First Annual Report of Post-Construction Wildlife Studies at the Ocotillo Express Wind Energy Facility Imperial County, California

August 26, 2013 – September 29, 2014

Final Report

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EXECUTIVE SUMMARY

Pattern Energy, through Ocotillo Express Wind LLC (OE LLC) owns and operates the Ocotillo Express Wind Energy Facility (OWEF or Project) in Imperial County, California, which consists of 112 Siemens 2.3-megawatt (MW) wind turbines. An Environmental Impact Statement (EIS) / Environmental Impact Report (EIR) was prepared for the Project. The Final EIS/EIR was released in February of 2012 and in May of 2012. The Bureau of Land Management (BLM) released a Record of Decision (ROD) approving the development of the OWEF. The OWEF was constructed in 2012 and 2013, with the Project becoming fully operational in the fall of 2013.

In accordance with BLM Instruction Memorandum No. 2010-156, an Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the project in consultation with the appropriate agencies and identified measures that OWEF would implement to avoid, minimize, and mitigate project-related impacts to birds and bats.

The Final EIS/EIR and associated ABPP and ECP identified post-construction monitoring studies and associated protocols for the OWEF. The ABPP required multiyear, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the first full year of post-construction wildlife monitoring studies for the OWEF including the first standardized year-long fatality monitoring study and avian use studies as well as comparisons of the first-year fatality rates to reported fatality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and provided to the Technical Advisory Committee (TAC). In addition, additional carcass discoveries that occurred prior to the start of the standardized year-long survey or during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility are provided to the agencies on a monthly basis.

The OWEF consists primarily of BLM land and a small portion of private land consisting of approximately 12,565 acres (5,085 hectares), and is located approximately five miles (eight kilometers) west of Ocotillo, California. Topography within the OWEF is generally considered flat, although there are several desert washes that cut throughout the site and there is more abrupt topography outside of the Project to the west and north. Land cover generally consists of a variety of desert scrub habitat types.

The first year of standardized year-long fatality monitoring began at the OWEF in October, 2013. Standardized carcass searches were conducted at 33 of the 112 turbines twice a month for a full year (October 2013 - September 2014). Two different plot sizes were searched during the study, including 160 X 160-meter (m; 525 X 525-foot [ft]) plots at 28 turbines and 270 X 270-m (886 X 886-ft) plots at five turbines. Searcher efficiency trials were conducted to develop estimates of the proportion of casualties which were not detected by searchers (searcher detection bias). Searcher efficiency trials were conducted throughout the year to encompass

variable field conditions that may affect surveyor carcass detection. Carcass removal trials were conducted to estimate the average length of time a carcass remained in the search plots and was available for detection by searchers. Carcass removal trials were conducted throughout the year to incorporate the effects of varying field conditions on scavenger densities.

Twenty-four rounds of searches were conducted at the 33 designated search turbines, for a total of 792 turbine searches. In total, 40 fatalities (14 bats and 26 birds) were documented from October 4, 2013, through September 29, 2014, during the first standardized year-long mortality monitoring study or incidentally during the study period. White-throated swift was the most commonly identified bird fatality (five fatalities), while no more than two fatalities were documented for other identified bird species. One red-tailed hawk (discovered incidentally) was the only raptor fatality identified during the study. One Bird of Conservation Concern in Bird Conservation Region 33 (yellow warbler) was identified during the study and no other sensitive bird species were identified. Cumulatively, no more than three bird fatalities were documented at a single turbine during the year of surveys. There was no strong pattern in the spatial distribution of bird fatalities within the project. Bird fatalities were documented throughout much of the year, although there were no fatalities identified during the summer period.

A total of 14 bat fatalities were found during the first year of standardized year-long fatality monitoring studies, with nine bats documented during scheduled turbine searches and five documented incidentally (two of the incidental bat discoveries were within standardized search plots and three were outside of standardized search plots). Mexican free-tailed bat was by far the most commonly documented fatality (11 fatalities); while canyon bat (two fatalities) and unidentified Lasiurus bat (one fatality) were the only other bat species identified as fatalities during the study. There were no sensitive bat species identified during the first standardized year-long mortality monitoring study or incidentally during the study period. No more than two bat fatalities were identified at any one turbine during the study and there were no strong patterns in the spatial distribution of bat fatalities identified during the study. Temporally, bat fatalities were concentrated in the late spring and late summer – early fall seasons.

Searcher efficiency trials included 129 small bird and 53 large bird trial carcasses. Bat carcasses were not used during searcher efficiency trials due to the small number of bats available from the site, and as such, searcher efficiency trial data for small birds was used for bats. The overall searcher efficiency rate for small birds (and bats) was 73.4%, while the efficiency rate for large birds was 94.3%. Carcass removal trials included 76 large bird, 100 small bird, and four bat carcasses. Average removal times did not differ significantly for small birds and bats in the spring season, therefore, removal times for small birds and bats were combined into a single estimate. In addition, average removal times did not differ significantly among the spring, summer, and fall seasons, therefore, average removal times were calculated across the three seasons for each size class (small birds/bats and large birds) for use in the analyses. Average removal times did differ for small birds in the winter season and so only the winter removal trials were applied to the winter season for small birds. No bat carcasses were discovered in the winter season. During the spring, summer, and fall seasons, the average

removal time for small birds/bats was 3.45 days, while the average removal time for large birds was 8.8 days. During the winter season, the average removal time for small birds was 5.5 days.

Fatality estimates and 90% confidence intervals were calculated for birds and bats. For small birds and bats in the spring, summer, and fall, the probability that a carcass would remain in a search plot and be found by a searcher was 0.17. For small birds and bats in the winter, the probability that a carcass would remain in the search plot and be found by a searcher was 0.25. For large birds, the probability was 0.45 across all seasons. Annual fatality rates for all birds, adjusted for searcher efficiency and carcass removal, was 0.88 fatalities/MW/year, and the annual adjusted fatality rate for bats was 0.90 fatalities/MW/year.

The estimated overall bird fatality rate of 0.88 birds/MW/year was low compared to other wind energy facilities in California and the desert southwest with publicly available data, where estimates have ranged from 0.55 to 8.3 birds/MW/year. The overall bird fatality rate at the OWEF ranked 2nd lowest compared to 12 other studies at facilities in California and the desert southwest. Based on the data, it is unlikely that operation of the OWEF will result in significant impacts to local or regional bird populations.

The estimated overall bat fatality rate at the OWEF (0.90 bats/MW/year) was also low compared to other wind energy facilities in California and the desert southwest with publicly available bat fatality data, where bat fatality rates ranged from 0.08 to 3.92 bats/MW/year. Based on the relatively small estimate of bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bat populations.

Twenty-six rounds of fixed-point avian use surveys were conducted at twenty-one survey stations from August 26, 2013, through September 29, 2014, resulting in 546 fixed-point surveys. Twenty-nine unique bird species were documented, but common raven, black-throated sparrow, and house finch accounted for a majority (43%) of all observations. Raptor use was low throughout all seasons, and varied from 0.05 raptors per 800-m (2,625-ft) plot per 30-min survey during the fall to 0.09 raptors/800-m plot/30-min survey during the spring. Red-tailed hawk accounted for the majority of observed raptor use. Passerine use varied from a low of 0.56 birds/100-m plot/30-min survey in the summer to a high of 1.1 birds/100-m plot/30-min survey in the spring. Black-throated sparrow, cactus wren, house finch, and rock wren were the most commonly observed small bird/passerine species, and accounted for between 17% and 56% of passerine use across all seasons.

During the 2013-2014 avian use study, common raven, black throated sparrow, house finch, cactus wren, and rock wren were the most abundant bird species. All of these species were also among the most abundant species observed during the pre-construction studies. However, avian abundance was significantly lower during the 2013-2014 study compared to the pre-construction study. There are a number of factors that may influence the observed results including the use of different observers and environmental conditions (e.g. drought conditions).

The results of the first year of standardized studies have provided new insights into the effects of the OWEF on wildlife, which are primarily supportive of the low level of predicted risk of the project on wildlife. The first year of studies found that impacts to birds (including raptors) and bats were low and that the operation of the OWEF is unlikely to result in significant impacts to local or regional bird or bat populations.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

Pattern Energy, through Ocotillo Express LLC (OE LLC) owns and operates the Ocotillo Express Wind Energy Facility (OWEF or Project) in Imperial County, California (Figure 1). An Environmental Impact Statement (EIS) / Environmental Impact Report (EIR) was prepared for the Project. The Final EIS/EIR was released in February of 2012 and in May of 2012 the Bureau of Land Management (BLM) released a Record of Decision (ROD) approving the development of the OWEF. The OWEF was constructed in 2012 and 2013 with the Project becoming fully operational in the fall of 2013.

In accordance with BLM Instruction Memorandum No. 2010-156, an Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the project and incorporated as Appendices to the Final EIS/EIR. The ABPP and ECP were developed in consultation with the appropriate agencies and identify measures that OWEF will implement to avoid, minimize, and mitigate project-related impacts to birds and bats.

The ABPP included provisions for a Technical Advisory Committee (TAC) that was formed to monitor OWEF activities, including mortality data, and to evaluate the need for any avoidance/minimization or mitigation measures. The TAC consists of representatives from the BLM, U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Wildlife (CDFW). The TAC has reviewed and approved the post-construction wildlife monitoring protocols, and has and will continue to review monitoring results, and provide advice and recommendations to the BLM Authorized Officer on developing and implementing effective measures to monitor, avoid, minimize, and mitigate impacts to avian and bat species and their habitats related to operations.

The Final EIS/EIR and associated ABPP and ECP identified post-construction monitoring studies and associated protocols for the OWEF. The ABPP required multiyear, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the first full year of post-construction wildlife monitoring studies for the OWEF including the first standardized year-long fatality monitoring study and avian use studies, as well as comparisons of the first-year fatality rates to reported fatality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and provided to the TAC. In addition, additional carcass discoveries that occurred prior to the start of the standardized year-long survey or during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility are provided to the agencies on a monthly basis.

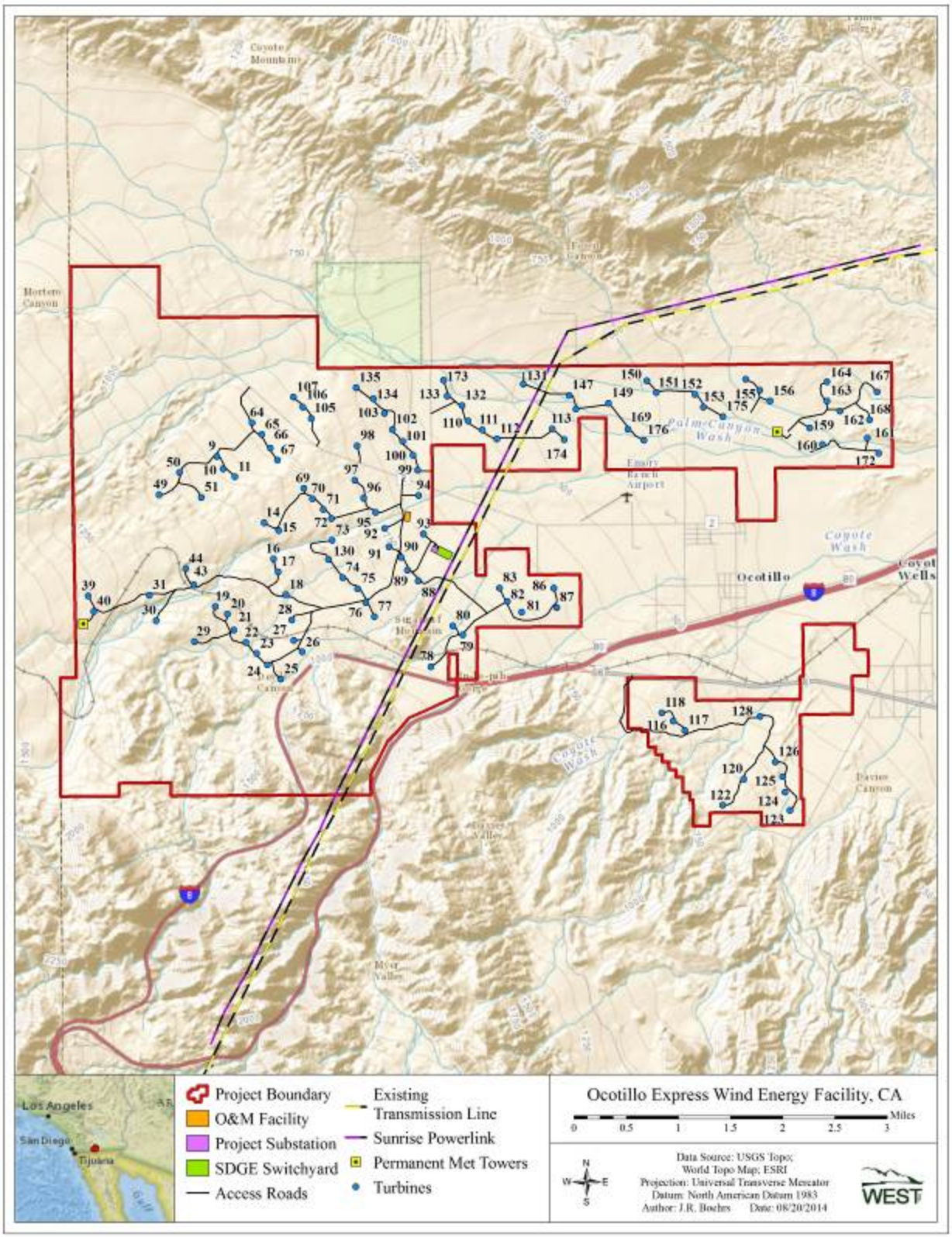

Figure 1. Location of the Ocotillo Express Wind Energy Facility in Imperial County, California.

STUDY AREA

The OWEF is located primarily on BLM land and a small portion of private land consisting of approximately 12,565 acres (5,085 hectares [ha]). The Project includes 112 Siemens SWT – 2.3-108 wind turbines (approximately 315 megawatts [MW]) and associated infrastructure (Figure 1). The diameter of the circle swept by the blades is 354 feet (ft; 108 meters [m]) and turbines are 440 ft (134 m) tall in height from the base of the tower to the fully extended blade tip. In addition to the 112 wind turbines, other above-ground infrastructure includes an Operations and Management (O&M) building, two permanent meteorological (met) towers, an electrical substation, and the Sunrise Powerlink transmission line.

The project site is located within four U.S. Geological Survey (USGS) 7.5-minute quadrangle maps; Carrizo Mountain, Coyote Wells, In-Ko-Pah Gorge, and Painted Gorge. The northern portion of the site is generally situated north of Interstate 8 (I-8), with the western edge along the Imperial/San Diego County border to approximately 1.5 miles (2.4 kilometers [km]) northeast of the town of Ocotillo on its eastern edge. The northern area includes several distinct features, including a portion of the I-8 Island, which is undeveloped rocky and hilly terrain between the eastbound and westbound lanes of I-8, Sugarloaf Mountain, and a portion of the San Diego and Arizona Eastern railroad tracks. County Route (CR) S2 bisects the northern project area, and I-8 passes through the southern portion of the northern project area. The southern area is much smaller than the northern area and the majority is south of State Route (SR) 98.

Vegetation on site consists of a variety of desert scrub habitat types (USGS National Land Cover Database [NLCD] 2001; Figure 2). Several dry desert washes cut through the site, generally from west to east: Palm Canyon Wash cuts through the center of the northern project area, Myer Creek Wash cuts through the southern portion of the northern project area, a portion of Coyote Wash cuts through the northwest portion of the southern project area, and several additional unnamed washes cut through the site.

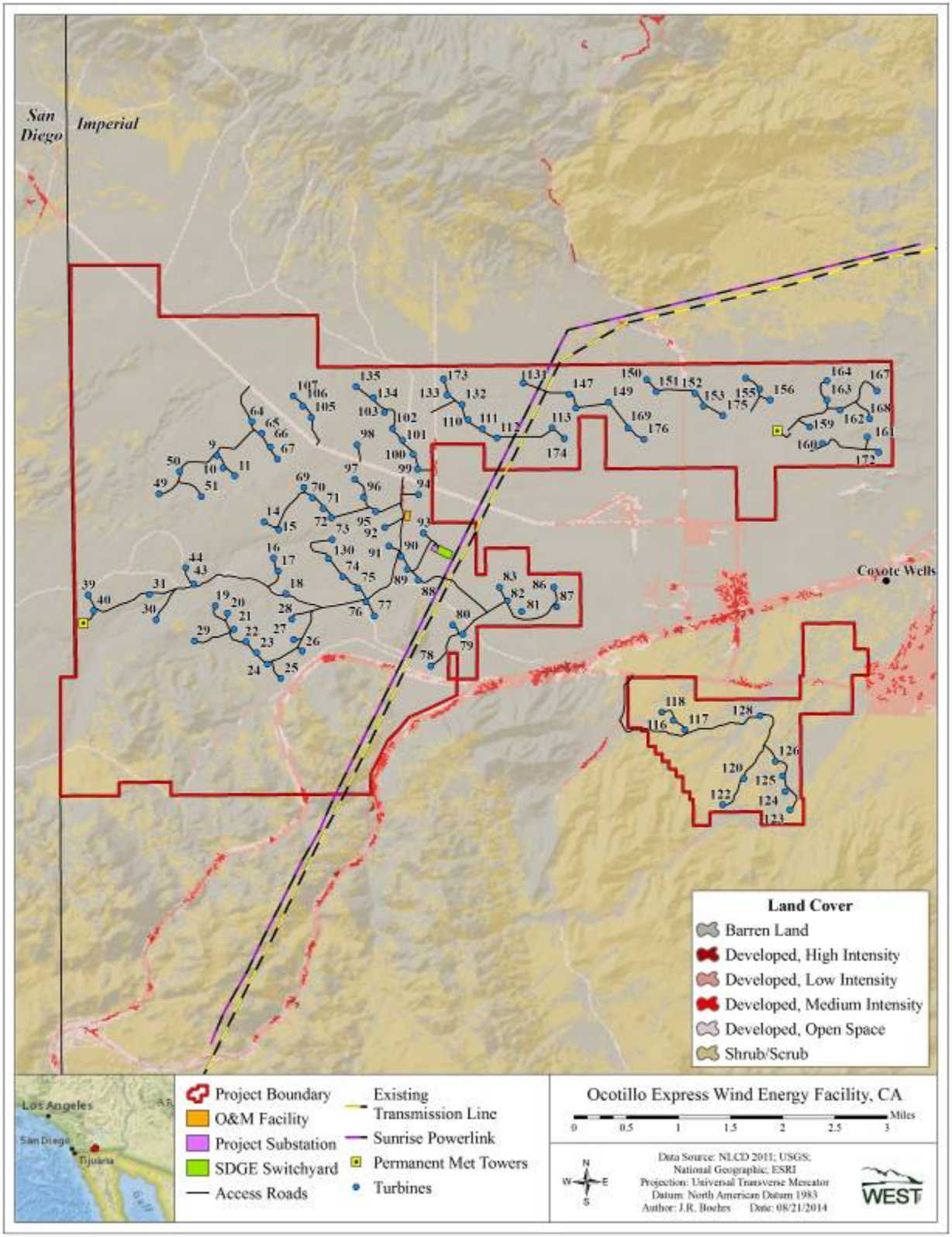

Figure 2. Landuse/landcover information for the Ocotillo Express Wind Energy Facility (USGS NLCD 2001).

METHODS

Year-Long Mortality Monitoring

The primary objective of the standardized mortality monitoring study is to estimate annual levels of avian and bat mortality at the OWEF.

Study Design

The four primary components of the standardized mortality monitoring study are: 1) standardized carcass searches, 2) searcher efficiency trials, 3) scavenger removal trials, and 4) data analyses and reporting.

Standardized Carcass Searches

Mortality surveys consisted of standardized carcass searches at 33 of the turbines (about 30% of 112 total turbines at least twice per month throughout the year (Table 1). A systematic sample with a random start was used to select the 33 search turbines out of the turbines that were determined to be available for searching (i.e., those turbines for which it was determined there were not cultural concerns).

Table 1. Turbines selected for Year 1 mortality surveys at the Ocotillo Express Wind Energy Facility.

Search Turbine Number		
22	86	147
24	87	148
27	89	149
28	93	151
31	111	152
43	112	153
44	113	156
71	118	169
75	124	176
76	130	173
82	133	174

Standardized carcass searches were conducted within 160 X 160 m (525 X 525-ft) plots centered on the turbine for 28 of the 33 turbines and 270 X 270 m (886 X 886-ft) plots centered on the turbine for the remaining five turbines (turbines 24, 82, 93, 133, and 149; Figure 3). Trained field technicians systematically searched each plot for avian and bat fatalities by walking parallel transects spaced approximately six m (about 20 ft) apart and scanning both sides of the transect for carcasses. For the purposes of the mortality surveys, the condition of carcasses found by searchers was classified according to the following criteria:

- **Intact** - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger;

- **Scavenged** – an entire carcass that shows signs of scavenging or is heavily infested by insects, or portion(s) of a carcass in one location (e.g., wings);
- **Feather Spot** - 10 or more feathers (or two or more primary feathers) at one location indicating predation or scavenging.

Handling of bird and bat carcasses was conducted under the appropriate agency permits. All bird and bat carcasses found during the standardized searches were labeled with a unique number, bagged, and stored in a freezer at the OWEF O&M building. A data sheet was completed for each carcass to record species, sex and age (when possible), date and time collected, location (Global Positioning System [GPS] coordinates), carcass condition, habitat type, suspected cause of death, and any comments. All casualties were photographed in the field and the location was plotted on a map that showed the location of the carcass in relation to the nearest turbine and other facilities (e.g., overhead power lines).

There are three scenarios under which casualties may have been found at the OWEF: 1) within search plots during the standardized carcass searches; 2) within search plots while searchers are on site but not conducting a standardized search; and 3) by project personnel during other activities, such as turbine maintenance. All casualties found by study personnel were recorded in accordance with the methods described above. It is assumed that casualties found incidentally within search plots (by searchers or project personnel) would have been found by searchers and these casualties have been included in fatality estimates. Casualties found incidentally by searchers or project personnel outside the formal search plot have been reported as incidental discoveries and are not included in fatality estimates.

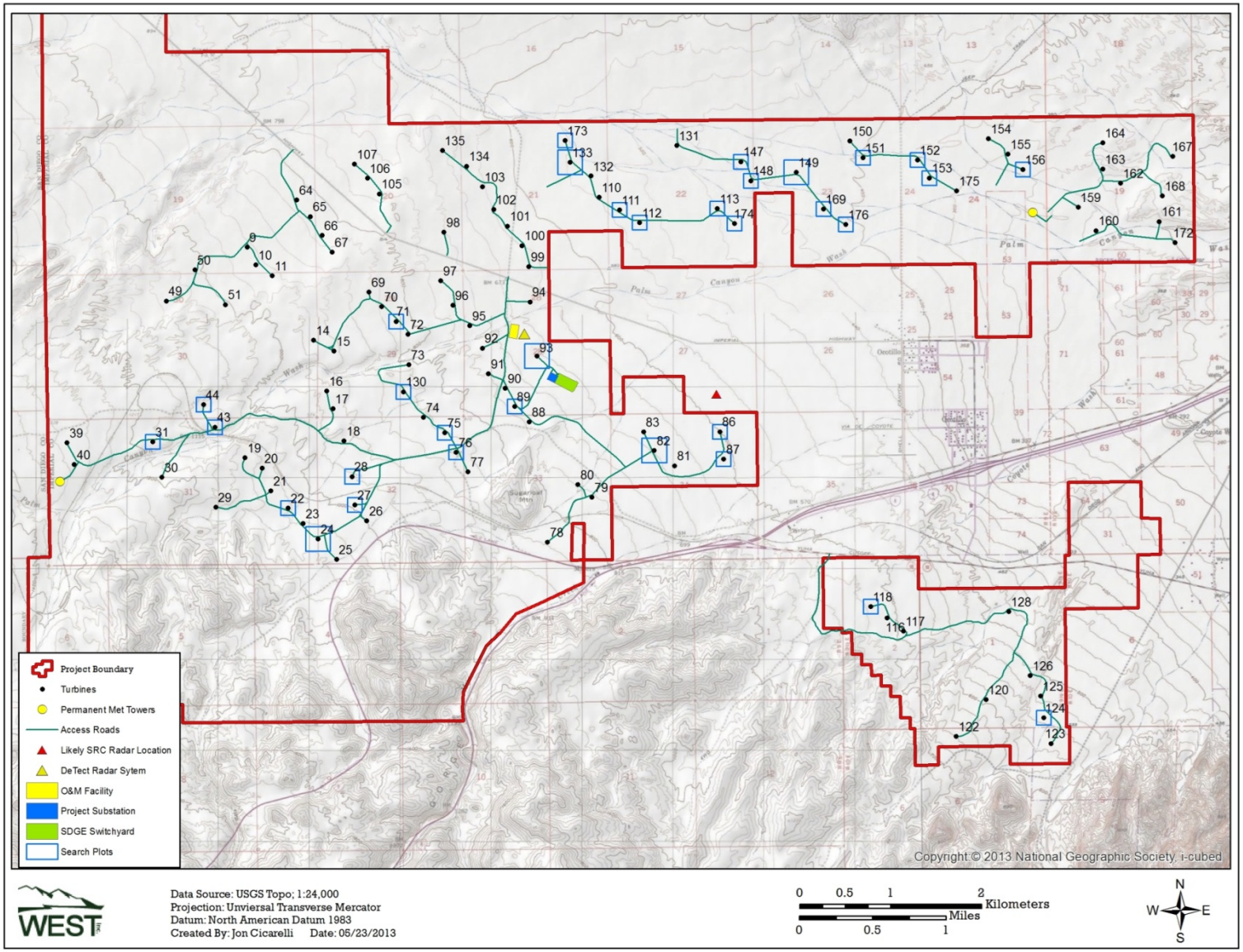

Figure 3. Turbines selected for the Year 1 mortality monitoring study at the Ocotillo Express Wind Energy Facility.

Experimental Bias Trials

Experimental bias trials were conducted to develop estimates of the proportion of casualties which were not detected by searchers. As a result of these estimates, correction factors have been applied to observed carcass discoveries to provide an annual estimate of mortality per turbine and per MW. Two types of experimental bias trials were conducted: 1) searcher efficiency trials, and 2) carcass removal trials.

Searcher Efficiency Trials

Searcher efficiency trials were conducted to develop estimates of the proportion of casualties which were detected by searchers (searcher detection bias). Searcher efficiency trials were conducted throughout the year to encompass variable field conditions that may have affected surveyor carcass detection. A minimum of two searcher efficiency trials were conducted in each of the four seasons, for a total of eight trials annually.

Each trial consisted of placing approximately 20 carcasses divided among two size classes (small and large) in search plots. Carcasses utilized for searcher efficiency trials consisted of birds and bats found during standardized carcass searches at OWEF and/or non-native or commercially-available species. Large birds were represented by species such as mallard (*Anas platyrhynchos*) or ring-necked pheasant (*Phasianus colchicus*), while small birds included species such as house sparrow (*Passer domesticus*) and rock pigeon (*Columba livia*). Small brown birds (e.g., house sparrows) were used in lieu of bat carcasses, if necessary.

