2012)		Hein et al. 2013
Chopin, OR (2016-2017)		Hallingstad and Riser-Espinoza 2017	Pinyon Pines I & II, CA (2013-2014)		Chatfield and Russo 2014

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility Study	Activity Estimate Citation	Fatality Estimate Citation	Facility Study	Activity Estimate Citation	Fatality Estimate Citation
Cohocton/Dutch Hill, NY (2009)		Stantec 2010	Pinyon Pines I & II, CA (2015-2016)		Rintz and Starcevich 2016
Cohocton/Dutch Hills, NY (2010)		Stantec 2011a	Pioneer Prairie I, IA (Phase II; 2011-2012)		Chodachek et al. 2012
Cohocton/Dutch Hill, NY (2013)		Stantec 2014b	Pioneer Prairie II, IA (2013)		Chodachek et al. 2014
Combine Hills, OR (Phase I; 2004-2005)		Young et al. 2006	Pleasant Valley, MN (2016-2017)		Tetra Tech 2017b
Combine Hills, OR (2011)		Enz et al. 2012	Prairie Rose, MN (2014)		Chodachek et al. 2015
Crescent Ridge, IL (2005-2006)		Kerlinger et al. 2007	PrairieWinds ND1 (Minot), ND (2010)		Derby et al. 2011d
Criterion, MD (2011)		Young et al. 2012b	PrairieWinds ND1 (Minot), ND (2011)		Derby et al. 2012d
Criterion, MD (2012)		Young et al. 2013	PrairieWinds SD1, SD (2011-2012)		Derby et al. 2012c
Criterion, MD (2013)		Young et al. 2014b	PrairieWinds SD1, SD (2012-2013)		Derby et al. 2013a
Crystal Lake II, IA (2009)		Derby et al. 2010b	PrairieWinds SD1, SD (2013-2014)		Derby et al. 2014
Diablo Winds, CA (2005-2007)		WEST 2006, 2008	Rail Splitter, IL (2012-2013)		Good et al. 2013b
Dillon, CA (2008-2009)		Chatfield et al. 2009	Record Hill, ME (2012)	Stantec 2008b	Stantec 2013b
Dry Lake I, AZ (2009-2010)	Thompson et al. 2011	Thompson et al. 2011	Record Hill, ME (2014)		Stantec 2015a
Dry Lake II, AZ (2011-2012)	Thompson and Bay 2012	Thompson and Bay 2012	Record Hill, ME (2016)		Stantec 2017
Elkhorn, OR (2008)		Jeffrey et a. 2009a	Red Hills, OK (2012-2013)		Derby et al. 2013c
Elkhorn, OR (2010)		Enk et al. 2011a	Ripley, Ont (2008)		Jacques Whitford 2009
Elm Creek, MN (2009-2010)		Derby et al. 2010e	Rising Tree, CA (2017-2018)		Chatfield et al. 2018
Elm Creek II, MN (2011-2012)		Derby et al. 2012b	Rollins, ME (2012)		Stantec 2013c
Foote Creek Rim I, WY (1999)		Young et al. 2003	Rollins, ME (2014)		Stantec 2015b
Foote Creek Rim I, WY (2000)	Gruver 2002	Young et al. 2003	Roth Rock, MD (2011)		Atwell, LLC 2012
Foote Creek Rim I, WY (2001-2002)	Gruver 2002	Young et al. 2003	Rugby, ND (2010-2011)		Derby et al. 2011c
Forward Energy Center, WI (2008-2010)	Watt and Drake 2011	Grodsky and Drake 2011	Shiloh I, CA (2006-2009)		Kerlinger et al. 2009
Fowler I, IN (2009)		Johnson et al. 2010a	Shiloh II, CA (2009-2010)		Kerlinger et al. 2010, 2013a
Fowler I, II, III, IN (2010)		Good et al. 2011	Shiloh II, CA (2010-2011)		Kerlinger et al. 2013a
Fowler I, II, III, IN (2011)		Good et al. 2012	Shiloh II, CA (2011-2012)		Kerlinger et al. 2013a
Fowler I, II, III, IN (2012)		Good et al. 2013a	Shiloh III, CA (2012-2013)		Kerlinger et al. 2013b
Fowler III, IN (2009)		Johnson et al. 2010b	Solano III, CA (2012-2013)		AECOM 2013

