Bat Acoustic Survey Report for the Crocker Wind Farm Clark County, South Dakota

April 14 – October 27, 2016

Prepared for:

Crocker Wind Farm, LLC

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EXECUTIVE SUMMARY

In April 2016, Western EcoSystems Technology, Inc. initiated a bat acoustic survey for the proposed Crocker Wind Farm (Project) in Clark County, South Dakota. The bat acoustic survey conducted at the Project was designed to estimate levels of bat activity throughout the Project during spring, summer, and fall.

Acoustic surveys were conducted using SM3 bat detectors from April 14 to October 27, 2016, at two meteorological tower stations located in agricultural fields. The paired ground and raised met tower stations recorded a combined mean (± standard error) of 1.84 ± 0.22 bat passes per detector-night. Detectors at fixed ground stations recorded 448 bat passes on 265 detector-nights for a mean (± standard error) of 1.84 ± 0.23 bat passes per detector-night. Raised stations recorded a similar number (455) of bat passes on 265 detector nights for a mean of 1.83 ± 0.24 per detector-night.

Low-frequency bat species, such as hoary bats and silver-haired bats, composed nearly 67% of bat passes overall. Four bat species and the *Myotis* group were identified at each of the four full-spectrum SM3 stations using the auto-classifier component of Kaleidoscope 3.1.7. Big brown bats were the least commonly recorded and hoary bats were the most commonly recorded species, present on 31% of detector nights.

Bat activity was also highest in the fall, peaking in early August. Activity during the standardized Fall Migration Period was 2.80 ± 0.42 bat passes per detector-night at ground met tower stations. Most wind energy facilities in the Midwest region have reported fewer than five bat fatalities/megawatt (MW)/year (1.64 – 4.35 bats/MW/year). The results from this study suggest that bat fatality rates at the Project may be fewer than five bats/MW/year, occur mainly in the fall, and mainly be composed of low-frequency species such as hoary bats and silver-haired bats.

STUDY PARTICIPANTS

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REPORT REFERENCE

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INTRODUCTION

Crocker Wind Farm, LLC is considering the development of the Crocker Wind Farm (Project) in Clark County, South Dakota. Crocker Wind Farm, LLC contracted Western EcoSystems Technology, Inc. (WEST) to complete a study of bat activity following the recommendations of the U.S. Fish and Wildlife Service (USFWS) Land-based Wind Energy Guidelines (USFWS 2012a) and Kunz et al. (2007a). WEST conducted acoustic monitoring surveys to estimate levels of bat activity throughout the Project during the spring, summer, and fall. The following report describes the results of acoustic monitoring surveys conducted at the Project between April 14 and October 27, 2016.

STUDY AREA

The proposed Project is approximately 31,131 acres (48.6 square miles) in size and lies just southwest of Bradley, South Dakota, in Clark County (Figure 1, Table 1). The landscape within the Project is flat to rolling with elevation ranges from 1,486.3 – 1,918.6 feet ([ft]; 453 – 585 meters [m]). Historically, the Project's landscape was dominated by grasslands but has since been converted largely to agricultural use with crop production and livestock grazing the primary practices. Trees and shrubs can be found around farmsteads, within planted shelter belts, and along/within drainages. Wetlands and lakes are scattered throughout the Project, with some being man-made.

Hay and pasturelands are the most abundant land cover/land use within the Project, making up nearly 37% of the area, followed by herbaceous plants (33%). The majority of the remaining landscape is comprised of cultivated crops (16%), open water (10%), and developed open space (2%). Small amounts (<0.5%) of deciduous forest, emergent herbaceous wetlands, shrub/scrub, developed low, medium, and high intensity lands, and woody wetlands are also present within the Project (Fry et al. 2011; Figure 1). Common agricultural crops include hay, corn, and soybeans.

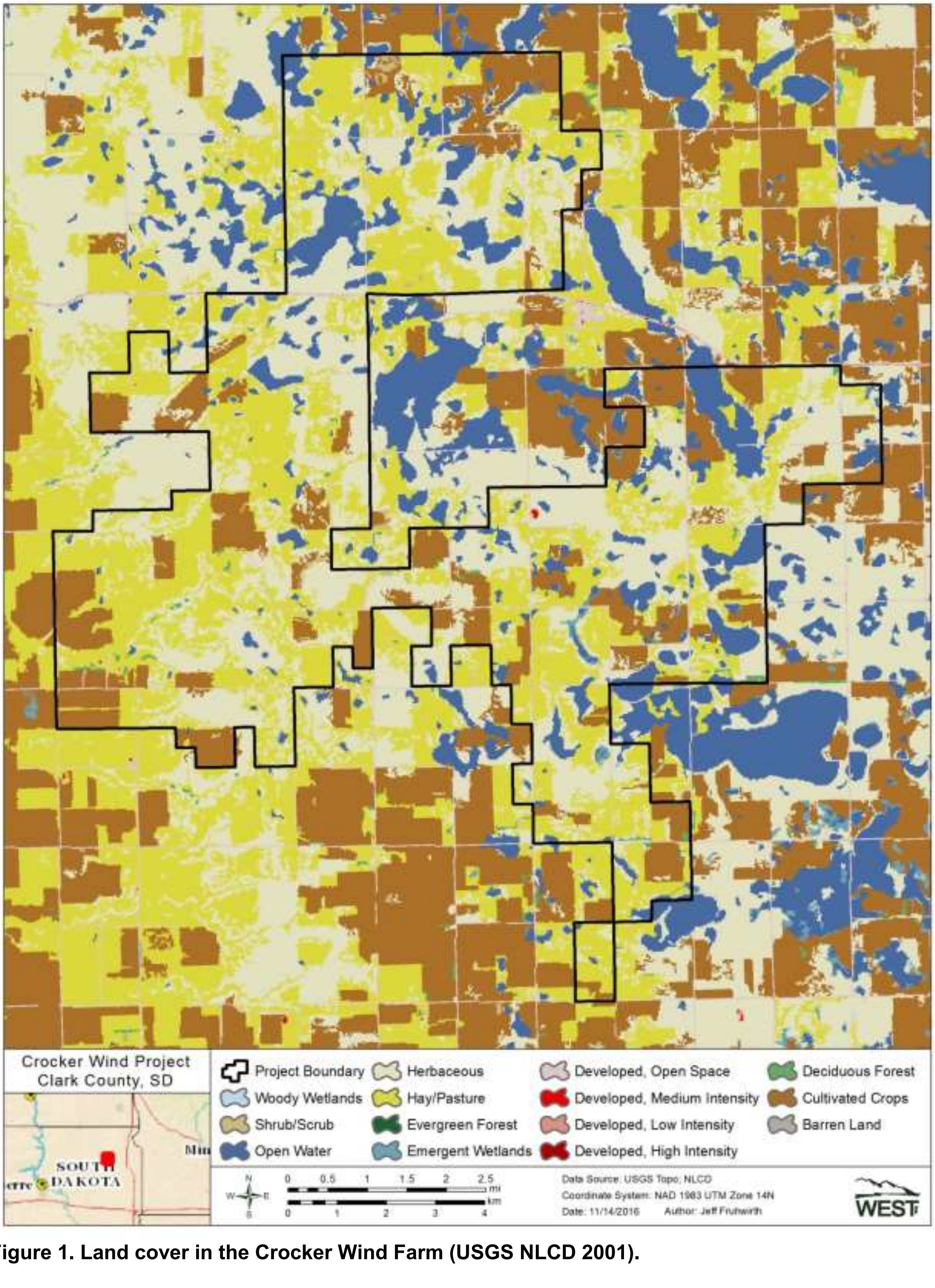

Figure 1. Land cover in the Crocker Wind Farm (USGS NLCD 2001).

Table 1. Land cover in the Crocker Wind Farm according to the United States Geological Survey National Land Cover Dataset (2001).

Land Cover	Acres	% Composition
Hay/Pasture	11,441.2	36.8%
Herbaceous	10,357.0	33.3%
Cultivated Crops	5,030.2	16.2%
Open Water	3,253.6	10.5%
Developed, Open Space	697.9	2.2%
Deciduous Forest	140.5	0.5%
Emergent Herbaceous Wetlands	103.2	0.3%
Shrub/Scrub	83.4	0.3%
Developed, Low Intensity	16.6	0.1%
Developed, Medium Intensity	4.2	0.0%
Woody Wetlands	2.2	0.0%
Developed, High Intensity	1.0	0.0%
Total	**31,131.1**	**100.00%**

Overview of Bat Diversity

Six species of bats potentially occur at the Project and all six species are known to have been killed at wind energy facilities (Table 2). *Myotis septentrionalis*, the northern long-eared bat (NLEB), is federally listed as threatened (USFWS 2016); the habitat analysis and summer presence/absence NLEB survey results are covered in a separate report. The NLEB and silver-haired bat are considered rare in the state by the South Dakota Natural Heritage Program (SDGFP 2016, Table 2).

Table 2. Bat species with potential to occur within the Crocker Wind Farm (IUCN 2009; USFWF 2016 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[1,3,4]	*Myotis septentrionalis*
Low-Frequency (< 30 kHz)	
big brown bat[1]	*Eptesicus fuscus*
silver-haired bat[1,2,4]	*Lasionycteris noctivagans*
hoary bat[1,2]	*Lasiurus cinereus*

[1] species known to have been killed at wind energy facilities;
[2] long-distance migrant;
[3] federally threatened species (USFWS 2016); and
[4] state-listed as rare (SDGPF 2016).

White-Nose Syndrome

Bats that hibernate in North America are being severely impacted by white-nose syndrome (WNS), an infectious mycosis in which bats are infected with a psychrophilic fungus from Europe (*Pseudogymnoascus* [formerly *Geomyces*] *destructans*) that is thought to act as a chronic disturbance during hibernation (USGS 2010; Minnis and Lindner 2013). Infected bats arouse frequently from hibernation, leading to premature loss of fat reserves and atypical behavior, which in turn leads to starvation prior to spring emergence (Boyles and Willis 2010; Reeder et al. 2012; Warnecke et al. 2012). WNS was first discovered in New York State in 2006 and by 2013 had rapidly spread to over 115 caves and mines and is now confirmed in 29 states and the causative fungus has been identified in an additional 3 states. To date, the full WNS has spread north into five Canadian provinces, reaching as far south as Alabama and as far west as Washington (Heffernan 2016). It is estimated that between 5.7 and 6.7 million bats have died as a result of WNS (USFWS 2012b). WNS is the primary reason the USFWS recently listed the NLEB as threatened under the Endangered Species Act (USFWS 2015), and is currently reviewing the status of the little brown bat. Neither WNS nor the causative fungal agent have been detected as of 2016 in South Dakota; however the fungus has been detected in the neighboring states of Minnesota, Iowa, and Nebraska.

METHODS

Bat Acoustic Surveys

WEST conducted acoustic monitoring studies to estimate levels of bat activity throughout the Project during the study period. Although it remains unclear whether baseline acoustic data are adequate to predict post-construction fatality (Hein et al. 2013a), ultrasonic detectors do collect information on the spatial distribution, timing, and species composition that can provide insights into the possible risk of wind development on bats (Kunz et al. 2007a; Britzke et al. 2013) and inform potential mitigation strategies (Weller and Baldwin 2012).

Survey Stations

Two Song Meter SM3 full-spectrum ultrasonic detectors (hereafter “SM3”; Wildlife Acoustics, Concord, MA) were used during the study. Each SM3 detector is equipped with two microphone ports. The SM3 detectors were placed at meteorological (met) towers with one microphone at ground level (approximately 3 m [10 ft] above ground level) and another at the proposed rotor-swept height (approximately 45 m [148 ft] above ground level; Figure 2). Species activity levels and composition can vary with altitude (Baerwald and Barclay 2009; Collins and Jones 2009; Müeller et al. 2013). Therefore, it can be useful to monitor activity at different heights (Kunz et al. 2007b). Ground-based microphones likely detect a more complete sample of the bat species present within the Project, whereas elevated microphones may give a more accurate assessment of risk to bat species flying at rotor swept heights (Kunz et al. 2007b; Müeller et al. 2013; but see Amorim et al. 2012). Both met tower stations were located in agricultural habitat (Figure 2) and are representative of potential turbine locations.

The SM3 detectors and external batteries deep-cycle were housed inside large tool-boxes for protection from livestock and wildlife. The ground microphone was raised on polyvinyl chloride (commonly PVC) pole to improve the quality of sound recordings for species identification. Raised SM3 microphones were elevated on met towers using a pulley system. The SM3 microphone is weather resistant, and does not require protection, however, the microphone was oriented parallel to the ground to minimize the potential for rain damage.

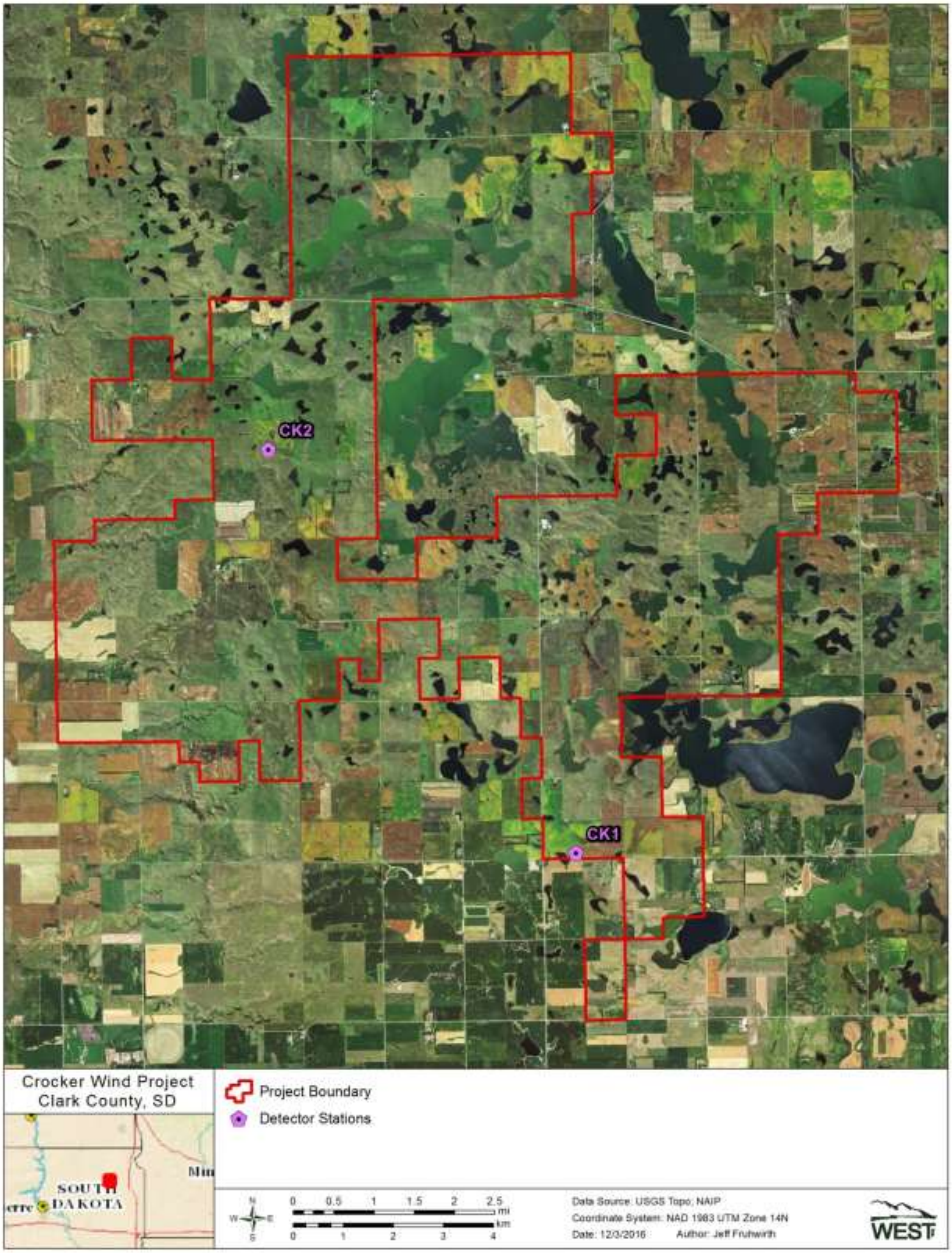

Figure 2. Location of met tower stations in the Crocker Wind Farm.