Searcher efficiency trials were conducted simultaneously with mortality searches. Trial carcasses were randomly placed within turbine search plots by a field supervisor immediately prior to a scheduled carcass search. Searchers were not told when or where trials were being conducted to minimize potential bias. Each trial carcass was discreetly marked to distinguish it from an actual fatality. Carcasses were dropped from waist height and allowed to land in a variety of postures. Searchers recorded the location of each trial carcass found during standardized carcass searches. Immediately following completion of the search, the field supervisor retrieved all carcasses not found by searchers to determine the number of carcasses that remained available for detection but were not found. Searcher efficiency trial data were analyzed to develop estimates of detection bias to adjust annual estimates of bird and bat mortality rates.

Carcass Removal Trials

The objective of the carcass removal trials was to estimate the average length of time a carcass remained in the search plot (was not removed by scavengers) and was available for detection by searchers. Carcass removal trials were initiated when carcass search studies began, and were conducted throughout the year to incorporate the effects of varying field conditions and scavenger densities. Carcasses were placed on a minimum of two dates during each season for a minimum total of eight trial initiation dates. For each trial, carcasses were discreetly marked and placed in the field. Small brown birds (e.g., house sparrows) were used in lieu of bat

carcasses, if necessary. All trial carcasses were handled with disposable gloves to minimize human scent on the carcasses.

Observers conducting carcass searches monitored the trial birds over a minimum of a 30-day period according to the following schedule as closely as possible. Carcasses were checked every day for the first four days, and then on days seven, 10, 14, 18, 24, and 30. This schedule varied slightly due to logistical constraints. At each visit, the observer noted the condition of the carcass (e.g., intact, scavenged, feather spot [i.e., more than 10 feathers], or absent [less than 10 feathers]). Removal trial carcasses were left at the location until the end of the trial or until the carcass was removed entirely by scavengers. After the trial, any remaining evidence of the carcasses was removed. Carcass removal trial data were analyzed to develop separate removal estimates for large birds, small birds, and bats, and the results were used to adjust annual estimates of bird and bat mortality rates.

Statistical Methods for Calculating Mortality Estimates

Adjusted annual mortality estimates were developed for all birds, all bats, small birds, large birds, and raptors. Estimates of facility-related mortalities are based on:

1) Observed number of carcasses found during standardized searches during the monitoring year for which the cause of death is either unknown or is probably facility-related;
2) Non-removal rates, expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials; and
3) Searcher efficiency, expressed as the proportion of placed carcasses found by observers during the searcher efficiency trials.

Fatality estimates were provided for a minimum of five categories: 1) all birds, 2) small birds, 3) large birds, 4) raptors, and 5) bats. The number of avian and bat fatalities attributable to operation of the facility, based on the number of avian and bat fatalities found at the facility whose death appears related to facility operation, were reported. All carcasses located within areas surveyed or incidentally, regardless of species, were recorded and, if possible, a cause of death was determined based on a cursory field necropsy. If the cause of death was not apparent, a “worst case” estimate was made by attributing the mortality to facility operation. The total number of avian and bat carcasses attributable to the facility was estimated by adjusting for removal and searcher efficiency biases.

Definition of Variables

The following variables are used in the equations below:

c_i the number of carcasses detected at plot *i* for the study period of interest (e.g., one monitoring year) for which the cause of death is either unknown or is attributed to the facility

n the number of search plots

k the number of turbines searched (including the turbines centered within each search plot)

$\bar{c}$ the average number of carcasses observed per turbine per monitoring year

s the number of carcasses used in removal trials

s_c the number of carcasses in removal trials that remain in the study area after 30 days

se standard error (square of the sample variance of the mean)

t_i the time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

$\bar{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

d the total number of carcasses placed in searcher efficiency trials

p the estimated proportion of detectable carcasses found by searchers, as determined by the searcher efficiency trials

I the average interval between standardized carcass searches, in days

A proportion of the search area of a turbine actually searched

$\hat{\pi}$ the estimated probability that a carcass is both available to be found during a search and is found, as determined by the removal trials and the searcher efficiency trials

m the estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency biases.

Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring year is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A} \qquad (1)$$

Estimation of Carcass Non-Removal Rates

Estimates of carcass non-removal rates are used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remains in the study area before it is removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \qquad (2)$$

Estimation of Searcher Efficiency Rates

Searcher efficiency rates are expressed as *p,* the proportion of trial carcasses that are detected by searchers in the searcher efficiency trials. These rates will be estimated by carcass size and season.

Estimation of Facility-Related Fatality Rates

The estimated per turbine annual fatality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \qquad (3)$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. Data for carcass removal and searcher efficiency biases will be pooled across the study to estimate $\hat{\pi}$.

The final reported estimates of *m* and associated standard errors and 90% confidence intervals for the OWEF were calculated using bootstrapping (see Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. For each bootstrap sample, $\bar{c}$, $\bar{t}$, *p*, $\hat{\pi}$, and m are calculated. A total of 1,000 bootstrap samples were used. The reported estimates are the mathematical means of the 1,000 bootstrap estimates that were sampled and the standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals for the reported estimates that will be reported.

Avian Monitoring

The ABPP requires that avian monitoring be conducted twice each month during the first two years of operation using the same methods as pre-construction studies. The ABPP states that "general use point-count data will be collected to provide an accurate comparison between pre- and post-construction use to inform our understanding of avian exposure and probability of mortality as well as behavioral responses to the facility". The avian monitoring was initiated at the same time as the year-long standardized mortality monitoring (i.e., once all 112 turbines were operating).

Fixed-Point Avian Use Surveys

Fixed-point avian use surveys were conducted at the 21 pre-construction avian point count locations located within and adjacent to the OWEF (Figure 4). The 21 avian use points were selected during the OWEF pre-construction phase to survey representative habitats and topography while also providing relatively even coverage of the OWEF. Fixed-point circular plots were used for both passerine and raptor surveys following the field methods described by Reynolds et al. (1980).

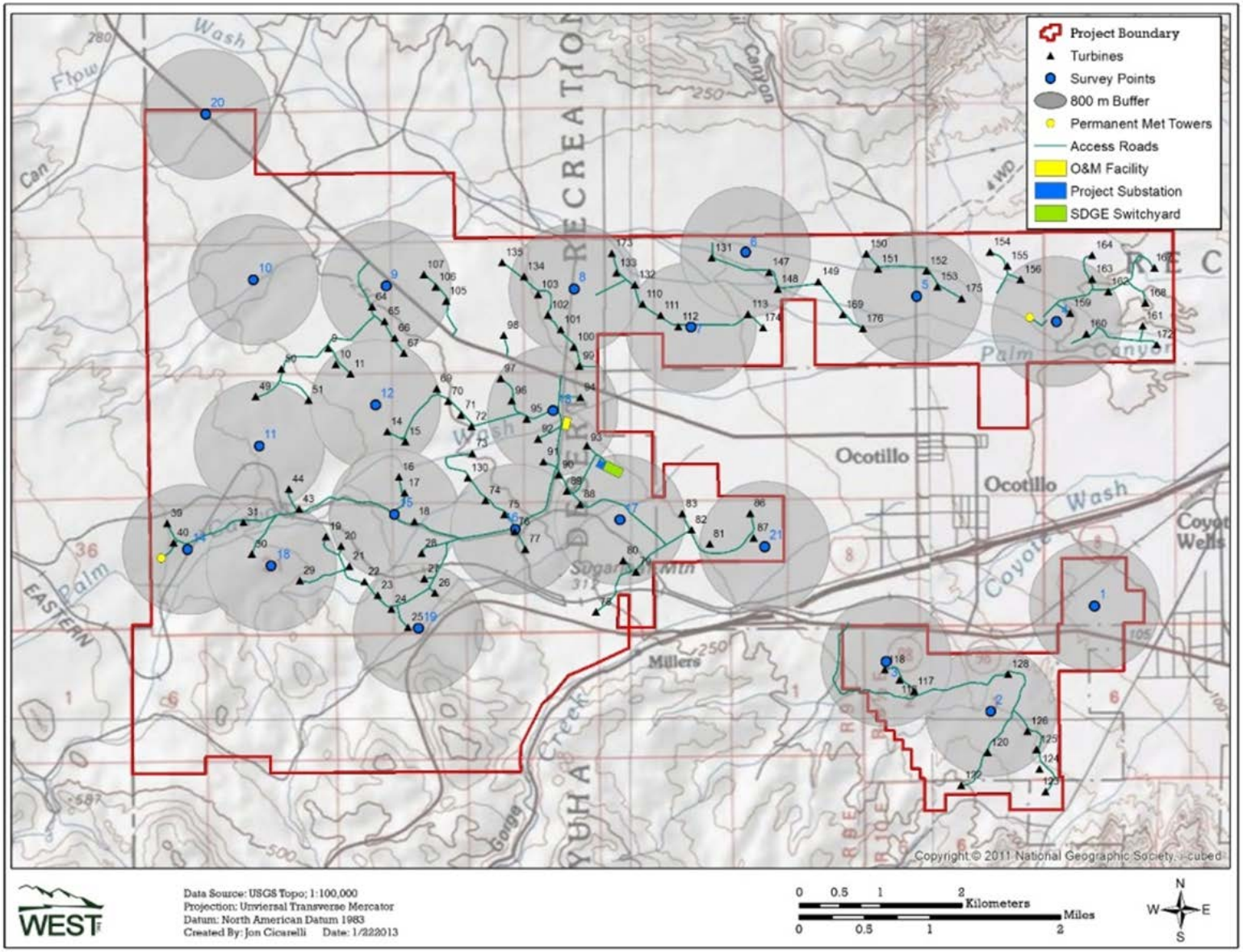

Figure 4. Fixed point locations for avian use surveys at the Ocotillo Express Wind Energy Facility.

Each observation point was surveyed for 30 minutes (min) twice a month. The survey viewsheds included an 800-m (2,625-ft) radius plot for large birds and 100-m (328-ft) radius plot for small birds. All birds observed during each fixed-point survey were recorded regardless of distance from observer. Due to potential for classification error, observations of large birds beyond 800 m and small birds beyond 100 m of the point were recorded but excluded from statistical analyses (e.g., not used for calculating standardized use estimates per plot). Flight paths of all raptors were recorded on paper maps and later digitized with a Geographic Information System (GIS). For this study, large birds included waterbirds, waterfowl, rails/coots, shorebirds, raptors, owls, vultures, upland game birds, doves/pigeons, and large corvids. Small birds included passerines (excluding large corvids), swifts/hummingbirds, woodpeckers, and cuckoos.

For analysis purposes, a visit was defined as the required length of time, in days, needed to survey all of the plots once within the study area. Visits were assigned according to the following criteria: 1) a single visit had to be completed in a single season; and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits.

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data was identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

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

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists (with the number of observations and the number of groups) were generated by season and included all observations of birds detected, regardless of their distance from the observer. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness by season was calculated by first averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall species richness was calculated as a weighted average of seasonal values by the number of days in each season. Species diversity and richness were compared among seasons for fixed-point bird use surveys.

Bird Use, Percent of Use, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, large birds detected within the 800-m radius plot at any time were used in the analysis; small birds recorded within a 100-m radius at any time were included. The metric used to measure mean bird use was number of birds per plot per 30-min survey. These standardized estimates of mean bird use were used to compare differences between bird types, seasons, survey points, and other studies where similar methods were used. Mean use by season was calculated by first averaging the total number of birds seen within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season.

Exposure to facility infrastructure is affected by how much a species utilizes an area (percent of use), as well as how often use occurs (frequency of occurrence). Frequency of occurrence and percent of use provide relative measures of species exposure to the proposed facility. Percent of use was calculated as the proportion of large or small bird mean use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. For example, flocks of waterfowl, waterbirds, and shorebirds can be comprised of several hundred, thousand, or tens of thousands of individual birds, which would result in a very high percentage of use. However, examining the percent of use alone would not account for the acute exposure to the facility associated with a small number of very large flocks (low frequency of occurrence). A high percent of use may indicate that a species has higher exposure relative to other species, but when the exposure is acute, the species may be less likely to be affected. Conversely, a species that has a low percentage of use and a high frequency of occurrence would have long-term exposure to the facility, increasing the likelihood that this species may be affected by the facility. Exposure to facility infrastructure is more accurately assessed by evaluating both percent of use and frequency of occurrence.

Bird Flight Height and Behavior

Bird flight heights are important metrics to assess potential exposure. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH; 25-150 m [82-492 ft] above ground level) for turbines likely to be used at the expansion area. The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded.

Bird Exposure Index

The bird exposure index is used as a relative measure of how often birds fly at heights similar to blades of modern wind turbines. A relative index of bird exposure (R) was calculated for bird species observed during the fixed-point bird use surveys using the following formula:

$$R = A*P_f*P_t$$

where A equals mean relative use for species *i* (large bird observations within 800 m of the observer or 100 m for small birds) averaged across all surveys, P_f equals the proportion of all

observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely RSH.

Spatial Use

Large bird flight paths were qualitatively compared to study area characteristics (e.g., topographic features). The objective of mapping observed large bird locations and flight paths was to identify areas of concentrated use by diurnal raptors and other large birds and/or consistent flight patterns within the study area.

RESULTS

Year-Long Mortality Monitoring

Turbine searches for the year-long mortality monitoring began on October 4, 2013, and continued through September 29, 2014. Twenty-four complete rounds of searches were conducted at the 33 designated search turbines during this period, for a total of 792 turbine searches. Data in the following results includes carcasses discovered during the standardized year-long mortality monitoring study and incidental discoveries from the same study period. Carcasses discovered during interim large bird searches and/or incidental discoveries outside of the study period are not included in the results presented herein. In total, 40 fatalities (26 birds and 14 bats) were documented during the first-year mortality monitoring studies from October 4, 2013 through September 29, 2014 (Table 2). A complete listing of all fatalities identified during the first standardized year-long fatality study or incidentally during the study period is provided in Appendix A. Twenty-six of the fatalities were documented during scheduled searches, while 14 fatalities were documented incidentally (Table 2). Two of the incidental bat carcass discoveries were located on search plots; therefore, these fatalities were included in analyses used to estimate annual fatality rates. All other incidental discoveries were located off search plots and were not included in analyses used to estimate annual fatality rates.

Bird Fatalities

During the study, 19 birds comprising nine identifiable species were found during scheduled searches (Table 2). An additional seven bird fatalities representing five species were found incidentally outside of search plots (Table 2), while no bird fatalities were found incidentally within search plots. Thirteen identifiable species were documented as fatalities during the study, as well as five unidentified large birds and three unidentified small birds (primarily bones or bone fragments). The bird species most commonly found during the study, either during scheduled searches or incidentally, was white-throated swift (*Aeronautes saxatalis*; five fatalities). Fatalities of all other species consisted of either one or two individuals (Table 2). One raptor (red-tailed hawk; *Buteo jamaicensis*) was discovered incidentally during the first year-long mortality monitoring study (Table 2). Yellow warbler (*Setophaga petechia*; a Bird of Conservation Concern (BCC) in Bird Conservation Region (BCR) 33 [see USFWS 2008]) was the only sensitive avian species identified as a fatality during the first year-long mortality monitoring study.

Table 2. Numbers and composition of bird and bat casualties discovered at the Ocotillo Express Wind Energy Facility during the year-long standardized searches and incidentally from October 4, 2013 – September 29, 2014.

	Fatalities during Scheduled Searches		Incidentals (on search plots)		Incidentals (off search plots)[1]		Total	
Species	**Total**	**Total**	**Total**	**%Comp.**	**Total**	**%Comp.**	**Total**	**%Comp.**
Birds								
unidentified large bird[2]	5	26.3	0	0	0	0	5	19.2
unidentified small bird	3	15.8	0	0	0	0	3	11.5
white-throated swift	2	10.5	0	0	3	42.8	5	20.8
domestic chicken[2]	2	10.5	0	0	0	0	2	7.7
greater roadrunner	1	5.3	0	0	0	0	1	3.8
mallard	1	5.3	0	0	0	0	1	3.8
Swainson's thrush	1	5.3	0	0	0	0	1	3.8
Townsend's warbler	1	5.3	0	0	0	0	1	3.8
warbling vireo	1	5.3	0	0	0	0	1	3.8
Wilson's warbler[2]	1	5.3	0	0	0	0	1	3.8
yellow warbler	1	5.3	0	0	0	0	1	3.8
mourning dove	0	0	0	0	1	14.3	1	3.8
red-tailed hawk	0	0	0	0	1	14.3	1	3.8
house finch	0	0	0	0	1	14.3	1	3.8
western meadowlark	0	0	0	0	1	14.3	1	3.8
Overall Birds	**19**	**100**	**0**	**0**	**7**	**100**	**26**	**100**
Bats								
Mexican free-tailed bat	7	77.8	1	50	3	100	11	78.6
canyon bat	2	22.2	0	0	0	0	2	14.3
unidentified Lasiurus bat	0	0	1	50	0	0	1	7.1
Overall Bats	**9**	**100**	**2**	**100**	**3**	**100**	**14**	**100**

[1] Incidental discoveries found off search plots were excluded from the annual fatality estimates.
[2] One unidentified large bird, one of the domestic chicken discoveries, and the Wilson's warbler discovery were found outside of the 160 X 160-m plot, but were within the larger 270 X 270-m plots.

The greatest number of bird fatalities found at any one search plot was three fatalities found at three turbines (turbines T75, T113, and T149); two bird fatalities were found at each of two turbines (T93 and T130); and single fatalities were found at six other search turbines (Figure 5 and Figure 6a). One bird fatality was found at the laydown yard/parking lot for the O&M building (western meadowlark; *Sturnella neglecta*) and was not associated with turbines. The lack of strong patterns in the spatial distribution of bird fatalities suggests no large differences in bird mortality by location within the project. Of the bird fatalities, about half (47.4%) were found within 60 m (197 ft) of the turbine and only two were found beyond 90 m (295 ft) from a turbine (Table 3). Three of the 19 bird carcasses discovered within search were located outside of the 160 X 160-m plots, but were within the larger 270 X 270-m plots. Temporally, bird fatalities were distributed throughout much of the year, although no fatalities were documented during the summer period (Figure 6b).

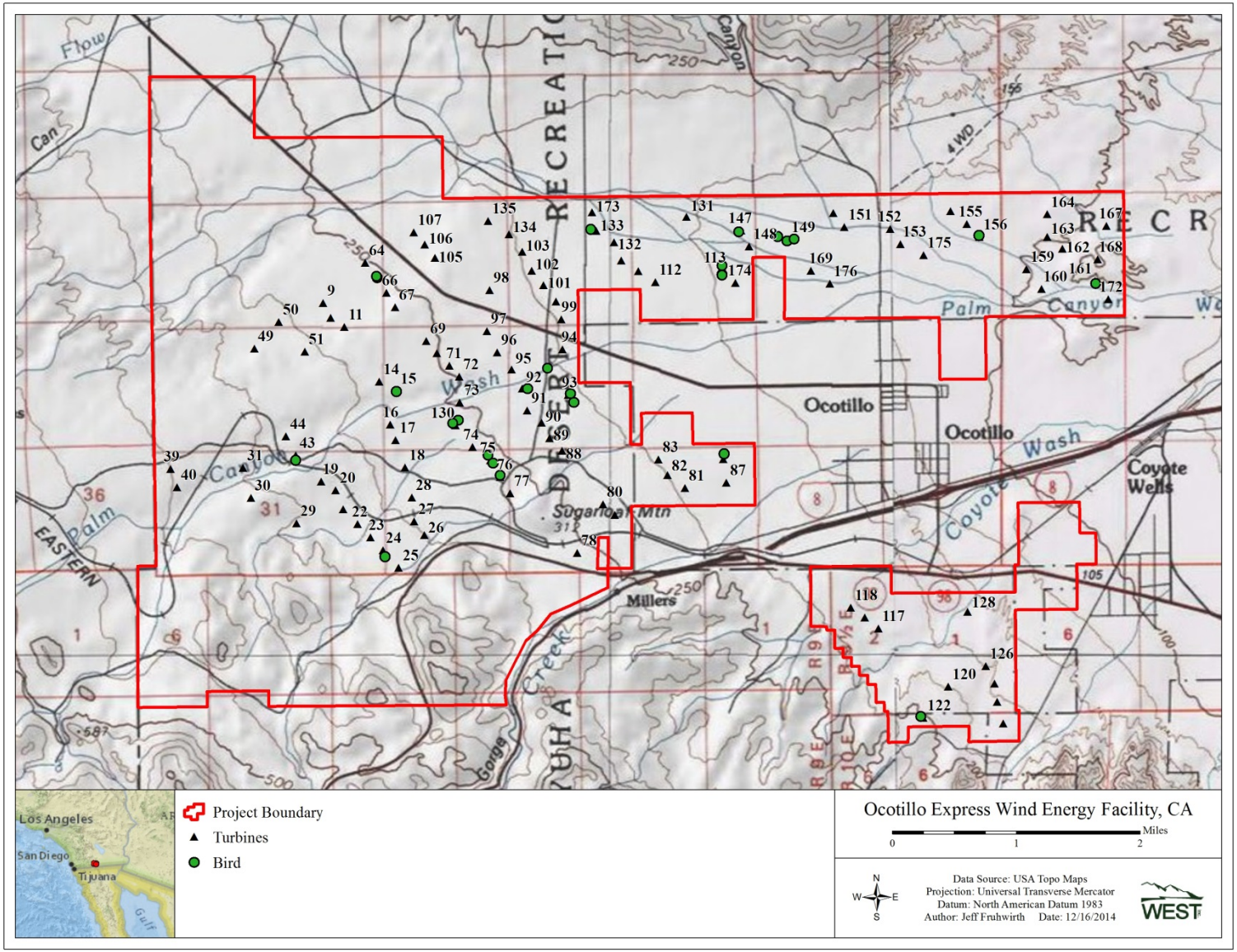

Figure 5. Location of all bird carcasses found during the first standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

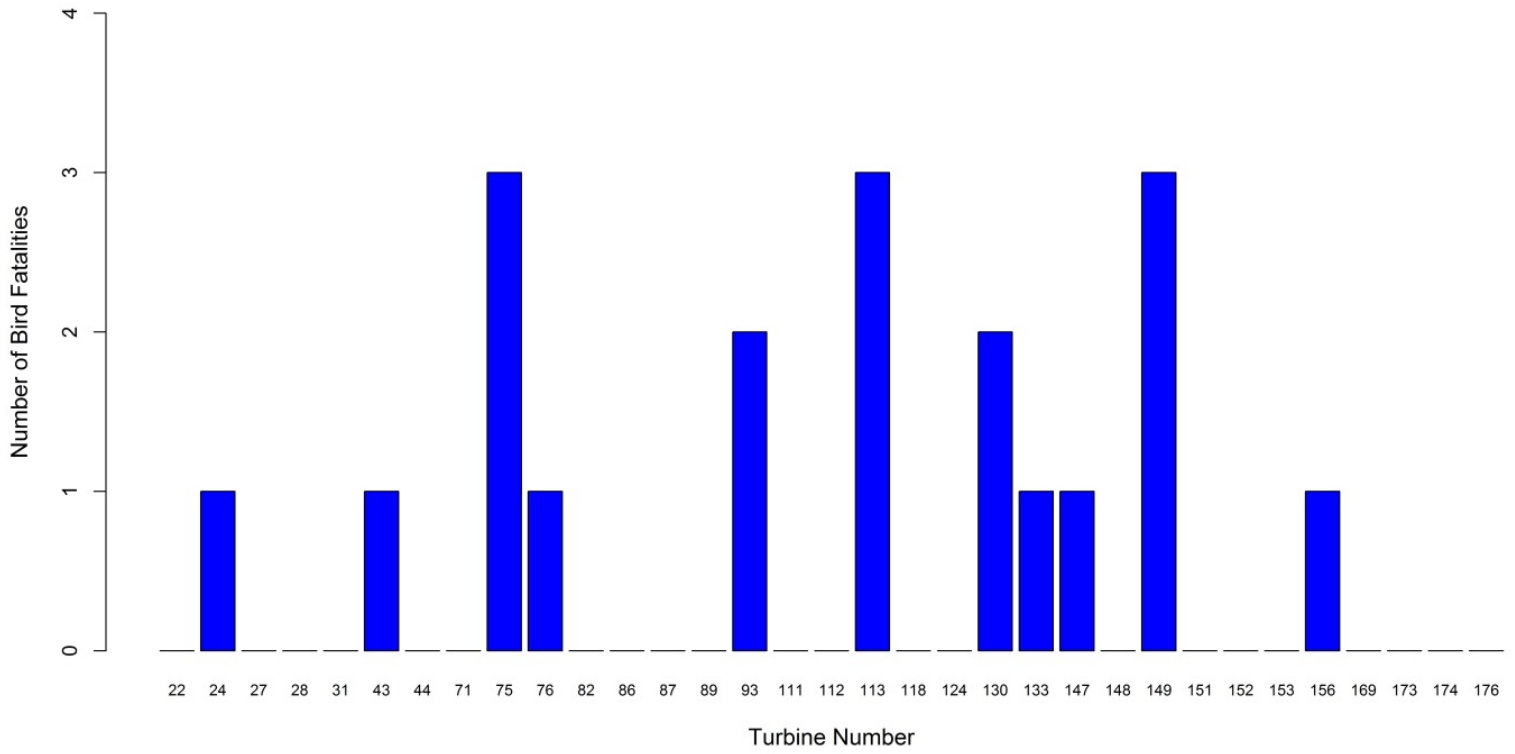

Figure 6a. Number of bird fatalities by turbine found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

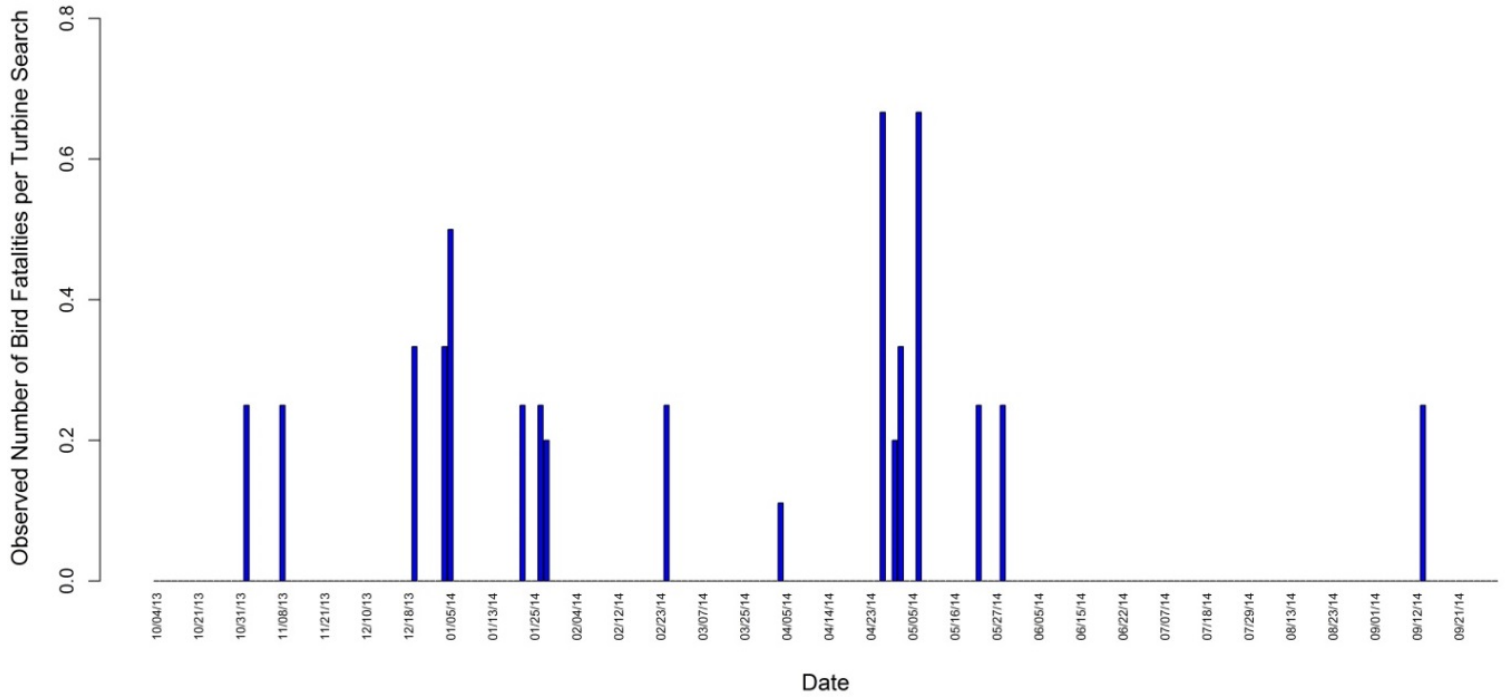

Figure 6b. Timing of bird fatalities by turbine found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Table 3. Distribution of distances from turbines of bird and bat casualties found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Distance to Turbine (m)	% Bird Casualties	% Bat Casualties
0 to 10	0.0	18.2
10 to 20	5.3	18.2
20 to 30	15.8	18.2
30 to 40	5.3	9.1
40 to 50	10.5	18.2
50 to 60	10.5	9.1
60 to 70	5.3	9.1
70 to 80	15.8	0.0
80 to 90	21.1	0.0
>90	10.5	0.0

Bat Fatalities

A total of 14 bat fatalities were found during the first standardized year-long fatality monitoring study or incidentally during the study period, with nine documented during scheduled turbine searches and five documented incidentally (two inside and three outside of search plots; Table 2). The bat species most commonly found during the study, either during scheduled searches or incidentally, was Mexican free-tailed bat (*Tadarida brasiliensis*; 11 fatalities). Canyon bat (*Parastrellus hesperus*; two fatalities) and unidentified Lasiurus bat (*Lasiurus* spp.; one fatality) were the only other bat species identified. None of the bat species identified during the first standardized year-long fatality or incidentally during the study period are considered sensitive species.