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility Study	Activity Estimate Citation	Fatality Estimate Citation	Facility Study	Activity Estimate Citation	Fatality Estimate Citation
Fowler, IN (2014)		Good et al. 2015	Spring Valley, NV (2012-2013)		WEST 2014
Fowler, IN (2015)		Good et al. 2016	Spruce Mountain Wind Project, ME (2014)		Tetra Tech 2015
Fowler, IN (2016)		Good et al. 2017	Stateline, OR/WA (2001-2002)		Erickson et al. 2004
Goodnoe, WA (2009-2010)		URS Corporation (URS) 2010a	Stateline, OR/WA (2003)		Erickson et al. 2004
Grand Ridge I, IL (2009-2010)		Derby et al. 2010a	Stateline, OR/WA (2006)		Erickson et al. 2007
Groton, NH (2013)		Stantec and WEST 2014	Steel Winds I & II, NY (2013)		Stantec 2014c
Groton, NH (2014)		Stantec and WEST 2015a	Stetson II, ME (2014)		Stantec 2015c
Groton, NH (2015)		Stantec and WEST 2015b	Stetson Mountain I, ME (2009)	Stantec 2009c	Stantec 2009c
Hancock, ME (2017)		TRC 2017b	Stetson Mountain I, ME (2011)		Normandeau Associates 2011
Harrow, Ont (2010)		Natural Resources Solutions Inc. (NRSI) 2011	Stetson Mountain I, ME (2013)		Stantec 2014d
Harvest Wind, WA (2010-2012)		Downes and Gritski 2012a	Stetson Mountain II, ME (2010)		Normandeau Associates 2010
Hatchet Ridge, CA (2011)		Tetra Tech 2013	Stetson Mountain II, ME (2012)		Stantec 2013d
Hatchet Ridge, CA (2012)		Tetra Tech 2013	Summerview, Alb (2005-2006)		Brown and Hamilton 2006
Hatchet Ridge, CA (2012-2013)		Tetra Tech 2014	Summerview, Alb (2006; 2007)	Baerwald 2008	Baerwald 2008
Hay Canyon, OR (2009-2010)		Gritski and Kronner 2010a	Top Crop I & II, IL (2012-2013)		Good et al. 2013c
High Sheldon, NY (2010)		Tidhar et al. 2012a	Top of Iowa, IA (2003)		Jain 2005
High Sheldon, NY (2011)		Tidhar et al. 2012b	Top of Iowa, IA (2004)	Jain 2005	Jain 2005
High Winds, CA (2003-2004)		Kerlinger et al. 2006	Top of the World, WY (2010-2011)		Rintz and Bay 2012
High Winds, CA (2004-2005)		Kerlinger et al. 2006	Top of the World, WY (2011-2012)		Rintz and Bay 2013
Hopkins Ridge, WA (2006)		Young et al. 2007	Top of the World, WY (2012-2013)		Rintz and Bay 2014
Hopkins Ridge, WA (2008)		Young et al. 2009b	Tucannon River, WA (2015)		Hallingstad et al. 2016
Howard, NY (2012)		Tidhar et al. 2013c	Tuolumne (Windy Point I), WA (2009-2010)		Enz and Bay 2010
Howard, NY (2013)		Lukins et al. 2014	Vansycle, OR (1999)		Erickson et al. 2000
Judith Gap, MT (2006-2007)		TRC Environmental Corporation 2008	Vantage, WA (2010-2011)		Ventus Environmental Solutions 2012
Judith Gap, MT (2009)		Poulton and Erickson 2010	Waverly Wind, KS (2016-2017)		Tetra Tech 2017a