Survey Schedule

Bats were surveyed in the Project from April 14 to October 27, 2016, and detectors were programmed to turn on approximately 30 minutes before sunset and turn off approximately 30 minutes after sunrise each night. To highlight seasonal activity patterns, the study was divided into three survey periods: spring (April 14 – May 31), summer (June 1 – July 31), and fall (August 1 – October 27). Mean bat activity was also calculated for a standardized Fall Migration Period (FMP), defined here as July 30 – October 14. The FMP was defined by WEST as a standard for comparison with activity from other wind energy facilities. During this time bats begin moving toward wintering areas, and many species of bats initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008; Arnett and Baerwald 2013).

Data Collection and Call Analysis

The Song Meter SM3 is a full-spectrum bat detector that records complete acoustic waveforms by sampling sound waves at 192 kilohertz (kHz). This high sampling rate enables the detector to record sound amplitude data at all frequencies up to 96 kHz and to make high resolution recordings. The high quality recordings produced by the SM3 detector provide more information for making species identifications than SM3 detectors at the cost of higher data storage requirements and slower data analysis.

Identification of calls was completed with the automated identification feature in program Kaleidoscope 3.1.7 (Wildlife Acoustics, Concord, Massachusetts) using the Bats of North America classifier 2.1.0. It utilizes Hidden Markov Models and other statistical methods known for their application in temporal pattern recognition such as speech analysis, handwriting analysis, and DNA sequencing (Agranat 2012). Despite the capabilities of Kaleidoscope, many bat passes cannot be identified with certainty, either because only call fragments were recorded due to the distance between the bat and microphone or because many bat species produce similar calls with overlapping call characteristics that often cannot be distinguished. The Kaleidoscope output was used to generate a list of species that may have been present in the Project.

The full-spectrum data recorded by the SM3 were also transformed into zero-crossing data using the program Kaleidoscope 3.1.7 (Wildlife Acoustics, Inc., Concord, Massachusetts), allowing data to be viewed in Analook© software as digital sonograms that show changes in echolocation 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.

For each survey location, bat passes were sorted into two groups based on their minimum frequency. High-frequency (HF) bats such as eastern red bats, evening bats, and *Myotis* species have minimum frequencies greater than 30 kHz. Low-frequency (LF) bats such as big brown bats, silver-haired bats, and hoary bats typically emit echolocation calls with minimum frequencies below 30 kHz. HF and LF species that may occur in the study area are listed in Table 2.

Statistical Analysis

The standard metric used for measuring bat activity is the number of bat passes per detector-night, and this metric was used as an index of bat activity in the project area. A bat pass was defined as a sequence of at least two echolocation 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. The terms bat pass and bat call are used interchangeably. Bat passes per detector-night was calculated for all bats, and for HF and LF bats. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. The number of bat passes was determined by an experienced bat biologist using Analook.

The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. If multiple seven-day periods equaled the peak sustained bat activity rate, all dates in these seven-day periods were reported. This and all multi-detector averages in this report were calculated as an unweighted average of total activity at each detector.

Risk Assessment

To assess the likelihood of relatively low or relatively high bat fatalities, bat activity recorded in the Project was compared to existing data at other wind energy facilities in the Midwest and Rocky Mountains. Given the relatively small number of publicly available studies and the significant ecological differences between geographically dispersed facilities, the risk assessment is qualitative, rather than quantitative. Among studies measuring both activity and fatality rates, most data were collected during the fall using AnaBat detectors placed near the ground. To make comparisons to the existing publicly available data, this report uses the activity rate recorded at ground-level met tower SM3 stations during the FMP as a standard for comparison with activity data from other wind energy facilities. However, full-spectrum detectors such as the SM3 units used at Crocker typically record more bat passes per detector-night on average than AnaBat (zero-cross) units, so direct comparison between activity rates should be done with caution.

Given the differences in microphone sensitivity and data processing algorithms between full-spectrum and zero-cross detectors, activity levels recorded by SM3 detectors (used at Crocker) are not readily comparable to activity recorded by AnaBat detectors because the two detectors sample a different volume of airspace and process the data differently (Solick et al. 2011, Adams et al. 2012). Although the detection range of ultrasonic detectors depends on a number of factors (e.g., echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, atmospheric conditions; Limpens and McCracken 2004), the SM2 detector (similar to the SM3 detector used at Crocker) was shown to detect signals at a greater distance than the zero-cross AnaBat detector (Adams et al. 2012). Under controlled conditions, the detection range for playback of synthetic echolocation calls for 55 kHz signals (HF) was similar for SM2 and AnaBat detectors (approximately 7 m [23 ft]), while for 25 kHz signals (LF) the detection range for AnaBat and SM2 detectors was approximately 15 m (49 ft) and 22 m (72 ft), respectively (Adams et al. 2012), meaning that, all else equal, the full-spectrum detector is likely to record more bat calls than the zero-cross detector (i.e., an SM3 unit such as used at Crocker generally would be expected to record higher number of calls per detector night than an AnaBat in the same location).

RESULTS

Bat Acoustic Surveys

Bat activity was monitored at two paired sampling locations for a total of 530 detector-nights between April 14 and October 27, 2016 (Table 3). SM3 units were operating for 78.2% of the sampling period (Figure 3). The primary causes of lost data were equipment malfunctions and data transfer errors. SM3 units overall recorded 903 bat passes for a mean of 1.84 ± 0.22 bat passes per detector night (Table 3).

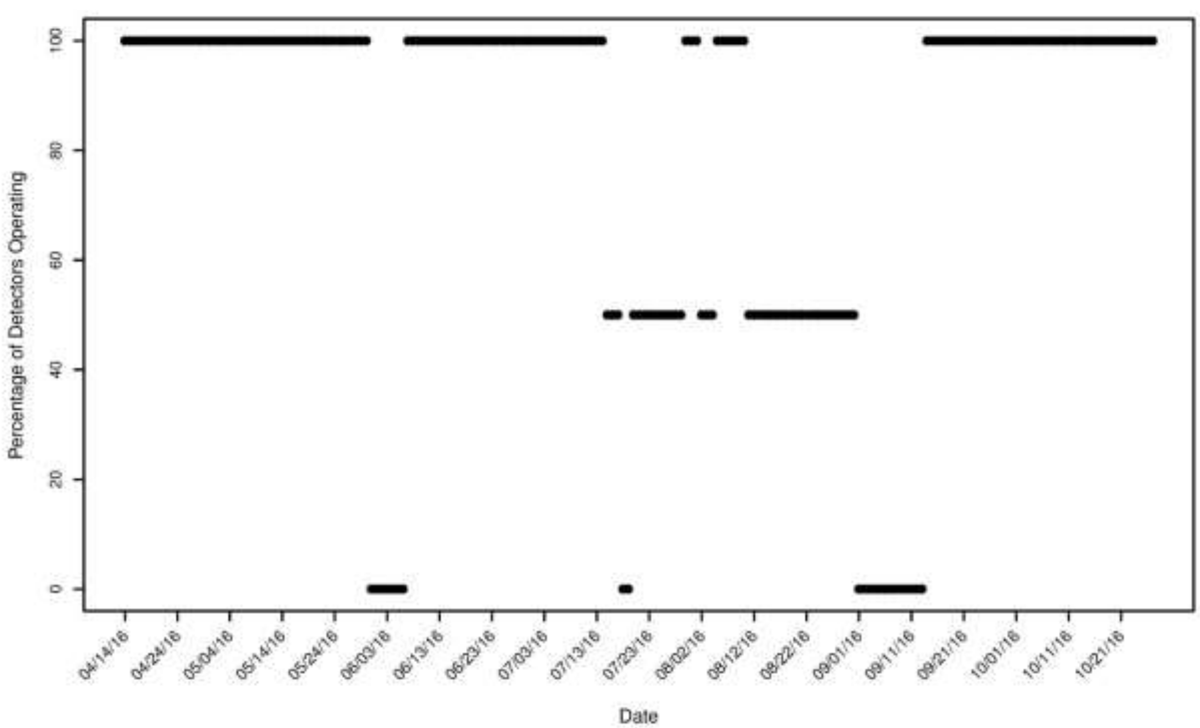

Figure 3. Operational status of bat microphones (n = 4) operating at the Crocker Wind Farm during each night of the study period April 14 to October 27, 2016.

Spatial Variation

SM3 units at ground met tower stations recorded 448 bat passes on 265 detector-nights for a mean (± standard error) of 1.84 ± 0.23 bat passes per detector-night. Raised stations recorded similar activity with 455 bat passes on 265 detector-nights for a mean of 1.83 ± 0.24 bat passes per detector-night (Table 3, Figure 4). At the paired stations, the ground detector at station CK1 recorded slightly more bat passes than the raised detector, while the opposite occurred at CK2 (Figure 5). It should be noted that, given the increased detection distance for full-spectrum microphones, it is possible that bats flying near met towers were recorded simultaneously by both ground and raised microphones.

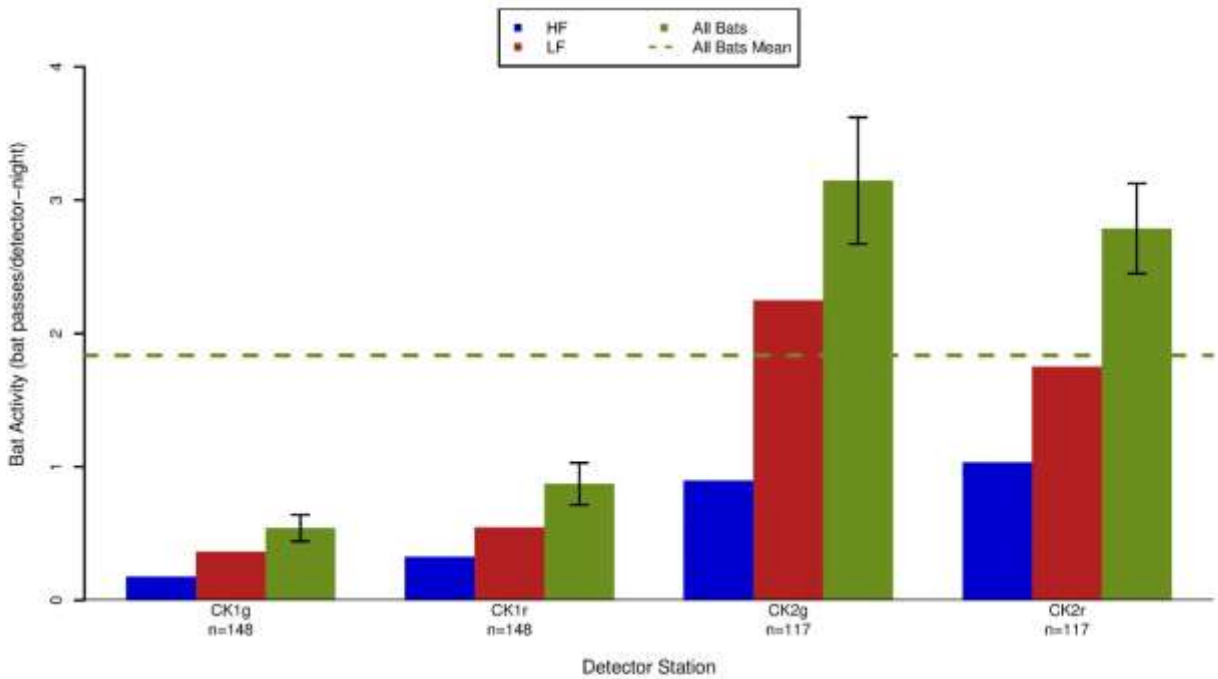

Figure 4. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at SM3 met tower stations in the Crocker Wind Farm from April 14 to October 27, 2016. The bootstrapped standard errors are represented by the black error bars on the 'All Bats' columns.

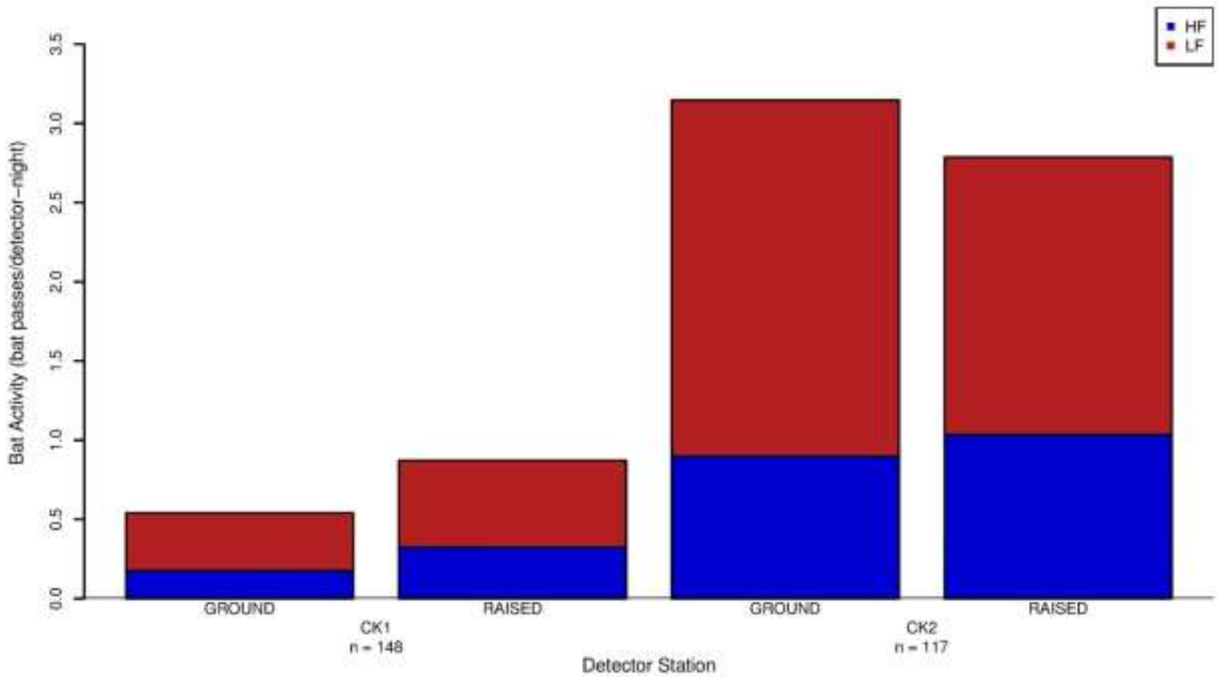

Figure 5. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at paired SM3 stations in the Crocker Wind Farm from April 14 to October 27, 2016.

Table 3. Results of acoustic bat surveys conducted at met tower stations within the Crocker Wind Farm from April 14 to October 27, 2016. Passes are separated by call frequency: high-frequency (HF) and low-frequency (LF).

SM3 Station	Type	Habitat	# of HF Bat Passes	# of LF Bat Passes	Total Bat Passes	Detector- Nights	Bat Passes/ Night***
CK1g	ground	cropland	26	54	80	148	0.54 ± 0.10
CK1r	raised	cropland	48	81	129	148	0.87 ± 0.16
CK2g	ground	cropland	105	263	368	117	3.15 ± 0.48
CK2r	raised	cropland	121	205	326	117	2.79 ± 0.34
Total Ground Met Tower Stations			**131**	**317**	**448**	**265**	**1.84 ± 0.23**
Total Raised Met Tower Stations			**169**	**286**	**455**	**265**	**1.83 ± 0.24**
Total			**300**	**603**	**903**	**530**	**1.84 ± 0.22**

***± bootstrapped standard error.

Temporal Variation

Bat activity at both met tower stations was highest in the fall (Table 4; Figure 6). Weekly acoustic activity at met towers was relatively low from April through mid-July, with activity increasing in late July and peaking in early August (9.80 bat passes per detector-night; Table 5). Activity decreased in late August through the end of the study period (Figure 7). At paired stations weekly activity was similar between ground and raised microphones throughout the study period (Figure 8).

Table 4. The number of bat passes per detector-night recorded at met tower stations in the Crocker Wind Farm during each season in 2016, separated by call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).