Two bat fatalities were found at each of two turbines (T133 and T148); and single fatalities were found at seven other search turbines (Figure 7a and Figure 8). The lack of strong patterns in the spatial distribution of bat fatalities suggests no large differences in bat mortality by location within the project. Of the bat fatalities, 81.9% were found within 50 m (164 ft) of the turbine, and no bat fatalities were found greater than 70 m (230 ft) from a turbine (Table 3). Temporally, bat fatalities were concentrated in the late spring (March and April) and late summer – early fall (mid-August into early October; Figure 7b).

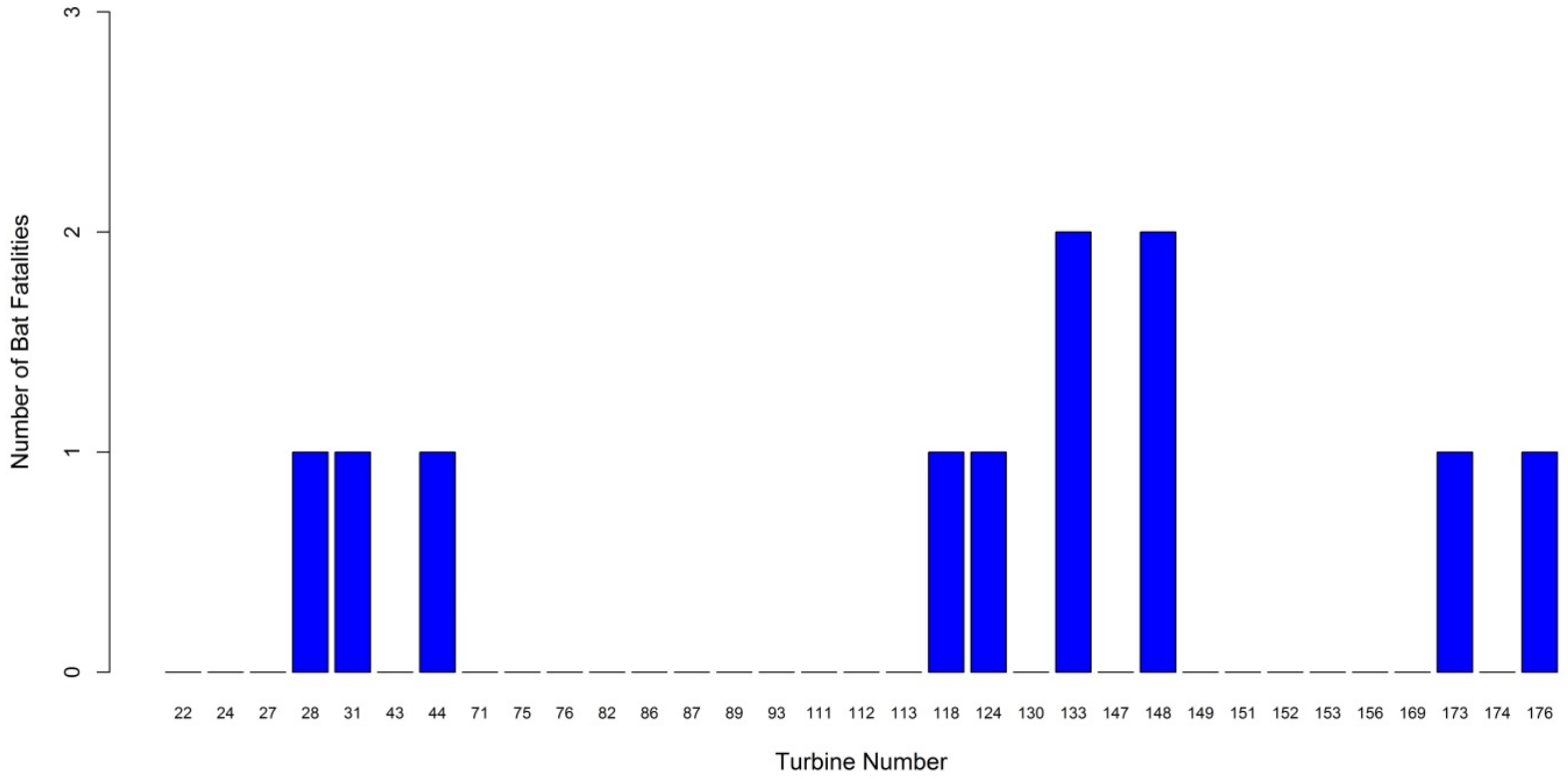

Figure 7a. Number of bat fatalities by turbine found during year-long scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

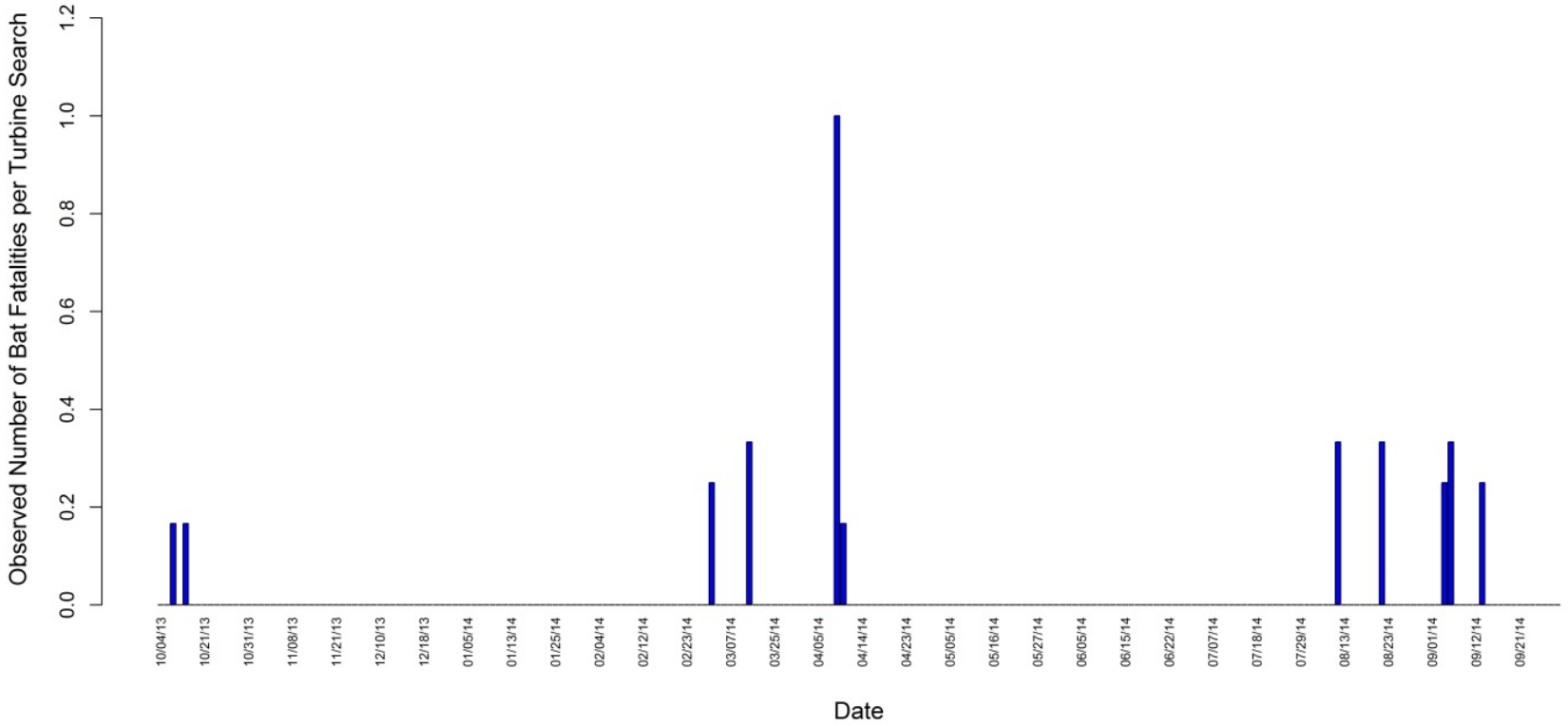

Figure 7b. Timing of bat fatalities by turbine found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

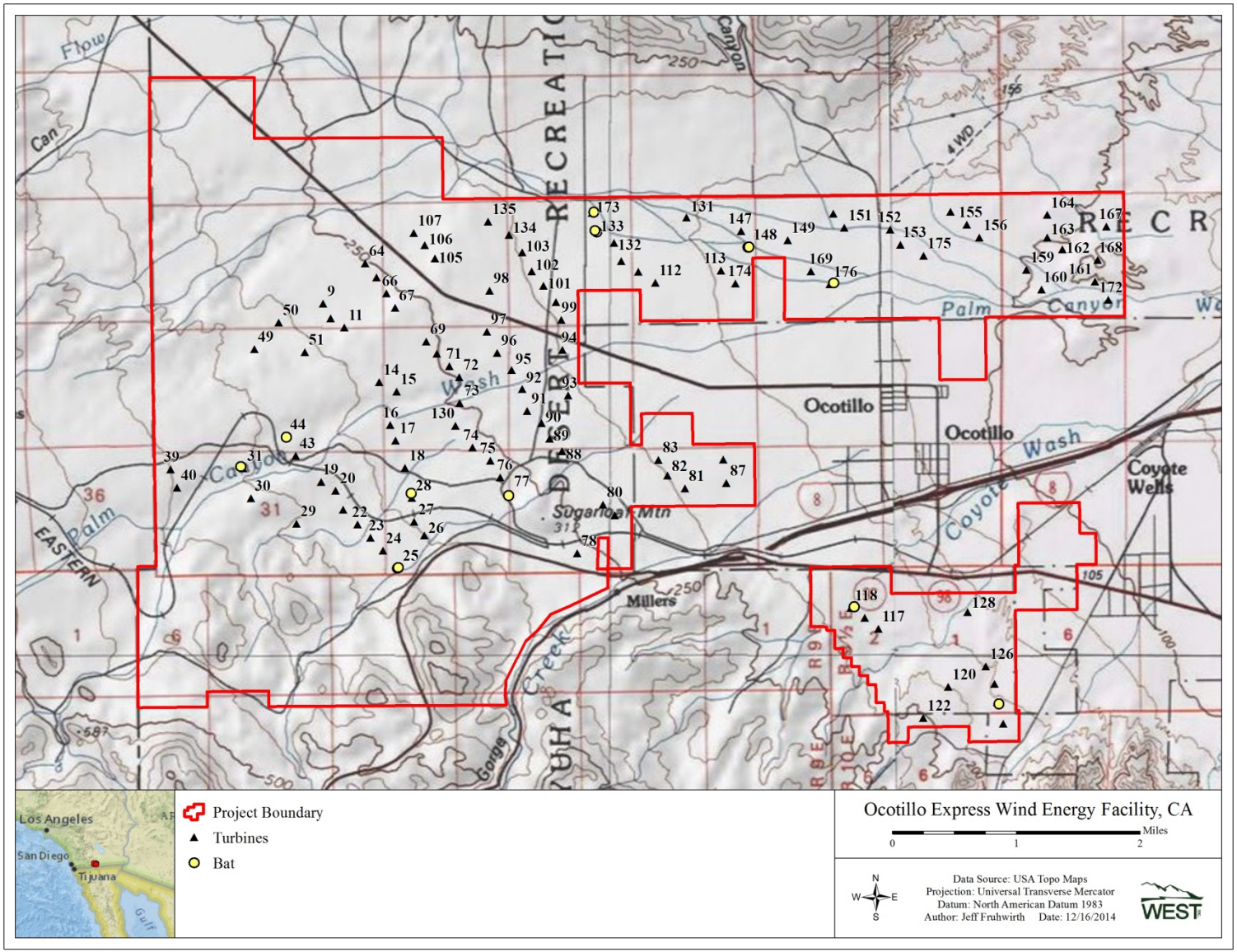

Figure 8. Location of all bat carcasses found during the first standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the year-long study period and included 129 small bird and 53 large bird trial carcasses. As bats were not used during searcher efficiency trials due to sample sizes and the small number of bats available from the site, efficiency trial data for small birds was used for bats (Table 4). The overall searcher efficiency rate for small birds (and bats) was 73.4%, while the efficiency rate for large birds was 94.3%. Efficiency rates did not differ significantly across seasons; therefore data were pooled and a single rate was used for each size class (small birds/ bats and large birds).

Table 4. Searcher efficiency results at the Ocotillo Express Wind Energy Facility by date and carcass size.

Size	Date	# Placed	# Available	# Found	% Found
Small Birds	11/21/2013	16	16	13	81.3
	1/24/2014	18	18	13	72.2
	3/3/2014	18	17	12	70.6
	5/17/2014	14	14	6	42.9
	6/22/2014	13	13	9	69.2
	8/2/2014	16	16	13	81.3
	9/27/2014	15	15	13	86.7
	11/8/2014	19	19	15	78.9
Total		**129**	**128**	**94**	**73.4**
Large Birds	11/21/2013	11	11	11	100
	1/24/2014	10	10	9	90.0
	3/3/2014	9	9	8	88.9
	5/17/2014	4	4	3	75.0
	6/22/2014	5	5	5	100
	8/2/2014	5	5	5	100
	9/27/2014	4	4	4	100
	11/8/2014	5	5	5	100
Total		**53**	**53**	**50**	**94.3**

Carcass Removal Trials

Fifteen carcass removal trials were conducted throughout the study period. In total, 76 large bird, 100 small bird, and four bat carcasses were used during removal trials (Table 5). Trials were distributed throughout the seasons. Average removal times did not differ significantly for small birds and bats in the spring season; therefore, small birds and bats were combined into a single estimate. In addition, average removal times did not differ significantly among the spring, summer, and fall seasons; therefore average removal times were calculated across the three seasons for each size class (small birds/bats and large birds) for use in the analyses. Average removal times did differ for small birds in the winter season and so only the winter removal trials were applied to the winter season for small birds. No bat carcasses were discovered in the winter season. During the spring, summer, and fall seasons, the average removal time for small birds/bats was 3.45 days, while the average removal time for large birds was 8.8 days (Figure 9 and Appendix B).During the winter season, the average removal time for small birds was 5.5 days (Appendix B).

Table 5. Carcass removal trials conducted at the Ocotillo Express Wind Energy Facility, November 22, 2013 – September 18, 2014.

Start Date	# Large Birds Placed	# Small Birds Placed	# Bats Placed
11/22/2013	7	13	0
1/3/2014	6	13	0
2/3/2014	4	13	0
4/4/2014	6	13	0
5/22/2014	5	2	2
5/23/2014	4	2	2
5/26/2014	4	4	0
6/26/2014	3	4	0
7/2/2014	7	6	0
7/15/2014	3	3	0
7/18/2014	2	5	0
7/21/2014	0	2	0
7/24/2014	5	0	0
8/19/2014	10	10	0
9/18/2014	10	10	0
Total	**76**	**100**	**4**

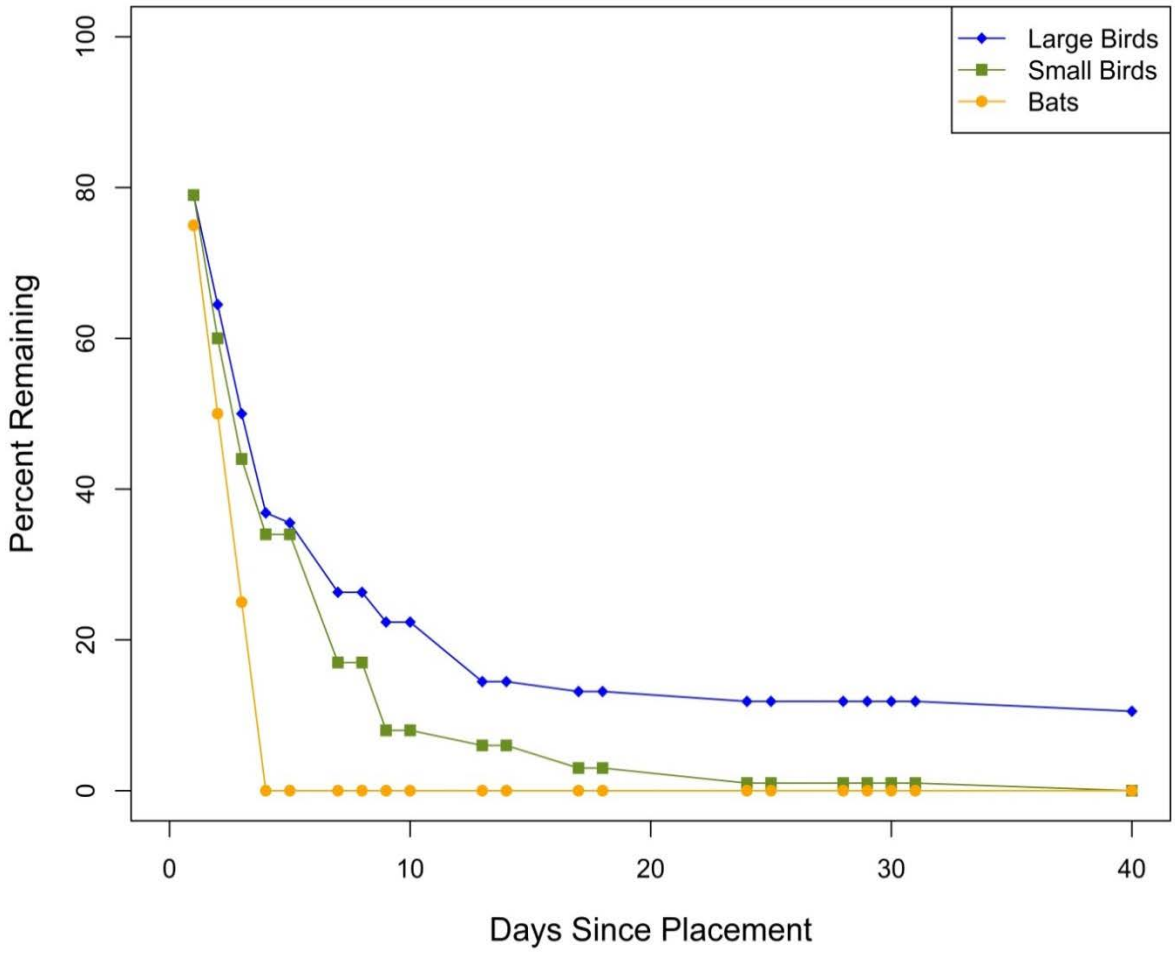

Figure 9. Carcass removal rates at the Ocotillo Express Wind Energy Facility.

Adjusted Fatality Estimates

Fatality estimates and 90% confidence intervals were calculated for birds and bats (Table 6, Appendix B). The fatality estimates were adjusted based on the corrections for carcass removal and observer detection bias (Appendix B). Searcher efficiency rates were consistent throughout the entire study period and therefore the same rates were applied across all seasons. However, since removal rates differed in the winter for small birds, two rates were applied to estimate annual small bird/bat fatalities (5.51 days in the spring, summer, fall seasons, and 3.45 days in the winter season; Appendix B). For small birds and bats in the spring, summer, and fall, the probability that a carcass would remain in a search plot and be found by a searcher was 0.17. For small birds and bats in the winter, the probability that a carcass would remain in the search plot and be found by a searcher was 0.25. For large birds, the probability was 0.45 across all seasons (Appendix B).

Since the study consisted of two different plot sizes, we estimated two different sets of annual fatality rates (one using data from 33 160 X 160-m plots and one using data from only the five 270 X 270-m plots). The resulting annual fatality estimates from the larger plots were lower than

the annual fatality estimates for the smaller plots across all categories (small birds, large birds, and bats). In order to facilitate comparison with other studies, the results presented here include only the annual fatality estimates resulting from the 33 160 X 160-m plots (Table 6). However, additional details of the two different plot sizes are provided in the discussion section below.

Table 6. Adjusted bird and bat fatality estimates for the Ocotillo Express Wind Energy Facility from October 4, 2013 – September 29, 2014.

	Corrected Fatality Estimates*	
Species Category	**# fatalities/turbine/study period**	**90% Confidence Intervals**
Small birds	1.55	0.69-2.61
Large birds	0.47	0.21-0.80
All birds	2.02	1.11-3.13
Bats	2.06	1.09-3.37
Species Category	**# fatalities/MW/study period**	**90% Confidence Intervals**
Small birds	0.68	0.30-1.13
Large birds	0.20	0.09-0.35
All birds	0.88	0.48-1.36
Bats	0.90	0.47-1.46

*For details concerning correction factors and confidence intervals for both bird and bat fatality estimates, refer to Appendix B.

Small Birds

The estimated annual fatality rate for small birds was 1.55 fatalities/turbine/year or 0.68 fatalities/MW/year. A detailed breakdown of fatality rates and the associated correction factors is presented in Appendix B.

Large Birds

The estimated annual fatality rate for large birds was 0.47 fatalities/turbine/year or 0.20 fatalities/MW/year. A detailed breakdown of fatality rates and the associated correction factors is presented in Appendix B.

All Birds

The estimated annual fatality rate for all birds was 2.02 fatalities/turbine/year or 0.88 fatalities/MW/year. A detailed breakdown of fatality rates and the associated correction factors is presented in Appendix B.

Raptors

While one red-tailed hawk was discovered incidentally during the study period, there were no raptor carcasses identified within the search plots. Therefore, an estimate of annual raptor fatalities was not calculated for the first standardized year-long fatality study.

Bats

The estimated annual fatality rate for all bats was 2.06 fatalities/turbine/year or 0.90 fatalities/MW/year. A detailed breakdown of bat fatality rates and the associated correction factors is presented in Appendix B.

Avian Monitoring

Fixed-Point Avian Use Surveys

Twenty-six rounds of fixed-point avian use surveys were conducted at 21 survey stations from August 26, 2013, through September 29, 2014, resulting in 546 fixed-point surveys (Table 7). Two viewsheds were utilized for all calculations: 800 m for large birds and 100 m for small birds.

Table 7. Species richness (species/plot[a]/30-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Ocotillo Express Wind Resource Area from August 26, 2013 to September 29, 2014.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Fall	8	168	17	0.17	0.54
Winter	8	168	19	0.18	0.81
Spring	5	105	18	0.42	0.81
Summer	5	105	14	0.12	0.35
Overall	**26**	**546**	**29**	**0.22**	**0.64**

[a] 800-m radius for large birds and 100-m radius for small birds.

Bird Diversity and Species Richness

Twenty-nine unique bird species were observed during fixed-point surveys (Table 7). The most abundant species observed were common raven (*Corvus corax*; 118 observations; 15.2% of all observations), black-throated sparrow (*Amphispiza bilineata*; 113 observations; 14.5% of all observations), and house finch (*Haemorhous mexicanus*; 103 observations; 13.3% of all observations; Appendix C). Species richness (i.e., the number of species observed per plot per survey) was greatest in the spring for large birds, and greatest in both the winter and spring for small birds, whereas species richness was lowest in the summer for both large and small bird types (Table 7).

Bird Use

Diurnal raptor use was relatively low throughout all seasons and varied from 0.05 raptors/800-m plot/30-min survey during the fall to 0.09 raptors/800-m plot/30-min survey during the spring (Appendix D1). Diurnal raptor use was fairly consistent across seasons, with red-tailed hawk accounting for the majority of the raptor use observed. Red-tailed hawk accounted for 100% of raptor use during fall and summer (Appendix D1), almost 100% of raptor use during winter, and more than half of all raptor use during spring (Appendix D1). American kestrel (*Falco sparverius*) was the only other raptor seen during winter (Appendix D1), and unidentified raptors accounted for the remainder of raptor use in the spring (Appendix D1).

Passerine use varied from a low of 0.56 birds/100-m plot/30-min survey in the summer to a high of 1.1 birds/100-m plot/30-min survey in the spring (Appendix D2). Passerine use was dominated by black-throated sparrows, cactus wrens (*Campylorhynchus brunneicapillus*), house finches, and rock wrens (*Salpinctes obsoletus*). Black-throated sparrow accounted for 20.9% of passerine use in fall, 23.6% in spring, and 55.7% in summer (Appendix D2). Cactus wren accounted for 17.1% of passerine use in fall and 21.3% in summer. House finch accounted for

41.2% of passerine use in winter, and rock wren accounted for 18.6% of passerine use in fall (Appendix D2).