Appendix A1 (*continued*). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility Study	Activity Estimate Citation	Fatality Estimate Citation	Facility Study	Activity Estimate Citation	Fatality Estimate Citation
Kewaunee County, WI (1999-2001)		Howe et al. 2002	Wessington Springs, SD (2009)		Derby et al. 2010c
Kibby, ME (2011)		Stantec 2012a	Wessington Springs, SD (2010)		Derby et al. 2011a
Kittitas Valley, WA (2011-2012)		Stantec Consulting Services 2012	White Creek, WA (2007-2011)		Downes and Gritski 2012b
Klondike, OR (2002-2003)		Johnson et al. 2003	Wild Horse, WA (2007)		Erickson et al. 2008
Klondike II, OR (2005-2006)		Northwest Wildlife Consultants (NWC) and WEST 2007	Windstar, CA (2012-2013)		Levenstein and Bay 2013b
Klondike III (Phase I), OR (2007-2009)		Gritski et al. 2010	Windy Flats, WA (2010-2011)		Enz et al. 2011
Klondike IIIa (Phase II), OR (2008-2010)		Gritski et al. 2011	Winnebago, IA (2009-2010)		Derby et al. 2010g
Lakefield Wind, MN (2012)		Minnesota Public Utilities Commission 2012	Wolfe Island, Ont (July-December 2009)		Stantec Ltd. 2010
Leaning Juniper, OR (2006-2008)		Gritski et al. 2008	Wolfe Island, Ont (July-December 2010)		Stantec Ltd. 2011
Lempster, NH (2009)		Tidhar et al. 2010	Wolfe Island, Ont (July-December 2011)		Stantec Ltd. 2012
Lempster, NH (2010)		Tidhar et al. 2011			

Appendix A2. Bat fatality estimates (bats/megawatt/year) for studies at North American wind-energy facilities.

Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Alite, CA (2009-2010)	0.24	Shrub/scrub & grassland	Chatfield et al. 2010
Alta I, CA (2011-2012)	1.28	Woodland, grassland, shrubland	Chatfield et al. 2012
Alta I, CA (2013-2014)	0.36	NA	Chatfield et al. 2014
Alta I, CA (2015-2016)	0.7	NA	Thompson et al. 2016a
Alta II-V, CA (2011-2012)	0.08	Desert scrub	Chatfield et al. 2012
Alta II-V, CA (2013-2014)	0	NA	Chatfield et al. 2014
Alta II-V, CA (2015-2016)	0	NA	Thompson et al. 2016a
Alta VIII, CA (2012-2013)	0	Grassland and riparian	Chatfield and Bay 2014
Alta VIII, CA (2014-2015)	0.17	NA	Western EcoSystems Technology, Inc. (WEST) 2016c
Alta X, CA (2014-2015)	0.42	NA	Chatfield et al. 2015
Alta X, CA (2015-2016)	0.8	Desert scrub	Thompson et al. 2016b
Barton I & II, IA (2010-2011)	1.85	Agriculture	Derby et al. 2011b
Barton Chapel, TX (2009-2010)	3.06	Agriculture/forest	WEST 2011
Beech Ridge, WV (2012)	2.03	Forest	Tidhar et al. 2013a
Beech Ridge, WV (2013)	0.58	Forest	Young et al. 2014a
Big Blue, MN (2013)	2.04	Agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	1.43	Agriculture	Fagen Engineering 2015
Big Horn, WA (2006-2007)	1.9	Agriculture/grassland	Kronner et al. 2008
Big Smile, OK (2012-2013)	2.9	Grassland, agriculture	Derby et al. 2013b
Biglow Canyon, OR (Phase I; 2008)	1.99	Agriculture/grassland	Jeffrey et al. 2009b
Biglow Canyon, OR (Phase I; 2009)	0.58	Agriculture/grassland	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	2.71	Agriculture	Enk et al. 2011b
Biglow Canyon, OR (Phase II; 2010-2011)	0.57	Grassland/shrub-steppe, agriculture	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 2010-2011)	0.22	Grassland/shrub-steppe, agriculture	Enk et al. 2012a
Bingham Wind Project, ME (2017)	0.23	NA	TRC 2017a
Blue Sky Green Field, WI (2008; 2009)	24.57	Agriculture	Gruver et al. 2009
Buffalo Gap I, TX (2006)	0.1	Grassland	Tierney 2007
Buffalo Gap II, TX (2007-2008)	0.14	Forest	Tierney 2009
Buffalo Mountain, TN (2000-2003)	31.54	Forest	Nicholson et al. 2005
Buffalo Mountain, TN (2005)	39.7	Forest	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 1999)	0.74	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 1998)	2.16	Agriculture	Johnson et al. 2000

Appendix A2. Bat fatality estimates (bats/megawatt/year) for studies at North American wind-energy facilities.

Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Buffalo Ridge, MN (Phase II; 1999)	2.59	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	4.35	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.64	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	2.72	Agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	3.71	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.81	Agriculture	Johnson et al. 2004
Buffalo Ridge I, SD (2009-2010)	0.16	Agriculture/grassland	Derby et al. 2010d
Buffalo Ridge II, SD (2011-2012)	2.81	Agriculture, grassland	Derby et al. 2012a
Bull Hill, ME (2013)	1.62	Forest	Stantec Consulting (Stantec) 2014a
Cameron Ridge/Section 15, CA (2014-2015)	0.15	NA	WEST 2016b
Cameron Ridge/Section 15, CA (2015-2016)	0.19	NA	Rintz and Thompson 2017
Casselman, PA (2008)	12.61	Forest	Arnett et al. 2009b
Casselman, PA (2009)	8.6	Forest, pasture, grassland	Arnett et al. 2010
Casselman Curtailment, PA (2008)	4.4	Forest	Arnett et al. 2009a
Cedar Ridge, WI (2009)	30.61	Agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	24.12	Agriculture	BHE Environmental 2011
Chopin, OR (2016-2017)	1.9	Agriculture	Hallingstad and Riser-Espinoza 2017
Cohocton/Dutch Hill, NY (2009)	8.62	Agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	10.32	Agriculture/forest	Stantec 2011a
Cohocton/Dutch Hill, NY (2013)	1.37	Agriculture, forest	Stantec 2014b
Combine Hills, OR (Phase I; 2004-2005)	1.88	Agriculture/grassland	Young et al. 2006
Combine Hills, OR (2011)	0.73	Grassland/shrub-steppe, agriculture	Enz et al. 2012
Crescent Ridge, IL (2005-2006)	3.27	Agriculture	Kerlinger et al. 2007
Criterion, MD (2011)	15.61	Forest, agriculture	Young et al. 2012b
Criterion, MD (2012)	7.62	Forest, agriculture	Young et al. 2013
Criterion, MD (2013)	5.32	Forest, agriculture	Young et al. 2014b
Crystal Lake II, IA (2009)	7.42	Agriculture	Derby et al. 2010b
Diablo Winds, CA (2005-2007)	0.82	NA	WEST 2006, 2008
Dillon, CA (2008-2009)	2.17	Desert	Chatfield et al. 2009

Appendix A2. Bat fatality estimates (bats/megawatt/year) for studies at North American wind-energy facilities.

Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Dry Lake I, AZ (2009-2010)	3.43	Desert grassland/forested	Thompson et al. 2011
Dry Lake II, AZ (2011-2012)	1.66	Desert grassland/forested	Thompson and Bay 2012
Elkhorn, OR (2008)	1.26	Shrub/scrub & agriculture	Jeffrey et a. 2009a
Elkhorn, OR (2010)	2.14	Shrub/scrub & agriculture	Enk et al. 2011a
Elm Creek, MN (2009-2010)	1.49	Agriculture	Derby et al. 2010e
Elm Creek II, MN (2011-2012)	2.81	Agriculture, grassland	Derby et al. 2012b
Foote Creek Rim I, WY (1999)	3.97	Grassland	Young et al. 2003
Foote Creek Rim I, WY (2000)	1.05	Grassland	Young et al. 2003
Foote Creek Rim I, WY (2001-2002)	1.57	Grassland	Young et al. 2003
Forward Energy Center, WI (2008-2010)	18.17	Agriculture	Grodsky and Drake 2011
Fowler I, IN (2009)	8.09	Agriculture	Johnson et al. 2010a
Fowler I, II, III, IN (2010)	18.96	Agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	20.19	Agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	2.96	Agriculture	Good et al. 2013a
Fowler III, IN (2009)	1.84	Agriculture	Johnson et al. 2010b
Fowler, IN (2014)	4.86	Agriculture	Good et al. 2015
Fowler, IN (2015)	4.54	Agriculture	Good et al. 2016
Fowler, IN (2016)	4.54	Agriculture	Good et al. 2017
Goodnoe, WA (2009-2010)	0.34	Grassland and shrub-steppe	URS Corporation (URS) 2010a
Grand Ridge I, IL (2009-2010)	2.1	Agriculture	Derby et al. 2010a
Groton, NH (2013)	1.31	Foothills, forest	Stantec and WEST 2014
Groton, NH (2014)	1.63	Foothills, forest	Stantec and WEST 2015a
Groton, NH (2015)	1.74	Foothills, forest	Stantec and WEST 2015b
Hancock, ME (2017)	0.3	Gravel, grassland	TRC 2017b
Harrow, Ont (2010)	11.13	Agriculture	Natural Resources Solutions Inc. 2011
Harvest Wind, WA (2010-2012)	1.27	Grassland/shrub-steppe	Downes and Gritski 2012a
Hatchet Ridge, CA (2011)	2.23	NA	Tetra Tech 2013
Hatchet Ridge, CA (2012)	5.22	NA	Tetra Tech 2013
Hatchet Ridge, CA (2012-2013)	4.2	NA	Tetra Tech 2014
Hay Canyon, OR (2009-2010)	0.53	Agriculture	Gritski and Kronner 2010a
High Sheldon, NY (2010)	2.33	Agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	1.78	Agriculture	Tidhar et al. 2012b
High Winds, CA (2003-2004)	2.51	Agriculture/grassland	Kerlinger et al. 2006