Station	Call Frequency	Spring April 14 – May 31	Summer June 1 – Jul 31	Fall Aug 1 – Oct 27	Fall Migration Period Jul 30 – Oct 14
	LF	0.38	0.26	0.43	0.51
CK1g	HF	0.02	0.19	0.29	0.38
	AB	0.4	0.44	0.72	0.89
	LF	0.34	0.47	0.78	1.04
CK1r	HF	0	0.14	0.72	0.91
	AB	0.34	0.6	1.5	1.96
	LF	NA	1.94	2.47	3.3
CK2g	HF	NA	0.63	1.09	1.4
	AB	NA	2.57	3.56	4.7
	LF	NA	1.51	1.93	2.56
CK2r	HF	NA	0.96	1.09	1.39
	AB	NA	2.47	3.01	3.95
	LF	**0.38 ± 0.11**	**1.10 ± 0.21**	**1.45 ± 0.25**	**1.90 ± 0.31**
Ground Total	**HF**	**0.02 ± 0.02**	**0.41 ± 0.09**	**0.69 ± 0.13**	**0.89 ± 0.16**
	AB	**0.40 ± 0.11**	**1.51 ± 0.27**	**2.14 ± 0.34**	**2.80 ± 0.42**
	LF	**0.34 ± 0.10**	**0.99 ± 0.23**	**1.35 ± 0.25**	**1.80 ± 0.29**
Raised Total	**HF**	**0.00 ± 0.00**	**0.55 ± 0.13**	**0.91 ± 0.17**	**1.15 ± 0.20**
	AB	**0.34 ± 0.10**	**1.54 ± 0.33**	**2.26 ± 0.39**	**2.95 ± 0.45**
	LF	**0.36 ± 0.09**	**1.04 ± 0.20**	**1.40 ± 0.26**	**1.85 ± 0.31**
Overall	**HF**	**0.01 ± 0.01**	**0.48 ± 0.10**	**0.80 ± 0.14**	**1.02 ± 0.17**
	AB	**0.37 ± 0.09**	**1.52 ± 0.27**	**2.20 ± 0.38**	**2.88 ± 0.45**

Table 5. Periods of peak activity for high-frequency (HF), low-frequency (LF), and all bats at met tower stations in the Crocker Wind Farm for the study period April 14 to October 27, 2016.

Species Group	Start Date of Peak Activity	End Date of Peak Activity	Bat Passes per Detector-Night
HF	August 1	August 7	3.06
LF	August 9	August 15	6.77
All Bats	August 9	August 15	9.80

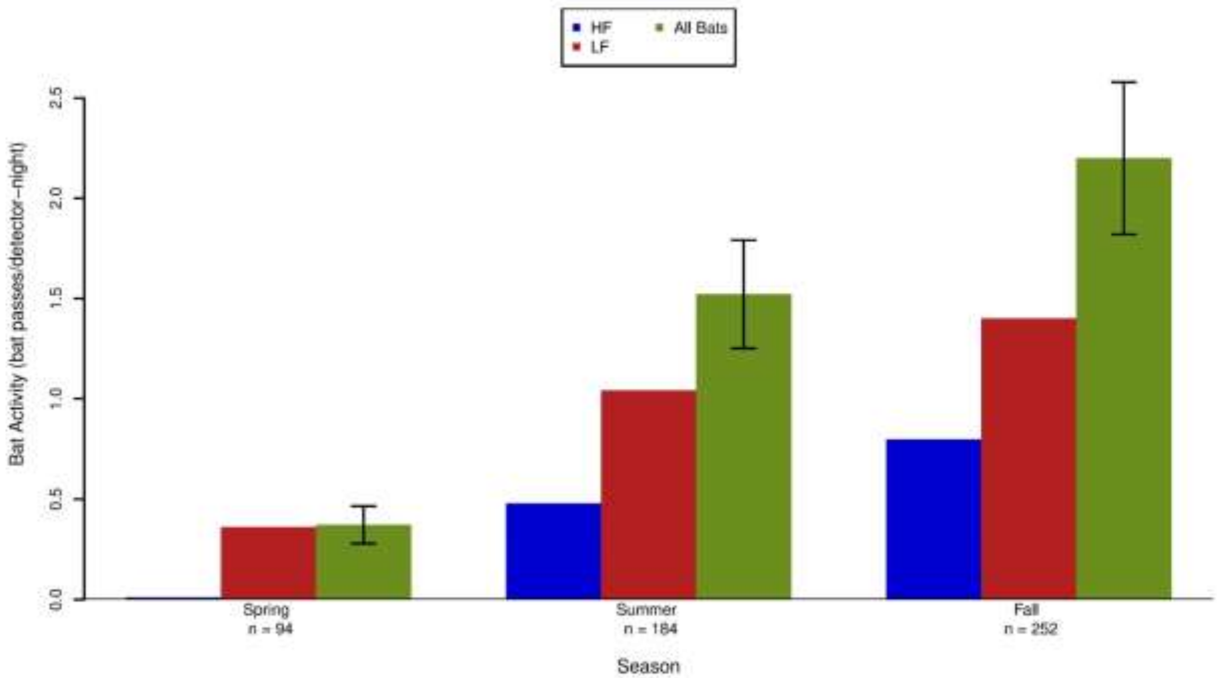

Figure 6. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at met tower stations in the Crocker Wind Farm from April 14 to October 27, 2016. The bootstrapped standard errors are represented on the 'All Bats' columns.

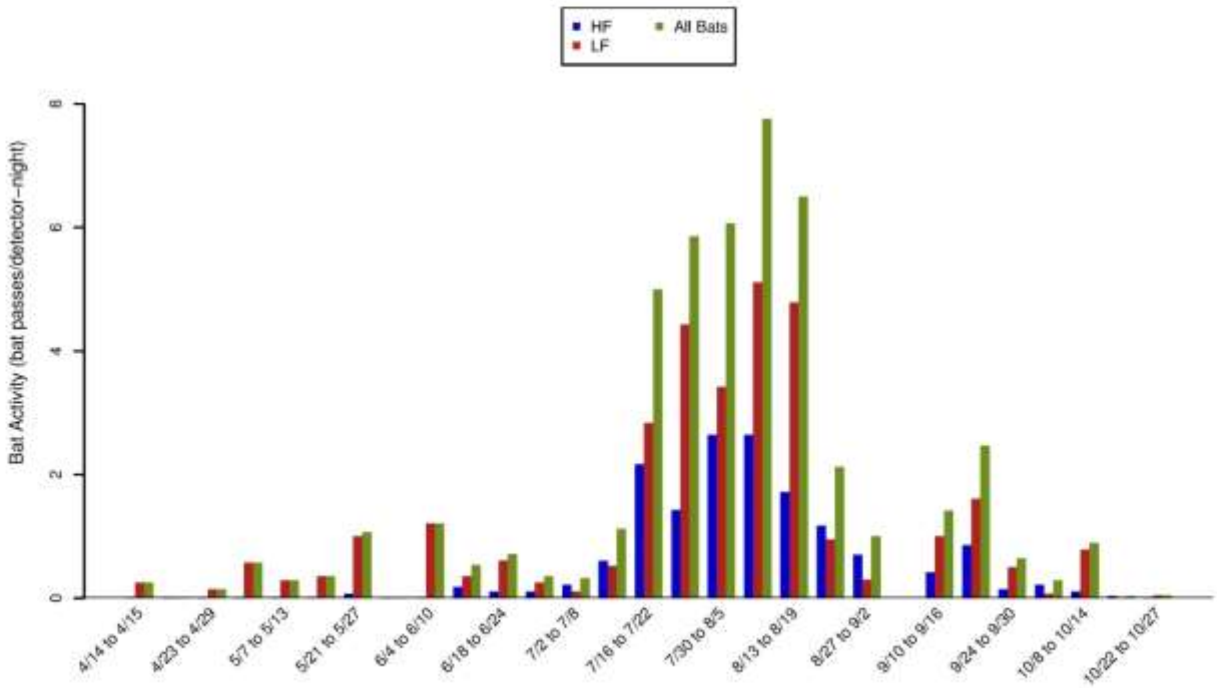

Figure 7. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at met tower stations in the Crocker Wind Farm for the study period April 14 to October 27, 2016.

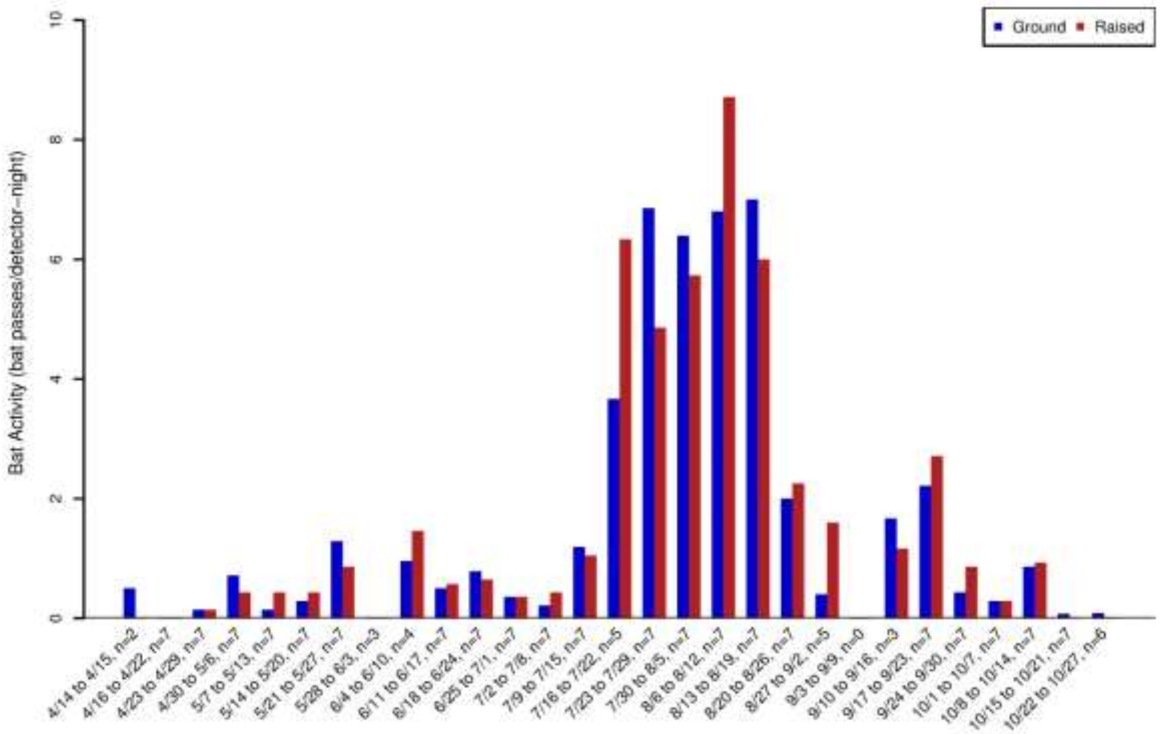

Figure 8. Weekly patterns of bat activity recorded by paired SM3 detectors at ground and raised met tower stations in the Crocker Wind Farm from April 14 – October 27, 2016.

Species Composition

Low-frequency bats (e.g., big brown bats, hoary bats, and silver-haired bats; Table 2) were the most commonly recorded species (66.8%) among all stations (Table 3), suggesting that these species are relatively more abundant than HF species in the Project Area. High-frequency bats (e.g., tri-colored bats, eastern red bats, and *Myotis* species) composed 33.2% of bat passes recorded at met tower stations (Table 2, Table 3). Overall and LF bat activity peaked between August 9 and 15 whereas HF bat activity peaked slightly earlier from August 1 – 7 (Table 5, Figure 7).

Four individual bat species and the *Myotis* group were identified at each of the four detectors using the auto-classifier component of Kaleidoscope 3.1.7 (Table 6). The hoary bat was the most frequently recorded species overall, present on 31% of detector-nights, while the big brown bat was the least frequently recorded species overall, present on just 7% of operational detector-nights. *Myotis* group presence was highest at CK2g where this group was present on 24% of detector-nights.

Table 6. The number (percent) of presence/absence dates for detector-nights with bat species present by station recorded by the SM3 full-spectrum detectors at the Crocker Wind Farm using Kaleidoscope 3.1.7

Common Name	CK1g	CK1r	CK2g	CK2r	Total
High-Frequency (> 30 kHz)					
eastern red bat	14 (9)	26 (18)	33 (28)	30 (26)	103 (19)
Myotis species	10 (7)	14 (9)	28 (24)	15 (13)	67 (13)
Low-Frequency (< 30 kHz)					
big brown bat	7 (5)	14 (9)	11 (9)	6 (5)	38 (7)
hoary bat	24 (16)	43 (29)	48 (41)	50 (43)	165 (31)
silver-haired bat	29 (20)	42 (28)	34 (29)	31 (26)	136 (26)

DISCUSSION

Bat fatalities have been discovered at most wind energy facilities monitored in North America, ranging from 0 (Chatfield and Bay 2014) to 40.2 bat fatalities/megawatt (MW)/year (Hein et al. 2013a; Appendix A). In 2012, an estimated 600,000 bats died as a result of interactions with wind turbines in the U.S. (Hayes 2013). Proximate causes of bat fatalities are primarily due to collisions with moving turbine blades (Grodsky et al. 2011; Rollins et al. 2012) but to a limited extent may also be caused by barotrauma (Baerwald et al. 2008). The underlying reasons for why bats come near turbines are still largely unknown (Cryan and Barclay 2009).To date, post-construction monitoring studies of wind energy facilities show that a) migratory tree-roosting species (e.g., eastern red bat [*Lasiurus borealis*], hoary bat [*Lasiurus cinereus*], and silver-haired bat [*Lasionycteris noctivagans*]) compose approximately 78% of reported bat fatalities; b) the majority of fatalities occur during the fall migration season (August and September); and c) most fatalities occur on nights with relatively low wind speeds (e.g., < 6.0 m/s; Arnett et al. 2008; Arnett and Baerwald 2013; Arnett et al. 2013).

It is generally expected that pre-construction bat activity is positively related to post-construction bat fatalities (Kunz et al. 2007b). However, to date, relatively few publicly available studies documenting bat passes per detector-night at proposed wind energy facilities are available to compare to publicly available studies reporting bat fatality rates (Appendix A). Given the limited availability of pre- and post-construction data sets, differences in protocols among studies (Ellison 2012), and significant ecological differences between geographically diverse facilities, the relationship between activity and fatalities has not yet been empirically established Hein et al. (2013a), though Baerwald and Barclay (2009) found a significant positive association between pass rates measured at 30 m and fatality rates for hoary and silver-haired bats across five sites in southern Alberta.

However, on a continental scale, a similar relationship has proven difficult to establish. The relatively few studies that have estimated both pre-construction activity and post-construction fatalities trend toward a positive association between activity and fatality rates, but they lack statistically significant correlations. Hein et al. (2013a) compiled data from wind projects that included both pre- and post-construction data from the same projects, as well as pre- and post-construction data from facilities within the same regions to assess if pre-construction acoustic activity predicted post-construction fatality rates. Based on data from 12 sites that had both pre- and post-construction data, they did not find a statistically significant relationship (p=0.07), although the trend was in the expected direction (i.e., low activity was generally associated with low fatalities and vice-versa). They concluded therefore, that pre-construction acoustic data could not currently predict bat fatalities, but acknowledged that the data set was limited and additional data may indicate a stronger relationship. Therefore, the current approach to assessing the risk to bats requires a qualitative analysis of activity levels, spatial and temporal relationships, species composition, and comparison to regional fatality patterns.

Mean bat activity during the FMP at ground met tower station SM3 detectors (2.80 ± 0.42 bat passes per detector-night; Table 4) was lower than rates established at other upper Midwest wind projects using AnaBat units (which generally record fewer bat passes). Anabat-derived bat activity rate estimates include the national median (7.68) and the majority of studies available from the Midwest (6.97) and Rocky Mountains (2.2; Appendix A). Although it is expected that bat activity data collected using SM3 detectors is not directly comparable with activity data from the studies in Appendix A, all of which used AnaBat detectors, it is assumed that SM3 detectors would detect more bat calls due to a greater detection distance and the fact that noise from insects or other sources does not inhibit detection of bats for full-spectrum detectors (Adams et al. 2012). Therefore, the activity data collected by SM3 detectors in this study provides a conservative risk assessment, and the fact that even with the SM3 units the bat passes were low indicates a relatively low use site.