Bird Exposure Index

A relative exposure index based on initial flight height observations and relative abundance (defined as the use estimate) was calculated for each bird species. Those species that had exposure to the RSH are listed in Appendices E1 and E2. All other species observed had exposure indices of zero, as none were observed flying within the RSH at the point of initial observation. The exposure index does not account for other possible collision risk factors, such as foraging or courtship behavior, nor does it account for avoidance behaviors. Hence, although common raven had the highest exposure index of any species (0.09; Appendix E1), no common ravens were found as fatalities during the first standardized year-long fatality study. Red-tailed hawk, turkey vulture (*Cathartes aura*), mourning dove (*Zenaida macroura*), and American kestrel were the only other identified large bird species with exposure indices greater than zero (ranging from less than 0.01 to 0.02; Appendix E1). Small birds with an exposure index greater than zero included black throated sparrow, white-throated swift, and house finch (all with exposure indices of less than 0.01; Appendix E2).

Spatial Use

For all large bird species combined, use was generally considered low throughout but was highest at Point 17 (0.85 birds/plot/30-min survey); Appendix F). Large bird use at other points ranged from zero to 0.62 birds/30-min survey (Appendix F). The mean use estimate for Point 17 was largely due to relatively high corvid use (0.58 birds/plot/30-min survey; Appendix F). Diurnal raptor use was also highest at Point 17 (0.27 birds/plot/30-min survey; Appendix F). Point 17 was located in close proximity to transmission towers with active common raven and red-tailed hawk nests and it is likely that the relatively higher use was due to the proximity to active nests. Point 7, with corvid use of 0.54 birds/plot/30-min survey (Appendix F), was also located in close proximity to a transmission tower with an active common raven nest. Small bird use, dominated by passerines, was greatest at Point 17 (2.54 birds/plot/30-min survey) compared to other points, where it ranged from 0.23 to 1.69 birds/plot/30-min survey (Appendix F).

Flight paths of diurnal raptors were digitized and mapped (Appendix G). Based on the fixed-point survey data, no obvious flyways or concentration areas were observed for any raptor species, which suggests that no particular portion of the OWEF seems to be of greater risk to flying raptors than other areas within the OWEF.

DISCUSSION

Year-Long Mortality Monitoring

The approach used for calculating adjusted fatality estimates is consistent with the approach outlined by Shoenfeld (2004) and Erickson (2006), and accounted for search interval, searcher efficiency rates, and carcass removal rates. It is hypothesized that scavenging could change through time at a given site and must be accounted for when attempting to estimate fatality

rates. We accounted for this by conducting scavenging trials throughout the year. We also estimated searcher efficiency rates throughout the study period to account for potential biases associated with changes in conditions that could have influenced searcher efficiency.

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006) and the overall design of this study incorporates several assumptions or factors that affect the results of the fatality estimates. First, all bird casualties found within the standardized search plots, either during a scheduled search or incidentally, were included in the analysis. Second, it was assumed that all carcasses found during the study on search plots were a result of collision with wind turbines; the true cause of death is unknown for most of the fatalities. It is likely that some of the bird fatalities were caused by predators and that some of the fatalities included in the data were potentially due to natural causes (background mortality). For example, it is unlikely that the domestic chicken carcass discoveries, the mallard, and the greater roadrunner (*Geococcyx californianus*) were due to collision with turbines; however, to be conservative, they were included in the estimates. It is less likely that bat fatalities were due to factors unrelated to interactions with wind turbines.

There are some other potential negative biases. For example, no adjustments were made for fatalities possibly occurring outside of the plot boundaries. While this could potentially lead to an underestimate of fatalities, to help address this issue, two different plot sizes were searched during the study (160 X 160-m and 270 X 270-m plots). The estimates of annual fatalities using the data from the larger plots were lower than the estimates from the smaller plot sizes (0.56 small birds/turbine/year compared to 1.55 small birds/turbine/year, 0.26 large birds/turbine/year compared to 0.47 large birds/turbine year, 0.82 all birds/turbine year compared to 2.02 all birds/turbine/year, and 0.37 bats/turbine/year compared to 2.06 bats/turbine/year). However, the 90% confidence intervals between the estimates from the different plot sizes overlapped for large birds, suggesting no statistically significant difference, while all other estimates were significantly lower using the data from the larger search plots.

Regardless of plot size, a total of 30 carcasses (19 birds and 11 bats) were found within standardized search plots. At the five turbines for which larger plots were searched, a total of nine carcasses were found (seven birds and two bats) and of those, three bird carcasses were found in the portion of the plot that did not overlap with a smaller 160 X 160-m plot. No bat carcasses were found beyond 70 m from a turbine. If we assume that on average the distribution of bird carcasses by distance is similar across the Project, we would expect to have found approximately 17 additional bird carcasses if we would have searched all 33 turbines at 270 X 270-m plots, which would equate to annual bird fatality estimates that are roughly two times higher than the estimates from the smaller plots (i.e., approximately three small birds/turbine/year, approximately one large bird/turbine/year, and approximately four all birds/turbine/year). However, this assessment evaluates estimates from 270 X 270-m plots, which are not necessarily comparable to the vast majority of publicly available fatality studies as smaller plots are typically searched during fatality monitoring studies.

While there are a number of factors that could be influencing the observed results (e.g. sample sizes, specific search plots, one year of data), given the level of estimated annual fatality and taking into account fatalities that might be expected to fall outside of the smaller 160 X 160-m plots, searching the larger plots does not change the overall assessment that estimated annual fatality rates at the OWEF are considered low relative to other comparable studies (see the discussion of comparisons to other fatality rates below).

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass removal trials and whether or not they are representative of actual carcasses. This may occur for example, if the types of birds used are larger or smaller than the carcasses of fatalities or more or less cryptic in color than the actual fatalities. Rock pigeons, mallards, Coturnix quail (*Coturnix japonica*), and house sparrows were used to represent the range of bird fatalities expected. It is believed that this variety of species approximates the range of sizes and other characteristics of actual fatalities and should be a reasonable representation of scavenging rates for birds as a group. A few bats were also used during the spring removal trials, although the sample size was low due to the low numbers of bats discovered during the study.

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates. Hypothetically, this would lead to underestimating true scavenging rates if the scavenger densities are low enough such that scavenging rates for placed carcasses are lower than for actual fatalities (Smallwood 2007, Smallwood et al. 2010). The logic is that if the trials are based on too many carcasses being placed on a given day, scavengers are unable to access all trial carcasses, whereas they could access all wind turbine collision fatalities. If this is the case, and the trial carcass density is much greater than actual turbine fatality density, the trials would underestimate scavenging rates compared to rates on actual fatalities. Carcass removal trials were conducted throughout the year with limited numbers of carcasses of each size class placed in the field during each trial. No more than 13 small bird and 10 large bird carcasses were placed in the field during an individual trial. Carcasses were placed throughout the Project to maintain dispersion and eliminate attraction of scavengers and/or overwhelming the local scavenger population.

Bird Fatalities

A total of 26 bird fatalities were found during the first standardized year-long fatality monitoring study, with 19 of those found during scheduled searches. With the exception of white-throated swift (five fatalities found), a maximum of two individuals were found for each of the other 12 species identified. No state- or federal-listed threatened or endangered bird species were documented as fatalities. One BCC species in BCR 33 (yellow warbler) was documented as a fatality during the study. Only one raptor fatality was documented incidentally within the OWEF during the study (red-tailed hawk). While red-tailed hawks are protected under the Migratory Bird Treaty Act (MBTA), the red-tailed hawk is not considered a sensitive species in California.

The estimated overall bird fatality rate of 0.88 birds/MW/year was low compared to other wind energy facilities in California and the desert southwest where estimates have ranged from 0.55 to 8.3 birds/MW/year (Figure 10, Appendix H1). The overall bird fatality rate at the OWEF ranked 2nd lowest compared to 12 other studies at facilities in California and the desert southwest (Figure 10). Based on the relatively small estimate of avian mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bird populations.

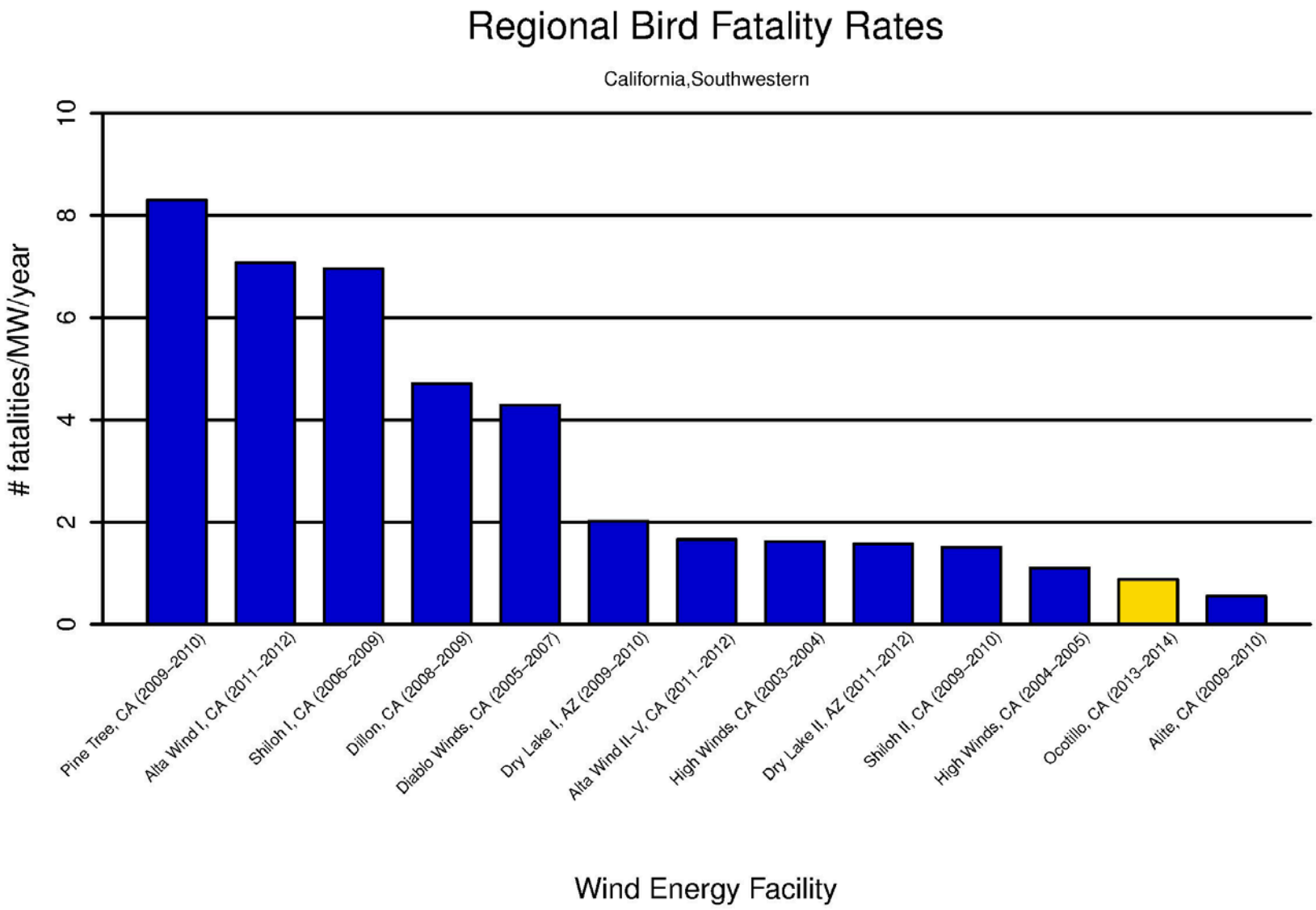

Figure 10. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Figure 10 (*continued*). Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (13-14)	This study.				
Pine Tree, CA (09-10)	BioResource Consultants 2010	Diablo Winds, CA (05-07)	WEST 2006, 2008	Dry Lake II, AZ (11-12)	Thompson and Bay 2012
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Dry Lake I, AZ (09-10)	Thompson et al. 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	High Winds, CA (04-05)	Kerlinger et al. 2006
Dillon, CA (08-09)	Chatfield et al. 2009	High Winds, CA (03-04)	Kerlinger et al. 2006	Alite, CA (09-10)	Chatfield et al. 2010b

Bat Fatalities

A total of 14 bats (including nine found during standardized searches, two incidentals on search plots, and three incidentals off plots) were discovered during the first year-long fatality monitoring study. Mexican free-tailed bats accounted for 78.6% of all documented bat fatalities, while canyon bat accounted for 14.3%, and unidentified Lasiurus bat accounted for 7.1%. None of the bat species identified during the first year-long fatality study are considered sensitive in California. The estimated overall bat fatality rate at the OWEF (0.90 bats/MW/year) was low compared to other wind energy facilities in California and the desert southwest with publicly available bat fatality data (Figure 11, Appendix H3). Bat fatality rates at these other facilities in California and the desert southwest ranged from 0.08 to 3.92 bats/MW/year (Appendix H3). Based on the relatively small estimate of bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bat populations.

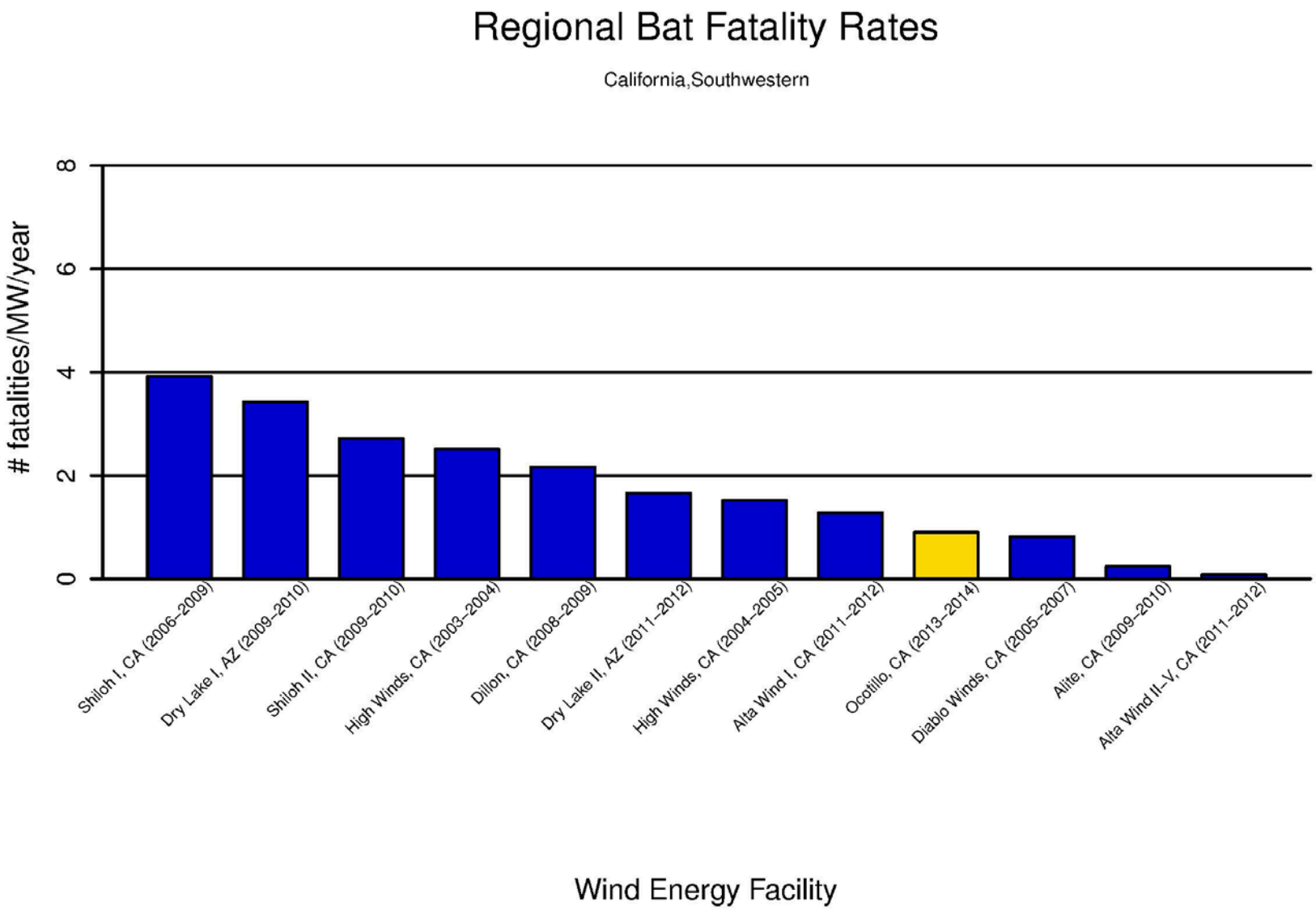

Figure 11. Fatality rates for bats (number of bats per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

Figure 11 (*continued*). Fatality rates for bats (number of bats per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (13-14)	This study.				
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Dillon, CA (08-09)	Chatfield et al. 2009	Diablo Winds, CA (05-07)	WEST 2006, 2008
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Alite, CA (09-10)	Chatfield et al. 2010b
Shiloh II, CA (09-10)	Kerlinger et al. 2010b	High Winds, CA (04-05)	Kerlinger et al. 2006	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012
High Winds, CA (03-04)	Kerlinger et al. 2006	Alta Wind I, CA (11-12)	Chatfield et al. 2012		

Avian Monitoring

Fixed-Point Avian Use Surveys

Based on the 2013-2014 avian use data, it appears that raptor use was greatest in the spring (0.09 raptors/800-m plot/30-min survey), compared to the rest of the seasons (range 0.05 – 0.09 raptors/800-m plot/survey). The relatively higher raptor use measured in spring was primarily due to use by red-tailed hawk (more than 50% of use). Red-tailed hawk had the highest exposure index of any raptor species and was also the only raptor species identified as a fatality (incidentally on a non-search turbine) during the first year-long fatality monitoring study. The only other raptors observed during the 2013-2014 avian use study were American kestrel and unidentified raptor. Overall, raptor use was low compared to other California and desert southwest projects where similar data have been collected (Figure 12). The low raptor use observed was in line with the low overall raptor fatalities observed during the first standardized year-long fatality study.

Small bird use was greatest in the winter and spring (1.21 birds/100-m plot/30-min survey during both seasons) and lowest in the summer (0.58), with fall use being moderate compared to the other seasons (0.77). This pattern of use by small birds was consistent with the observed bird fatalities, which were dispersed throughout the winter, spring, and fall seasons, with no fatalities identified during the summer season. The most common small bird species identified as a fatality during the study was white-throated swift, which had the second highest exposure index for small birds based on the avian use data.

During the 2013-2014 avian use study, common raven, black-throated sparrow, house finch, cactus wren, and rock wren were the most abundant bird species. All of these species were also among the most abundant species observed during the pre-construction studies. However, avian abundance was significantly lower during the 2013-2014 study compared to the pre-construction study. There are a number of factors that may influence the observed results, including the use of different observers and environmental conditions (e.g. drought conditions).

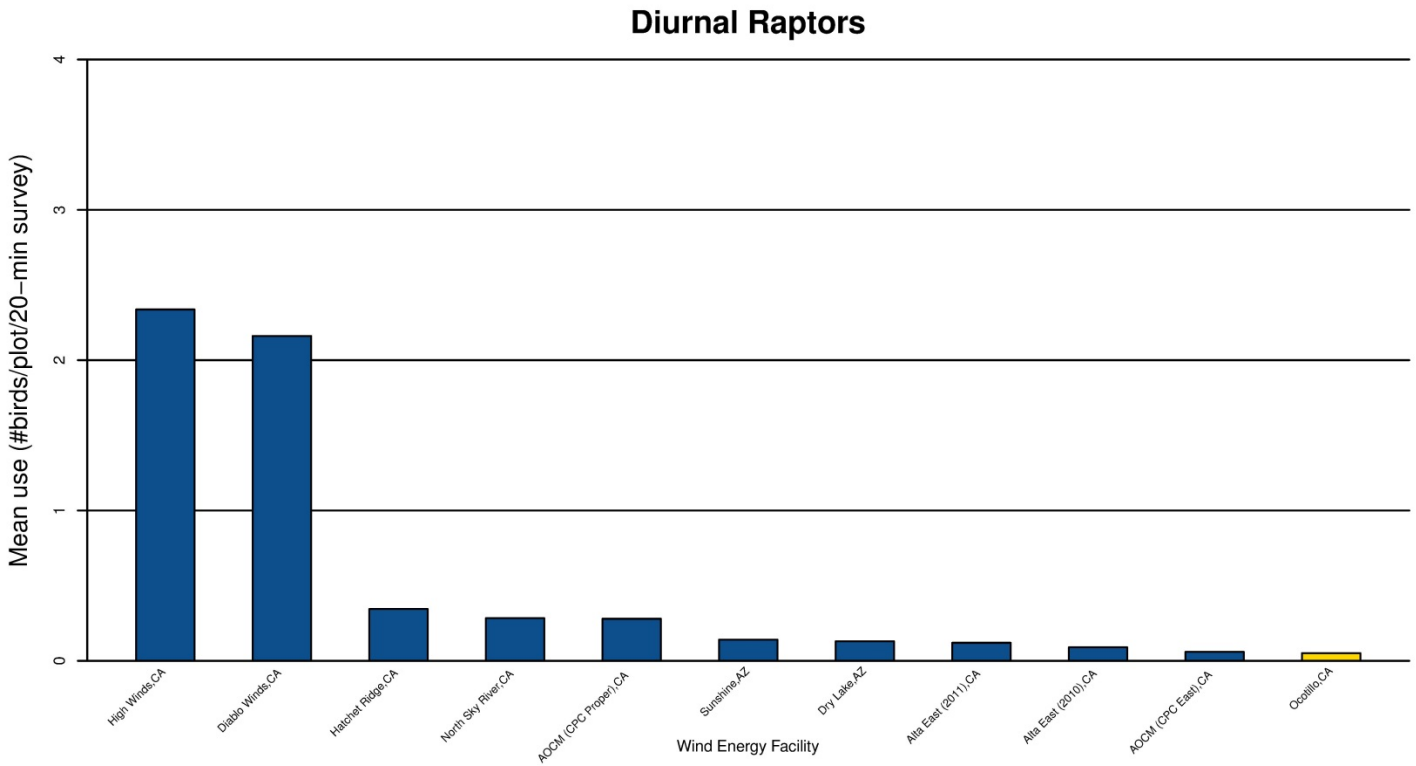

Figure 12. Comparison of estimated annual diurnal raptor use (raptors/800-m plot/20-min survey) during fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014, and diurnal raptor use at other California and desert southwest wind resource areas with three or four other seasons of raptor use data.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Ocotillo, CA	This Study				
High Winds, CA	Kerlinger et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010a	Alta East (2010), CA	Chatfield et al. 2011
Diablo Winds, CA	WEST 2006	Sunshine, AZ	WEST and the CPRS 2006	AOCM (CPC East), CA	Chatfield et al. 2010a
Hatchet Ridge, CA	Young et al. 2007b	Dry Lake, AZ	Young et al. 2007c		
North Sky River, CA	Erickson et al. 2011	Alta East (2011), CA	Chatfield et al. 2011		

CONCLUSIONS

The first standardized year-long fatality monitoring study and avian use study at the OWEF were completed in the fall of 2014, with the conclusion of the 12 months of mortality surveys. This report presents only the results of the first full year of standardized fatality surveys and avian use surveys. Additional carcass discoveries that occurred prior to the start of the standardized year-long survey or during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcasses discoveries at the facility are provided to the agencies on a monthly basis. The results of the first year of standardized studies have provided new insights into the effects of the OWEF on wildlife, which are primarily supportive of the low level of predicted risk of the Project on wildlife. The first year of studies found that impacts to birds (including raptors) and bats were low compared to other wind energy projects in the California and the desert southwest. No federal or state listed species or BLM sensitive species were identified during the first year-long standardized fatality monitoring study. One BCC species in BCR 33 (yellow warbler) was identified as a fatality during the study. Based on the relatively small estimates of avian and bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bird or bat populations.

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Appendix A. Complete Fatality Listing for Carcasses Discovered During the First Year of Standardized Year-Long Fatality Monitoring and Incidentally at the Ocotillo Express Wind Energy Facility, October 4, 2013 – September 29, 2014

Appendix B. Complete fatality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
10/8/2013	Mexican free-tailed bat	173	32	Scheduled Carcass Search	Year-long	Intact
10/11/2013	Mexican free-tailed bat	176	52	Scheduled Carcass Search	Year-long	Intact
11/1/2013	greater roadrunner	75	48	Scheduled Carcass Search	Year-long	Feather Spot
11/8/2013	unidentified large bird	133	76	Scheduled Carcass Search	Year-long	Dismemberd
12/5/2013	house finch	161	35	Incidental Find	Year-long	Intact
12/13/2013	white-throated swift	15	2	Incidental Find	Year-long	Intact
12/19/2013	unidentified bird (small)	130	77	Scheduled Carcass Search	Year-long	Dismemberd
12/19/2013	white-throated swift	65	15	Incidental Find	Year-long	Intact
12/19/2013	white-throated swift	65	17	Incidental Find	Year-long	Intact
12/26/2013	red-tailed hawk	122	20	Incidental Find	Year-long	Intact
1/4/2014	unidentified large bird	43	56	Scheduled Carcass Search	Year-long	Dismemberd
1/5/2014	unidentified large bird	24	81	Scheduled Carcass Search	Year-long	Dismemberd
1/23/2014	unidentified bird (small)	75	75	Scheduled Carcass Search	Year-long	Feather Spot
1/29/2014	domestic chicken	149	158	Scheduled Carcass Search	Year-long	Feather Spot
1/30/2014	domestic chicken	147	30	Scheduled Carcass Search	Year-long	Feather Spot
2/12/2014	Mexican free-tailed bat	77	3	Incidental	Year-long	Intact
2/24/2014	mallard	156	30	Scheduled Carcass Search	Year-long	Feather Spot
3/2/2014	Mexican free-tailed bat	31	41	Scheduled Carcass Search	Year-long	Intact
3/10/2014	western meadowlark	94	311	Incidental Find	Year-long	Dismemberd
3/10/2014	canyon bat	124	27	Scheduled Carcass Search	Year-long	Intact
3/31/2014	unidentified large bird	93	110	Scheduled Carcass Search	Year-long	Scavenged
4/8/2014	canyon bat	118	46	Scheduled Carcass Search	Year-long	Intact
4/10/2014	Mexican free-tailed bat	133	12	Incidental Find	Year-long	Intact
4/21/2014	mourning dove	92	69	Incidental Find	Year-long	Dismemberd
4/26/2014	warbling vireo	113	82	Scheduled Carcass Search	Year-long	Intact
4/26/2014	Swainson's thrush	113	60	Scheduled Carcass Search	Year-long	Intact
4/28/2014	yellow warbler	75	83	Scheduled Carcass Search	Year-long	Dismemberd
4/29/2014	unidentified bird (small)	93	35	Scheduled Carcass Search	Year-long	Dismemberd
5/6/2014	Townsend's warbler	149	17	Scheduled Carcass Search	Year-long	Scavenged
5/6/2014	Wilson's warbler	149	85	Scheduled Carcass Search	Year-long	Intact
5/23/2014	unidentified large bird	113	66	Scheduled Carcass Search	Year-long	Dismemberd
5/28/2014	white-throated swift	130	46	Scheduled Carcass Search	Year-long	Intact
8/12/2014	unidentified lasiurus bat	44	1	Incidental Find	Year-long	Intact
8/22/2014	Mexican free-tailed bat	148	17	Scheduled Carcass Search	Year-long	Intact
9/5/2014	Mexican free-tailed bat	148	5	Scheduled Carcass Search	Year-long	Intact
9/6/2014	Mexican free-tailed bat	133	23	Scheduled Carcass Search	Year-long	Intact
9/13/2014	white-throated swift	76	22	Scheduled Carcass Search	Year-long	Intact

Appendix B. Complete fatality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
9/13/2014	Mexican free-tailed bat	28	63	Scheduled Carcass Search	Year-long	Intact
9/18/2014	Mexican free-tailed bat	25	15	Incidental Find	Year-long	Intact
9/18/2014	Mexican free-tailed bat	25	17	Incidental Find	Year-long	Intact

Appendix B. Complete Bird and Bat Fatality Table for the Ocotillo Express Wind Energy Facility for Studies Conducted from October 4, 2013 – September 29, 2014

Appendix B. Correction factors and bird and bat fatality rates by season and turbine type for studies conducted within the Ocotillo Express Wind Energy Facility from October 4, 2013 – September 29, 2014.