Appendix A2. Bat fatality estimates (bats/megawatt/year) for studies at North American wind-energy facilities.

Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
High Winds, CA (2004-2005)	1.52	Agriculture/grassland	Kerlinger et al. 2006
Hopkins Ridge, WA (2006)	0.63	Agriculture/grassland	Young et al. 2007
Hopkins Ridge, WA (2008)	1.39	Agriculture/grassland	Young et al. 2009b
Howard, NY (2012)	10	Agriculture	Tidhar et al. 2013c
Howard, NY (2013)	2.13	Agriculture	Lukins et al. 2014
Judith Gap, MT (2006-2007)	8.93	Agriculture/grassland	TRC Environmental Corporation 2008
Judith Gap, MT (2009)	3.2	Agriculture/grassland	Poulton and Erickson 2010
Kewaunee County, WI (1999-2001)	6.45	Agriculture	Howe et al. 2002
Kibby, ME (2011)	0.12	Forest; commercial forest	Stantec 2012a
Kittitas Valley, WA (2011-2012)	0.12	Sagebrush-steppe, grassland	Stantec Consulting Services 2012
Klondike, OR (2002-2003)	0.77	Agriculture/grassland	Johnson et al. 2003
Klondike II, OR (2005-2006)	0.41	Agriculture/grassland	Northwest Wildlife Consultants (NWC) and WEST 2007
Klondike III (Phase I), OR (2007-2009)	1.11	Agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	0.14	Grassland/shrub-steppe and agriculture	Gritski et al. 2011
Lakefield Wind, MN (2012)	19.87	Agriculture	Minnesota Public Utilities Commission 2012
Leaning Juniper, OR (2006-2008)	1.98	Agriculture	Gritski et al. 2008
Lempster, NH (2009)	3.11	Grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	3.57	Grasslands/forest/rocky embankments	Tidhar et al. 2011
Linden Ranch, WA (2010-2011)	1.68	Grassland/shrub-steppe, agriculture	Enz and Bay 2011
Locust Ridge, PA (Phase II; 2009)	14.11	Grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	14.38	Grassland	Arnett et al. 2011
Lower West, CA (2012-2013)	2.17	NA	Levenstein and Bay 2013a
Lower West, CA (2014-2015)	1.13	NA	Levenstein and DiDonato 2015
Lower West, CA (2016-2017)	0	Desert scrub, Joshua tree	WEST 2017b
Maple Ridge, NY (2006)	11.21	Agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007-2008)	4.96	Agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007)	6.49	Agriculture/forested	Jain et al. 2009b
Maple Ridge, NY (2012)	7.3	Agriculture/forested	Tidhar et al. 2013b
Marengo I, WA (2009-2010)	0.17	Agriculture	URS 2010b

Appendix A2. Bat fatality estimates (bats/megawatt/year) for studies at North American wind-energy facilities.

Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Marengo II, WA (2009-2010)	0.27	Agriculture	URS 2010c
Mars Hill, ME (2007)	2.91	Forest	Stantec 2008a
Mars Hill, ME (2008)	0.45	Forest	Stantec 2009a
Milford I, UT (2010-2011)	2.05	Desert shrub	Stantec 2011b
Milford I & II, UT (2011-2012)	1.67	Desert shrub	Stantec 2012b
Montezuma I, CA (2011)	1.9	Agriculture and grasslands	ICF International 2012
Montezuma I, CA (2012)	0.84	Agriculture and grasslands	ICF International 2013
Montezuma II, CA (2012-2013)	0.91	Agriculture	Harvey & Associates 2013
Moraine II, MN (2009)	2.42	Agriculture/grassland	Derby et al. 2010f
Mount Storm, WV (Fall 2008)	6.62	Forest	Young et al. 2009c
Mount Storm, WV (2009)	17.53	Forest	Young et al. 2009a, 2010b
Mount Storm, WV (2010)	15.18	Forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	7.43	Forest	Young et al. 2011a, 2012a
Mountaineer, WV (2003)	31.69	Forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	1.93	Agriculture/forest	Stantec 2009b
Mustang Hills, CA (2012-2013)	0.1	Grasslands and riparian	Chatfield and Bay 2014
Mustang Hills, CA (2014-2015)	0	Na	WEST 2016c
Mustang Hills, CA (2016-2017)	0.33	Desert scrub, Joshua tree	WEST 2018
Nine Canyon, WA (2002-2003)	2.47	Agriculture/grassland	Erickson et al. 2003
Noble Altona, NY (2010)	4.34	Forest	Jain et al. 2011a
Noble Bliss, NY (2008)	7.8	Agriculture/forest	Jain et al.2009c
Noble Bliss, NY (2009)	3.85	Agriculture/forest	Jain et al. 2010c
Noble Chateaugay, NY (2010)	2.44	Agriculture	Jain et al. 2011b
Noble Clinton, NY (2008)	3.14	Agriculture/forest	Jain et al. 2009d
Noble Clinton, NY (2009)	4.5	Agriculture/forest	Jain et al. 2010a
Noble Ellenburg, NY (2008)	3.46	Agriculture/forest	Jain et al. 2009e
Noble Ellenburg, NY (2009)	3.91	Agriculture/forest	Jain et al. 2010b
Noble Wethersfield, NY (2010)	16.3	Agriculture	Jain et al. 2011c
NPPD Ainsworth, NE (2006)	1.16	Agriculture/grassland	Derby et al. 2007
Oakfield, ME (2017)	0.51	Grassland	TRC 2018
Odell, MN (2016-2017)	6.74	Agriculture	Chodachek and Gustafson 2018
Pacific Wind, CA (2014-2015)	0.21	NA	WEST 2016a
Pacific Wind, CA (2015-2016)	0	NA	WEST 2017a

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Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Palouse Wind, WA (2012-2013)	4.23	Agriculture and grasslands	Stantec 2013a
Pebble Springs, OR (2009-2010)	1.55	Grassland	Gritski and Kronner 2010b
Pinnacle, WV (2012)	40.2	Forest	Hein et al. 2013
Pinyon Pines I & II, CA (2013-2014)	0.04	NA	Chatfield and Russo 2014
Pinyon Pines I & II, CA (2015-2016)	0.18	NA	Rintz and Starcevich 2016
Pioneer Prairie I, IA (Phase II; 2011-2012)	4.43	Agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	3.83	Agriculture	Chodachek et al. 2014
Pleasant Valley, MN (2016-2017)	1.8	NA	Tetra Tech 2017b
Prairie Rose, MN (2014)	0.41	Agriculture	Chodachek et al. 2015
PrairieWinds ND1 (Minot), ND (2010)	2.13	Agriculture	Derby et al. 2011d
PrairieWinds ND1 (Minot), ND (2011)	1.39	Agriculture, grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2011-2012)	1.23	Grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2012-2013)	1.05	Grassland	Derby et al. 2013a
PrairieWinds SD1, SD (2013-2014)	0.52	Grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	11.21	Agriculture	Good et al. 2013b
Record Hill, ME (2012)	2.96	Forest	Stantec 2013b
Record Hill, ME (2014)	0.55	Forest	Stantec 2015a
Record Hill, ME (2016)	1.25	Forest	Stantec 2017
Red Hills, OK (2012-2013)	0.11	Grassland	Derby et al. 2013c
Ripley, Ont (2008)	4.67	Agriculture	Jacques Whitford 2009
Rising Tree, CA (2017-2018)	0	Desert scrub, woodland	Chatfield et al. 2018
Rollins, ME (2012)	0.18	Forest	Stantec 2013c
Rollins, ME (2014)	0.33	Gravel	Stantec 2015b
Roth Rock, MD (2011)	6.24	Rocky	Atwell, LLC 2012
Rugby, ND (2010-2011)	1.6	Agriculture	Derby et al. 2011c
Shiloh I, CA (2006-2009)	3.92	Agriculture/grassland	Kerlinger et al. 2009
Shiloh II, CA (2009-2010)	2.6	Agriculture	Kerlinger et al. 2010, 2013a
Shiloh II, CA (2010-2011)	3.8	Agriculture	Kerlinger et al. 2013a
Shiloh II, CA (2011-2012)	3.4	Agriculture	Kerlinger et al. 2013a
Shiloh III, CA (2012-2013)	0.4	NA	Kerlinger et al. 2013b
Solano III, CA (2012-2013)	0.31	NA	AECOM 2013
Spring Valley, NV (2012-2013)	3.73	Grassland, shrub steppe	WEST 2014
Spruce Mountain Wind Project, ME (2014)	0.31	NA	Tetra Tech 2015
Stateline, OR/WA (2001-2002)	1.09	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.29	Agriculture/grassland	Erickson et al. 2004