Overall bat activity was highest within the Project during the fall peaking in early to mid-August. This timing is close to peak fatality periods for most wind energy facilities in the U.S. (Arnett et al. 2008), and suggests that bat fatalities at the Project will be highest during the fall and may consist largely of migrating individuals.

Activity by LF bat species composed nearly 67% of bat passes recorded in the Project. Hoary and silver-haired bats are usually the most common LF species found during carcass searches (Arnett et al. 2008; Arnett and Baerwald 2013). Activity by HF bats composed approximately 33% of bat passes recorded at all stations, suggesting lower relative abundance of species such as eastern red bats and *Myotis* species. *Myotis* are recorded less commonly than other species as fatalities at most post-construction studies of wind energy facilities (Kunz et al. 2007b; Arnett et al. 2008), with a few notable exceptions (Kerns and Kerlinger 2004; Jain 2005; Brown and Hamilton 2006a; Gruver et al. 2009a). 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), it is expected that these three species would be the most common fatalities at the Project.

The closest operating wind-energy facility to the Project with public post-construction fatality data is the Buffalo Ridge II Wind Facility, located approximately 60 miles from the Project in Brookings County, South Dakota. At Buffalo Ridge II the pre-construction bat activity rate was a relatively low rate of 1.75 bats/detector-night (Derby et al. 2008) and the casualty rate was also relatively low at 2.81 bats/MW/study period (Derby et al. 2012a). Due to the similar low rates of pre-construction bat activity, it is possible that Crocker will have similarly low fatality rates, although the habitat at Buffalo Ridge II (primarily corn and soybeans, with limited water features and limited wooded habitat) is somewhat different than Crocker (primarily grassland, with more prevalence of wetlands and open water, also with limited wooded habitat). The pre-construction bat studies completed at the Project will add to the growing body of research regarding the impacts of wind energy development on bats and will provide a valuable comparison to post-construction studies to be completed at Project.

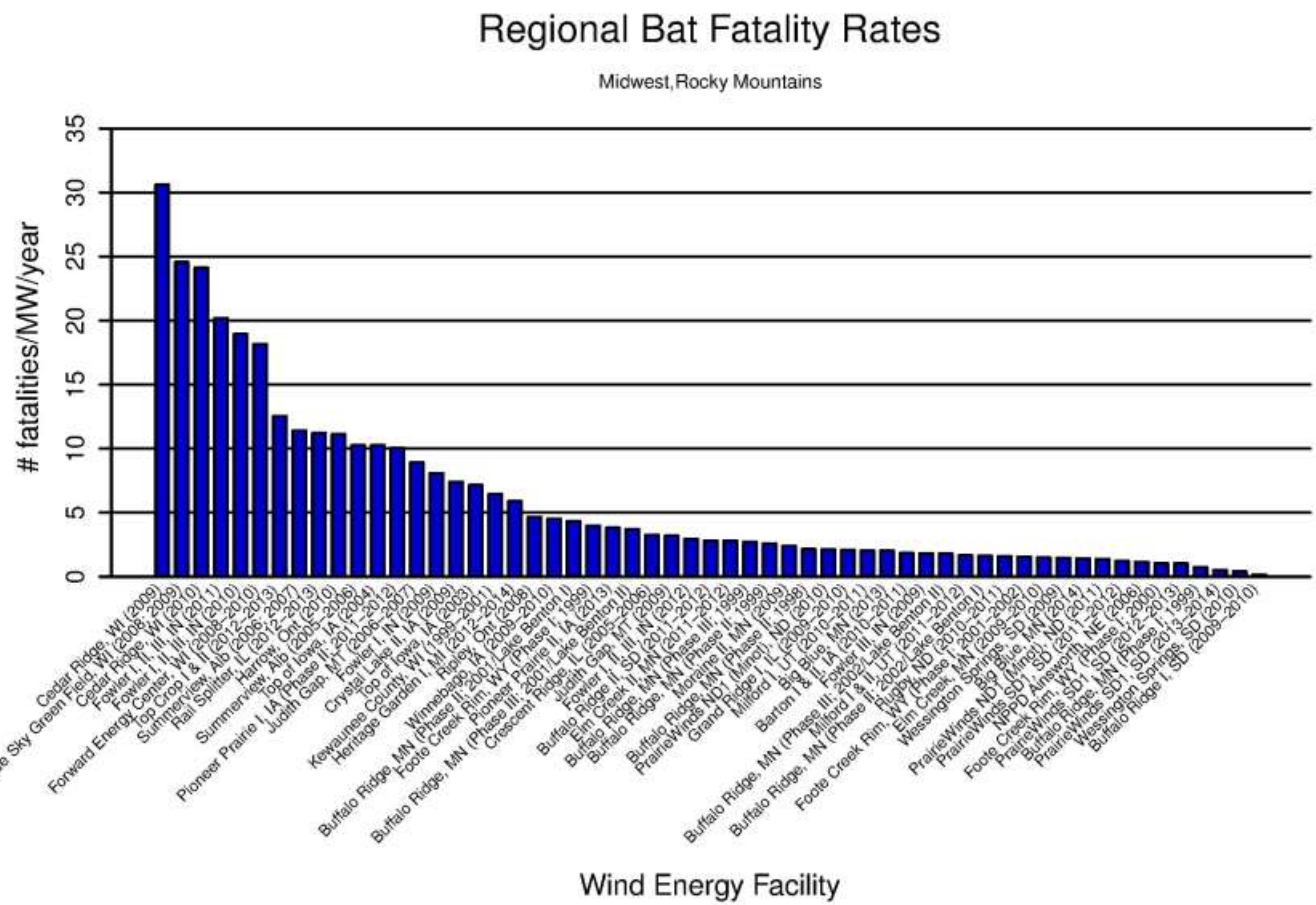

Figure 9. Fatality rates for bats (number of bats per MW per year) from publicly-available wind energy facilities in the Midwest and Rocky Mountains regions of North America.

Figure 9. (continued) Fatality rates for bats (number of bats per MW per year) from publicly-available wind energy facilities in the Midwest and Rocky Mountains regions of North America.

Data from the following sources

Project, Location	Reference	Project, Location	Reference
Cedar Ridge, WI (09)	BHE Environmental 2010	Elm Creek II, MN (11-12)	Derby et al. 2012b
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009b	Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000
Cedar Ridge, WI (10)	BHE Environmental 2011	Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000
Fowler I, II, III, IN (11)	Good et al. 2012	Moraine II, MN (09)	Derby et al. 2010d
Fowler I, II, III, IN (10)	Good et al. 2011	Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c
Top Crop I & II, IL (12-13)	Good et al. 2013a	Grand Ridge I, IL (09-10)	Derby et al. 2010g
Summerview, Alb (06; 07)	Baerwald 2008	Milford I, UT (10-11)	Stantec 2011b
Rail Splitter, IL (12-13)	Good et al. 2013b	Big Blue, MN (14)	Fagen Engineering 2015
Harrow, Ont (10)	Natural Resource Solutions 2011	Barton I & II, IA (10-11)	Derby et al. 2011a
Summerview, Alb (05-06)	Brown and Hamilton 2006b	Fowler III, IN (09)	Johnson et al. 2010b
Top of Iowa, IA (04)	Jain 2005	Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004
Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012	Milford I & II, UT (11-12)	Stantec 2012b
Judith Gap, MT (06-07)	TRC 2008	Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004
Fowler I, IN (09)	Johnson et al. 2010a	Rugby, ND (10-11)	Derby et al. 2011b
Crystal Lake II, IA (09)	Derby et al. 2010a	Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003a
Top of Iowa, IA (03)	Jain 2005	Elm Creek, MN (09-10)	Derby et al. 2010c
Kewaunee County, WI (99-01)	Howe et al. 2002	Wessington Springs, SD (09)	Derby et al. 2010f
Heritage Garden I, MI (12-14)	Kerlinger et al. 2014	Big Blue, MN (13)	Fagen Engineering 2014
Ripley, Ont (08)	Jacques Whitford 2009	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Winnebago, IA (09-10)	Derby et al. 2010e	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	NPPD Ainsworth, NE (06)	Derby et al. 2007
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003a	Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003a
Pioneer Prairie II, IA (13)	Chodachek et al. 2014	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	PrairieWinds SD1 (Crow Lake), SD (13-14)	Derby et al. 2014
Judith Gap, MT (09)	Poulton and Erickson 2010	Wessington Springs, SD (10)	Derby et al. 2011d
Fowler I, II, III, IN (12)	Good et al. 2013c	Buffalo Ridge I, SD (09-10)	Derby et al. 2010b
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a		

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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	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Crocker, SD	**2.80 ± 0.42**				
	Rocky Mountains				
Foote Creek Rim, WY (Phase I; 1999)	NA	NA	3.97	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2 [A]	6/15/00-9/1/00	1.05	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	2.2 [A]	6/15/01-9/1/01	1.57	69	41.4
Judith Gap, MT (2006-2007)	NA	NA	8.93	90	135
Judith Gap, MT (2009)	NA	NA	3.2	90	135
Milford I & II, UT (2011-2012)	NA	NA	1.67	107	160.5 (58.5 phase I; 102 phase II)
Milford I, UT (2010-2011)	NA	NA	2.05	58	145
Summerview, Alb (2005-2006)	NA	NA	10.27	39	70.2
Summerview, Alb (2006; 2007)	7.65 [A]	07/15/06-07-09/30/06-07	11.42	39	70.2
	Midwest				
Barton I & II, IA (2010-2011)	NA	NA	1.85	80	160
Big Blue, MN (2013)	NA	NA	2.04	18	36
Big Blue, MN (2014)	NA	NA	1.43	18	36
Blue Sky Green Field, WI (2008; 2009)	7.7 [B]	7/24/07-10/29/07	24.57	88	145
Buffalo Ridge I, SD (2009-2010)	NA	NA	0.16	24	50.4
Buffalo Ridge II, SD (2011-2012)	1.75	7/1/08-10/14/08	2.81	105	210
Buffalo Ridge, MN (Phase I; 1999)	NA	NA	0.74	73	25
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9	6/15/02-9/15/02	1.64	143	107.25
Buffalo Ridge, MN (Phase II; 1998)	NA	NA	2.16	143	107.25
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2 [A]	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9 [A]	6/15/02-9/15/02	1.64	143	107.25
Buffalo Ridge, MN (Phase III; 1999)	NA	NA	2.72	138	103.5
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2 [A]	6/15/01-9/15/01	3.71	138	103.5
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9 [A]	6/15/02-9/15/02	1.81	138	103.5
Cedar Ridge, WI (2009)	9.97 [A,B,C,D]	7/16/07-9/30/07	30.61	41	67.6
Cedar Ridge, WI (2010)	9.97 [A,B,C,D]	7/16/07-9/30/07	24.12	41	68
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	33	49.5
Crystal Lake II, IA (2009)	NA	NA	7.42	80	200
Elm Creek II, MN (2011-2012)	NA	NA	2.81	62	148.8
Elm Creek, MN (2009-2010)	NA	NA	1.49	67	100
Forward Energy Center, WI (2008-2010)	6.97	8/5/08-11/08/08	18.17	86	129

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	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Fowler I, II, III, IN (2010)	NA	NA	18.96	355	600
Fowler I, II, III, IN (2011)	NA	NA	20.19	355	600
Fowler I, II, III, IN (2012)	NA	NA	2.96	355	600
Fowler I, IN (2009)	NA	NA	8.09	162	301
Fowler III, IN (2009)	NA	NA	1.84	60	99
Grand Ridge I, IL (2009-2010)	NA	NA	2.1	66	99
Harrow, Ont (2010)	NA	NA	11.13	24 (four 6-turb facilities)	39.6
Heritage Garden I, MI (2012-2014)	NA	NA	5.9	14	28
Kewaunee County, WI (1999-2001)	NA	NA	6.45	31	20.46
Moraine II, MN (2009)	NA	NA	2.42	33	49.5
NPPD Ainsworth, NE (2006)	NA	NA	1.16	36	20.5
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	NA	10.06	62	102.3
Pioneer Prairie II, IA (2013)	NA	NA	3.83	62	102.3
PrairieWinds ND1 (Minot), ND (2010)	NA	NA	2.13	80	115.5
PrairieWinds ND1 (Minot), ND (2011)	NA	NA	1.39	80	115.5
PrairieWinds SD1, SD (2011-2012)	NA	NA	1.23	108	162
PrairieWinds SD1, SD (2012-2013)	NA	NA	1.05	108	162
PrairieWinds SD1, SD (2013-2014)	NA	NA	0.52	108	162
Rail Splitter, IL (2012-2013)	NA	NA	11.21	67	100.5
Ripley, Ont (2008)	NA	NA	4.67	38	76
Rugby, ND (2010-2011)	NA	NA	1.6	71	149
Top Crop I & II (2012-2013)	NA	NA	12.55	68 (phase I; 132 phase II)	300 (102 phase I; 198 phase II)
Top of Iowa, IA (2003)	NA	NA	7.16	89	80
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80
Wessington Springs, SD (2009)	NA	NA	1.48	34	51
Wessington Springs, SD (2010)	NA	NA	0.41	34	51
Winnebago, IA (2009-2010)	NA	NA	4.54	10	20
California					
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta VIII, CA (2012-2013)	NA	NA	0	50	150
Alta Wind I, CA (2011-2012)	4.42[E]	6/26/2009 - 10/31/2009	1.28	100	150
Alta Wind II-V, CA (2011-2012)	0.78	6/26/2009 - 10/31/2009	0.08	190	570
Alta Wind I-V, CA (2013-2014)	NA	NA	0.2	290	720 (150 GE, 570 vestas)
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
High Winds, CA (2003-2004)	NA	NA	2.51	90	162

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	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Montezuma I, CA (2011)	NA	NA	1.9	16	36.8
Montezuma I, CA (2012)	NA	NA	0.84	16	36.8
Montezuma II, CA (2012-2013)	NA	NA	0.91	34	78.2
Mustang Hills, CA (2012-2013)	NA	NA	0.1	50	150
Pinyon Pines I & II, CA (2013-2014)	NA	NA	0.04	100	NA
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2009-2010)	NA	NA	2.6	75	150
Shiloh II, CA (2010-2011)	NA	NA	3.8	75	150
Shiloh III, CA (2012-2013)	NA	NA	0.4	50	102.5
Solano III, CA (2012-2013)	NA	NA	0.31	55	128
Northeastern					
Beech Ridge, WV (2012)	NA	NA	2.03	67	100.5
Beech Ridge, WV (2013)	NA	NA	0.58	67	100.5
Casselman Curtailment, PA (2008)	NA	NA	4.4	23	35.4
Casselman, PA (2008)	NA	NA	12.61	23	34.5
Casselman, PA (2009)	NA	NA	8.6	23	34.5
Cohocton/Dutch Hill, NY (2009)	NA	NA	8.62	50	125
Cohocton/Dutch Hills, NY (2010)	NA	NA	10.32	50	125
Criterion, MD (2011)	NA	NA	15.61	28	70
Criterion, MD (2012)	NA	NA	7.62	28	70
Criterion, MD (2013)	NA	NA	5.32	28	70
High Sheldon, NY (2010)	NA	NA	2.33	75	112.5
High Sheldon, NY (2011)	NA	NA	1.78	75	112.5
Kibby, ME (2011)	NA	NA	0.12	44	132
Lempster, NH (2009)	NA	NA	3.11	12	24
Lempster, NH (2010)	NA	NA	3.57	12	24
Locust Ridge, PA (Phase II; 2009)	NA	NA	14.11	51	102
Locust Ridge, PA (Phase II; 2010)	NA	NA	14.38	51	102
Maple Ridge, NY (2006)	NA	NA	11.21	120	198
Maple Ridge, NY (2007)	NA	NA	6.49	195	321.75
Maple Ridge, NY (2007-2008)	NA	NA	4.96	195	321.75
Maple Ridge, NY (2012)	NA	NA	7.3	195	321.75
Mars Hill, ME (2007)	NA	NA	2.91	28	42
Mars Hill, ME (2008)	NA	NA	0.45	28	42
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	17.53	132	264
Mount Storm, WV (2010)	36.67[c]	4/18/10-10/15/10	15.18	132	264
Mount Storm, WV (2011)	NA	NA	7.43	132	264
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164
Mountaineer, WV (2003)	NA	NA	31.69	44	66
Munnsville, NY (2008)	NA	NA	1.93	23	34.5
Noble Altona, NY (2010)	NA	NA	4.34	65	97.5
Noble Bliss, NY (2008)	NA	NA	7.8	67	100