	Winter (33 turbines searched)		Spring/Summer/Fall (33 turbines searched)	
Parameter	**Mean**	**90% CI**	**Mean**	**90% CI**
Search Area Adjustment				
A (small birds)	1.00	-	1.00	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.00	-
Observer Detection Rate				
p (small birds)	0.73	0.67-0.80	0.73	0.67-0.80
p (large birds)	0.94	0.89-0.98	0.94	0.89-0.98
p (bats)	0.73	0.67-0.80	0.73	0.67-0.80
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	5.51	4.12-6.91	3.45	2.52-4.57
$\bar{t}$ (large birds)	8.80	6.19-11.98	8.80	6.19-11.98
$\bar{t}$ (bats)	5.51	4.12-6.91	3.45	2.52-4.57
Observed Fatality Rates (Fatalities/Turbine/Season(s))				
small birds	0.06	0.00-0.15	0.21	0.09-0.36
large birds	0.12	0.03-0.21	0.09	0.03-0.18
bats	0	-	0.33	0.18-0.48
Average Probability of Carcass Availability and Detected				
small birds	0.25	0.19-0.31	0.17	0.12-0.22
large birds	0.45	0.35-0.55	0.45	0.35-0.55
bats	0.25	0.19-0.31	0.17	0.12-0.22
Adjusted Fatality Rates (Fatalities/Turbine/Seasons(s))				
small birds	0.24	0.00-0.56	1.31	0.50-2.32
large birds	0.27	0.08-0.50	0.20	0.05-0.41
bats	0	-	2.06	1.09-3.37
Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)				
	Mean		**90% CI**	
small birds	1.55		0.69-2.61	
large birds	0.47		0.21-0.80	
all birds	2.02		1.11-3.13	
bats	2.06		1.09-3.37	

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Appendix C. Summary of Individuals and Group Observations by Bird Type and Species for Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

Appendix C. Summary of individuals and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility[a] from August 26, 2013 – September 29, 2014.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Diurnal Raptors		**8**	**8**	**14**	**16**	**11**	**11**	**5**	**5**	**38**	**40**
Buteos		*8*	*8*	*11*	*12*	*6*	*6*	*5*	*5*	*30*	*31*
red-tailed hawk	*Buteo jamaicensis*	8	8	11	12	6	6	5	5	30	31
Falcons		*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*1*	*1*
American kestrel	*Falco sparverius*	0	0	1	1	0	0	0	0	1	1
Other Raptors		*0*	*0*	*2*	*3*	*5*	*5*	*0*	*0*	*7*	*8*
unidentified raptor		0	0	2	3	5	5	0	0	7	8
Vultures		**2**	**2**	**1**	**1**	**8**	**8**	**4**	**4**	**15**	**15**
turkey vulture	*Cathartes aura*	2	2	1	1	8	8	4	4	15	15
Doves/Pigeons		**0**	**0**	**0**	**0**	**2**	**3**	**5**	**13**	**7**	**16**
Eurasian collared-dove	*Streptopelia decaocto*	0	0	0	0	0	0	2	10	2	10
mourning dove	*Zenaida macroura*	0	0	0	0	2	3	3	3	5	6
Large Corvids		**23**	**30**	**27**	**39**	**35**	**48**	**1**	**1**	**86**	**118**
common raven	*Corvus corax*	23	30	27	39	35	48	1	1	86	118
Cuckoos		**2**	**2**	**1**	**1**	**0**	**0**	**1**	**1**	**4**	**4**
greater roadrunner	*Geococcyx californianus*	2	2	1	1	0	0	1	1	4	4
Passerines		**120**	**142**	**146**	**189**	**108**	**128**	**61**	**75**	**435**	**534**
barn swallow	*Hirundo rustica*	0	0	0	0	1	2	0	0	1	2
black-tailed gnatcatcher	*Polioptila melanura*	8	10	7	8	4	5	3	3	22	26
black-throated gray warbler	*Setophaga nigrescens*	0	0	0	0	1	1	0	0	1	1
black-throated sparrow	*Amphispiza bilineata*	23	30	12	13	27	30	29	40	91	113
black phoebe	*Sayornis nigricans*	5	5	0	0	0	0	0	0	5	5
cactus wren	*Campylorhynchus brunneicapillus*	22	25	12	13	19	19	19	20	72	77
house finch	*Haemorhous mexicanus*	0	0	53	87	9	15	1	1	63	103
Le Conte's thrasher	*Toxostoma lecontei*	2	3	0	0	2	2	1	2	5	7
loggerhead shrike	*Lanius ludovicianus*	7	8	11	11	7	7	4	4	29	30
orange-crowned warbler	*Oreothlypis celata*	1	2	0	0	0	0	0	0	1	2
rock wren	*Salpinctes obsoletus*	25	30	27	31	0	0	0	0	52	61
Say's phoebe	*Sayornis saya*	3	3	3	4	5	6	0	0	11	13
Townsend's warbler	*Setophaga townsendi*	0	0	0	0	1	1	0	0	1	1
unidentified passerine		15	17	11	11	19	21	2	3	47	52
unidentified sparrow		0	0	0	0	2	3	0	0	2	3
unidentified thrush		3	3	0	0	0	0	0	0	3	3

Appendix C. Summary of individuals and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility [a] from August 26, 2013 – September 29, 2014.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
unidentified warbler		0	0	0	0	4	5	0	0	4	5
verdin	*Auriparus flaviceps*	1	1	1	1	0	0	2	2	4	4
western kingbird	*Tyrannus verticalis*	5	5	4	4	1	1	0	0	10	10
yellow-rumped warbler	*Setophaga coronate*	0	0	5	6	6	10	0	0	11	16
Swifts/Hummingbirds		**3**	**3**	**23**	**28**	**12**	**13**	**2**	**2**	**40**	**46**
Anna's hummingbird	*Calypte anna*	2	2	7	7	0	0	0	0	9	9
calliope hummingbird	*Selasphorus calliope*	0	0	0	0	0	0	1	1	1	1
Costa's hummingbird	*Calypte costae*	0	0	7	8	0	0	0	0	7	8
unidentified hummingbird		1	1	8	8	10	10	1	1	20	20
white-throated swift	*Aeronautes saxatalis*	0	0	1	5	2	3	0	0	3	8
Woodpeckers		**0**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**4**	**4**
ladder-backed woodpecker	*Picoides scalaris*	0	0	4	4	0	0	0	0	4	4
Overall		**158**	**187**	**216**	**278**	**176**	**211**	**79**	**101**	**629**	**777**

[a] Regardless of distance from observer.

Appendix D. Mean Use, Percent of Use, and Frequency of Occurrence for Large and Small Birds Observed during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September, 2014

Appendix D1. Mean bird use (number of birds/plot[a]/30-min survey), percent of use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Diurnal Raptors	**0.05**	**0.08**	**0.09**	**0.05**	**21.6**	**26.0**	**13.8**	**22.7**	**4.8**	**6.5**	**8.6**	**4.8**
Buteos	*0.05*	*0.07*	*0.05*	*0.05*	*21.6*	*24.0*	*7.7*	*22.7*	*4.8*	*6.0*	*4.8*	*4.8*
red-tailed hawk	0.05	0.07	0.05	0.05	21.6	24.0	7.7	22.7	4.8	6.0	4.8	4.8
Falcons	*0*	*<0.01*	*0*	*0*	*0*	*2.0*	*0*	*0*	*0*	*0.6*	*0*	*0*
American kestrel	0	<0.01	0	0	0	2.0	0	0	0	0.6	0	0
Other Raptors	*0*	*0*	*0.04*	*0*	*0*	*0*	*6.2*	*0*	*0*	*0*	*3.8*	*0*
unidentified raptor	0	0	0.04	0	0	0	6.2	0	0	0	3.8	0
Vultures	**0.01**	**0**	**0.07**	**0.03**	**5.4**	**0**	**10.8**	**13.6**	**1.2**	**0**	**5.7**	**2.9**
turkey vulture	0.01	0	0.07	0.03	5.4	0	10.8	13.6	1.2	0	5.7	2.9
Doves/Pigeons	**0**	**0**	**0.03**	**0.12**	**0**	**0**	**4.6**	**59.1**	**0**	**0**	**1.9**	**3.8**
Eurasian collared-dove	0	0	0	0.10	0	0	0	45.5	0	0	0	1.0
mourning dove	0	0	0.03	0.03	0	0	4.6	13.6	0	0	1.9	2.9
Large Corvids	**0.16**	**0.22**	**0.44**	**<0.01**	**73.0**	**74.0**	**70.8**	**4.5**	**11.3**	**11.3**	**25.7**	**1.0**
common raven	0.16	0.22	0.44	<0.01	73.0	74.0	70.8	4.5	11.3	11.3	25.7	1.0
Overall Large Birds	**0.22**	**0.30**	**0.62**	**0.21**	**100**	**100**	**100**	**100**				

[a.] 800-meter (m) radius plot for large birds

Appendix D2. Mean bird use (number of birds/plot[a]/30-min survey), percent of use (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Cuckoos	**0.01**	**<0.01**	**0**	**0**	**1.6**	**0.5**	**0**	**0**	**1.2**	**0.6**	**0**	**0**
greater roadrunner	0.01	<0.01	0	0	1.6	0.5	0	0	1.2	0.6	0	0
Passerines	**0.74**	**1.02**	**1.10**	**0.56**	**96.1**	**83.8**	**90.6**	**96.7**	**34.5**	**48.2**	**44.8**	**22.9**
barn swallow	0	0	0.02	0	0	0	1.6	0	0	0	1.0	0
black-tailed gnatcatcher	0.06	0.05	0.05	0.03	7.8	3.9	3.9	4.9	3.6	4.2	2.9	2.9
black-throated gray warbler	0	0	<0.01	0	0	0	0.8	0	0	0	1.0	0
black-throated sparrow	0.16	0.07	0.29	0.32	20.9	5.9	23.6	55.7	10.1	6.0	17.1	14.3
black phoebe	0.02	0	0	0	2.3	0	0	0	1.8	0	0	0
cactus wren	0.13	0.07	0.13	0.12	17.1	5.9	11.0	21.3	10.1	6	10.5	9.5
house finch	0	0.50	0.13	<0.01	0	41.2	11.0	1.6	0	22.0	4.8	1.0
Le Conte's thrasher	0.02	0	0.02	0.02	2.3	0	1.6	3.3	1.2	0	1.9	1.0
loggerhead shrike	0.04	0.05	0.06	0.04	4.7	4.4	4.7	6.6	3.0	4.8	5.7	2.9
orange-crowned warbler	0.01	0	0	0	1.6	0	0	0	0.6	0	0	0
rock wren	0.14	0.12	0	0	18.6	10.3	0	0	7.7	9.5	0	0
Say's phoebe	0.01	0.02	0.06	0	1.6	2.0	4.7	0	1.2	1.2	4.8	0
Townsend's warbler	0	0	<0.01	0	0	0	0.8	0	0	0	1.0	0
unidentified passerine	0.10	0.06	0.15	0	13.2	4.9	12.6	0	7.7	4.8	10.5	0
unidentified sparrow	0	0	0.03	0	0	0	2.4	0	0	0	1.9	0
unidentified thrush	0.01	0	0	0	1.6	0	0	0	1.2	0	0	0
unidentified warbler	0	0	0.05	0	0	0	3.9	0	0	0	3.8	0
verdin	<0.01	<0.01	0	0.02	0.8	0.5	0	3.3	0.6	0.6	0	1.9
western kingbird	0.03	0.02	<0.01	0	3.9	2.0	0.8	0	2.4	2.4	1.0	0
yellow-rumped warbler	0	0.04	0.09	0	0	2.9	7.1	0	0	3.0	4.8	0
Swifts/Hummingbirds	**0.02**	**0.17**	**0.11**	**0.02**	**2.3**	**13.7**	**9.4**	**3.3**	**1.8**	**11.9**	**8.6**	**1.9**
Anna's hummingbird	0.01	0.04	0	0	1.6	3.4	0	0	1.2	4.2	0	0
calliope hummingbird	0	0	0	<0.01	0	0	0	1.6	0	0	0	1.0
Costa's hummingbird	0	0.05	0	0	0	3.9	0	0	0	4.2	0	0
unidentified hummingbird	<0.01	0.05	0.09	<0.01	0.8	3.9	7.1	1.6	0.6	4.8	6.7	1.0
white-throated swift	0	0.03	0.03	0	0	2.5	2.4	0	0	0.6	1.9	0
Woodpeckers	**0**	**0.02**	**0**	**0**	**0**	**2.0**	**0**	**0**	**0**	**2.4**	**0**	**0**
ladder-backed woodpecker	0	0.02	0	0	0	2.0	0	0	0	2.4	0	0
Overall Small Birds	**0.77**	**1.21**	**1.21**	**0.58**	**100**	**100**	**100**	**100**				

[a] 100-meter (m) radius plot for small birds.

Appendix E. Species Exposure Indices for Large Birds and Small Birds during Fixed-Point Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

Appendix E1. Relative exposure index and flight characteristics by large bird species during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
common raven	38	0.21	52.3	82.8	0.09	87.9
red-tailed hawk	15	0.05	50.0	80.0	0.02	93.3
turkey vulture	12	0.03	100	66.7	0.02	75.0
unidentified raptor	3	<0.01	75.0	100	<0.01	100
mourning dove	3	0.01	50.0	33.3	<0.01	33.3
American kestrel	1	<0.01	100	100	<0.01	100
Eurasian collared-dove	1	0.02	90.0	0	0	0

RSH: The likely “rotor swept heights” for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

Appendix E2. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
black-throated sparrow	23	0.21	28.2	6.9	<0.01	6.9
white-throated swift	3	0.02	100	25.0	<0.01	25.0
house finch	16	0.18	37.4	5.4	<0.01	13.5
cactus wren	8	0.11	18.0	0	0	0
unidentified passerine	7	0.08	20.9	0	0	0
rock wren	9	0.07	35.6	0	0	0
loggerhead shrike	12	0.05	48.0	0	0	0
black-tailed gnatcatcher	11	0.05	50.0	0	0	0
unidentified hummingbird	13	0.04	68.4	0	0	0
yellow-rumped warbler	6	0.03	60.0	0	0	0
Say's phoebe	1	0.02	16.7	0	0	0
western kingbird	4	0.02	40.0	0	0	0
Anna's hummingbird	3	0.01	33.3	0	0	0
Costa's hummingbird	1	0.01	12.5	0	0	0
Le Conte's thrasher	2	0.01	42.9	0	0	0
unidentified warbler	3	0.01	80.0	0	0	0
verdin	1	<0.01	25.0	0	0	0
unidentified sparrow	1	<0.01	66.7	0	0	0
ladder-backed woodpecker	2	<0.01	50.0	0	0	0
barn swallow	1	<0.01	100	0	0	0
greater roadrunner	1	<0.01	33.3	0	0	0
black phoebe	1	<0.01	33.3	0	0	0
unidentified thrush	1	<0.01	50.0	0	0	0
orange-crowned warbler	0	<0.01	0	0	0	0
Townsend's warbler	1	<0.01	100	0	0	0
calliope hummingbird	1	<0.01	100	0	0	0
black-throated gray warbler	0	<0.01	0	0	0	0

RSH: The likely “rotor swept heights” for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

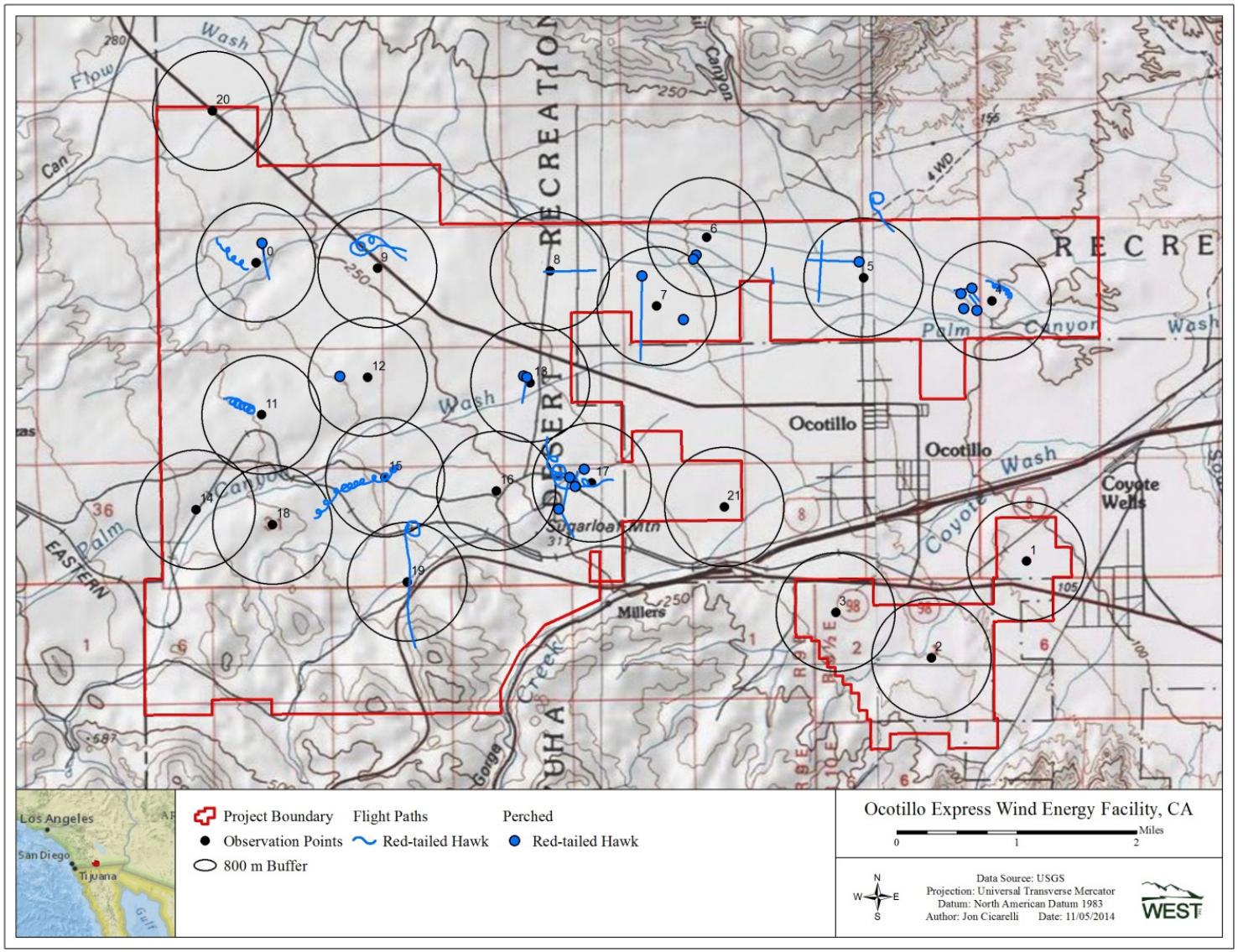
Appendix F. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

Appendix F. Mean use (number of birds/30-minute survey) by point for all birds[a], major bird types, and diurnal raptor subtypes observed at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2013 to September 29, 2014.

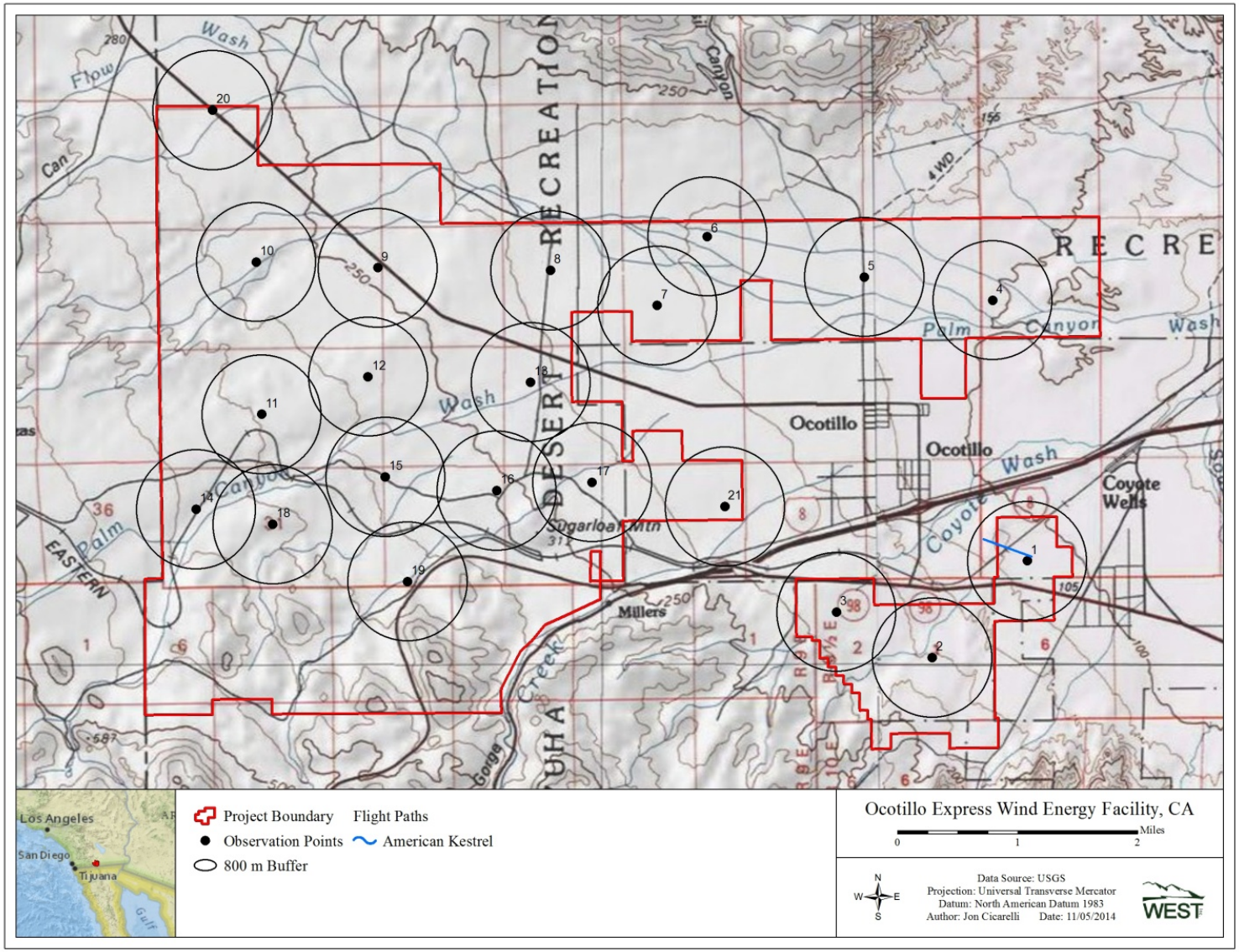
	Survey Point																				
Bird Type	**0**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Diurnal Raptor	0.04	0	0	0.23	0.15	0.12	0.08	0.04	0.04	0.08	0.08	0.08	0.08	0	0.04	0	0.27	0	0.04	0	0
Buteo	*0*	*0*	*0*	*0.23*	*0.12*	*0.08*	*0.08*	*0.04*	*0.04*	*0.08*	*0.04*	*0.04*	*0.08*	*0*	*0.04*	*0*	*0.27*	*0*	*0.04*	*0*	*0*
Falcon	*0.04*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Raptor	*0*	*0*	*0*	*0*	*0.04*	*0.04*	*0*	*0*	*0*	*0*	*0.04*	*0.04*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Vulture	0.12	0.12	0.08	0	0	0	0	0	0.08	0	0.08	0	0	0	0	0	0	0	0	0	0
Dove/Pigeon	0.15	0	0	0	0	0	0	0	0	0	0	0	0.38	0	0	0	0	0.04	0	0.04	0
Large Corvid	0.08	0.12	0.08	0.27	0.42	0.42	0.54	0.12	0.12	0.08	0.19	0.04	0.08	0	0.12	0.08	0.58	0.08	0.12	0.27	0.50
All Large Birds	**0.38**	**0.23**	**0.15**	**0.50**	**0.58**	**0.54**	**0.62**	**0.15**	**0.23**	**0.15**	**0.35**	**0.12**	**0.54**	**0**	**0.15**	**0.08**	**0.85**	**0.12**	**0.15**	**0.31**	**0.50**
Passerine	0.5	0.73	0.38	0.50	0.54	0.35	0.23	0.27	0.50	1.27	1.54	0.96	0.46	1.73	1.38	0.46	2.35	1.42	0.54	1.23	0.69
Cuckoo	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0.04	0	0	0	0	0	0.04
Swifts/ Hummingbird	0	0.08	0	0	0.08	0.15	0	0.27	0	0.15	0.12	0.08	0.08	0.12	0.04	0	0.19	0.23	0.04	0.08	0.04
Woodpecker	0	0	0	0	0	0	0	0.04	0	0.04	0	0	0.04	0	0	0	0	0.04	0	0	0
All Small Birds	**0.5**	**0.81**	**0.38**	**0.5**	**0.62**	**0.50**	**0.23**	**0.58**	**0.50**	**1.50**	**1.65**	**1.04**	**0.58**	**1.85**	**1.46**	**0.46**	**2.54**	**1.69**	**0.58**	**1.31**	**0.77**

[a.] 800-meter (m) radius plot for large birds, 100-m for small birds.