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Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Stateline, OR/WA (2006)	0.95	Agriculture/grassland	Erickson et al. 2007
Steel Winds I & II, NY (2013)	6.14	Steel Winds I: grassland, shrub forest; Steel Winds II: gravel, steel slag	Stantec 2014c
Stetson II, ME (2014)	0.83	Forest	Stantec 2015c
Stetson Mountain I, ME (2009)	1.4	Forest	Stantec 2009c
Stetson Mountain I, ME (2011)	0.28	Forest	Normandeau Associates 2011
Stetson Mountain I, ME (2013)	0.18	Forest	Stantec 2014d
Stetson Mountain II, ME (2010)	1.65	Forest	Normandeau Associates 2010
Stetson Mountain II, ME (2012)	2.27	Forest	Stantec 2013d
Summerview, Alb (2005-2006)	10.27	Agriculture	Brown and Hamilton 2006
Summerview, Alb (2006; 2007)	11.42	Agriculture/grassland	Baerwald 2008
Top Crop I & II, IL (2012-2013)	12.55	Agriculture	Good et al. 2013c
Top of Iowa, IA (2003)	7.16	Agriculture	Jain 2005
Top of Iowa, IA (2004)	10.27	Agriculture	Jain 2005
Top of the World, WY (2010-2011)	2.74	Scrub-shrub, grassland	Rintz and Bay 2012
Top of the World, WY (2011-2012)	2.43	Scrub-shrub, grassland	Rintz and Bay 2013
Top of the World, WY (2012-2013)	2.34	Scrub-shrub, grassland	Rintz and Bay 2014
Tucannon River, WA (2015)	2.22	Agriculture	Hallingstad et al. 2016
Tuolumne (Windy Point I), WA (2009-2010)	0.94	Grassland/shrub-steppe, agriculture and forest	Enz and Bay 2010
Vansycle, OR (1999)	1.12	Agriculture/grassland	Erickson et al. 2000
Vantage, WA (2010-2011)	0.4	Shrub-steppe, grassland	Ventus Environmental Solutions 2012
Wessington Springs, SD (2009)	1.48	Grassland	Derby et al. 2010c
Wessington Springs, SD (2010)	0.41	Grassland	Derby et al. 2011a
White Creek, WA (2007-2011)	2.04	Grassland/shrub-steppe, agriculture	Downes and Gritski 2012b
Wild Horse, WA (2007)	0.39	Grassland	Erickson et al. 2008
Windstar, CA (2012-2013)	0	NA	Levenstein and Bay 2013b
Windy Flats, WA (2010-2011)	0.41	Grassland/shrub-steppe, agriculture	Enz et al. 2011
Winnebago, IA (2009-2010)	4.54	Agriculture/grassland	Derby et al. 2010g
Wolfe Island, Ont (July-December 2009)	6.42	Grassland	Stantec Consulting Ltd. (Stantec Ltd.) 2010

Appendix A2. Bat fatality estimates (bats/megawatt/year) for studies at North American wind-energy facilities.

Facility Study	Bat Fatalities	Predominant Habitat Type	Fatality Citation
Wolfe Island, Ont (July-December 2010)	9.5	Grassland	Stantec Ltd. 2011
Wolfe Island, Ont (July-December 2011)	2.49	Grassland	Stantec Ltd. 2012