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	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Noble Bliss, NY (2009)	NA	NA	3.85	67	100
Noble Clinton, NY (2009)	1.9	8/1/09-09/31/09	4.5	67	100
Noble Chateaugay, NY (2010)	NA	NA	2.44	71	106.5
Noble Clinton, NY (2008)	2.1 [D]	8/8/08-09/31/08	3.14	67	100
Noble Clinton, NY (2009)	1.9 [D]	1/9/09-09/31/09	4.5	67	100
Noble Ellenburg, NY (2008)	NA	NA	3.46	54	80
Noble Ellenburg, NY (2009)	16.1 [D]	8/16/09-09/15/09	3.91	54	80
Noble Wethersfield, NY (2010)	NA	NA	16.3	84	126
Pinnacle, WV (2012)	NA	NA	40.2	23	55.2
Record Hill, ME (2012)	24.6	4/16/12-10/23/12	2.96	22	50.6
Record Hill, ME (2014)	NA	NA	0.55	22	50.6
Rollins, ME (2012)	NA	NA	0.18	40	60
Stetson Mountain I, ME (2009)	28.5; 0.3 [F]	7/10/09-10/15/09	1.4	38	57
Stetson Mountain I, ME (2011)	NA	NA	0.28	38	57
Stetson Mountain I, ME (2013)	NA	NA	0.18	38	57
Stetson Mountain II, ME (2010)	NA	NA	1.65	17	25.5
Stetson Mountain II, ME (2012)	NA	NA	2.27	17	25.5
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	86	197.8
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	86	197.8
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	86	197.8
Pacific Northwest					
Big Horn, WA (2006-2007)	NA	NA	1.9	133	199.5
Biglow Canyon, OR (Phase I; 2008)	NA	NA	1.99	76	125.4
Biglow Canyon, OR (Phase I; 2009)	NA	NA	0.58	76	125.4
Biglow Canyon, OR (Phase II; 2009-2010)	NA	NA	2.71	65	150
Biglow Canyon, OR (Phase II; 2010-2011)	NA	NA	0.57	65	150
Biglow Canyon, OR (Phase III; 2010-2011)	NA	NA	0.22	76	174.8
Combine Hills, OR (2011)	NA	NA	0.73	104	104
Combine Hills, OR (Phase I; 2004-2005)	NA	NA	1.88	41	41
Elkhorn, OR (2008)	NA	NA	1.26	61	101
Elkhorn, OR (2010)	NA	NA	2.14	61	101
Goodnoe, WA (2009-2010)	NA	NA	0.34	47	94
Harvest Wind, WA (2010-2012)	NA	NA	1.27	43	98.9
Hay Canyon, OR (2009-2010)	NA	NA	0.53	48	100.8
Hopkins Ridge, WA (2006)	NA	NA	0.63	83	150
Hopkins Ridge, WA (2008)	NA	NA	1.39	87	156.6
Kittitas Valley, WA (2011-2012)	NA	NA	0.12	48	100.8
Klondike II, OR (2005-2006)	NA	NA	0.41	50	75
Klondike III (Phase I), OR (2007-2009)	NA	NA	1.11	125	223.6
Klondike IIIa (Phase II), OR (2008-2010)	NA	NA	0.14	51	76.5
Klondike, OR (2002-2003)	NA	NA	0.77	16	24

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	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Leaning Juniper, OR (2006-2008)	NA	NA	1.98	67	100.5
Linden Ranch, WA (2010-2011)	NA	NA	1.68	25	50
Marengo I, WA (2009-2010)	NA	NA	0.17	78	140.4
Marengo II, WA (2009-2010)	NA	NA	0.27	39	70.2
Nine Canyon, WA (2002-2003)	NA	NA	2.47	37	48.1
Pebble Springs, OR (2009-2010)	NA	NA	1.55	47	98.7
Stateline, OR/WA (2001-2002)	NA	NA	1.09	454	299
Stateline, OR/WA (2003)	NA	NA	2.29	454	299
Stateline, OR/WA (2006)	NA	NA	0.95	454	299
Tuolumne (Windy Point I), WA (2009-2010)	NA	NA	0.94	62	136.6
Vansycle, OR (1999)	NA	NA	1.12	38	24.9
Vantage, WA (2010-2011)	NA	NA	0.4	60	90
White Creek, WA (2007-2011)	NA	NA	2.04	89	204.7
Wild Horse, WA (2007)	NA	NA	0.39	127	229
Windy Flats, WA (2010-2011)	NA	NA	0.41	114	262.2
Southeastern					
Buffalo Mountain, TN (2000-2003)	23.7 [G]	NA	31.54	3	1.98
Buffalo Mountain, TN (2005)	NA	NA	39.7	18	28.98
Southern Plains					
Barton Chapel, TX (2009-2010)	NA	NA	3.06	60	120
Big Smile, OK (2012-2013)	NA	NA	2.9	66	132
Buffalo Gap I, TX (2006)	NA	NA	0.1	67	134
Buffalo Gap II, TX (2007-2008)	NA	NA	0.14	155	233
Red Hills, OK (2012-2013)	NA	NA	0.11	82	123
Southwest					
Dry Lake I, AZ (2009-2010)	8.8	4/29/10-11/10/10	3.43	30	63
Dry Lake II, AZ (2011-2012)	11.5	5/11/11-10/26/11	1.66	31	65

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

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

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

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

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

F= 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

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

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

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Crocker, SD		This study.			
Alite, CA (09-10)		Chatfield et al. 2010	Lempster, NH (09)		Tidhar et al. 2010
Alta Wind I, CA (11-12)	Solick et al. 2010	Chatfield et al. 2012	Lempster, NH (10)		Tidhar et al. 2011
Alta Wind I-V, CA (13-14)		Chatfield et al. 2014	Linden Ranch, WA (10-11)		Enz and Bay 2011
Alta Wind II-V, CA (11-12)	Solick et al. 2010	Chatfield et al. 2012	Locust Ridge, PA (Phase II; 09)		Arnett et al.
Alta VIII, CA (12-13)		Chatfield and Bay 2014	Locust Ridge, PA (Phase II; 10)		Arnett et al.
Barton I & II, IA (10-11)		Derby et al. 2011a	Maple Ridge, NY (06)		Jain et al. 2007
Barton Chapel, TX (09-10)		WEST 2011	Maple Ridge, NY (07)		Jain et al. 2009a
Beech Ridge, WV (12)		Tidhar et al. 2013b	Maple Ridge, NY (07-08)		Jain et al. 2009d
Beech Ridge, WV (13)		Young et al. 2014b	Maple Ridge, NY (12)		Tidhar et al. 2013a
Big Blue, MN (13)		Fagen Engineering 2014	Marengo I, WA (09-10)		URS Corporation 2010b
Big Blue, MN (14)		Fagen Engineering 2015	Marengo II, WA (09-10)		URS Corporation 2010c
Big Horn, WA (06-07)		Kronner et al. 2008	Mars Hill, ME (07)		Stantec 2008a
Big Smile, OK (12-13)		Derby et al. 2013b	Mars Hill, ME (08)		Stantec 2009a
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009a	Milford I, UT (10-11)		Stantec 2011b
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010	Milford I & II, UT (11-12)		Stantec 2012b
Biglow Canyon, OR (Phase II; 09-10)		Enk et al. 2011a	Montezuma I, CA (11)		ICF International 2012
Biglow Canyon, OR (Phase II; 10-11)		Enk et al. 2012b	Montezuma I, CA (12)		ICF International 2013
Biglow Canyon, OR (Phase III; 10-11)		Enk et al. 2012a	Montezuma II, CA (12-13)		Harvey & Associates 2013
Blue Sky Green Field, WI (08; 09)	Gruver 2008	Gruver et al. 2009b	Moraine II, MN (09)		Derby et al. 2010d
Buffalo Gap I, TX (06)		Tierney 2007	Mount Storm, WV (Fall 08)	Young et al. 2009b	Young et al. 2009b
Buffalo Gap II, TX (07-08)		Tierney 2009	Mount Storm, WV (09)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Buffalo Mountain, TN (00-03)	Fiedler 2004	Nicholson et al. 2005	Mount Storm, WV (10)	Young et al. 2010a, 2011b	Young et al. 2010a, 2011b
Buffalo Mountain, TN (05)		Fiedler et al. 2007	Mount Storm, WV (11)		Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase I; 99)		Johnson et al. 2000	Mountaineer, WV (03)		Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase II; 98)		Johnson et al. 2000	Munnsville, NY (08)		Stantec 2009b
Buffalo Ridge, MN (Phase II; 99)		Johnson et al. 2000	Mustang Hills, CA (12-13)		Chatfield and Bay 2014
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Nine Canyon, WA (02-03)		Erickson et al. 2003
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Noble Altona, NY (10)		Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 99)		Johnson et al. 2000	Noble Bliss, NY (08)		Jain et al.2009e
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Noble Bliss, NY (09)		Jain et al. 2010a
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Noble Chateaugay, NY (10)		Jain et al. 2011c
Buffalo Ridge I, SD (09-10)		Derby et al. 2010b	Noble Clinton, NY (08)	Reynolds 2010a	Jain et al. 2009c
Buffalo Ridge II, SD (11-12)		Derby et al. 2012a	Noble Clinton, NY (09)	Reynolds 2010a	Jain et al. 2010b
Casselman, PA (08)		Arnett et al. 2009b	Noble Ellenburg, NY (08)		Jain et al. 2009b
Casselman, PA (09)		Arnett et al. 2010	Noble Ellenburg, NY (09)	Reynolds 2010b	Jain et al. 2010c
Casselman Curtailment, PA (08)		Arnett et al. 2009a	Noble Wethersfield, NY (10)		Jain et al. 2011a
Cedar Ridge, WI (09)	BHE Environmental 2008	BHE Environmental 2010	NPPD Ainsworth, NE (06)		Derby et al. 2007
Cedar Ridge, WI (10)	BHE Environmental 2008	BHE Environmental 2011	Palouse Wind, WA (12-13)		Stantec 2013a
Cohocton/Dutch Hill, NY (09)		Stantec 2010	Pebble Springs, OR (09-10)		Gritski and Kronner 2010b
Cohocton/Dutch Hills, NY (10)		Stantec 2011a	Pinnacle, WV (12)		Hein et al. 2013b
Combine Hills, OR (Phase I; 04-05)		Young et al. 2006	Pinyon Pines I&II, CA (13-14)		Chatfield and Russo 2014
Combine Hills, OR (11)		Enz et al. 2012	Pioneer Prairie I, IA (Phase II; 11-12)		Chodachek et al. 2012
Crescent Ridge, IL (05-06)		Kerlinger et al. 2007	Pioneer Prairie II, IA (13)		Chodachek et al. 2014
Criterion, MD (11)		Young et al. 2012a	PrairieWinds ND1 (Minot), ND (10)		Derby et al. 2011c
Criterion, MD (12)		Young et al. 2013	PrairieWinds ND1 (Minot), ND (11)		Derby et al. 2012c
Criterion, MD (13)		Young et al. 2014a	PrairieWinds SD1 (Crow Lake), SD (11-12)		Derby et al. 2012d
Crystal Lake II, IA (09)		Derby et al. 2010a	PrairieWinds SD1 (Crow Lake), SD (12-13)		Derby et al. 2013a
Diablo Winds, CA (05-07)		WEST 2006, 2008	PrairieWinds SD1, SD (13-14)		Derby et al. 2014

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

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Dillon, CA (08-09)		Chatfield et al. 2009	Rail Splitter, IL (12-13)		Good et al. 2013b
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	Record Hill, ME (12)	Stantec 2008b	Stantec 2013b
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Thompson and Bay 2012	Record Hill, ME (14)		Stantec 2015
Elkhorn, OR (08)		Jeffrey et a. 2009b	Red Hills, OK (12-13)		Derby et al. 2013c
Elkhorn, OR (10)		Enk et al. 2011b	Ripley, Ont (08)		Jacques Whitford 2009
Elm Creek, MN (09-10)		Derby et al. 2010c	Rollins, ME (12)		Stantec 2013c
Elm Creek II, MN (11-12)		Derby et al. 2012b	Rugby, ND (10-11)		Derby et al. 2011b
Foote Creek Rim, WY (Phase I; 99)		Young et al. 2003a	Shiloh I, CA (06-09)		Kerlinger et al. 2009
Foote Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003a, 2003b	Shiloh II, CA (09-10)		Kerlinger et al. 2010
Foote Creek Rim, WY (Phase I; 01-02)	Gruver 2002	Young et al. 2003a, 2003b	Shiloh II, CA (10-11)		Kerlinger et al. 2013a
Forward Energy Center, WI (08-10)	Watt and Drake 2011	Grodsky and Drake 2011	Shiloh III, CA (12-13)		Kerlinger et al. 2013b
Fowler I, IN (09)		Johnson et al. 2010a	Solano III, CA (12-13)		AECOM 2013
Fowler III, IN (09)		Johnson et al. 2010b	Stateline, OR/WA (01-02)		Erickson et al. 2004
Fowler I, II, III, IN (10)		Good et al. 2011	Stateline, OR/WA (03)		Erickson et al. 2004
Fowler I, II, III, IN (11)		Good et al. 2012	Stateline, OR/WA (06)		Erickson et al. 2007
Fowler I, II, III, IN (12)		Good et al. 2013c	Stetson Mountain I, ME (09)	Stantec 2009c	Stantec 2009c
Goodnoe, WA (09-10)		URS Corporation 2010a	Stetson Mountain I, ME (11)		Normandeau Associates 2011
Grand Ridge I, IL (09-10)		Derby et al. 2010g	Stetson Mountain I, ME (13)		Stantec 2014
Harrow, Ont (10)		NRSI 2011	Stetson Mountain II, ME (10)		Normandeau Associates 2010
Harvest Wind, WA (10-12)		Downes and Gritski 2012a	Stetson Mountain II, ME (12)		Stantec 2013e
Hay Canyon, OR (09-10)		Gritski and Kronner 2010a	Summerview, Alb (05-06)		Brown and Hamilton 2006b
Heritage Garden I, MI (2012-2014)		Kerlinger et al. 2014	Summerview, Alb (06; 07)	Baerwald 2008	Baerwald 2008
High Sheldon, NY (10)		Tidhar et al. 2012a	Top Crop I & II, IL (12-13)		Good et al. 2013a
High Sheldon, NY (11)		Tidhar et al. 2012b	Top of Iowa, IA (03)		Jain 2005
High Winds, CA (03-04)		Kerlinger et al. 2006	Top of Iowa, IA (04)	Jain 2005	Jain 2005
High Winds, CA (04-05)		Kerlinger et al. 2006	Tuolumne (Windy Point I), WA (09-10)		Enz and Bay 2010
Hopkins Ridge, WA (06)		Young et al. 2007	Vansycle, OR (99)		Erickson et al. 2000
Hopkins Ridge, WA (08)		Young et al. 2009c	Vantage, WA (10-11)		Ventus 2012
Judith Gap, MT (06-07)		TRC 2008	Wessington Springs, SD (09)		Derby et al. 2010f
Judith Gap, MT (09)		Poulton and Erickson 2010	Wessington Springs, SD (10)		Derby et al. 2011d
Kewaunee County, WI (99-01)		Howe et al. 2002	White Creek, WA (07-11)		Downes and Gritski 2012b
Kibby, ME (11)		Stantec 2012a	Wild Horse, WA (07)		Erickson et al. 2008
Kittitas Valley, WA (11-12)		Stantec Consulting Services 2012	Windy Flats, WA (10-11)		Enz et al. 2011
Klondike, OR (02-03)		Johnson et al. 2003	Winnebago, IA (09-10)		Derby et al. 2010e
Klondike II, OR (05-06)		NWC and WEST 2007	Wolfe Island, Ont (July-December 09)		Stantec Ltd. 2010b
Klondike III (Phase I), OR (07-09)		Gritski et al. 2010	Wolfe Island, Ont (July-December 10)		Stantec Ltd. 2011b
Klondike IIIa (Phase II), OR (08-10)		Gritski et al. 2011	Wolfe Island, Ont (July-December 11)		Stantec Ltd. 2012
Leaning Juniper, OR (06-08)		Gritski et al. 2008			