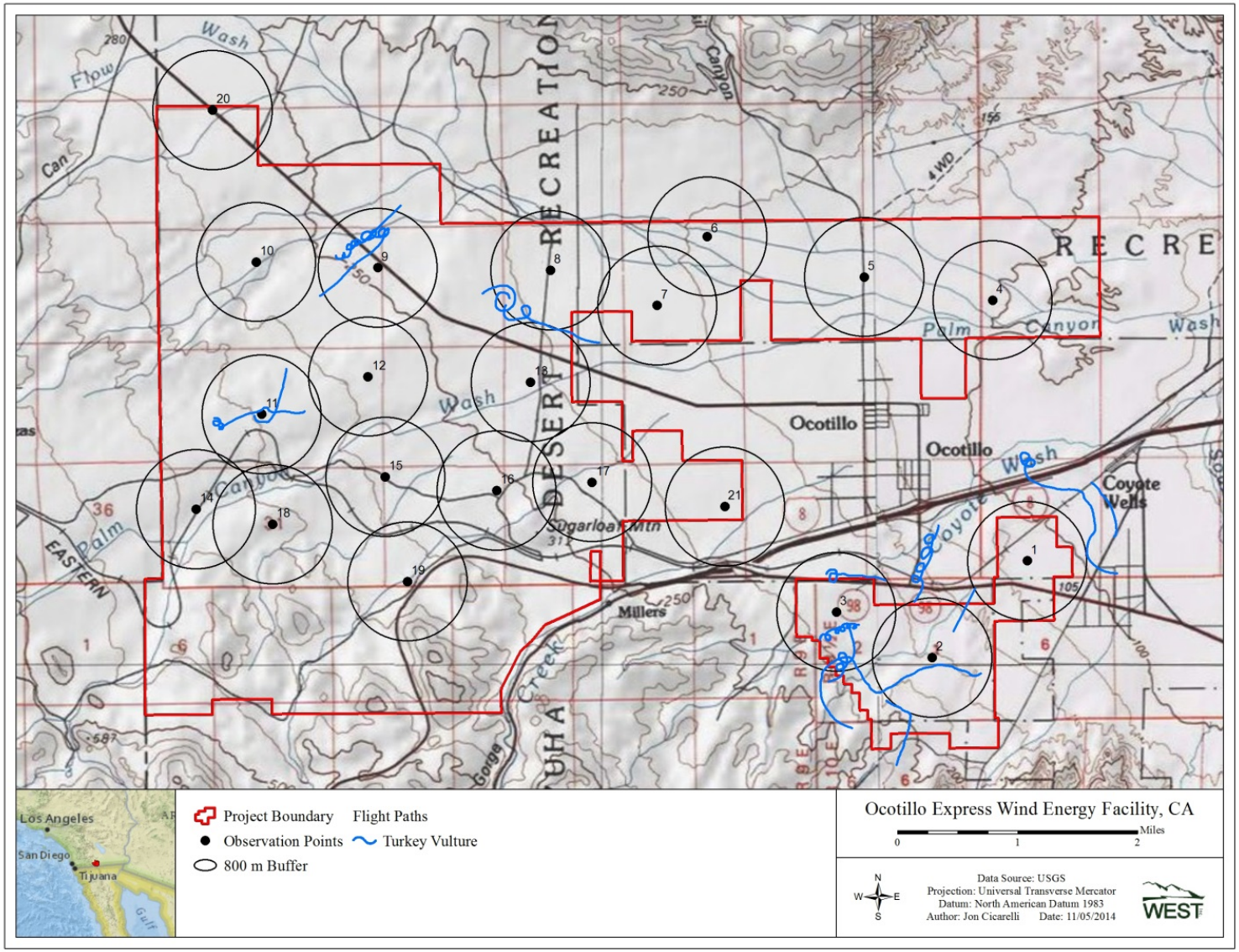
Appendix G. Large Bird Flight Paths Recorded during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014



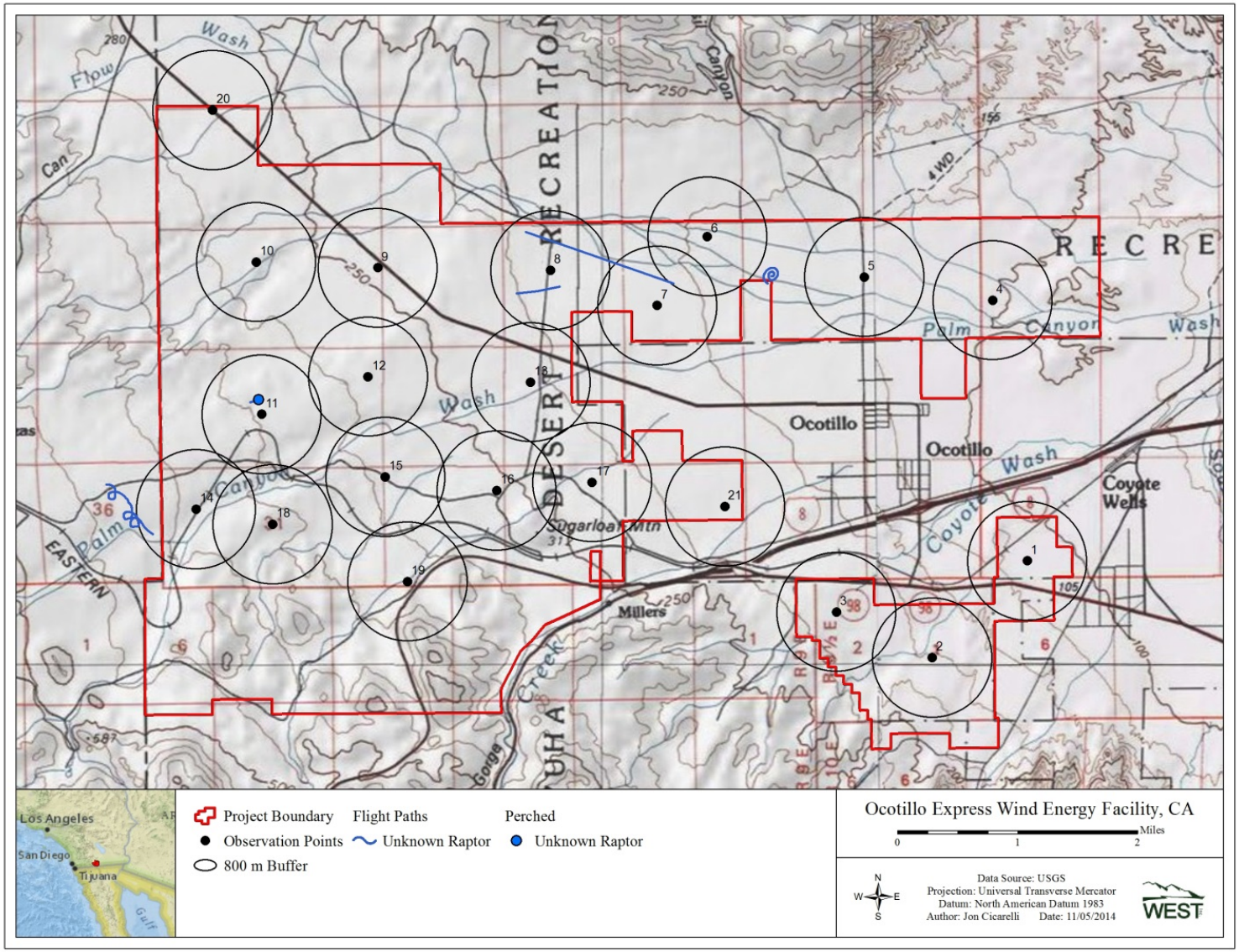
Appendix G. Buteo flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



Appendix G (*continued*). Falcon flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



Appendix G (*continued*). Turkey vulture flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



Appendix G (*continued*). Unidentified raptor flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.

Appendix H. North American Fatality Summary Tables

Appendix H1. Wind energy facilities in North America with publicly-available and comparable fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Ocotillo, CA	**0.88**	**112**	**315**
California			
Pine Tree, CA (2009-2010)	8.30	90	135
Alta Wind I, CA (2011-2012)	7.07	100	150
Shiloh I, CA (2006-2009)	6.96	100	150
Dillon, CA (2008-2009)	4.71	45	45
Diablo Winds, CA (2005-2007)	4.29	31	20.46
Alta Wind II-V, CA (2011-2012)	1.66	190	570
High Winds, CA (2003-2004)	1.62	90	162
Shiloh II, CA (2009-2010)	1.51	75	150
High Winds, CA (2004-2005)	1.10	90	162
Alite, CA (2009-2010)	0.55	8	24
Southwest			
Dry Lake I, AZ (2009-2010)	2.02	30	63
Dry Lake II, AZ (2011-2012)	1.57	31	65
Pacific Northwest			
Windy Flats, WA (2010-2011)	8.45	114	262.2
Leaning Juniper, OR (2006-2008)	6.66	67	100.5
Linden Ranch, WA (2010-2011)	6.65	25	50
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	65	150
White Creek, WA (2007-2011)	4.05	89	204.7
Tuolumne (Windy Point I), WA (2009-2010)	3.20	62	136.6
Stateline, OR/WA (2001-2002)	3.17	454	299
Klondike II, OR (2005-2006)	3.14	50	75
Klondike III (Phase I), OR (2007-2009)	3.02	125	223.6
Hopkins Ridge, WA (2008)	2.99	87	156.6
Harvest Wind, WA (2010-2012)	2.94	43	98.9
Nine Canyon, WA (2002-2003)	2.76	37	48.1
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	65	150
Stateline, OR/WA (2003)	2.68	454	299
Klondike IIIa (Phase II), OR (2008-2010)	2.61	51	76.5
Combine Hills, OR (Phase I; 2004-2005)	2.56	41	41
Big Horn, WA (2006-2007)	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Combine Hills, OR (2011)	2.33	104	104
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	76	174.8
Hay Canyon, OR (2009-2010)	2.21	48	100.8
Elkhorn, OR (2010)	1.95	61	101
Pebble Springs, OR (2009-2010)	1.93	47	98.7
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA (2007)	1.55	127	229
Goodnoe, WA (2009-2010)	1.40	47	94
Vantage, WA (2010-2011)	1.27	60	90
Hopkins Ridge, WA (2006)	1.23	83	150
Stateline, OR/WA (2006)	1.23	454	299
Kittitas Valley, WA (2011-2012)	1.06	48	100.8
Klondike, OR (2002-2003)	0.95	16	24
Vansycle, OR (1999)	0.95	38	24.9
Elkhorn, OR (2008)	0.64	61	101
Marengo I, WA (2009-2010)	0.27	78	140.4
Marengo II, WA (2009-2010)	0.16	39	70.2

Appendix H1. Wind energy facilities in North America with publicly-available and comparable fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Rocky Mountains			
Foote Creek Rim, WY (Phase I; 1999)	3.40	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.42	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	69	41.4
Summerview, Alb (2005-2006)	1.06	39	70.2
Northeast			
Criterion, MD (2011)	6.40	28	70
Mount Storm, WV (2011)	4.24	132	264
Mount Storm, WV (2009)	3.85	132	264
Lempster, NH (2009)	3.38	12	24
Casselman, PA (2009)	2.88	23	34.5
Mountaineer, WV (2003)	2.69	44	66
Stetson Mountain I, ME (2009)	2.68	38	57
Noble Ellenburg, NY (2009)	2.66	54	80
Lempster, NH (2010)	2.64	12	24
Mount Storm, WV (2010)	2.60	132	264
Maple Ridge, NY (2007)	2.34	195	321.75
Noble Bliss, NY (2009)	2.28	67	100
Criterion, MD (2012)	2.14	28	70
Maple Ridge, NY (2007-2008)	2.07	195	321.75
Noble Altona, NY (2010)	1.84	65	97.5
Mars Hill, ME (2008)	1.76	28	42
High Sheldon, NY (2010)	1.76	75	112.5
Noble Wethersfield, NY (2010)	1.70	84	126
Mars Hill, ME (2007)	1.67	28	42
Noble Chateaugay, NY (2010)	1.66	71	106.5
Noble Clinton, NY (2008)	1.59	67	100
High Sheldon, NY (2011)	1.57	75	112.5
Casselman, PA (2008)	1.51	23	34.5
Munnsville, NY (2008)	1.48	23	34.5
Stetson Mountain II, ME (2010)	1.42	17	25.5
Cohocton/Dutch Hill, NY (2009)	1.39	50	125
Cohocton/Dutch Hills, NY (2010)	1.32	50	125
Noble Bliss, NY (2008)	1.30	67	100
Beech Ridge, WV (2012)	1.19	67	100.5
Stetson Mountain I, ME (2011)	1.18	38	57
Noble Clinton, NY (2009)	1.11	67	100
Locust Ridge, PA (Phase II; 2009)	0.84	51	102
Noble Ellenburg, NY (2008)	0.83	54	80
Locust Ridge, PA (Phase II; 2010)	0.76	51	102
Midwest			
Wessington Springs, SD (2009)	8.25	34	51
Blue Sky Green Field, WI (2008; 2009)	7.17	88	145
Cedar Ridge, WI (2009)	6.55	41	67.6
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN (2009)	5.59	33	49.5
Barton I & II, IA (2010-2011)	5.50	80	160
Buffalo Ridge I, SD (2009-2010)	5.06	24	50.4
Buffalo Ridge, MN (Phase I; 1996)	4.14	73	25
Winnebago, IA (2009-2010)	3.88	10	20
Rugby, ND (2010-2011)	3.82	71	149

Appendix H1. Wind energy facilities in North America with publicly-available and comparable fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Cedar Ridge, WI (2010)	3.72	41	68
Elm Creek II, MN (2011-2012)	3.64	62	148.8
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Buffalo Ridge, MN (Phase I; 1998)	3.14	73	25
Ripley, Ont (2008)	3.09	38	76
Fowler I, IN (2009)	2.83	162	301
Buffalo Ridge, MN (Phase I; 1997)	2.51	73	25
Buffalo Ridge, MN (Phase II; 1998)	2.47	143	107.25
PrairieWinds SD1, SD (2012-2013)	2.01	108	162
Buffalo Ridge II, SD (2011-2012)	1.99	105	210
Kewaunee County, WI (1999-2001)	1.95	31	20.46
NPPD Ainsworth, NE (2006)	1.63	36	20.5
PrairieWinds ND1 (Minot), ND (2011)	1.56	80	115.5
Elm Creek, MN (2009-2010)	1.55	67	100
PrairieWinds ND1 (Minot), ND (2010)	1.48	80	115.5
Buffalo Ridge, MN (Phase I; 1999)	1.43	73	25
PrairieWinds SD1, SD (2011-2012)	1.41	108	162
Wessington Springs, SD (2010)	0.89	34	51
Top of Iowa, IA (2004)	0.81	89	80
Grand Ridge I, IL (2009-2010)	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	62	102.3
Southeast			
Buffalo Mountain, TN (2000-2003)	11.02	3	1.98
Buffalo Mountain, TN (2005)	1.10	18	28.98
Southern Plains			
Buffalo Gap I, TX (2006)	1.32	67	134
Barton Chapel, TX (2009-2010)	1.15	60	120
Buffalo Gap II, TX (2007-2008)	0.15	155	233
Big Smile, OK (2012-2013)	0.09	66	132
Red Hills, OK (2012-2013)	0.08	82	123

A=number of bird fatalities/MW/year

Appendix H1 (*continued*). Wind energy facilities in North America with fatality data for all bird species, by geographic region.

Data from the following sources:

Wind Energy Facility	Fatality Estimate	Wind Energy Facility	Fatality Estimate
Ocotillo, CA	This study.		
Alite, CA (09-10)	Chatfield et al. 2010b	Klondike II, OR (05-06)	NWC and WEST 2007
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Klondike III, OR (Phase I; 07-09)	Gritski et al. 2010
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Klondike IIIa, OR (Phase II; 08-10)	Gritski et al. 2011
Barton I & II, IA (10-11)	Derby et al. 2011a	Leaning Juniper, OR (06-08)	Gritski et al. 2008
Barton Chapel, TX (09-10)	WEST 2011	Lempster, NH (09)	Tidhar et al. 2010
Beech Ridge, WV (12)	Tidhar et al. 2013	Lempster, NH (10)	Tidhar et al. 2011
Big Horn, WA (06-07)	Kronner et al. 2008	Linden Ranch, WA (10-11)	Enz and Bay 2011
Big Smile, OK (12-13)	Derby et al. 2013b	Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Maple Ridge, NY (07)	Jain et al. 2009a
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Maple Ridge, NY (07-08)	Jain et al. 2009d
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Marengo I, WA (09-10)	URS Corporation 2010b
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Marengo II, WA (09-10)	URS Corporation 2010c
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Mars Hill, ME (07)	Stantec 2008
Buffalo Gap I, TX (06)	Tierney 2007	Mars Hill, ME (08)	Stantec 2009a
Buffalo Gap II, TX (07-08)	Tierney 2009	Moraine II, MN (09)	Derby et al. 2010d
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Mountaineer, WV (03)	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Nine Canyon, WA (02-03)	Erickson et al. 2003b
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Noble Bliss, NY (08)	Jain et al. 2009e
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge I, SD (09-10)	Derby et al. 2010b	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Noble Clinton, NY (08)	Jain et al. 2009c
Casselman, PA (08)	Arnett et al. 2009a	Noble Clinton, NY (09)	Jain et al. 2010b
Casselman, PA (09)	Arnett et al. 2010	Noble Ellenburg, NY (08)	Jain et al. 2009b
Cedar Ridge, WI (09)	BHE Environmental 2010	Noble Ellenburg, NY (09)	Jain et al. 2010c
Cedar Ridge, WI (10)	BHE Environmental 2011	Noble Wethersfield, NY (10)	Jain et al. 2011a
Cohocton/Dutch Hill, NY (09)	Stantec 2010	NPPD Ainsworth, NE (06)	Derby et al. 2007
Cohocton/Dutch Hill, NY (10)	Stantec 2011	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Combine Hills, OR (Ph. I; 04-05)	Young et al. 2006	Pine Tree, CA (09-10)	BioResource Consultants 2010
Combine Hills, OR (11)	Enz et al. 2012	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
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
Diablo Winds, CA (05-07)	WEST 2006, 2008	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Dillon, CA (08-09)	Chatfield et al. 2009	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Red Hills, OK (12-13)	Derby et al. 2013c
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Ripley, Ont (08)	Jacques Whitford 2009
Elkhorn, OR (08)	Jeffrey et al. 2009b	Rugby, ND (10-11)	Derby et al. 2011b
Elkhorn, OR (10)	Enk et al. 2011b	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Elm Creek, MN (09-10)	Derby et al. 2010c	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Elm Creek II, MN (11-12)	Derby et al. 2012b	Stateline, OR/WA (01-02)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003b	Stateline, OR/WA (03)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003b	Stateline, OR/WA (06)	Erickson et al. 2007
Foote Creek Rim, WY (Ph. I; 01-02)	Young et al. 2003b	Stetson Mountain I, ME (09)	Stantec 2009c
Fowler I, IN (09)	Johnson et al. 2010a	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Goodnoe, WA (09-10)	URS Corporation 2010a	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Grand Ridge, IL (09-10)	Derby et al. 2010g	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Top of Iowa, IA (03)	Jain 2005
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Top of Iowa, IA (04)	Jain 2005
High Sheldon, NY (10)	Tidhar et al. 2012a	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
High Sheldon, NY (11)	Tidhar et al. 2012b	Vansycle, OR (99)	Erickson et al. 2000b
High Winds, CA (03-04)	Kerlinger et al. 2006	Vantage, WA (10-11)	Ventus 2012
High Winds, CA (04-05)	Kerlinger et al. 2006	Wessington Springs, SD (09)	Derby et al. 2010f
Hopkins Ridge, WA (06)	Young et al. 2007a	Wessington Springs, SD (10)	Derby et al. 2011d
Hopkins Ridge, WA (08)	Young et al. 2009c	White Creek, WA (07-11)	Downes and Gritski 2012b
Kewaunee County, WI (99-01)	Howe et al. 2002	Wild Horse, WA (07)	Erickson et al. 2008
Kittitas Valley, WA (11-12)	Stantec 2012	Windy Flats, WA (10-11)	Enz et al. 2011
Klondike, OR (02-03)	Johnson et al. 2003b	Winnebago, IA (09-10)	Derby et al. 2010e

Appendix H2. Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**0.05**	**NA**	**112**	**315**
	California			
High Winds, CA (2003-2004)	2.337	0.5	90	162
Shiloh I, CA (2006-2009)	NA	0.42	100	150
Diablo Winds, CA (2005-2007)	2.161	0.4	31	20.46
High Winds, CA (2004-2005)	2.337	0.28	90	162
Alta Wind I, CA (2011-2012)	0.19	0.27	100	150
Pine Tree, CA (2009-2010)	NA	0.133	90	135
Alite, CA (2009-2010)	NA	0.12	8	24
Shiloh II, CA (2009-2010)	NA	0.12	75	150
Alta Wind II-V, CA (2011-2012)	0.04	0.05	190	570
Dillon, CA (2008-2009)	NA	0	45	45
	Southwest			
Dry Lake I, AZ (2009-2010)	0.13	0.13	0.13	0.13
Dry Lake II, AZ (2011-2012)	NA	NA	NA	NA
	Pacific Northwest			
White Creek, WA (2007-2011)	NA	0.47	89	204.7
Vantage, WA (2010-2011)	NA	0.29	60	90
Tuolumne (Windy Point I), WA (2009-2010)	0.77	0.29	62	136.6
Linden Ranch, WA (2010-2011)	NA	0.27	25	50
Harvest Wind, WA (2010-2012)	NA	0.23	43	98.9
Goodnoe, WA (2009-2010)	NA	0.17	47	94
Leaning Juniper, OR (2006-2008)	0.522	0.16	67	100.5
Klondike III (Phase I), OR (2007-2009)	NA	0.15	125	223.6
Hopkins Ridge, WA (2006)	0.698	0.14	83	150
Biglow Canyon, OR (Phase II; 2009-2010)	0.318	0.14	65	150
Big Horn, WA (2006-2007)	0.511	0.11	133	199.5
Stateline, OR/WA (2006)	0.478	0.11	454	299
Kittitas Valley, WA (2011-2012)	NA	0.09	48	100.8
Wild Horse, WA (2007)	0.291	0.09	127	229
Stateline, OR/WA (2001-2002)	0.478	0.09	454	299
Stateline, OR/WA (2003)	0.478	0.09	454	299
Elkhorn, OR (2010)	1.07	0.08	61	101
Hopkins Ridge, WA (2008)	0.698	0.07	87	156.6
Klondike II, OR (2005-2006)	0.504	0.06	50	75
Klondike IIIa (Phase II), OR (2008-2010)	NA	0.06	51	76.5
Elkhorn, OR (2008)	1.07	0.06	61	101
Marengo II, WA (2009-2010)	NA	0.05	39	70.2
Combine Hills, OR (2011)	0.746	0.05	104	104
Biglow Canyon, OR (Phase III; 2010-2011)	0.318	0.05	76	174.8
Pebble Springs, OR (2009-2010)	NA	0.04	47	98.7
Windy Flats, WA (2010-2011)	NA	0.04	114	262.2
Nine Canyon, WA (2002-2003)	0.35	0.03	37	48.1
Biglow Canyon, OR (Phase I; 2008)	0.318	0.03	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)	0.318	0.03	65	150
Klondike, OR (2002-2003)	0.504	0	16	24
Vansycle, OR (1999)	0.66	0	38	24.9
Combine Hills, OR (Phase I; 2004-2005)	0.746	0	41	41
Hay Canyon, OR (2009-2010)	NA	0	48	100.8
Biglow Canyon, OR (Phase I; 2009)	0.318	0	76	125.4
Marengo I, WA (2009-2010)	NA	0	78	140.4

Appendix H2. Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Rocky Mountains				
Summerview, Alb (2005-2006)	NA	0.11	39	70.2
Foote Creek Rim, WY (Phase I; 1999)	0.554	0.08	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	0.554	0.05	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	0.554	0	69	41.4
Midwest				
Buffalo Ridge, MN (Phase I; 1999)	NA	0.47	73	25
Moraine II, MN (2009)	NA	0.37	33	49.5
Winnebago, IA (2009-2010)	NA	0.27	10	20
Buffalo Ridge I, SD (2009-2010)	NA	0.2	24	50.4
Cedar Ridge, WI (2009)	NA	0.18	41	67.6
Top of Iowa, IA (2004)	NA	0.17	89	80
Cedar Ridge, WI (2010)	NA	0.13	41	68
Ripley, Ont (2008)	NA	0.1	38	76
Wessington Springs, SD (2010)	0.232	0.07	34	51
NPPD Ainsworth, NE (2006)	NA	0.06	36	20.5
Wessington Springs, SD (2009)	0.232	0.06	34	51
Rugby, ND (2010-2011)	NA	0.06	71	149
PrairieWinds ND1 (Minot), ND (2011)	NA	0.05	80	115.5
PrairieWinds ND1 (Minot), ND (2010)	NA	0.05	80	115.5
PrairieWinds SD1, SD (2012-2013)	NA	0.03	108	162
Kewaunee County, WI (1999-2001)	NA	0	31	20.46
Buffalo Ridge, MN (Phase I; 1996)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1997)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1998)	NA	0	73	25
Top of Iowa, IA (2003)	NA	0	89	80
Grand Ridge I, IL (2009-2010)	0.195	0	66	99
Elm Creek, MN (2009-2010)	NA	0	67	100
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	0	62	102.3
Buffalo Ridge, MN (Phase III; 1999)	NA	0	138	103.5
Buffalo Ridge, MN (Phase II; 1998)	NA	0	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	NA	0	143	107.25
Blue Sky Green Field, WI (2008; 2009)	NA	0	88	145
Elm Creek II, MN (2011-2012)	NA	0	62	148.8
Barton I & II, IA (2010-2011)	NA	0	80	160
PrairieWinds SD1, SD (2011-2012)	NA	0	108	162
Buffalo Ridge II, SD (2011-2012)	NA	0	105	210
Fowler I, IN (2009)	NA	0	162	301
Northeast				
Munnsville, NY (2008)	NA	0.59	23	34.5
Noble Ellenburg, NY (2009)	NA	0.25	54	80
Noble Clinton, NY (2009)	NA	0.16	67	100
Noble Wethersfield, NY (2010)	NA	0.13	84	126
Noble Bliss, NY (2009)	NA	0.12	67	100
Noble Ellenburg, NY (2008)	NA	0.11	54	80
Noble Bliss, NY (2008)	NA	0.1	67	100
Noble Clinton, NY (2008)	NA	0.1	67	100
Mount Storm, WV (2010)	NA	0.1	132	264
Noble Chateaugay, NY (2010)	NA	0.08	71	106.5
Cohocton/Dutch Hills, NY (2010)	NA	0.08	50	125

Appendix H2. Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Mountaineer, WV (2003)	NA	0.07	44	66
High Sheldon, NY (2010)	NA	0.06	75	112.5
Mount Storm, WV (2011)	NA	0.03	132	264
Maple Ridge, NY (2007-2008)	NA	0.03	195	321.75
Criterion, MD (2011)	NA	0.02	28	70
Beech Ridge, WV (2012)	NA	0.01	67	100.5
Lempster, NH (2009)	NA	0	12	24
Lempster, NH (2010)	NA	0	12	24
Stetson Mountain II, ME (2010)	NA	0	17	25.5
Casselman, PA (2009)	NA	0	23	34.5
Casselman, PA (2008)	NA	0	23	34.5
Mars Hill, ME (2007)	NA	0	28	42
Mars Hill, ME (2008)	NA	0	28	42
Stetson Mountain I, ME (2011)	NA	0	38	57
Stetson Mountain I, ME (2009)	NA	0	38	57
Noble Altona, NY (2010)	NA	0	65	97.5
Locust Ridge, PA (Phase II; 2009)	NA	0	51	102
Locust Ridge, PA (Phase II; 2010)	NA	0	51	102
High Sheldon, NY (2011)	NA	0	75	112.5
Cohocton/Dutch Hill, NY (2009)	NA	0	50	125
Mount Storm, WV (2009)	NA	0	132	264
Southeast				
Buffalo Mountain, TN (2000-2003)	NA	0	3	1.98
Buffalo Mountain, TN (2005)	NA	0	18	28.98
Southern Plains				
Barton Chapel, TX (2009-2010)	NA	0.25	60	120
Buffalo Gap I, TX (2006)	NA	0.1	67	134
Red Hills, OK (2012-2013)	NA	0.04	82	123
Big Smile, OK (2012-2013)	NA	0	66	132
Buffalo Gap II, TX (2007-2008)	NA	0	155	233

A=number of raptors/plot/20min survey
B=number of fatalities/MW/year

Appendix H2 (*continued*). Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Data from the following sources:

Facility	Use Estimate	Fatality Estimate	Facility	Use Estimate	Fatality Estimate
Ocotillo, CA	This study	NA			
Alite, CA (09-10)	NA	Chatfield et al. 2010b	Klondike II, OR (05-06)	Johnson et al. 2002	NWC and WEST 2007
Alta Wind I, CA (11-12)	Erickson and Chatfield 2009	Chatfield et al. 2012	Klondike III (Phase I), OR (07-09)	NA	Gritski et al. 2010
Alta Wind II-V, CA (11-12)	Erickson and Chatfield 2009	Chatfield et al. 2012	Klondike IIIa (Phase II), OR (08-10)	NA	Gritski et al. 2011
Barton I & II, IA (10-11)	NA	Derby et al. 2011a	Leaning Juniper, OR (06-08)	Kronner et al. 2005	Gritski et al. 2008
Barton Chapel, TX (09-10)	NA	WEST 2011	Lempster, NH (09)	NA	Tidhar et al. 2010
Beech Ridge, WV (12)	NA	Tidhar et al. 2013	Lempster, NH (10)	NA	Tidhar et al. 2011
Big Horn, WA (06-07)	Johnson and Erickson 2004	Kronner et al. 2008	Linden Ranch, WA (10-11)	NA	Enz and Bay 2011
Big Smile, OK (12-13)	NA	Derby et al. 2013b	Locust Ridge, PA (Phase II; 09)	NA	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	WEST 2005b	Jeffrey et al. 2009a	Locust Ridge, PA (Phase II; 10)	NA	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 09)	WEST 2005b	Enk et al. 2010	Maple Ridge, NY (07-08)	NA	Jain et al. 2009d
Biglow Canyon, OR (Phase II; 09-10)	WEST 2005b	Enk et al. 2011a	Marengo I, WA (09-10)	NA	URS Corporation 2010b
Biglow Canyon, OR (Phase II; 10-11)	WEST 2005b	Enk et al. 2012b	Marengo II, WA (09-10)	NA	URS Corporation 2010c
Biglow Canyon, OR (Phase III; 10-11)	WEST 2005b	Enk et al. 2012a	Mars Hill, ME (07)	NA	Stantec 2008
Blue Sky Green Field, WI (08; 09)	NA	Gruver et al. 2009	Mars Hill, ME (08)	NA	Stantec 2009a
Buffalo Gap I, TX (06)	NA	Tierney 2007	Moraine II, MN (09)	NA	Derby et al. 2010d
Buffalo Gap II, TX (07-08)	NA	Tierney 2009	Mount Storm, WV (09)	NA	Young et al. 2009a, 2010b
Buffalo Mountain, TN (00-03)	NA	Nicholson et al. 2005	Mount Storm, WV (10)	NA	Young et al. 2010a, 2011b
Buffalo Mountain, TN (05)	NA	Fiedler et al. 2007	Mount Storm, WV (11)	NA	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase I; 96)	NA	Johnson et al. 2000a	Mountaineer, WV (03)	NA	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase I; 97)	NA	Johnson et al. 2000a	Munnsville, NY (08)	NA	Stantec 2009b
Buffalo Ridge, MN (Phase I; 98)	NA	Johnson et al. 2000a	Nine Canyon, WA (02-03)	Erickson et al. 2001	Erickson et al. 2003b
Buffalo Ridge, MN (Phase I; 99)	NA	Johnson et al. 2000a	Noble Altona, NY (10)	NA	Jain et al. 2011b
Buffalo Ridge, MN (Phase II; 98)	NA	Johnson et al. 2000a	Noble Bliss, NY (08)	NA	Jain et al. 2009e
Buffalo Ridge, MN (Phase II; 99)	NA	Johnson et al. 2000a	Noble Bliss, NY (09)	NA	Jain et al. 2010a
Buffalo Ridge, MN (Phase III; 99)	NA	Johnson et al. 2000a	Noble Chateaugay, NY (10)	NA	Jain et al. 2011c
Buffalo Ridge I, SD (09-10)	NA	Derby et al. 2010b	Noble Clinton, NY (08)	NA	Jain et al. 2009c
Buffalo Ridge II, SD (11-12)	NA	Derby et al. 2012a	Noble Clinton, NY (09)	NA	Jain et al. 2010b
Casselman, PA (08)	NA	Arnett et al. 2009a	Noble Ellenburg, NY (08)	NA	Jain et al. 2009b
Casselman, PA (09)	NA	Arnett et al. 2010	Noble Ellenburg, NY (09)	NA	Jain et al. 2010c
Cedar Ridge, WI (09)	NA	BHE Environmental 2010	Noble Wethersfield, NY (10)	NA	Jain et al. 2011a
Cedar Ridge, WI (10)	NA	BHE Environmental 2011	NPPD Ainsworth, NE (06)	NA	Derby et al. 2007
Cohocton/Dutch Hill, NY (09)	NA	Stantec 2010	Pebble Springs, OR (09-10)	NA	Gritski and Kronner 2010b
Cohocton/Dutch Hills, NY (10)	NA	Stantec 2011	Pine Tree, CA (09-10)	NA	BioResource Consultants 2010
Combine Hills, OR (Phase I; 04-05)	Young et al. 2003c	Young et al. 2006	Pioneer Prairie I, IA (Phase II; 11-12)	NA	Chodachek et al. 2012
Combine Hills, OR (11)	Young et al. 2003c	Enz et al. 2012	PrairieWinds ND1 (Minot), ND (10)	NA	Derby et al. 2011c
Criterion, MD (11)	NA	Young et al. 2012a	PrairieWinds ND1 (Minot), ND (11)	NA	Derby et al. 2012c
Diablo Winds, CA (05-07)	WEST 2006, 2008	WEST 2006, 2008	PrairieWinds SD1 (Crow Lake), SD (11-12)	NA	Derby et al. 2012d
Dillon, CA (08-09)	NA	Chatfield et al. 2009	PrairieWinds SD1 (Crow Lake), SD (12-13)	NA	Derby et al. 2013a

Appendix H2 (*continued*). Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Data from the following sources:

Facility	Use Estimate	Fatality Estimate	Facility	Use Estimate	Fatality Estimate
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	Red Hills, OK (12-13)	NA	Derby et al. 2013c
Dry Lake II, AZ (11-12)	NA	Thompson and Bay 2012	Ripley, Ont (08)	NA	Jacques Whitford 2009
Elkhorn, OR (08)	WEST 2005a	Jeffrey et al. 2009b	Rugby, ND (10-11)	NA	Derby et al. 2011b
Elkhorn, OR (10)	WEST 2005a	Enk et al. 2011b	Shiloh I, CA (06-09)	NA	Kerlinger et al. 2009
Elm Creek, MN (09-10)	NA	Derby et al. 2010c	Shiloh II, CA (09-10)	NA	Kerlinger et al. 2010b
Elm Creek II, MN (11-12)	NA	Derby et al. 2012b	Stateline, OR/WA (01-02)	Erickson et al. 2003a	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 99)	Johnson et al. 2000b	Young et al. 2003b	Stateline, OR/WA (03)	NA	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 00)	Johnson et al. 2000b	Young et al. 2003b	Stateline, OR/WA (06)	NA	Erickson et al. 2007
Foote Creek Rim, WY (Phase I; 01-02)	Johnson et al. 2000b	Young et al. 2003b	Stetson Mountain I, ME (09)	NA	Stantec 2009c
Fowler I, IN (09)	NA	Johnson et al. 2010a	Stetson Mountain I, ME (11)	NA	Normandeau Associates 2011
Goodnoe, WA (09-10)	NA	URS Corporation 2010a	Stetson Mountain II, ME (10)	NA	Normandeau Associates 2010
Grand Ridge I, IL (09-10)	Derby et al. 2009	Derby et al. 2010g	Summerview, Alb (05-06)	NA	Brown and Hamilton 2006b
Harvest Wind, WA (10-12)	NA	Downes and Gritski 2012a	Top of Iowa, IA (03)	NA	Jain 2005
Hay Canyon, OR (09-10)	NA	Gritski and Kronner 2010a	Top of Iowa, IA (04)	NA	Jain 2005
High Sheldon, NY (10)	NA	Tidhar et al. 2012a	Tuolumne (Windy Point I), WA (09-10)	Johnson et al. 2006	Enz and Bay 2010
High Sheldon, NY (11)	NA	Tidhar et al. 2012b	Vansycle, OR (99)	WCIA and WEST 1997	Erickson et al. 2000b
High Winds, CA (03-04)	Kerlinger et al. 2005	Kerlinger et al. 2006	Vantage, WA (10-11)	NA	Ventus 2012
High Winds, CA (04-05)	Kerlinger et al. 2005	Kerlinger et al. 2006	Wessington Springs, SD (09)	Derby et al. 2008	Derby et al. 2010f
Hopkins Ridge, WA (06)	Young et al. 2003a	Young et al. 2007a	Wessington Springs, SD (10)	Derby et al. 2008	Derby et al. 2011d
Hopkins Ridge, WA (08)	NA	Young et al. 2009c	White Creek, WA (07-11)	NA	Downes and Gritski 2012b
Kewaunee County, WI (99-01)	NA	Howe et al. 2002	Wild Horse, WA (07)	Erickson et al. 2003c	Erickson et al. 2008
Kittitas Valley, WA (11-12)	NA	Stantec 2012	Windy Flats, WA (10-11)	NA	Enz et al. 2011
Klondike, OR (02-03)	Johnson et al. 2002	Johnson et al. 2003b	Winnebago, IA (09-10)	NA	Derby et al. 2010e

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**NA**	**NA**	**0.90**	**112**	**315**
		California			
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2009-2010)	NA	NA	2.72	75	150
High Winds, CA (2003-2004)	NA	NA	2.51	90	162
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Alta Wind I, CA (2011-2012)	4.42[C]	6/26/2009 - 10/31/2009	1.28	100	150
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta Wind II-V, CA (2011-2012)	0.78	6/26/2009 - 10/31/2009	0.08	190	570
		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
Biglow Canyon, OR (Phase II; 2009-2010)	NA	NA	2.71	65	150
Nine Canyon, WA (2002-2003)	NA	NA	2.47	37	48.1
Stateline, OR/WA (2003)	NA	NA	2.29	454	299
Elkhorn, OR (2010)	NA	NA	2.14	61	101
White Creek, WA (2007-2011)	NA	NA	2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)	NA	NA	1.99	76	125.4
Leaning Juniper, OR (2006-2008)	NA	NA	1.98	67	100.5
Big Horn, WA (2006-2007)	NA	NA	1.9	133	199.5
Combine Hills, OR (Phase I; 2004-2005)	NA	NA	1.88	41	41
Linden Ranch, WA (2010-2011)	NA	NA	1.68	25	50
Pebble Springs, OR (2009-2010)	NA	NA	1.55	47	98.7
Hopkins Ridge, WA (2008)	NA	NA	1.39	87	156.6
Harvest Wind, WA (2010-2012)	NA	NA	1.27	43	98.9
Elkhorn, OR (2008)	NA	NA	1.26	61	101
Vansycle, OR (1999)	NA	NA	1.12	38	24.9
Klondike III (Phase I), OR (2007-2009)	NA	NA	1.11	125	223.6
Stateline, OR/WA (2001-2002)	NA	NA	1.09	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
Klondike, OR (2002-2003)	NA	NA	0.77	16	24
Combine Hills, OR (2011)	NA	NA	0.73	104	104
Hopkins Ridge, WA (2006)	NA	NA	0.63	83	150
Biglow Canyon, OR (Phase I; 2009)	NA	NA	0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)	NA	NA	0.57	65	150
Hay Canyon, OR (2009-2010)	NA	NA	0.53	48	100.8
Klondike II, OR (2005-2006)	NA	NA	0.41	50	75
Windy Flats, WA (2010-2011)	NA	NA	0.41	114	262.2
Vantage, WA (2010-2011)	NA	NA	0.4	60	90

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Wild Horse, WA (2007)	NA	NA	0.39	127	229
Goodnoe, WA (2009-2010)	NA	NA	0.34	47	94
Marengo II, WA (2009-2010)	NA	NA	0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010-2011)	NA	NA	0.22	76	174.8
Marengo I, WA (2009-2010)	NA	NA	0.17	78	140.4
Klondike IIIa (Phase II), OR (2008-2010)	NA	NA	0.14	51	76.5
Kittitas Valley, WA (2011-2012)	NA	NA	0.12	48	100.8
Rocky Mountains					
Summerview, Alb (2006; 2007)	7.65[D]	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)	NA	NA	10.27	39	70.2
Judith Gap, MT (2006-2007)	NA	NA	8.93	90	135
Foote Creek Rim, WY (Phase I; 1999)	NA	NA	3.97	69	41.4
Judith Gap, MT (2009)	NA	NA	3.2	90	135
Foote Creek Rim, WY (Phase I; 2001-2002)	2.2[D,E]	6/15/01-9/1/01	1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2[D,E]	6/15/00-9/1/00	1.05	69	41.4
Northeast					
Mountaineer, WV (2003)	NA	NA	31.69	44	66
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	17.53	132	264
Noble Wethersfield, NY (2010)	NA	NA	16.3	84	126
Criterion, MD (2011)	NA	NA	15.61	28	70
Mount Storm, WV (2010)	36.67[F]	4/18/10-10/15/10	15.18	132	264
Locust Ridge, PA (Phase II; 2010)	NA	NA	14.38	51	102
Locust Ridge, PA (Phase II; 2009)	NA	NA	14.11	51	102
Casselman, PA (2008)	NA	NA	12.61	23	34.5
Maple Ridge, NY (2006)	NA	NA	11.21	120	198
Cohocton/Dutch Hills, NY (2010)	NA	NA	10.32	50	125
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	86	197.8
Cohocton/Dutch Hill, NY (2009)	NA	NA	8.62	50	125
Casselman, PA (2009)	NA	NA	8.6	23	34.5
Noble Bliss, NY (2008)	NA	NA	7.8	67	100
Criterion, MD (2012)	NA	NA	7.62	28	70
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
Maple Ridge, NY (2007)	NA	NA	6.49	195	321.75
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	86	197.8
Maple Ridge, NY (2007-2008)	NA	NA	4.96	195	321.75
Noble Clinton, NY (2009)	1.9[G]	8/1/09-09/31/09	4.5	67	100
Casselman Curtailment, PA (2008)	NA	NA	4.4	23	35.4
Noble Altona, NY (2010)	NA	NA	4.34	65	97.5
Noble Ellenburg, NY (2009)	16.1[G]	8/16/09-09/15/09	3.91	54	80
Noble Bliss, NY (2009)	NA	NA	3.85	67	100
Lempster, NH (2010)	NA	NA	3.57	12	24

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Noble Ellenburg, NY (2008)	NA	NA	3.46	54	80
Noble Clinton, NY (2008)	2.1[G]	8/8/08-09/31/08	3.14	67	100
Lempster, NH (2009)	NA	NA	3.11	12	24
Mars Hill, ME (2007)	NA	NA	2.91	28	42
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	86	197.8
Noble Chateaugay, NY (2010)	NA	NA	2.44	71	106.5
High Sheldon, NY (2010)	NA	NA	2.33	75	112.5
Beech Ridge, WV (2012)	NA	NA	2.03	67	100.5
Munnsville, NY (2008)	NA	NA	1.93	23	34.5
High Sheldon, NY (2011)	NA	NA	1.78	75	112.5
Stetson Mountain II, ME (2010)	NA	NA	1.65	17	25.5
Stetson Mountain I, ME (2009)	28.5; 0.3[H]	7/10/09-10/15/09	1.4	38	57
Mars Hill, ME (2008)	NA	NA	0.45	28	42
Stetson Mountain I, ME (2011)	NA	NA	0.28	38	57
Kibby, ME (2011)	NA	NA	0.12	44	132
Midwest					
Cedar Ridge, WI (2009)	9.97[D,E,G]	7/16/07-9/30/07	30.61	41	67.6
Blue Sky Green Field, WI (2008; 2009)	7.7[I]	7/24/07-10/29/07	24.57	88	145
Cedar Ridge, WI (2010)	9.97[D,E,G]	7/16/07-9/30/07	24.12	41	68
Fowler I, II, III, IN (2011)	NA	NA	20.19	355	600
Fowler I, II, III, IN (2010)	NA	NA	18.96	355	600
Forward Energy Center, WI (2008-2010)	6.97	8/5/08-11/08/08	18.17	86	129
Harrow, Ont (2010)	NA	NA	11.13	24 (four 6-turb facilities)	39.6
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	NA	10.06	62	102.3
Fowler I, IN (2009)	NA	NA	8.09	162	301
Crystal Lake II, IA (2009)	NA	NA	7.42	80	200
Top of Iowa, IA (2003)	NA	NA	7.16	89	80
Kewaunee County, WI (1999-2001)	NA	NA	6.45	31	20.46
Ripley, Ont (2008)	NA	NA	4.67	38	76
Winnebago, IA (2009-2010)	NA	NA	4.54	10	20
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2[D]	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2[D]	6/15/01-9/15/01	3.71	138	103.5
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	33	49.5
Fowler I, II, III, IN (2012)	NA	NA	2.96	355	600
Elm Creek II, MN (2011-2012)	NA	NA	2.81	62	148.8
Buffalo Ridge II, SD (2011-2012)	NA	NA	2.81	105	210
Buffalo Ridge, MN (Phase III; 1999)	NA	NA	2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)	NA	NA	2.59	143	107.25
Moraine II, MN (2009)	NA	NA	2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)	NA	NA	2.16	143	107.25

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
PrairieWinds ND1 (Minot), ND (2010)	NA	NA	2.13	80	115.5
Grand Ridge I, IL (2009-2010)	NA	NA	2.1	66	99
Barton I & II, IA (2010-2011)	NA	NA	1.85	80	160
Fowler III, IN (2009)	NA	NA	1.84	60	99
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9[D]	6/15/02-9/15/02	1.81	138	103.5
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9[D]	6/15/02-9/15/02	1.64	143	107.25
Rugby, ND (2010-2011)	NA	NA	1.6	71	149
Elm Creek, MN (2009-2010)	NA	NA	1.49	67	100
Wessington Springs, SD (2009)	NA	NA	1.48	34	51
PrairieWinds ND1 (Minot), ND (2011)	NA	NA	1.39	80	115.5
PrairieWinds SD1, SD (2011-2012)	NA	NA	1.23	108	162
NPPD Ainsworth, NE (2006)	NA	NA	1.16	36	20.5
PrairieWinds SD1, SD (2012-2013)	NA	NA	1.05	108	162
Buffalo Ridge, MN (Phase I; 1999)	NA	NA	0.74	73	25
Wessington Springs, SD (2010)	NA	NA	0.41	34	51
Buffalo Ridge I, SD (2009-2010)	NA	NA	0.16	24	50.4
Southeast					
Buffalo Mountain, TN (2005)	NA	NA	39.7	18	28.98
Buffalo Mountain, TN (2000-2003)	23.7[E]	NA	31.54	3	1.98
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 II, TX (2007-2008)	NA	NA	0.14	155	233
Red Hills, OK (2012-2013)	NA	NA	0.11	82	123
Buffalo Gap I, TX (2006)	NA	NA	0.1	67	134

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Average of ground-based detectors at CPC Proper (Phase I) for late summer/fall period only
D = Activity rate was averaged across phases and/or years
E = Activity rate calculated by WEST from data presented in referenced report
F = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer and fall seasons
G = Activity rate based on data collected at various heights all other activity rates are from ground-based units only
H = 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
I = Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently

Appendix H3 (*continued*). Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats.

Project, Location	Activity Reference	Fatality Reference	Project, Location	Activity Reference	Fatality Reference
Ocotillo, CA	**NA**	**This study**			
Alite, CA (09-10)	NA	Chatfield et al. 2010b	Kewaunee County, WI (99-01)	NA	Howe et al. 2002
Alta Wind I, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Kibby, ME (11)	NA	Stantec 2012
Alta Wind II-V, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Kittitas Valley, WA (11-12)	NA	Stantec Consulting Services 2012
Barton I & II, IA (10-11)	NA	Derby et al. 2011a	Klondike, OR (02-03)	NA	Johnson et al. 2003a
Barton Chapel, TX (09-10)	NA	WEST 2011	Klondike II, OR (05-06)	NA	NWC and WEST 2007
Beech Ridge, WV (12)	NA	Tidhar et al. 2013	Klondike III (Phase I), OR (07-09)	NA	Gritski et al. 2010
Big Horn, WA (06-07)	NA	Kronner et al. 2008	Klondike IIIa (Phase II), OR (08-10)	NA	Gritski et al. 2011
Big Smile, OK (12-13)	NA	Derby et al. 2013b	Leaning Juniper, OR (06-08)	NA	Gritski et al. 2008
Biglow Canyon, OR (Phase I; 08)	NA	Jeffrey et al. 2009a	Lempster, NH (09)	NA	Tidhar et al. 2010
Biglow Canyon, OR (Phase I; 09)	NA	Enk et al. 2010	Lempster, NH (10)	NA	Tidhar et al. 2011
Biglow Canyon, OR (Phase II; 09-10)	NA	Enk et al. 2011a	Linden Ranch, WA (10-11)	NA	Enz and Bay 2011
Biglow Canyon, OR (Phase II; 10-11)	NA	Enk et al. 2012b	Locust Ridge, PA (Phase II; 09)	NA	Arnett et al. 2011
Biglow Canyon, OR (Phase III; 10-11)	NA	Enk et al. 2012a	Locust Ridge, PA (Phase II; 10)	NA	Arnett et al. 2011
Blue Sky Green Field, WI (08; 09)	Gruver 2008	Gruver et al. 2009	Maple Ridge, NY (06)	NA	Jain et al. 2007
Buffalo Gap I, TX (06)	NA	Tierney 2007	Maple Ridge, NY (07)	NA	Jain et al. 2009a
Buffalo Gap II, TX (07-08)	NA	Tierney 2009	Maple Ridge, NY (07-08)	NA	Jain et al. 2009d
Buffalo Mountain, TN (00-03)	Fiedler 2004	Nicholson et al. 2005	Marengo I, WA (09-10)	NA	URS Corporation 2010b
Buffalo Mountain, TN (05)	NA	Fiedler et al. 2007	Marengo II, WA (09-10)	NA	URS Corporation 2010c
Buffalo Ridge, MN (Phase I; 99)	NA	Johnson et al. 2000a	Mars Hill, ME (07)	NA	Stantec 2008
Buffalo Ridge, MN (Phase II; 98)	NA	Johnson et al. 2000a	Mars Hill, ME (08)	NA	Stantec 2009a
Buffalo Ridge, MN (Phase II; 99)	NA	Johnson et al. 2000a	Moraine II, MN (09)	NA	Derby et al. 2010d
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (Fall 08)	Young et al. 2009b	Young et al. 2009b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (09)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase III; 99)	NA	Johnson et al. 2000a	Mount Storm, WV (10)	Young et al. 2010a, 2011b	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (11)	NA	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mountaineer, WV (03)	NA	Kerns and Kerlinger 2004
Buffalo Ridge I, SD (09-10)	NA	Derby et al. 2010b	Munnsville, NY (08)	NA	Stantec 2009b
Buffalo Ridge II, SD (11-12)	NA	Derby et al. 2012a	Nine Canyon, WA (02-03)	NA	Erickson et al. 2003b
Casselman, PA (08)	NA	Arnett et al. 2009a	Noble Altona, NY (10)	NA	Jain et al. 2011b
Casselman, PA (09)	NA	Arnett et al. 2010	Noble Bliss, NY (08)	NA	Jain et al.2009e
Casselman Curtailment, PA (08)	NA	Arnett et al. 2009b	Noble Bliss, NY (09)	NA	Jain et al. 2010a
Cedar Ridge, WI (09)	BHE Environmental 2008	BHE Environmental 2010	Noble Chateaugay, NY (10)	NA	Jain et al. 2011c
Cedar Ridge, WI (10)	BHE Environmental 2008	BHE Environmental 2011	Noble Clinton, NY (08)	Reynolds 2010a	Jain et al. 2009c
Cohocton/Dutch Hill, NY (09)	NA	Stantec 2010	Noble Clinton, NY (09)	Reynolds 2010a	Jain et al. 2010b
Cohocton/Dutch Hills, NY (10)	NA	Stantec 2011	Noble Ellenburg, NY (08)	NA	Jain et al. 2009b
Combine Hills, OR (Phase I; 04-05)	NA	Young et al. 2006	Noble Ellenburg, NY (09)	Reynolds 2010b	Jain et al. 2010c
Combine Hills, OR (11)	NA	Enz et al. 2012	Noble Wethersfield, NY (10)	NA	Jain et al. 2011a
Crescent Ridge, IL (05-06)	NA	Kerlinger et al. 2007	NPPD Ainsworth, NE (06)	NA	Derby et al. 2007
Criterion, MD (11)	NA	Young et al. 2012a	Pebble Springs, OR (09-10)	NA	Gritski and Kronner 2010b
Criterion, MD (12)	NA	Young et al. 2013	Pioneer Prairie I, IA (Phase II; 11-12)	NA	Chodachek et al. 2012
Crystal Lake II, IA (09)	NA	Derby et al. 2010a	PrairieWinds ND1 (Minot), ND (10)	NA	Derby et al. 2011c
Diablo Winds, CA (05-07)	NA	WEST 2006, 2008	PrairieWinds ND1 (Minot), ND (11)	NA	Derby et al. 2012c
Dillon, CA (08-09)	NA	Chatfield et al. 2009	PrairieWinds SD1 (Crow	NA	Derby et al. 2012d

Appendix H3 (*continued*). Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats.