Appendix A2. Fatality estimates for North American wind-energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Alite, CA (2009-2010)	0.24	shrub/scrub & grassland	Chatfield et al. 2010
Alta VIII, CA (2012-2013)	0	grassland and riparian	Chatfield and Bay 2014
Alta Wind I-V, CA (2013-2014)	0.2	NA	Chatfield et al 2014
Alta Wind I, CA (2011-2012)	1.28	woodland, grassland, shrubland	Chatfield et al. 2012
Alta Wind II-V, CA (2011-2012)	0.08	desert scrub	Chatfield et al. 2012
Barton Chapel, TX (2009-2010)	3.06	agriculture/forest	WEST 2011
Barton I & II, IA (2010-2011)	1.85	agriculture	Derby et al. 2011
Beech Ridge, WV (2012)	2.03	forest	Tidhar et al. 2013
Beech Ridge, WV (2013)	0.58	forest	Young et al. 2014
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. 2013
Biglow Canyon, OR (Phase I; 2008)	1.99	agriculture/grassland	Jeffrey et al. 2009
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. 2011
Biglow Canyon, OR (Phase II; 2010-2011)	0.57	grassland/shrub-steppe, agriculture	Enk et al. 2012
Biglow Canyon, OR (Phase III; 2010-2011)	0.22	grassland/shrub-steppe, agriculture	Enk et al. 2012
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 I, SD (2009-2010)	0.16	agriculture/grassland	Derby et al. 2010
Buffalo Ridge II, SD (2011-2012)	2.81	agriculture, grassland	Derby et al. 2012
Buffalo Ridge, MN (Phase I; 1996)	NA	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase I; 1997)	NA	agriculture	Johnson et al. 2000
Buffalo Ridge, MN (Phase I; 1998)	NA	agriculture	Johnson et al. 2000
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
Buffalo Ridge, MN (Phase II; 1999)	2.59	agriculture	Johnson et al. 2000

Appendix A2. Fatality estimates for North American wind-energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
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
Casselman Curtailment, PA (2008)	4.4	forest	Arnett et al. 2009
Casselman, PA (2008)	12.61	forest	Arnett et al. 2009
Casselman, PA (2009)	8.6	forest, pasture, grassland	Arnett et al. 2010
Cedar Ridge, WI (2009)	30.61	agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	24.12	agriculture	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	8.62	agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	10.32	agriculture, forest	Stantec 2011
Combine Hills, OR (2011)	0.73	grassland/shrub-steppe, agriculture	Enz et al. 2012
Combine Hills, OR (Phase I; 2004-2005)	1.88	agriculture/grassland	Young et al. 2006
Crescent Ridge, IL (2005-2006)	3.27	agriculture	Kerlinger et al. 2007
Criterion, MD (2011)	15.61	forest, agriculture	Young et al. 2012
Criterion, MD (2012)	7.62	forest, agriculture	Young et al. 2013
Criterion, MD (2013)	5.32	forest, agriculture	Young et al. 2014
Crystal Lake II, IA (2009)	7.42	agriculture	Derby et al. 2010
Diablo Winds, CA (2005-2007)	0.82		WEST 2006, WEST 2008
Dillon, CA (2008-2009)	2.17	desert	Chatfield et al. 2009
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	Jeffery et al. 2009
Elkhorn, OR (2010)	2.14	shrub/scrub & agriculture	Enk et al. 2011
Elm Creek II, MN (2011-2012)	2.81	agriculture, grassland	Derby et al. 2012
Elm Creek, MN (2009-2010)	1.49	agriculture	Derby et al. 2010
Foote Creek Rim, WY (Phase I; 1999)	3.97	grassland	Young et al. 2003b

Appendix A2. Fatality estimates for North American wind-energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Foote Creek Rim, WY (Phase I; 2000)	1.05	grassland	Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2001-2002)	1.57	grassland	Young et al. 2003b
Forward Energy Center, WI (2008-2010)	18.17	agriculture	Grodsky and Drake 2011
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. 2013
Fowler I, IN (2009)	8.09	agriculture	Johnson et al. 2010
Fowler III, IN (2009)	1.84	agriculture	Johnson et al. 2010
Goodnoe, WA (2009-2010)	0.34	grassland and shrub-steppe	URS 2010a
Grand Ridge I, IL (2009-2010)	2.1	agriculture	Derby et al. 2010
Harrow, Ont (2010)	11.13	agriculture	Natural Resources Solutions Inc. (NRSI) 2011
Harvest Wind, WA (2010-2012)	1.27	grassland/shrub-steppe	Downes and Gristki 2012
Hay Canyon, OR (2009-2010)	0.53	agriculture	Gritski and Kronner 2010a
Heritage Garden I, MI (2012-2014)	5.9	agriculture	Curry & Kerlinger 2014
High Sheldon, NY (2010)	2.33	agriculture	Tidhar et al. 2012
High Sheldon, NY (2011)	1.78	agriculture	Tidhar et al. 2012
High Winds, CA (2003-2004)	2.51	agriculture/grassland	Kerlinger et al. 2006
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. 2009
Judith Gap, MT (2006-2007)	8.93	agriculture/grassland	TRC 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 2012
Kittitas Valley, WA (2011-2012)	0.12	sagebrush-steppe, grassland	Stantec 2012
Klondike II, OR (2005-2006)	0.41	agriculture/grassland	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
Klondike, OR (2002-2003)	0.77	agriculture/grassland	Johnson et al. 2003b
Leaning Juniper, OR (2006-2008)	1.98	agriculture	Gritski et al. 2008
Lempster, NH (2009)	3.11	grassland/forest/rocky embankments	Tidhar et al. 2010

Appendix A2. Fatality estimates for North American wind-energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Lempster, NH (2010)	3.57	grassland/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. 2010
Locust Ridge, PA (Phase II; 2010)	14.38	grassland	Arnett et al. 2010
Maple Ridge, NY (2006)	11.21	agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007-2008)	4.96	agriculture/forested	Jain et. al 2009d
Maple Ridge, NY (2007)	6.49	agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2012)	7.3	agriculture/forested	Tidhar et al. 2013
Marengo I, WA (2009-2010)	0.17	agriculture	URS 2010b
Marengo II, WA (2009-2010)	0.27	agriculture	URS 2010c
Mars Hill, ME (2007)	2.91	forest	Stantec 2008b
Mars Hill, ME (2008)	0.45	forest	Stantec 2009
Milford I & II, UT (2011-2012)	1.67	desert shrub	Stantec Consulting 2012
Milford I, UT (2010-2011)	2.05	desert shrub	Stantec Consulting 2011
Montezuma I, CA (2011)	1.9	agriculture and grassland	ICF International 2012
Montezuma I, CA (2012)	0.84	agriculture and grassland	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. 2010
Mount Storm, WV (2009)	17.53	forest	Young et. al 2009a, 2010b
Mount Storm, WV (2010)	15.18	forest	Young et al. 2010a, 2011
Mount Storm, WV (2011)	7.43	forest	Young et al. 2011; Young et al. 2012
Mount Storm, WV (Fall 2008)	6.62	forest	Young et. al 2009b
Mountaineer, WV (2003)	31.69	forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	1.93	agriculture/forest	Stantec 2009
Mustang Hills, CA (2012-2013)	0.1	grassland and riparian	Chatfield and Bay 2014
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. 2009
Noble Bliss, NY (2009)	3.85	agriculture/forest	Jain et al. 2010a
Noble Chateaugay, NY (2010)	2.44	agriculture	Jain et al. 2011b
Noble Clinton, NY (2008)	3.14	agriculture/forest	Jain et al. 2009

Appendix A2. Fatality estimates for North American wind-energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Noble Clinton, NY (2009)	4.5	agriculture/forest	Jain et al. 2010b
Noble Ellenburg, NY (2008)	3.46	agriculture/forest	Jain et al. 2009
Noble Ellenburg, NY (2009)	3.91	agriculture/forest	Jain et al. 2010c
Noble Wethersfield, NY (2010)	16.3	agriculture	Jain et al. 2011c
NPPD Ainsworth, NE (2006)	1.16	agriculture/grassland	Derby et al. 2007
Palouse Wind, WA (2012-2013)	4.23	agriculture and grassland	Stantec Consulting 2013
Pebble Springs, OR (2009-2010)	1.55	grassland	Gritski and Kronner 2010b
Pine Tree, CA (2009-2010, 2011)	NA	grassland	BioResource Consultants 2012
Pinnacle, WV (2012)	40.2	forest	Hein et al. 2013
Pinyon Pines I & II, CA (2013-2014)	0.04	NA	Chatfield and Russo 2014
Pioneer Prairie I, IA (Phase II; 2011-2012)	10.06	agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	3.83	agriculture	Chodachek et al 2014
PrairieWinds ND1 (Minot), ND (2010)	2.13	agriculture	Derby et al. 2011
PrairieWinds ND1 (Minot), ND (2011)	1.39	agriculture, grassland	Derby et al. 2012
PrairieWinds SD1, SD (2011-2012)	1.23	grassland	Derby et al. 2012
PrairieWinds SD1, SD (2012-2013)	1.05	grassland	Derby et al. 2013
PrairieWinds SD1, SD (2013-2014)	0.52	grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	11.21	agriculture	Good et al 2013
Record Hill, ME (2012)	2.96	forest	Stantec 2013
Record Hill, ME (2014)	0.55	forest	Stantec 2015
Red Hills, OK (2012-2013)	0.11	grassland	Derby et al. 2013
Ripley, Ont (2008)	4.67	agriculture	Jacques Whitford 2009
Rollins, ME (2012)	0.18	forest	Stantec 2013
Rugby, ND (2010-2011)	1.6	agriculture	Derby et al. 2011
Shiloh I, CA (2006-2009)	3.92	agriculture/grassland	Kerlinger et al. 2010
Shiloh II, CA (2009-2010)	2.6	agriculture	Curry and Kerlinger 2010, Curry & Kerlinger 2013
Shiloh II, CA (2010-2011)	3.8	agriculture	Curry & Kerlinger 2013
Shiloh III, CA (2012-2013)	0.4	NA	Curry & Kerlinger 2013
Solano III, CA (2012-2013)	0.31	NA	AECOM 2013
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

Appendix A2. Fatality estimates for North American wind-energy facilities.

Project	Bat Fatalities (bats/MW/year)	Predominant Habitat Type	Citation
Stateline, OR/WA (2006)	0.95	agriculture/grassland	Erickson et al. 2007
Stetson Mountain I, ME (2009)	1.4	forest	Stantec 2009
Stetson Mountain I, ME (2011)	0.28	forest	Normandeau Associates 2011
Stetson Mountain I, ME (2013)	0.18	forest	Stantec 2014
Stetson Mountain II, ME (2010)	1.65	forest	Normandeau Associates 2010
Stetson Mountain II, ME (2012)	2.27	forest	Stantec Consulting 2013
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 (2012-2013)	12.55	agriculture	Good et al 2013
Top of Iowa, IA (2003)	7.16	agriculture	Jain 2005
Top of Iowa, IA (2004)	10.27	agriculture	Jain 2005
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. 2010
Wessington Springs, SD (2010)	0.41	grassland	Derby et al. 2011
White Creek, WA (2007-2011)	2.04	grassland/shrub-steppe, agriculture	Downes and Gristki 2012
Wild Horse, WA (2007)	0.39	grassland	Erickson et al. 2008
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. 2010
Wolfe Island, Ont (July-December 2009)	6.42	grassland	Stantec Ltd. 2010
Wolfe Island, Ont (July-December 2010)	9.5	grassland	Stantec Ltd. 2011b
Wolfe Island, Ont (July-December 2011)	2.49	grassland	Stantec Ltd. 2012

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Alite, CA (2009-2010)	8	24	80	8	200 m x 200 m	1 year	weekly (spring, fall), bi-monthly (summer, winter)
Alta VIII, CA (2012-2013)	50	150	90	12 plots (equivalent to 15 turbines)	240 x 240 m	1 year	bi-weekly
Alta Wind I, CA (2011-2012)	100	150	80	25	120-m radius circle	12.5 months	every two weeks
Alta Wind II-V, CA (2011-2012)	190	570	80	41	120-m radius circle	14.5 months	every two weeks
Alta Wind I-V, CA (2013-2014)	290	720 (150 GE, 570 vestas)	80	55 (25 at Alta I, 30 at Alta II-V)	120 m radius circles	NA	monthly or bi-weekly
Barton Chapel, TX (2009-2010)	60	120	78	30	200 m x 200 m	1 year	10 turbines weekly, 20 monthly
Barton I & II, IA (2010-2011)	80	160	100	35 (9 turbines were dropped in June 2010 due to landowner issues) 26 turbines were searched for the remainder of the study	200 m x 200 m	1 year	weekly (spring, fall; migratory turbines), monthly (summer, winter; non-migratory turbines)
Beech Ridge, WV (2012)	67	100.5	80	67	40 m radius	7 months	every two days
Beech Ridge, WV (2013)	67	100.5	80	67	40 m radius	7.5 months	every two days
Big Blue, MN (2013)	18	36	78 or 90 (according to Gamesa website)	18	200m diameter	NA	weekly, monthly (Nov and Dec)
Big Blue, MN (2014)	18	36	78 or 90 (according to Gamesa website)	18	200m diameter	NA	weekly, monthly (Nov and Dec)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Big Horn, WA (2006-2007)	133	199.5	80	133	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Big Smile, OK (2012-2013)	66	132	78	17 (plus one met tower)	100 x 100	1 year	weekly (spring, summer, fall), monthly (winter)
Biglow Canyon, OR (Phase I; 2008)	76	125.4	80	50	110 m x 110 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase I; 2009)	76	125.4	80	50	110 m x 110 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2009-2010)	65	150	80	50	250 m x 250 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2010-2011)	65	150	80	50	252 m x 252 m	1 year	bi-weekly(spring, fall), monthly (summer, winter)
Biglow Canyon, OR (Phase III; 2010-2011)	76	174.8	80	50	252 m x 252 m	1 year	bi-weekly(spring, fall), monthly (summer, winter)
Blue Sky Green Field, WI (2008; 2009)	88	145	80	30	160 m x 160 m	fall, spring	daily(10 turbines), weekly (20 turbines)
Buena Vista, CA (2008-2009)	38	38	45-55	38	75-m radius	1 year	monthly to bi-monthly starting in September 2008
Buffalo Gap I, TX (2006)	67	134	78	21	215 m x 215 m	10 months	every 3 weeks
Buffalo Gap II, TX (2007-2008)	155	233	80	36	215 m x 215 m	14 months	every 21 days
Buffalo Mountain, TN (2000-2003)	3	1.98	65	3	50-m radius	3 years	bi-weekly, weekly, bi-monthly
Buffalo Mountain, TN (2005)	18	28.98	V47 = 65; V80 = 78	18	50-m radius	1 year	bi-weekly, weekly, bi-monthly, and 2 to 5 day intervals

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge, MN (1994-1995)	73	25	37	1994:10 plots (3 turbines/plot), 20 addition plots in Sept & Oct 1994, 1995: 30 turbines search every other week (Jan-Mar), 60 searched weekly (Apr, July, Aug) 73 searched weekly (May-June and Sept-Oct), 30 searched weekly (Nov-Dec)	100 x 100m	20 months	varies. See number turbines searched or page 44 of report
Buffalo Ridge, MN (Phase I; 1996)	73	25	36	21	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1997)	73	25	36	21	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1998)	73	25	36	21	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1999)	73	25	36	21	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1998)	143	107.25	50	40	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1999)	143	107.25	50	40	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	143	107.25	50	83	60 m x 60 m	summer, fall	bi-monthly
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	143	107.25	50	103	60 m x 60 m	summer, fall	bi-monthly
Buffalo Ridge, MN (Phase III; 1999)	138	103.5	50	30	126 m x 126 m	1 year	bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	138	103.5	50	83	60 m x 60 m	summer, fall	bi-monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	138	103.5	50	103	60 m x 60 m	summer, fall	bi-monthly
Buffalo Ridge I, SD (2009-2010)	24	50.4	79	24	200 m x 200 m	1 year	weekly (migratory), monthly (non-migratory)
Buffalo Ridge II, SD (2011-2012)	105	210	78	65 (60 road and pad, 5 turbine plots)	100 x 100m	1 year	weekly (spring, summer, fall), monthly (winter)
Casselman, PA (2008)	23	34.5	80	10	126 m x 120 m	7 months	daily
Casselman, PA (2009)	23	34.5	80	10	126 m x 120 m	7.5 months	daily searches
Casselman Curtailment, PA (2008)	23	35.4	80	12 experimental; 10 control	126 m x 120 m	2.5 months	daily
Castle River, Alb (2001-2002)	60	39.6	50	60	50-m radius	2 years	weekly, bi-weekly
Castle River, Alb (2001-2002)	60	39.6	50	60	50-m radius	2 years	weekly, bi-weekly
Cedar Ridge, WI (2009)	41	67.6	80	20	160 m x 160 m	spring, summer, fall	daily, every 4 days; late fall searched every 3 days
Cedar Ridge, WI (2010)	41	68	80	20	160 m x 160 m	1 year	Five turbines were surveyed daily, 15 turbines surveyed every 4 days in rotating groups each day. All 20 surveyed every three days during late fall
Cohocton/Dutch Hill, NY (2009)	50	125	80	17	130 m x 130 m	spring, summer, fall	daily (5 turbines), weekly (12 turbines)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Cohocton/Dutch Hills, NY (2010)	50	125	80	17	120 m x 120 m	spring, summer, fall	daily, weekly
Combine Hills, OR (Phase I; 2004-2005)	41	41	53	41	90-m radius	1 year	monthly
Combine Hills, OR (2011)	104	104	53	52 (plus 1 MET tower)	180 m x 180 m	1 year	bi-weekly(spring, fall), monthly (summer, winter)
Condon, OR	84	n/a	n/a	n/a	n/a	n/a	n/a
Crescent Ridge, IL (2005-2006)	33	49.5	80	33	70-m radius	1 year	weekly (fall, spring)
Criterion, MD (2011)	28	70	80	28	40-50m radius	7.3 months	daily
Criterion, MD (2012)	28	70	80	14	40-50m radius	7.5 months	weekly
Criterion, MD (2013)	28	70	80	14	40-50m radius	7.5 months	weekly
Crystal Lake II, IA (2009)	80	200	80	16 turbines through week 6, and then 15 for duration of study	100 m x 100 m	spring, summer, fall	3 times per week for 26 weeks
Diablo Winds, CA (2005-2007)	31	20.46	50 and 55	31	75 m x 75 m	2 years	monthly
Dillon, CA (2008-2009)	45	45	69	15	200 m x 200 m	1 year	weekly, bi-monthly in winter
Dry Lake I, AZ (2009-2010)	30	63	78	15	160 m x 160 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Dry Lake II, AZ (2011-2012)	31	65	78	31: 5 (full plot), 26 (road & pad)	160 m x 160 m	1 year	twice weekly (spring, summer, fall), weekly (winter)
Elkhorn, OR (2008)	61	101	80	61	220 m x 220 m	1 year	monthly
Elkhorn, OR (2010)	61	101	80	31	220 m x 220 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Elm Creek, MN (2009-2010)	67	100	80	29	200 m x 200 m	1 year	weekly, monthly
Elm Creek II, MN (2011-2012)	62	148.8	80	30	200 x 200m (2 random migration search areas 100 x 100m)	1 year	20 searched every 28 days, 10 turbines every 7 days during migration)
Erie Shores, Ont (2006)	66	99	80	66	40-m radius	2 years	weekly, bi-monthly, 2-3 times weekly (migration)
Foote Creek Rim, WY (Phase I; 1999)	69	41.4	40	69	126 m x 126 m	1 year	monthly
Foote Creek Rim, WY (Phase I; 2000)	69	41.4	40	69	126 m x 126 m	1 year	monthly
Foote Creek Rim, WY (Phase I; 2001-2002)	69	41.4	40	69	126 m x 126 m	1 year	monthly
Forward Energy Center, WI (2008-2010)	86	129	80	29	160 m x 160 m	2 years	11 turbines daily, 9 every 3 days, 9 every 5 days
Fowler I, IN (2009)	162	301	78 (Vestas), 80 (Clipper)	25	160 m x 160 m	spring, summer, fall	weekly, bi-weekly
Fowler I, II, III, IN (2010)	355	600	Vestas = 80, Clipper = 80, GE = 80	36 turbines, 100 road and pads	80 m x 80 m for turbines ; 40-m radius for roads and pads	spring, fall	daily, weekly
Fowler I, II, III, IN (2011)	355	600	Vestas = 80, Clipper = 80, GE = 80	177 road and pads (spring), 9 turbines & 168 roads and pads (fall)	turbines (80 m circular plot), roads and pads (out to 80 m)	spring, fall	daily, weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Fowler I, II, III, IN (2012)	355	600	Vestas = 80, Clipper = 80, GE = 80	118 roads and pads	roads and pads (out to 80 m)	2.5 months	weekly
Fowler III, IN (2009)	60	99	78	12	160 m x 160 m	10 weeks	weekly, bi-weekly
Goodnoe, WA (2009-2010)	47	94	80	24	180 m x 180 m	1 year	14 days during migration periods, 28 days during non-migration periods
Grand Ridge I, IL (2009-2010)	66	99	80	30	160 m x 160 m	1 year	weekly, monthly
Harrow, Ont (2010)	24 (four 6-turb facilities)	39.6	NA	12 in July, 24 Aug-Oct	50-m radius from turbine base	4 months	twice-weekly
Harvest Wind, WA (2010-2012)	43	98.9	80	32	180 m x 180 m & 240 m x 240 m	2 years	twice a week, weekly and monthly
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Heritage Garden I, MI (2012-2014)	14	28	90	14	120x120 m except one plot that was 280x280 m	1 years	weekly (spring, summer, and fall) and bi-weekly (winter)
High Winds, CA (2003-2004)	90	162	60	90	75-m radius	1 year	bi-monthly
High Winds, CA (2004-2005)	90	162	60	90	75-m radius	1 year	bi-monthly
Hopkins Ridge, WA (2006)	83	150	67	41	180 m x 180 m	1 year	monthly, weekly (subset of 22 turbines spring and fall migration)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Hopkins Ridge, WA (2008)	87	156.6	67	41-43	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Jersey Atlantic, NJ (2008)	5	7.5	80	5	130 m x 120 m	9 months	weekly
Judith Gap, MT (2006-2007)	90	135	80	20	190 m x 190 m	7 months	monthly
Judith Gap, MT (2009)	90	135	80	30	100 m x 100 m	5 months	bi-monthly
Kewaunee County, WI (1999-2001)	31	20.46	65	31	60 m x 60 m	2 years	bi-weekly (spring, summer), daily (spring, fall migration), weekly (fall, winter)
Kibby, ME (2011)	44	132	124	22 turbines	75-m diameter circular plots	22 weeks	avg 5-day
Kittitas Valley, WA (2011-2012)	48	100.8	80	48	100 m x 102 m	1 year	bi-weekly from Aug 15 - Oct 31 and March 16 - May 15; every 4 weeks from Nov 1 - March 15 and May 16 - Aug 14
Klondike, OR (2002-2003)	16	24	80	16	140 m x 140 m	1 year	monthly
Klondike II, OR (2005-2006)	50	75	80	25	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (summer, winter)
Klondike III (Phase I), OR (2007-2009)	125	223.6	GE = 80; Siemens= 80, Mitsubishi = 80	46	240 m x 240 m (1.5MW) 252 m x 252 m (2.3MW)	2 year	bi-monthly (spring, fall migration), monthly (summer, winter)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Klondike IIIa (Phase II), OR (2008-2010)	51	76.5	GE = 80	34	240 m x 240 m	2 years	bi-monthly (spring, fall), monthly (summer, winter)
Lakefield Wind, MN (2012)	137	205.5	80	26	100 m x 100 m	7.5 months	3 times per week
Leaning Juniper, OR (2006-2008)	67	100.5	80	17	240 m x 240 m	2 years	bi-monthly (spring, fall), monthly (winter, summer)
Lempster, NH (2009)	12	24	78	4	120 m x 130 m	6 months	daily
Lempster, NH (2010)	12	24	78	12	120 m x 130 m	6 months	weekly
Linden Ranch, WA (2010-2011)	25	50	80	25	110 m x 110 m	1 year	bi-weekly(spring, fall), monthly (summer, winter)
Locust Ridge, PA (Phase II; 2009)	51	102	80	15	120m x 126m	6.5 months	daily
Locust Ridge, PA (Phase II; 2010)	51	102	80	15	120m x 126m	6.5 months	daily
Madison, NY (2001-2002)	7	11.55	67	7	60-m radius	1 year	weekly (spring, fall), monthly (summer)
Maple Ridge, NY (2006)	120	198	80	50	130 m x 120 m	5 months	daily (10 turbines), every 3 days (10 turbines), weekly (30 turbines)
Maple Ridge, NY (2007)	195	321.75	80	64	130 m x 120 m	7 months	weekly
Maple Ridge, NY (2007-2008)	195	321.75	80	64	130 m x 120 m	7 months	weekly
Maple Ridge, NY (2012)	195	321.75	80	105 (5 turbines, 100 roads/pads)	100 m x 100 m	3 months	weekly
Marengo I, WA (2009-2010)	78	140.4	67	39	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Marengo II, WA (2009-2010)	39	70.2	67	20	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Mars Hill, ME (2007)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	spring, summer, fall	daily (2 random turbines), weekly (all turbines): extended plot searched once per season
Mars Hill, ME (2008)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	spring, summer, fall	weekly: extended plot searched once per season
McBride, Alb (2004)	114	75	50	114	4 parallel transects 120-m wide	1 year	weekly, bi-weekly
Melancthon, Ont (Phase I; 2007)	45	NA	NA	45	35m radius	5 months	weekly, twice weekly
Meyersdale, PA (2004)	20	30	80	20	130 m x 120 m	6 weeks	daily (half turbines), weekly (half turbines)
Milford I & II, UT (2011-2012)	107	160.5 (58.5 I, 102 II)	80	43	120x120	NA	every 10.5 days
Milford I, UT (2010-2011)	58	145	80	24	120x120	NA	weekly
Montezuma I, CA (2011)	16	36.8	80	16	105 m radius	1 year	Weekly and bi-Weekly
Montezuma I, CA (2012)	16	36.8	80	16	105 m radius	1 year	Weekly and bi-Weekly
Montezuma II, CA (2012-2013)	34	78.2	80	17	105 m radius	1 year	Weekly
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	weekly (migratory), monthly (non-migratory)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Mount Storm, WV (2009)	132	264	78	44	varied	4.5 months	weekly (28 turbines), daily (16 turbines)
Mount Storm, WV (2010)	132	264	78	24	20 to 60 m from turbine	6 months	daily
Mount Storm, WV (2011)	132	264	78	24	varied	6 months	daily
Mount Storm, WV (Fall 2008)	82	164	78	27	varied	3 months	weekly (18 turbines), daily (9 turbines)
Mountaineer, WV (2003)	44	66	80	44	60-m radius	7 months	weekly, monthly
Mountaineer, WV (2004)	44	66	80	44	130 m x 120 m	6 weeks	daily, weekly
Munnsville, NY (2008)	23	34.5	69.5	12	120 m x 120 m	spring, summer, fall	weekly
Mustang Hills, CA (2012-2013)	50	150	90	13 plots (equivalent to 15 turbines)	240 x 240 m	1 year	bi-weekly
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	bi-monthly (spring, summer, fall), monthly (winter)
Nine Canyon II, WA (2004)	12	15.6	60	12	90 m x 90 m	3 months	once every two weeks
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	spring, summer, fall	daily, weekly
Noble Altona, NY (2011)	65	97.5	80	22	120m x 120m	2 months	daily
Noble Bliss, NY (2008)	67	100	80	23	120 m x 120 m	spring, summer, fall	daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Bliss, NY (2009)	67	100	80	23	120 m x 120 m	spring, summer, fall	weekly, 8 turbines searched daily from July 1 to August 15

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Noble Bliss/Wethersfield, NY (2011)	151	226	80	48 (24 from each site:12 ag, 12 forest)	road & pad 70 m out from turbine	2 months	daily
Noble Chateaugay, NY (2010)	71	106.5	80	24	120 m x 120 m	spring, summer, fall	weekly
Noble Clinton, NY (2008)	67	100	80	23	120 m x 120 m	spring, summer, fall	daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Clinton, NY (2009)	67	100	80	23	120 m x 120 m	spring, summer, fall	daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15
Noble Ellenburg, NY (2008)	54	80	80	18	120 m x 120 m	spring, summer, fall	daily (6 turbines), 3-day (6 turbines), weekly (6 turbines)
Noble Ellenburg, NY (2009)	54	80	80	18	120 m x 120 m	spring, summer, fall	daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15
Noble Wethersfield, NY (2010)	84	126	80	28	120 m x 120 m	spring, summer, fall	weekly
NPPD Ainsworth, NE (2006)	36	20.5	70	36	220 m x 220 m	spring, summer, fall	bi-monthly
Oklahoma Wind Energy Center, OK (2004; 2005)	68	102	70	68	20m radius	3 months (2 years)	bi-monthly
Pacific, CA (2012-2013)	70	140	78.5	20	126 m radius	NA	Twice weekly (fall), and biweekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Palouse Wind, WA (2012-2013)	58	104.4	80, 90, or 105 M (according to the Vestas website)	19	120m x 120m	1 year	Montly (Winter) and Weekly (Spring-Fall)
Pebble Springs, OR (2009-2010)	47	98.7	79	20	180 m x 180 m	1 year	bi-monthly (spring, fall), monthly (winter, summer)
Pine Tree, CA (2009-2010, 2011)	90	135	65	40	100 m radius	1.5 year	bi-weekly, weekly
Pinnacle, WV (2012)	23	55.2	80	11	126 m x 120m	9 months	weekly
Pinnacle Operational Mitigation Study (2012)	23	55.2	80	12	126m x 120m	2.5 months	daily
Pinyon Pines I & II, CA (2013-2014)	100	NA	90	25 plots (aprox 31 turbines)	240x240 m	NA	bi-weekly
Pioneer Prairie II, IA (2013)	62	102.3	80	62	80x80 m (5 turbines), road and pad within 100 m of turbine (57 turbines)	NA	weekly
Pioneer Prairie I, IA (Phase II; 2011-2012)	62	102.3	80	62 (57 road/pad) 5 full search plots	80 x 80m	1 year	weekly (spring and fall), every two weeks (summer), monthly (winter)
Pioneer Trail, IL (2012-2013)	94	150.5	NA	50	80x80m	fall, spring	weekly
Prairie Rose, MN (2014)	119	200	80	10	100x100m	6 months	weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200 x 200m	1 year	bi-weekly
PrairieWinds SD1, SD (2013-2014)	108	162	80	45	200 x 200m	1 year	twice monthly (spring, summer, fall), monthly (winter)
PrairieWinds ND1 (Minot), ND (2010)	80	115.5	89	35	minimum of 100 m x 100 m	3 seasons	bi-monthly
PrairieWinds ND1 (Minot), ND (2011)	80	115.5	80	35	minimum 100 x 100m	3 season	twice monthly
PrairieWinds SD1, SD (2011-2012)	108	162	80	50	200 x 200m	1 year	twice monthly (spring, summer, fall), monthly (winter)
Rail Splitter, IL (2012-2013)	67	100.5	80	34	60 m radius	1 year	weekly (spring, summer, and fall) and bi-weekly (winter)
Record Hill, ME (2012)	22	50.6	80	22	126.5x126.5	5 months	three times every two weeks
Record Hill, ME (2014)	22	50.6	80	10	varied due to steep terrain and heavily vegetated areas	4.5 months	daily for 5 days a week
Red Canyon, TX (2006-2007)	56	84	70	28	200 m x 200 m in fall and winter; 160 m x 160 m in spring and summer	1 year	every 14 days in fall and winter; 7 days in spring, 3 days in summer
Red Hills, OK (2012-2013)	82	123	80	20 (plus one met tower)	100 x 100	1 year	weekly (spring, summer, fall), monthly (winter)