Project, Location	Activity Reference	Fatality Reference	Project, Location	Activity Reference	Fatality Reference
			Lake), SD (11-12)		
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	PrairieWinds SD1 (Crow Lake), SD (12-13)	NA	Derby et al. 2013a
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Thompson and Bay 2012	Red Hills, OK (12-13)	NA	Derby et al. 2013c
Elkhorn, OR (08)	NA	Jeffrey et a. 2009b	Ripley, Ont (08)	NA	Jacques Whitford 2009
Elkhorn, OR (10)	NA	Enk et al. 2011b	Rugby, ND (10-11)	NA	Derby et al. 2011b
Elm Creek II, MN (11-12)	NA	Derby et al. 2010c	Shiloh I, CA (06-09)	NA	Kerlinger et al. 2009
Elm Creek, MN (09-10)	NA	Derby et al. 2012b	Shiloh II, CA (09-10)	NA	Kerlinger et al. 2010b
Foote Creek Rim, WY (Phase I; 99)	NA	Young et al. 2003b	Stateline, OR/WA (01-02)	NA	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003b, 2003d	Stateline, OR/WA (03)	NA	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 01-02)	Gruver 2002	Young et al. 2003b, 2003d	Stateline, OR/WA (06)	NA	Erickson et al. 2007
Forward Energy Center, WI (08-10)	Watt and Drake 2011	Grodsky and Drake 2011	Stetson Mountain I, ME (09)	Stantec 2009c	Stantec 2009c
Fowler I, IN (09)	NA	Johnson et al. 2010a	Stetson Mountain I, ME (11)	NA	Normandeau Associates 2011
Fowler III, IN (09)	NA	Johnson et al. 2010b	Stetson Mountain II, ME (10)	NA	Normandeau Associates 2010
Fowler I, II, III, IN (10)	NA	Good et al. 2011	Summerview, Alb (05-06)	NA	Brown and Hamilton 2006b
Fowler I, II, III, IN (11)	NA	Good et al. 2012	Summerview, Alb (06; 07)	Baerwald 2008	Baerwald 2008
Fowler I, II, III, IN (12)	NA	Good et al. 2013	Top of Iowa, IA (03)	NA	Jain 2005
Goodnoe, WA (09-10)	NA	URS Corporation 2010a	Top of Iowa, IA (04)	Jain 2005	Jain 2005
Grand Ridge I, IL (09-10)	NA	Derby et al. 2010g	Tuolumne (Windy Point I), WA (09-10)	NA	Enz and Bay 2010
Harrow, Ont (10)	NA	NRSI 2011	Vansycle, OR (99)	NA	Erickson et al. 2000a
Harvest Wind, WA (10-12)	NA	Downes and Gritski 2012a	Vantage, WA (10-11)	NA	Ventus 2012
Hay Canyon, OR (09-10)	NA	Gritski and Kronner 2010a	Wessington Springs, SD (09)	NA	Derby et al. 2010f
High Sheldon, NY (10)	NA	Tidhar et al. 2012a	Wessington Springs, SD (10)	NA	Derby et al. 2011d
High Sheldon, NY (11)	NA	Tidhar et al. 2012b	White Creek, WA (07-11)	NA	Downes and Gritski 2012b
High Winds, CA (03-04)	NA	Kerlinger et al. 2006	Wild Horse, WA (07)	NA	Erickson et al. 2008
High Winds, CA (04-05)	NA	Kerlinger et al. 2006	Windy Flats, WA (10-11)	NA	Enz et al. 2011
Hopkins Ridge, WA (06)	NA	Young et al. 2007a	Winnebago, IA (09-10)	NA	Derby et al. 2010e
Hopkins Ridge, WA (08)	NA	Young et al. 2009c	Wolfe Island, Ont (July-December 09)	NA	Stantec Ltd. 2010b
Judith Gap, MT (06-07)	NA	TRC 2008	Wolfe Island, Ont (July-December 10)	NA	Stantec Ltd. 2011b
Judith Gap, MT (09)	NA	Poulton and Erickson 2010	Wolfe Island, Ont (July-December 11)	NA	Stantec Ltd. 2012

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Alite, CA (2009-2010)	0.55	0.12	0.24	Shrub/scrub & grassland	Chatfield et al. 2010b
Alta Wind I, CA (2011-2012)	7.07	0.27	1.28	Woodland, grassland, shrubland	Chatfield et al. 2012
Alta Wind II-V, CA (2011-2012)	1.66	0.05	0.08	Desert scrub	Chatfield et al. 2012
Barton I & II, IA (2010-2011)	5.5	0	1.85	Agriculture	Derby et al. 2011a
Barton Chapel, TX (2009-2010)	1.15	0.25	3.06	Agriculture/forest	WEST 2011
Beech Ridge, WV (2012)	1.19	0.01	2.03	Forest	Tidhar et al. 2013
Big Horn, WA (2006-2007)	2.54	0.11	1.9	Agriculture/grassland	Kronner et al. 2008
Big Smile, OK (2012-2013)	0.09	0	2.9	Grassland, agriculture	Derby et al. 2013b
Biglow Canyon, OR (Phase I; 2008)	1.76	0.03	1.99	Agriculture/grassland	Jeffrey et al. 2009a
Biglow Canyon, OR (Phase I; 2009)	2.47	0	0.58	Agriculture/grassland	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	0.14	2.71	Agriculture	Enk et al. 2011a
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	0.03	0.57	Grassland/shrub-steppe, agriculture	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	0.05	0.22	Grassland/shrub-steppe, agriculture	Enk et al. 2012a
Blue Sky Green Field, WI (2008; 2009)	7.17	0	24.57	Agriculture	Gruver et al. 2009
Buffalo Gap I, TX (2006)	1.32	0.1	0.1	Grassland	Tierney 2007
Buffalo Gap II, TX (2007-2008)	0.15	0	0.14	Forest	Tierney 2009
Buffalo Mountain, TN (2000-2003)	11.02	0	31.54	Forest	Nicholson et al. 2005
Buffalo Mountain, TN (2005)	1.1	0	39.7	Forest	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 1996)	4.14	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1997)	2.51	0	NA	Agriculture	Johnson et al. 2000a

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Buffalo Ridge, MN (Phase I; 1998)	3.14	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1999)	1.43	0.47	0.74	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1998)	2.47	0	2.16	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1999)	3.57	0	2.59	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	NA	NA	4.35	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	NA	NA	1.64	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	5.93	0	2.72	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	NA	NA	3.71	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	NA	NA	1.81	Agriculture	Johnson et al. 2004
Buffalo Ridge I, SD (2009-2010)	5.06	0.2	0.16	Agriculture/grassland	Derby et al. 2010b
Buffalo Ridge II, SD (2011-2012)	1.99	0	2.81	Agriculture, grassland	Derby et al. 2012a
Casselman Curtailment, PA (2008)	NA	NA	4.4	Forest	Arnett et al. 2009b
Casselman, PA (2008)	1.51	0	12.61	Forest	Arnett et al. 2009a
Casselman, PA (2009)	2.88	0	8.6	Forest, pasture, grassland	Arnett et al. 2010
Cedar Ridge, WI (2009)	6.55	0.18	30.61	Agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	3.72	0.13	24.12	Agriculture	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	1.39	0	8.62	Agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	1.32	0.08	10.32	Agriculture, forest	Stantec 2011
Combine Hills, OR (Phase I; 2004-2005)	2.56	0	1.88	Agriculture/grassland	Young et al. 2006
Combine Hills, OR (2011)	2.33	0.05	0.73	Grassland/shrub-steppe, agriculture	Young et al. 2006
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	Agriculture	Kerlinger et al. 2007

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Criterion, MD (2011)	6.4	0.02	15.61	Forest, agriculture	Young et al. 2012a
Criterion, MD (2012)	2.14	NA	7.62	Forest, agriculture	Young et al. 2013
Crystal Lake II, IA (2009)	NA	NA	7.42	Agriculture	Derby et al. 2010a
Diablo Winds, CA (2005-2007)	4.29	0.4	0.82	NA	WEST 2006, 2008
Dillon, CA (2008-2009)	4.71	0	2.17	Desert	Chatfield et al. 2009
Dry Lake I, AZ (2009-2010)	2.02	0	3.43	Desert grassland/forested	Thompson et al. 2011
Dry Lake II, AZ (2011-2012)	1.57	0	1.66	Desert grassland/forested	Thompson and Bay 2012
Elkhorn, OR (2008)	0.64	0.06	1.26	Shrub/scrub & agriculture	Jeffrey et al. 2009b
Elkhorn, OR (2010)	1.95	0.08	2.14	Shrub/scrub & agriculture	Enk et al. 2011b
Elm Creek, MN (2009-2010)	1.55	0	1.49	Agriculture	Derby et al. 2010c
Elm Creek II, MN (2011-2012)	3.64	0	2.81	Agriculture, grassland	Derby et al. 2012b
Foote Creek Rim, WY (Phase I; 1999)	3.4	0.08	3.97	Grassland	Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2000)	2.42	0.05	1.05	Grassland	Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	0	1.57	Grassland	Young et al. 2003b
Forward Energy Center, WI (2008-2010)	NA	NA	18.17	Agriculture	Grodsky and Drake 2011
Fowler I, II, III, IN (2010)	NA	NA	18.96	Agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	NA	NA	20.19	Agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	NA	NA	2.96	Agriculture	Good et al. 2013
Fowler I, IN (2009)	2.83	0	8.09	Agriculture	Johnson et al. 2010a
Fowler III, IN (2009)	NA	NA	1.84	Agriculture	Johnson et al. 2010b

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Goodnoe, WA (2009-2010)	1.4	0.17	0.34	Grassland and shrub-steppe	URS Corporation 2010a
Grand Ridge I, IL (2009-2010)	0.48	0	2.1	Agriculture	Derby et al. 2010g
Harrow, Ont (2010)	NA	NA	11.13	Agriculture	Natural Resource Solutions Inc. (NRSI) 2011
Harvest Wind, WA (2010-2012)	2.94	0.23	1.27	Grassland/shrub-steppe	Downes and Gritski 2012a
Hay Canyon, OR (2009-2010)	2.21	0	0.53	Agriculture	Gritski and Kronner 2010a
High Sheldon, NY (2010)	1.76	0.06	2.33	Agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	1.57	0	1.78	Agriculture	Tidhar et al. 2012b
High Winds, CA (2003-2004)	1.62	0.5	2.51	Agriculture/grassland	Kerlinger et al. 2006
High Winds, CA (2004-2005)	1.1	0.28	1.52	Agriculture/grassland	Kerlinger et al. 2006
Hopkins Ridge, WA (2006)	1.23	0.14	0.63	Agriculture/grassland	Young et al. 2007a
Hopkins Ridge, WA (2008)	2.99	0.07	1.39	Agriculture/grassland	Young et al. 2009c
Judith Gap, MT (2006-2007)	NA	NA	8.93	Agriculture/grassland	TRC 2008
Judith Gap, MT (2009)	NA	NA	3.2	Agriculture/grassland	Poulton and Erickson 2010
Kewaunee County, WI (1999-2001)	1.95	0	6.45	Agriculture	Howe et al. 2002
Kibby, ME (2011)	NA	NA	0.12	Forest; commercial forest	Stantec 2012
Kittitas Valley, WA (2011-2012)	1.06	0.09	0.12	Sagebrush-steppe, grassland	Stantec Consulting Services 2012
Klondike, OR (2002-2003)	0.95	0	0.77	Agriculture/grassland	Johnson et al. 2003a
Klondike II, OR (2005-2006)	3.14	0.06	0.41	Agriculture/grassland	NWC and WEST 2007
Klondike III (Phase I), OR (2007-2009)	3.02	0.15	1.11	Agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	2.61	0.06	0.14	Grassland/shrub-steppe and agriculture	Gritski et al. 2011
Leaning Juniper, OR (2006-2008)	6.66	0.16	1.98	Agriculture	Gritski et al. 2008

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Lempster, NH (2009)	3.38	0	3.11	Grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	2.64	0	3.57	Grasslands/forest/rocky embankments	Tidhar et al. 2011
Linden Ranch, WA (2010-2011)	6.65	0.27	1.68	Grassland/shrub-steppe, agriculture	Enz and Bay 2011
Locust Ridge, PA (Phase II; 2009)	0.84	0	14.11	Grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	0.76	0	14.38	Grassland	Arnett et al. 2011
Maple Ridge, NY (2006)	NA	NA	11.21	Agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007-2008)	2.07	0.03	4.96	Agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007)	2.34	NA	6.49	Agriculture/forested	Jain et al. 2009d
Marengo I, WA (2009-2010)	0.27	0	0.17	Agriculture	URS Corporation 2010b
Marengo II, WA (2009-2010)	0.16	0.05	0.27	Agriculture	URS Corporation2010c
Mars Hill, ME (2007)	1.67	0	2.91	Forest	Stantec 2008
Mars Hill, ME (2008)	1.76	0	0.45	Forest	Stantec 2009a
Moraine II, MN (2009)	5.59	0.37	2.42	Agriculture/grassland	Derby et al. 2010d
Mount Storm, WV (Fall 2008)	NA	NA	6.62	Forest	Young et al. 2009b
Mount Storm, WV (2009)	3.85	0	17.53	Forest	Young et al. 2009a, 2010b
Mount Storm, WV (2010)	2.6	0.1	15.18	Forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	4.24	0.03	7.43	Forest	Young et al. 2011a, 2012b
Mountaineer, WV (2003)	2.69	0.07	31.69	Forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	1.48	0.59	1.93	Agriculture/forest	Stantec 2009b
Nine Canyon, WA (2002-2003)	2.76	0.03	2.47	Agriculture/grassland	Erickson et al. 2003b
Noble Altona, NY (2010)	1.84	0	4.34	Forest	Jain et al. 2011b
Noble Bliss, NY (2008)	1.3	0.1	7.8	Agriculture/forest	Jain et al. 2009e
Noble Bliss, NY (2009)	2.28	0.12	3.85	Agriculture/forest	Jain et al. 2010a
Noble Chateaugay, NY (2010)	1.66	0.08	2.44	Agriculture	Jain et al. 2011c
Noble Clinton, NY (2008)	1.59	0.1	3.14	Agriculture/forest	Jain et al. 2009c
Noble Clinton, NY (2009)	1.11	0.16	4.5	Agriculture/forest	Jain et al. 2010b

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Noble Ellenburg, NY (2008)	0.83	0.11	3.46	Agriculture/forest	Jain et al. 2009b
Noble Ellenburg, NY (2009)	2.66	0.25	3.91	Agriculture/forest	Jain et al. 2010c
Noble Wethersfield, NY (2010)	1.7	0.13	16.3	Agriculture	Jain et al. 2011a
NPPD Ainsworth, NE (2006)	1.63	0.06	1.16	Agriculture/grassland	Derby et al. 2007
Pebble Springs, OR (2009-2010)	1.93	0.04	1.55	Grassland	Gritski and Kronner 2010b
Pine Tree, CA (2009-2010)	8.3	0.133	NA	Grassland	BioResource Consultants 2010
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	0	10.06	Agriculture, grassland	Chodachek et al. 2012
PrairieWinds ND1 (Minot), ND (2010)	1.48	0.05	2.13	Agriculture	Derby et al. 2011c
PrairieWinds ND1 (Minot), ND (2011)	1.56	0.05	1.39	Agriculture, grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2011-2012)	1.41	0	1.23	Grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2012-2013)	2.01	0.03	1.05	Grassland	Derby et al. 2013a
Red Hills, OK (2012-2013)	0.08	0.04	0.11	Grassland	Derby et al. 2013c
Ripley, Ont (2008)	3.09	0.1	4.67	Agriculture	Jacques Whitford 2009
Rugby, ND (2010-2011)	3.82	0.06	1.6	Agriculture	Derby et al. 2011b
Shiloh I, CA (2006-2009)	6.96	0.42	3.92	Agriculture/grassland	Kerlinger et al. 2010a
Shiloh II, CA (2009-2010)	1.51	0.12	2.72	Agriculture	Kerlinger et al. 2010b
Stateline, OR/WA (2001-2002)	3.17	0.09	1.09	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.68	0.09	2.29	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2006)	1.23	0.11	0.95	Agriculture/grassland	Erickson et al. 2007
Stetson Mountain I, ME (2009)	2.68	0	1.4	Forest	Stantec 2009c
Stetson Mountain I, ME (2011)	1.18	0	0.28	Forested	Normandeau Associates 2011
Stetson Mountain II, ME (2010)	1.42	0	1.65	Forested	Normandeau Associates 2010
Summerview, Alb (2005-2006)	1.06	0.11	10.27	Agriculture	Brown and Hamilton 2006b
Summerview, Alb (2006; 2007)	NA	NA	11.42	Agriculture/grassland	Baerwald 2008
Top of Iowa, IA (2003)	0.42	0	7.16	Agriculture	Jain 2005
Top of Iowa, IA (2004)	0.81	0.17	10.27	Agriculture	Jain 2005

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Tuolumne (Windy Point I), WA (2009-2010)	3.2	0.29	0.94	Grassland/shrub-steppe, agriculture and forest	Enz and Bay 2010
Vansycle, OR (1999)	0.95	0	1.12	Agriculture/grassland	Erickson et al. 2000a
Vantage, WA (2010-2011)	1.27	0.29	0.4	Shrub-steppe, grassland	Ventus Environmental Solutions 2012
Wessington Springs, SD (2009)	8.25	0.06	1.48	Grassland	Derby et al. 2010f
Wessington Springs, SD (2010)	0.89	0.07	0.41	Grassland	Derby et al. 2011d
White Creek, WA (2007-2011)	4.05	0.47	2.04	Grassland/shrub-steppe, agriculture	Downes and Gritski 2012b
Wild Horse, WA (2007)	1.55	0.09	0.39	Grassland	Erickson et al. 2008
Windy Flats, WA (2010-2011)	8.45	0.04	0.41	Grassland/shrub-steppe, agriculture	Enz et al. 2011
Winnebago, IA (2009-2010)	3.88	0.27	4.54	Agriculture/grassland	Derby et al. 2010e
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	Grassland	Stantec Ltd. 2010b
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	Grassland	Stantec Ltd. 2011b
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	Grassland	Stantec Ltd. 2012

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	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 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	NA	41	120-m radius circle	14.5 months	Every two weeks
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
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	NA	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	NA	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	NA	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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	NA	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
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)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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)
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	NA	NA	NA	NA	NA	NA
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
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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)
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
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)
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)
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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)
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)
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Marengo I, WA (2009-2010)	78	140.4	67	39	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
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)
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	Bi-monthly (spring, summer, fall), monthly (winter)
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	Spring, summer, fall	Daily, weekly
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
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
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
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)	90	135	65	40	NA	1 year	Bi-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)
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200m x 200m	1 year	Bi-weekly
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)
Prince Wind Farm, Ont (2006)	126	189	80	38	63-m radius	4 months	Daily, weekly
Prince Wind Farm, Ont (2007)	126	189	80	38 turbines from January 1st - July 8th, 126 turbines from July 9th-October 31st	63- to 45-m radius	10 months	Daily, weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Prince Wind Farm, Ont (2008)	126	189	80	126	45m radius	6.5 months	Daily, 3x/week, 2x/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	NA	20 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)
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.
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	NA	24.4-42.7	NA	50-m radius	2 years	Quarterly
Searsburg, VT (1997)	11	7	65	11	20- to 55-m radius	Spring, fall	Weekly (fall migration)
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	Weekly
Shiloh II, CA (2009-2010)	75	150	33 turbs = 115; 42 turbs = 125	25	100m radius	1 year	Once/week
SMUD Solano, CA (2004-2005)	22	15	65	22	60-m radius	1 year	Bi-monthly
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Stateline, OR/WA (2006)	454	299	50	39	Variable turbine strings	1 year	Bi-weekly
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	Varied	6 months	Weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	Varied	6 months	Weekly (3 turbines twice a week)
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	NA	14.7 to 57.6	201	50-m radius	20 months	Quarterly
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

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	Monthly, a subset of 10 searched weekly during migration
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	NA	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
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50m radius	6 months	43 twice weekly, 43 weekly

Appendix H5 (*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. 2010b	Klondike III (Phase I), OR (07-09)	Gritski et al. 2010
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Klondike IIIa (Phase II), OR (08-10)	Gritski et al. 2011
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Leaning Juniper, OR (06-08)	Gritski et al. 2008
Barton I & II, IA (10-11)	Derby et al. 2011a	Lempster, NH (09)	Tidhar et al. 2010
Barton Chapel, TX (09-10)	WEST 2011	Lempster, NH (10)	Tidhar et al. 2011
Beech Ridge, WV (12)	Tidhar et al. 2013	Linden Ranch, WA (10-11)	Enz and Bay 2011
Big Horn, WA (06-07)	Kronner et al. 2008	Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011
Big Smile, OK (12-13)	Derby et al. 2013b	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Madison, NY (01-02)	Kerlinger 2002b
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Maple Ridge, NY (06)	Jain et al. 2007
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Maple Ridge, NY (07)	Jain et al. 2009a
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Maple Ridge, NY (07-08)	Jain et al. 2009d
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Marengo I, WA (09-10)	URS Corporation 2010b
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Marengo II, WA (09-10)	URS Corporation 2010c
Buena Vista, CA (08-09)	Insignia Environmental 2009	Mars Hill, ME (07)	Stantec 2008
Buffalo Gap I, TX (06)	Tierney 2007	Mars Hill, ME (08)	Stantec 2009a
Buffalo Gap II, TX (07-08)	Tierney 2009	McBride, Alb (04)	Brown and Hamilton 2004
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Melancthon, Ont (Phase I; 07)	Stantec Ltd. 2008
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Meyersdale, PA (04)	Arnett et al. 2005
Buffalo Ridge, MN (94-95)	Osborn et al. 1996, 2000	Moraine II, MN (09)	Derby et al. 2010d
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Mount Storm, WV (Fall 08)	Young et al. 2009b
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Mountaineer, WV (03)	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Mountaineer, WV (04)	Arnett et al. 2005
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Nine Canyon, WA (02-03)	Erickson et al. 2003b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Noble Bliss, NY (08)	Jain et al.2009e
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge I, SD (09-10)	Derby et al. 2010b	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Noble Clinton, NY (08)	Jain et al. 2009c
Casselman, PA (08)	Arnett et al. 2009a	Noble Clinton, NY (09)	Jain et al. 2010b
Casselman, PA (09)	Arnett et al. 2010	Noble Ellenburg, NY (08)	Jain et al. 2009b
Casselman Curtailment, PA (08)	Arnett et al. 2009b	Noble Ellenburg, NY (09)	Jain et al. 2010c
Castle River, Alb. (01)	Brown and Hamilton 2006a	Noble Wethersfield, NY (10)	Jain et al. 2011a
Castle River, Alb. (02)	Brown and Hamilton 2006a	NPPD Ainsworth, NE (06)	Derby et al. 2007
Cedar Ridge, WI (09)	BHE Environmental 2010	Oklahoma Wind Energy Center, OK (04; 05)	Piorkowski and O'Connell 2010
Cedar Ridge, WI (10)	BHE Environmental 2011	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Pine Tree, CA (09-10)	BioResource Consultants 2010
Cohocton/Dutch Hills, NY (10)	Stantec 2011	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
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	Prince Wind Farm, Ont (06)	Natural Resource Solutions 2009
Criterion, MD (12)	Young et al. 2013	Prince Wind Farm, Ont (07)	Natural Resource Solutions 2009
Crystal Lake II, IA (09)	Derby et al. 2010a	Prince Wind Farm, Ont (08)	Natural Resource Solutions 2009
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	Rugby, ND (10-11)	Derby et al. 2011b
Elkhorn, OR (10)	Enk et al. 2011b	San Gorgonio, CA (97-98; 99-00)	Anderson et al. 2005
Elm Creek, MN (09-10)	Derby et al. 2010c	Searsburg, VT (97)	Kerlinger 2002a
Elm Creek II, MN (11-12)	Derby et al. 2012b	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Erie Shores, Ont. (06)	James 2008	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003b	SMUD Solano, CA (04-05)	Erickson and Sharp 2005
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003b	Stateline, OR/WA (01-02)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003b	Stateline, OR/WA (03)	Erickson et al. 2004
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Stateline, OR/WA (06)	Erickson et al. 2007

Appendix H5 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Fowler I, IN (09)	Johnson et al. 2010a	Stetson Mountain I, ME (09)	Stantec 2009c
Fowler III, IN (09)	Johnson et al. 2010b	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Fowler I, II, III, IN (10)	Good et al. 2011	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Fowler I, II, III, IN (11)	Good et al. 2012	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Fowler I, II, III, IN (12)	Good et al. 2013	Summerview, Alb (06; 07)	Baerwald 2008
Goodnoe, WA (09-10)	URS Corporation 2010a	Tehachapi, CA (96-98)	Anderson et al. 2004
Grand Ridge I, IL (09-10)	Derby et al. 2010g	Top of Iowa, IA (03)	Jain 2005
Harrow, Ont (10)	Natural Resource Solutions 2011	Top of Iowa, IA (04)	Jain 2005
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Vansycle, OR (99)	Erickson et al. 2000a
High Sheldon, NY (10)	Tidhar et al. 2012a	Vantage, WA (10-11)	Ventus Environmental Solutions 2012
High Sheldon, NY (11)	Tidhar et al. 2012b	Wessington Springs, SD (09)	Derby et al. 2010f
High Winds, CA (03-04)	Kerlinger et al. 2006	Wessington Springs, SD (10)	Derby et al. 2011d
High Winds, CA (04-05)	Kerlinger et al. 2006	White Creek, WA (07-11)	Downes and Gritski 2012b
Hopkins Ridge, WA (06)	Young et al. 2007a	Wild Horse, WA (07)	Erickson et al. 2008
Hopkins Ridge, WA (08)	Young et al. 2009c	Windy Flats, WA (10-11)	Enz et al. 2011
Jersey Atlantic, NJ (08)	NJAS 2008a, 2008b, 2009	Winnebago, IA (09-10)	Derby et al. 2010e
Judith Gap, MT (06-07)	TRC 2008	Wolfe Island, Ont (May-June 09)	Stantec Ltd. 2010a
Judith Gap, MT (09)	Poulton and Erickson 2010	Wolfe Island, Ont (July-December 09)	Stantec Ltd. 2010b
Kewaunee County, WI (99-01)	Howe et al. 2002	Wolfe Island, Ont (January-June 10)	Stantec Ltd. 2011a
Kibby, ME (11)	Stantec 2012	Wolfe Island, Ont (July-December 10)	Stantec Ltd. 2011b
Kittitas Valley, WA (11-12)	Stantec Consulting 2012	Wolfe Island, Ont (January-June 11)	Stantec Ltd. 2011c
Klondike, OR (02-03)	Johnson et al. 2003a	Wolfe Island, Ont (July-December 11)	Stantec Ltd. 2012
Klondike II, OR (05-06)	NWC and WEST 2007		