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Ripley, Ont (2008)	38	76	64	38	80 m x 80 m	spring, fall	twice weekly for odd turbines; weekly for even turbines.
Ripley, Ont (2008-2009)	38	76	64	38	80 m x 80 m	6 weeks	twice weekly for odd turbines; weekly for even turbines.
Rollins, ME (2012)	40	60	80	20	varied; turbine laydown area and gravel access roads out to 60m	6 months	weekly
Roth Rock, MD (2011)	20	50	80	10	80m x 80m	3 months	daily
Rugby, ND (2010-2011)	71	149	78	32	200 m x 200 m	1 year	weekly (spring, fall; migratory turbines), monthly (non-migratory turbines)
San Gorgonio, CA (1997-1998; 1999-2000)	3000	n/a		24.4-42.7	50-m radius	2 years	quarterly
Searsburg, VT (1997)	11	7	65	11	20- to 55-m radius	spring, fall	weekly (fall migration)
Sheffield, VT (2012)	16	40	80	8	126m x 120m	3 months	daily
Sheffield Operational Mitigation Study (2012)	16	40	80	16	126m x 120m	4 months	daily
High Sheldon, NY (2010)	75	112.5	80	25	115 m x 115 m	7 months	daily (8 turbines), weekly (17 turbines)
High Sheldon, NY (2011)	75	112.5	80	25	115 m x 115 m	7 months	daily (8 turbines), weekly (17 turbines)
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	weekly
Shiloh II, CA (2009-2010)	75	150	80	25	100m radius	1 year	weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Shiloh II, CA (2010-2011)	75	150	80	25	100 m radius	1 year	weekly
Shiloh III, CA (2012-2013)	50	102.5	78.5	25	100 m radius	NA	weekly
SMUD Solano, CA (2004-2005)	22	15	65	22	60-m radius	1 year	bi-monthly
Solano III, CA (2012-2013)	55	128	80	19	100 m radius	NA	bi-Weekly
Spruce Mountain, ME (2012)	10	20	78	10	100 m x 100 m	7 months	weekly
Stateline, OR/WA (2001-2002)	454	299	50	124	minimum 126 m x 126 m	17 months	bi-weekly, monthly
Stateline, OR/WA (2003)	454	299	50	153	minimum 126 m x 126 m	1 year	bi-weekly, monthly
Stateline, OR/WA (2006)	454	299	50	39	variable turbine strings	1 year	bi-weekly
Steel Winds I & II, NY (2012)	14	35	80	8 (1 was just gravel pad)	120m x 120m	6 months	weekly, bi-weekly (November only)
Steel Winds I, NY (2007)	8	20	80	8	176m x 176m	6.5 months	every 10 days (spring, fall) every 21 days (summer)
Stetson Mountain I, ME (2009)	38	57	80	19	76-m diameter	27 weeks (spring, summer, fall)	weekly
Stetson Mountain I, ME (2011)	38	57	80	19	79.45x79.45m	6 months	weekly
Stetson Mountain I, ME (2013)	38	57	80	19	76 m diameter	6 months	weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	74.5x74.5m	6 months	weekly (3 turbines twice a week)
Stetson Mountain II, ME (2012)	17	25.5	80	17	laydown area and road up to 60m	6 months	weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Summerview, Alb (2005-2006)	39	70.2	67	39	140 m x 140 m	1 year	weekly, bi-weekly (May to July, September)
Summerview, Alb (2006; 2007)	39	70.2	65	39	52-m radius; 2 spiral transects 7 m apart	summer, fall (2 years)	daily (10 turbines), weekly (29 turbines)
Tehachapi, CA (1996-1998)	3300	n/a	14.7 to 57.6	201	50-m radius	20 months	quarterly
Top Crop I & II (2012-2013)	68 (phase I) 132 (phase (II)	300 (102 (phase I) 198 (phase II))	65 (phase I) 80 (phase II)	100	61 m radius	1 year	weekly (spring, summer, and fall) and bi-weekly (winter)
Top of Iowa, IA (2003)	89	80	71.6	26	76 m x 76 m	spring, summer, fall	once every 2 to 3 days
Top of Iowa, IA (2004)	89	80	71.6	26	76 m x 76 m	spring, summer, fall	once every 2 to 3 days
Tuolumne (Windy Point I), WA (2009-2010)	62	136.6	80	21	180 m x 180 m	1 year	monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall
Vansycle, OR (1999)	38	24.9	50	38	126 m x 126 m	1 year	monthly
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	monthly, a subset of 10 searched weekly during migration
Vasco, CA (2012-2013)	34	78.2	80	34	105 m radius	1 year	weekly, monthly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Wessington Springs, SD (2009)	34	51	80	20	200 m x 200 m	spring, summer, fall	bi-monthly
Wessington Springs, SD (2010)	34	51	80	20	200 m x 200 m	8 months	bi-weekly (spring, summer, fall)
White Creek, WA (2007-2011)	89	204.7	80	89	180 m x 180 m & 240 m x 240 m	4 years	twice a week, weekly and monthly
Wild Horse, WA (2007)	127	229	67	64	110 m from two turbines in plot	1 year	monthly, weekly (fall, spring migration at 16 turbines)
Windy Flats, WA (2010-2011)	114	262.2	80	36 (plus 1 MET tower)	180 m x 180 m (120m at MET tower)	1 year	monthly (spring, summer, fall, and winter), weekly (spring and fall migration)
Winnebago, IA (2009-2010)	10	20	78	10	200 m x 200 m	1 year	weekly (migratory), monthly (non-migratory)
Wolfe Island, Ont (May-June 2009)	86	197.8	80	86	60-m radius	spring	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2009)	86	197.8	80	86	60-m radius	summer, fall	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2010)	86	197.8	80	86	60-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2010)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2011)	86	197.8	80	86	50m radius	6 months	43 twice weekly, 43 weekly

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower size (m)	Number turbines searches	Plot Size	Length of Study	Survey Frequency
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2012)	86	197.8	NA	86	50 m radius	NA	1/2 searched twice weekly, 1/2 searched weekly

Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology. Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Alite, CA (09-10)	Chatfield et al. 2010	Marengo I, WA (09-10)	URS Corporation 2010b
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Marengo II, WA (09-10)	URS Corporation 2010c
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Mars Hill, ME (07)	Stantec 2008a
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Mars Hill, ME (08)	Stantec 2009a
Alta VIII, CA (12-13)	Chatfield and Bay 2014	McBride, Alb (04)	Brown and Hamilton 2004
Barton I & II, IA (10-11)	Derby et al. 2011a	Melancthon, Ont (Phase I; 07)	Stantec Ltd. 2008
Barton Chapel, TX (09-10)	WEST 2011	Meyersdale, PA (04)	Arnett et al. 2005
Beech Ridge, WV (12)	Tidhar et al. 2013b	Milford I, UT (10-11)	Stantec 2011b
Beech Ridge, WV (13)	Young et al. 2014b	Milford I & II, UT (11-12)	Stantec 2012b
Big Blue, MN (13)	Fagen Engineering 2014	Montezuma I, CA (11)	ICF International 2012
Big Blue, MN (14)	Fagen Engineering 2015	Montezuma I, CA (12)	ICF International 2013
Big Horn, WA (06-07)	Kronner et al. 2008	Montezuma II, CA (12-13)	Harvey & Associates 2013
Big Smile, OK (12-13)	Derby et al. 2013b	Moraine II, MN (09)	Derby et al. 2010d
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Mount Storm, WV (Fall 08)	Young et al. 2009b
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Mountaineer, WV (03)	Kerns and Kerlinger 2004
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009b	Mountaineer, WV (04)	Arnett et al. 2005
Buena Vista, CA (08-09)	Insignia Environmental 2009	Munnsville, NY (08)	Stantec 2009b
Buffalo Gap I, TX (06)	Tierney 2007	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Buffalo Gap II, TX (07-08)	Tierney 2009	Nine Canyon, WA (02-03)	Erickson et al. 2003
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Nine Canyon II, WA (04)	Erickson et al. 2005
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (94-95)	Osborn et al. 1996, 2000	Noble Altona, NY (11)	Kerlinger et al. 2011b
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000	Noble Bliss, NY (08)	Jain et al.2009e
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000	Noble Bliss/Wethersfield, NY (11)	Kerlinger et al. 2011a
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000	Noble Clinton, NY (08)	Jain et al. 2009c
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000	Noble Clinton, NY (09)	Jain et al. 2010b
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Noble Ellenburg, NY (08)	Jain et al. 2009b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Noble Ellenburg, NY (09)	Jain et al. 2010c
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000	Noble Wethersfield, NY (10)	Jain et al. 2011a
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	NPPD Ainsworth, NE (06)	Derby et al. 2007
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Oklahoma Wind Energy Center, OK (04; 05)	Piorkowski and O'Connell 2010
Buffalo Ridge I, SD (09-10)	Derby et al. 2010b	Pacific, CA (12-13)	Sapphos 2014
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Palouse Wind, WA (12-13)	Stantec 2013a
Casselman, PA (08)	Arnett et al. 2009b	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Casselman, PA (09)	Arnett et al. 2010	Pine Tree, CA (09-10, 11)	BioResource Consultants 2012
Casselman Curtailment, PA (08)	Arnett et al. 2009a	Pinnacle, WV (12)	Hein et al. 2013b
Castle River, Alb. (01)	Brown and Hamilton 2006a	Pinnacle Operational Mitigation Study (12)	Hein et al. 2013c
Castle River, Alb. (02)	Brown and Hamilton 2006a	Pinyon Pines I & II, CA (13-14)	Chatfield and Russo 2014
Cedar Ridge, WI (09)	BHE Environmental 2010	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
Cedar Ridge, WI (10)	BHE Environmental 2011	Pioneer Prairie II, IA (13)	Chodachek et al. 2014
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Pioneer Trail, IL (12-13)	ARCADIS 2013
Cohocton/Dutch Hills, NY (10)	Stantec 2011a	Prairie Rose, MN (14)	Chodachek et al. 2015
Combine Hills, OR (Phase I; 04-05)	Young et al. 2006	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c
Combine Hills, OR (11)	Enz et al. 2012	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Condon, OR	Fishman Ecological Services 2003	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Criterion, MD (11)	Young et al. 2012a	PrairieWinds SD1 (Crow Lake), SD (13-14)	Derby et al. 2014
Criterion, MD (12)	Young et al. 2013	Rail Splitter, IL (12-13)	Good et al. 2013b
Criterion, MD (13)	Young et al. 2014a	Record Hill, ME (12)	Stantec 2013b
Crystal Lake II, IA (09)	Derby et al. 2010a	Record Hill, ME (14)	Stantec 2015
Diablo Winds, CA (05-07)	WEST 2006, 2008	Red Canyon, TX (06-07)	Miller 2008
Dillon, CA (08-09)	Chatfield et al. 2009	Red Hills, OK (12-13)	Derby et al. 2013c
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Ripley, Ont (08)	Jacques Whitford 2009
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Ripley, Ont (08-09)	Golder Associates 2010
Elkhorn, OR (08)	Jeffrey et a. 2009b	Rollins, ME (12)	Stantec 2013c
Elkhorn, OR (10)	Enk et al. 2011b	Roth Rock, MD (11)	Atwell 2012
Elm Creek, MN (09-10)	Derby et al. 2010c	Rugby, ND (10-11)	Derby et al. 2011b
Elm Creek II, MN (11-12)	Derby et al. 2012b	San Gorgonio, CA (97-98; 99-00)	Anderson et al. 2005
Erie Shores, Ont. (06)	James 2008	Searsburg, VT (97)	Kerlinger 2002a
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003a	Sheffield, VT (12)	Martin et al. 2013

Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology. Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003a	Sheffield Operational Mitigation Study (12)	Martin et al. 2013
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003a	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010
Fowler I, IN (09)	Johnson et al. 2010a	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
Fowler I, II, III, IN (10)	Good et al. 2011	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
Fowler I, II, III, IN (11)	Good et al. 2012	SMUD Solano, CA (04-05)	Erickson and Sharp 2005
Fowler I, II, III, IN (12)	Good et al. 2013c	Solano III, CA (12-13)	AECOM 2013
Fowler III, IN (09)	Johnson et al. 2010b	Spruce Mountain, ME (12)	Tetra Tech 2013
Goodnoe, WA (09-10)	URS Corporation 2010a	Stateline, OR/WA (01-02)	Erickson et al. 2004
Grand Ridge I, IL (09-10)	Derby et al. 2010g	Stateline, OR/WA (03)	Erickson et al. 2004
Harrow, Ont (10)	Natural Resource Solutions 2011	Stateline, OR/WA (06)	Erickson et al. 2007
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Steel Winds I, NY (07)	Grehan 2008
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Steel Winds I & II, NY (12)	Stantec 2013d
Heritage Garden I, MI (12-14)	Kerlinger et al. 2014	Stetson Mountain I, ME (09)	Stantec 2009c
High Sheldon, NY (10)	Tidhar et al. 2012a	Stetson Mountain I, ME (11)	Normandeau Associates 2011
High Sheldon, NY (11)	Tidhar et al. 2012b	Stetson Mountain I, ME (13)	Stantec 2014
High Winds, CA (03-04)	Kerlinger et al. 2006	Stetson Mountain II, ME (10)	Normandeau Associates 2010
High Winds, CA (04-05)	Kerlinger et al. 2006	Stetson Mountain II, ME (12)	Stantec 2013e
Hopkins Ridge, WA (06)	Young et al. 2007	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Hopkins Ridge, WA (08)	Young et al. 2009c	Summerview, Alb (06; 07)	Baerwald 2008
Jersey Atlantic, NJ (08)	NJAS 2008a, 2008b, 2009	Tehachapi, CA (96-98)	Anderson et al. 2004
Judith Gap, MT (06-07)	TRC 2008	Top Crop I & II, IL (12-13)	Good et al. 2013a
Judith Gap, MT (09)	Poulton and Erickson 2010	Top of Iowa, IA (03)	Jain 2005
Kewaunee County, WI (99-01)	Howe et al. 2002	Top of Iowa, IA (04)	Jain 2005
Kibby, ME (11)	Stantec 2012a	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Kittitas Valley, WA (11-12)	Stantec Consulting 2012	Vansycle, OR (99)	Erickson et al. 2000
Klondike, OR (02-03)	Johnson et al. 2003	Vantage, WA (10-11)	Ventus Environmental Solutions 2012
Klondike II, OR (05-06)	NWC and WEST 2007	Vasco, CA (12-13)	Brown et al. 2013
Klondike III (Phase I), OR (07-09)	Gritski et al. 2010	Wessington Springs, SD (09)	Derby et al. 2010f
Klondike IIIa (Phase II), OR (08-10)	Gritski et al. 2011	Wessington Springs, SD (10)	Derby et al. 2011d
Lakefield Wind, MN (12)	MPUC 2012	White Creek, WA (07-11)	Downes and Gritski 2012b
Leaning Juniper, OR (06-08)	Gritski et al. 2008	Wild Horse, WA (07)	Erickson et al. 2008
Lempster, NH (09)	Tidhar et al. 2010	Windy Flats, WA (10-11)	Enz et al. 2011
Lempster, NH (10)	Tidhar et al. 2011	Winnebago, IA (09-10)	Derby et al. 2010e
Linden Ranch, WA (10-11)	Enz and Bay 2011	Wolfe Island, Ont (May-June 09)	Stantec Ltd. 2010a
Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011	Wolfe Island, Ont (July-December 09)	Stantec Ltd. 2010b
Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011	Wolfe Island, Ont (January-June 10)	Stantec Ltd. 2011a
Madison, NY (01-02)	Kerlinger 2002b	Wolfe Island, Ont (July-December 10)	Stantec Ltd. 2011b
Maple Ridge, NY (06)	Jain et al. 2007	Wolfe Island, Ont (January-June 11)	Stantec Ltd. 2011c
Maple Ridge, NY (07)	Jain et al. 2009a	Wolfe Island, Ont (July-December 11)	Stantec Ltd. 2012
Maple Ridge, NY (07-08)	Jain et al. 2009d	Wolfe Island, Ont (January-June 12)	Stantec Ltd. 2014
Maple Ridge, NY (12)	Tidhar et al. 2013a		